PHOENIX
ENVIRONMENTAL SCIENCES

Detailed terrestrial fauna and targeted Bilby survey for the Port Hedland Solar Farm Project

Prepared for Alinta Energy Development Pty Ltd

January 2022

Final

Detailed terrestrial fauna and targeted Bilby survey for the Port Hedland Solar Farm Project

Prepared for Alinta Energy

Version history

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EXECUTIVE SUMMARY

Alinta Energy Development Pty Ltd (Alinta Energy) is seeking to develop the Port Hedland Solar Farm Project (PHSF; the 'Project'), located 3.5 kilometres (km) to the south-west of South Hedland in the Pilbara bioregion, Western Australia (WA). The Project will see a new 90 Megawatt (MW) solar facility constructed and operated on Unallocated Crown Land nearby Alinta Energy's existing Port Hedland Power Station.

In January 2021, Phoenix Environmental Sciences Pty Ltd (Phoenix) was commissioned by Alinta Energy to undertake a detailed vertebrate fauna and short-range endemic (SRE) invertebrate survey (phase one) for the Project. During that survey, secondary evidence of the Bilby (Bilby; Vulnerable (VU); *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act) and *Biodiversity Conservation Act* (BC Act)) was recorded in the Study Area. Subsequently Alinta Energy commissioned Phoenix in August 2021 to undertake an additional (phase two) targeted Bilby survey (TBS).

Phase one

The PHSF Study Area (624.9 ha) is dissected in the west by the Great Northern Highway, and traversed in the east by a minor drainage line entering the Study Area in the north-east. This minor drainage line continues south and fans out into a broad floodplain just north of the southern boundary (of the Study Area). The constant flow of heavy transport vehicles along the GNH functions as a significant barrier to dispersal for local fauna. On the other hand, the minor drainage line provides a dispersal corridor under the GNH just north of the Study Area.

Survey conditions were close to ideal during phase one owing to significantly higher than average rainfall in the months preceding the survey. This is supported by the high total recorded abundance of 1193 of vertebrate taxa.

The phase one survey comprised a total of 14 survey sites; five systematic trapping sites, eight targeted species search transects and a single opportunistic site. The Desktop review identified 11 fauna habitat types within the search extent (40 km) and 347 native and 15 introduced vertebrate taxa. The field survey identified two broad habitat types (sandplain and minor drainage) and recorded 78 native vertebrate species. This represents only 22.46% of the desktop assemblage. This is attributed to the low diversity of fauna habitats types present in the Study Area (two) relative to the desktop search extent (11).

Of the two habitat types identified in the Study Area, sandplain (602.35 hectare (ha); 96.39%) comprises the majority. Minor drainage habitat comprises only 2.17% (13.59 ha). Both are typical of the Uaroo land system, which is widespread throughout the Roebourne subregion and other parts of the Pilbara Bioregion. A small portion (1.35%) of the Study Area comprises road and infrastructure and previously cleared or disturbed areas.

Recent wildfire throughout most of the Study Area, specifically the central and southern extent, has led to the concentration of higher fauna values (specifically Bilby), to the mature, unburnt vegetation complex present along minor drainage habitat in the east and in long-unburnt mixed *Acacia* shrubland west of the GNH. These parts of the Study Area are considered somewhat locally restricted in the short term, depending on climate driven regrowth and future fires (frequency and extent). However on a broad scale, wildfire plays an important role in the ecology of native fauna, including Bilby, which have large moving home ranges in order to respond to fluctuating availability of food resources (Cramer *et al.* 2017; Dziminski *et al.* 2020; Southgate *et al.* 2019). The small size of the Study Area (less than 1000 ha), represents only a fraction of the area that would comprise the long-term range typically occupied by individuals of the species.

Three species of feral predator (Cat, Dog and Fox) were recorded in the Study Area from secondary evidence during the phase one survey. Accordingly, it is no surprise that no evidence of Bilby was recorded in the open, recently burnt central and southern extents. It is likely that Bilby will utilise this

portion of the Study Area in the future when the vegetation regenerates sufficiently to provide suitable shelter from predation.

Despite extensive and targeted effort during the phase one survey, no Bilby burrows were located.

According to the Department of Biodiversity, Conservation and Attractions (DBCA) *Threatened and Priority Fauna Database,* Brush-tailed Mulgara were previously recorded at 32 locations within the Study Area in 2012. This species was only recorded twice in the phase one survey from secondary evidence (one track sequence and one burrow). Their relative absence in 2021, compared with 2012, is a likely a result of the high frequency and extent of fires within the Study Area since 2012. While the species may return to the Study Area after sufficient regeneration of spinifex grasslands, suitable habitat for the species is abundant both locally (within the Roebourne subregion and Uaroo land system) and throughout the Pilbara bioregion. As such, the relatively small area of suitable habitat present within ther Study Area is not regarded as high value to the species.

Seven other significant fauna species were identified as possibly occurring in the Study Area. Of these the Peregrine Falcon (Other Specially Protected (OS); BC Act), Grey Falcon (VU; BC Act) and Ghost Bat (VU; EPBC and BC Acts) are potential visitors to the Study Area as part of their wide foraging range but are unlikely to occur as resident species in the absence of suitable nesting or roosting habitat. Similarly, the Northern Quoll (Endangered (EN); EPBC and BC Acts) may possibly occur along minor drainage habitat during dispersal events but is unlikely to occupy the Study Area as a resident.

Fork-tailed Swift (Migratory; EPBC and BC Acts) is migratory and is possible to occur sporadically while foraging above all habitat types during the summer. Oriental Plover and Oriental Pratincole (Migratory; EPBC and BC Acts) may forage in open, recently burnt sandplain habitat very infrequently during summer months.

The SRE desktop review identified 1,706 individual records (1,310 Arachnida/Myriapoda, 134 Mollusca and 259 Crustacea) from a minimum of 117 distinct taxa. Of these taxa, 85 are potential SREs and 32 are of uncertain SRE status. The records indicate that none of the SRE taxa have previously been recorded within the Study Area. The SRE assemblage is dominated by pseudoscorpions, mygalomorph spiders and scorpions which make up 24.6%, 19.7% and 18.9% respectively of the total number of taxa.

A total of four species from four SRE groups were collected within the Study Area, comprising of one representative each from the Mygalomorphae, Scorpiones, Isopoda and Coleoptera SRE groups. Of these, three are potential SREs and one is widespread. One species was recorded only from the sandplain habitat (*Aname* 'Phoenix0068'), one species was recorded only from the minor drainage habitat (*Lychas* 'SCO039/glauerti') and one species was recorded from both the sandplain and minor drainage habitat (*Buddelundia* '14re').

Three potential SRE species were recorded from the survey. Of these, only one is known only from the Study Area, *Aname* 'Phoenix0068'. This species was identified using both morphological and molecular techniques and does not morphologically or genetically match any other specimen lodged with the WA Museum or with GenBank. The specimens were recorded from the overwhelmingly dominant habitat type, a habitat with low SRE habitat potential. i.e. it is widespread locally and regionally and there appears to be little to no geographical barrier to dispersal.

Phase two

The phase two TBS comprised a total of 49 transect searches covering a combined distance of 123.5 km of suitable habitat. Bilby are known to forage on fire-ephemeral plants in recently burnt habitat where it is proximal to suitable cover, but are unlikely to persist where large patches of habitat have been destroyed by fire (Cramer *et al.* 2017). As such, a desktop assessment of fire history was conducted, prior to the field survey to inform transect allocation and optimise survey effort. Unburnt habitat (at least five years since fire) and where it intersects recently burnt areas were prioritised.

No recent scats were recorded in TBS Area. As such, the current extent of the target population was not located. There are two possible explanations for this:

- the target population has been wiped out by feral predators, or
- the target population has dispersed to where food resources are more readily available.

According to Dziminski *et al.* (2020) Bilby populations in the Pilbara are isolated and consist of a small number of individuals. As a result, they are more susceptible to large or frequent wildfires and predation (Cramer *et al.* 2017; Dziminski *et al.* 2020; Southgate *et al.* 2019). Given the widespread occurrence of feral predators throughout the Study Area, as evident from the 36 locations of secondary evidence, it is possible that the target population has been wiped out in the six months between survey phases. The frequent fire history of the Study Area, the most recent of which affected approximately 300 ha (48%) of vegetation within the central and southern extents, adds further weight to this explanation as fire creates favourable conditions for predators because it destroys suitable cover for prey species (Dziminski *et al.* 2020).

The relationship between Bilby and fire is complex and paradoxical. Bilby have been reported to occur in a range of fire ages in WA (Cramer *et al.* 2017), though their persistence in recently burnt habitats is contingent on proximity of long-unburnt refugia (Browne-Cooper & Bamford 2010; Cramer *et al.* 2017; Thompson & Thompson 2008) and intensive control or eradication of cats and foxes (Cramer *et al.* 2017). While fire destroys important food resources in the short term, after sufficient rainfall these areas can become highly productive with the proliferation of fire-ephemeral plants (Cramer *et al.* 2017). Bilby have been observed moving into areas after recent fire, in response to this increased availability of food resources (Dziminski *et al.* 2020).

We conclude that core range of the target population is west of the GNH, given the widespread locations of old scats recorded during phase two. Furthermore, the 45 old scats recorded along the minor drainage line, which crosses under the GNH and into the Study Area, provides strong evidence of dispersal both into and out of the Study Area. Sandplain habitat is common and widespread at both the local and regional scale. Given the large, moving home-range occupied by Bilby (Dziminski *et al.* 2020), the small portion of sandplain habitat (less than 1000 ha) present in the Study Area is not regarded as important to the the local population. In contrast, minor drainage habitat is important and high value to the local Bilby population and other local fauna due to its function as a dispersal corridor.

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1 INTRODUCTION

Alinta Energy is seeking to develop the Port Hedland Solar Farm Project, located 3.5 km to the south-west of South Hedland in the Pilbara bioregion, WA (Figure 1-1).

In January 2021, Phoenix was commissioned by Alinta Energy to undertake a detailed vertebrate fauna and SRE invertebrate survey (phase one) for the Project. During that survey, secondary evidence (scats, digging) of the Bilby (Bilby; VU; EPBC and BC Acts) was recorded in the Study Area. Subsequently Alinta Energy commissioned Phoenix in August 2021 to undertake an additional (phase two) targeted Bilby survey.

The purpose of the phase one survey was to define the fauna values for both vertebrate and SRE invertebrates in the PHSF Study Area to inform Project planning and environmental impact assessment processes. The purpose of the phase two targeted Bilby survey was to delineate the current extent and suitable dispersal habitat present for the population identified in phase one.

1.1 PROJECT BACKGROUND

Alinta Energy is seeking to develop a new 90 MW solar facility on Unallocated Crown Land nearby Alinta Energys existing PHPS. The new solar facility will consist of three 30 MW blocks configured as a single facility, two new 33/66 kV step-up transformers and a short (~2 km) 66 kV double circuit underground and overhead line connection to the existing PHPS 66 kV switchyard. The Project will supply power to Alinta Energy's 66 kV Port Hedland power system for which Alinta Energy is the network service provider.

The PHSF Project will be built using an Engineer, Procure, Construct (EPC) model which allows the contractor to bring their innovations and experience to build on Alinta Energy's concept design. The concept design for the PHSF Project includes:

- formalised access to the site near the intersection of GNH and Boodarie Station Access Road
- a chain link security fence around the solar panel equipment including security cameras and lighting
- approximately 220,000 solar panels equating to 90 MW. These panels will be fixed tilt, cyclone rated and mounted on steel piles
- approximately 35 km of cabling connecting the solar panels
- a control room
- two 33/66 kV step-up transformers
- approximately two kilometres of 66 kV double circuit line from the step-up transformers to the PHPS 66 kV switchyard. This will be a combination of buried cable and overhead line
- approximately nine kilometres of access tracks
- temporary construction compound including site office and amenities, vehicle and plant parking and laydown area.

The existing facilities and amenities at Alinta Energy's PHPS will be used to operate the Project. The PHSF Project has a 30-year operational life after which time it can be re-powered or made good in accordance with any Crown Lease conditions.

1.2 SCOPE

Survey work was completed at two times of year as follows:

Phase one (March 2021):

- desktop assessment
- detailed terrestrial vertebrate fauna assessment
- detailed SRE invertebrate assessment
- targeted Night Parrot (Endangered (EN), EPBC Act; Critically Endangered (CR), BC Act) habitat assessment
- targeted searches significant fauna identified by the desktop review
- data analyses, audio and image processing and species identifications
- preparation of maps showing significant species records and habitats in the Study Area
- preparation of a comprehensive terrestrial fauna report.

Phase two (September 2021):

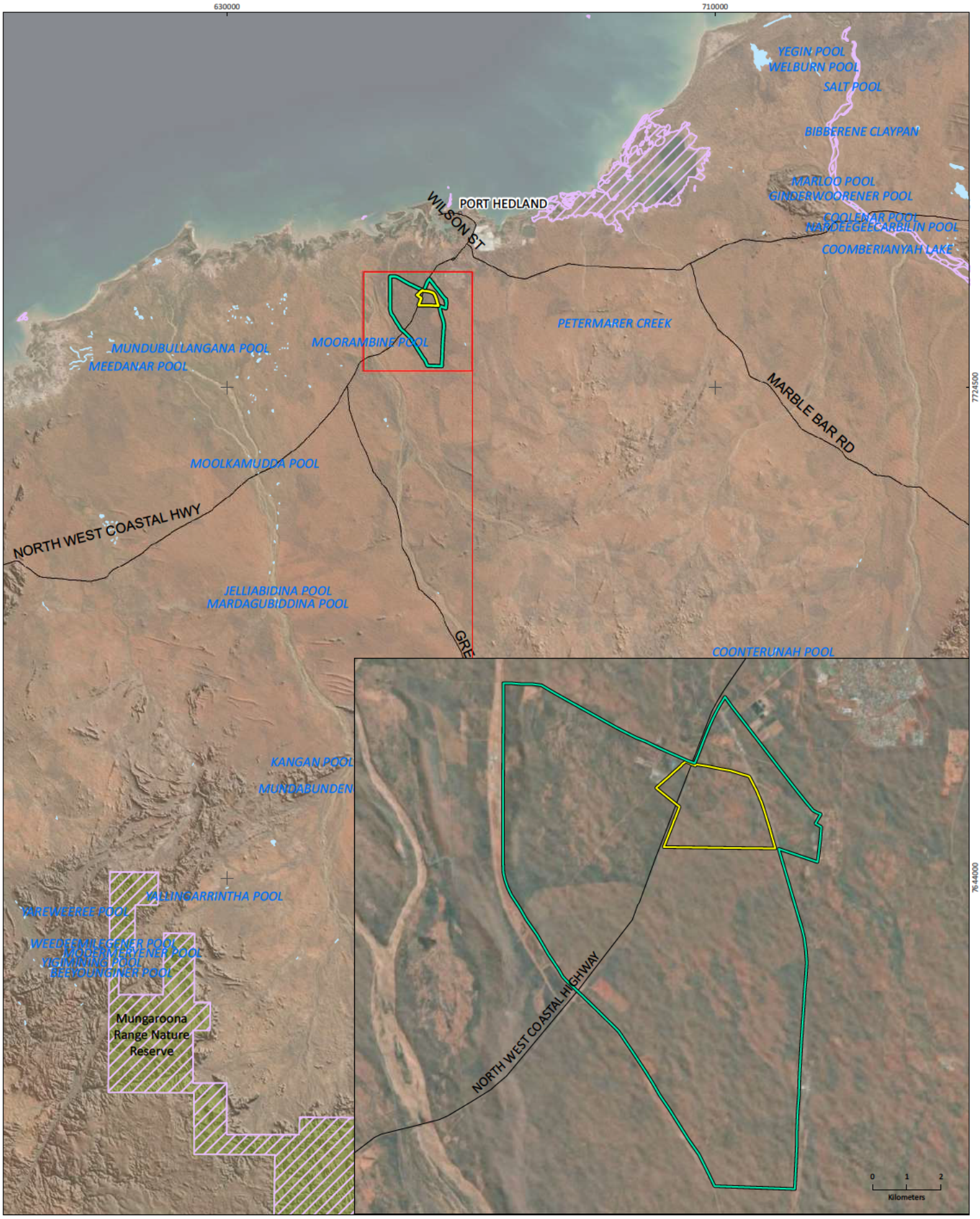
- undertake a desktop analysis of fire history to determine suitable habitat likely to support Bilby within the targeted Bilby survey area
- undertake targeted searches for signs of Bilby activity within the PHSF Study Area and the larger (phase two) targeted Bilby survey area
- determine the extent of suitable dispersal habitat within the PHSF Study Area and targeted Bilby survey area
- preparation of maps showing location and coverage of targeted searches and the location and of Bilby sign recorded during the survey
- preparation of a single comprehensive report that consolidates and interprets the results of from both survey phases.

Note that the intention of the Phase two targeted Bilby survey was to find and secure Bilby scats less than two weeks old and utilise the materials for DNA extraction, genotyping and spatially explicit capture-recapture analysis of Bilby scats collected during targeted survey to estimate population size.

1.3 STUDY AREA

The PHSF Study Area is located approximately five kilometres south-west of South Hedland on portions of two parcels of Unallocated Crown Land identified as Lot 1504 (74.55 ha) on Deposited Plan 404497 and Lot 273 (670.37 ha) on Deposited Plan 219540. The eastern portion of the Study Area is traversed by South West Creek (Figure 1-1).

The Study Area is located in the Eremaean Botanical Province as defined by EPA (2016b).



Alinta Energy Pty Ltd via Preston Consulting
Port Hedland Solar Farm Project

Project No	1454
Date	8/11/2021
Drawn by	IN
Map author	SP

0 10 20
Kilometers

1 800,000 (at A4) GDA 1994 MGA Zone 50

- Study Area
- Targeted Bilby survey area
- Environmentally sensitive areas
- Lake
- DBCA managed land
- Road

Figure 1-1

Location of the PHSF Study Area and targeted Bilby survey area

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2 LEGISLATIVE CONTEXT

The protection of fauna in WA is principally governed by three Acts:

- Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*)
- State *Biodiversity Conservation Act 2016*
- State *Environmental Protection Act 1986* (EP Act).

The BC Act came into full effect on 1 January 2019 and replaced the functions of the *Wildlife Conservation Act 1950*.

2.1 COMMONWEALTH

The EPBC Act is administered by the Federal Department of the Agriculture, Water and the Environment (DAWE). The EPBC Act provides for the listing of Threatened fauna as Matters of National Environmental Significance (MNES). Under the EPBC Act, actions that have, or are likely to have, a significant impact on MNES, require approval from the Australian Government Minister for the Environment through a formal referral process.

Conservation categories applicable to Threatened fauna species under the EPBC Act are as follows:

- Extinct (EX)[1] – there is no reasonable doubt that the last individual has died
- Extinct in the Wild (EW) – taxa known to survive only in captivity
- Critically Endangered (CR) – taxa facing an extremely high risk of extinction in the wild in the immediate future
- Endangered (EN) – taxa facing a very high risk of extinction in the wild in the near future
- Vulnerable (VU) – taxa facing a high risk of extinction in the wild in the medium-term
- Conservation Dependent (CD)[1] – taxa whose survival depends upon ongoing conservation measures; without these measures, a conservation dependent taxon would be classified as Vulnerable, Endangered or Critically Endangered.

The EPBC Act is also the enabling legislation for protection of Migratory species as MNES under several international agreements:

- Japan-Australia Migratory Bird Agreement
- China-Australia Migratory Bird Agreement
- Convention on the Conservation of Migratory Species of Wild Animals
- Republic of Korea-Australia Migratory Bird Agreement.

2.2 STATE

2.2.1 Threatened and Priority species

In WA, the BC Act provides for the listing of Threatened fauna (Government of Western Australia 2018a, b)[2] in the following categories:

[1] Species listed as Extinct and Conservation Dependent are not MNES and therefore do not trigger the EPBC Act.

[2] 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 BC Act.

- Critically Endangered (CR) – species facing an extremely high risk of extinction in the wild in the immediate future[3]
- Endangered (EN) – species facing a very high risk of extinction in the wild in the near future[3]
- Vulnerable (VU) – species facing a high risk of extinction in the wild in the medium-term future[3].

Species may also be listed as specially protected (SP) under the BC Act in one or more of the following categories:

- species of special conservation interest (conservation dependent fauna, CD) – species with a naturally low population, restricted natural range, of special interest to science, or subject to or recovering from a significant population decline or reduction in natural range
- Migratory species (Mig.), including birds subject to international agreement
- species otherwise in need of special protection (OS).

The Department of Biodiversity, Conservation and Attractions (DBCA) administers the BC Act and also maintains a non-statutory list of Priority fauna. Priority species are still considered to be of conservation significance – that is they may be Threatened – but cannot be considered for listing under the BC Act until there is adequate understanding of threat levels imposed on them. Species on the Priority fauna lists are assigned to one of four Priority (P) categories, P1 (highest) – P4 (lowest), based on level of knowledge/concern.

2.2.2 Critical habitat

Under the BC Act, habitat is eligible for listing as critical habitat if it is critical to the survival of a Threatened species or a Threatened Ecological Communities (TECs) and its listing is otherwise in accordance with the ministerial guidelines.

2.2.3 Short-range endemic invertebrates

SRE fauna are defined as animals that display restricted geographic distributions, nominally less than 10,000 km^2, that may also be disjunct and highly localised (Harvey 2002). EPA (2016a) identifies species with restricted distributions as being significant fauna in the context of environmental impact assessments (EIA). SRE fauna need to be considered in EIA as localised, small populations of species that are generally at greater risk of changes in conservation status due to environmental change than other, more widely distributed taxa.

Short-range endemism in terrestrial invertebrates is believed to have evolved through two primary processes (Harvey 2002):

- Relictual – where the drying climate reduced the area of suitable habitat available to a species, forcing a range contraction. Such habitats typically maintain historic mesic conditions (e.g. south-facing rock faces or slopes of mountains or gullies)
- Habitat speciality – where species settled in particular isolated habitat types (e.g. rocky outcrops) by means of dispersal and evolved in isolation into distinct species.

However, SRE invertebrates have also been reported in more widespread habitats such as spinifex plains or woodlands, mainly in groups with low dispersal capabilities, for example mygalomorph spiders and millipedes (see for example Car & Harvey 2014; Rix *et al.* 2018).

There can be uncertainty in categorising a specimen as an SRE due to several factors including poor regional survey density, lack of taxonomic research and problems of identification, i.e. specimens that may represent SREs cannot be identified to species level based on the life stage at hand. For example,

[3] As determined in accordance with criteria set out in the ministerial guidelines.

in contrast to mature males, juvenile and female millipedes, mygalomorph spiders and scorpions cannot be identified to species level. Molecular techniques such as 'barcoding' (Hebert *et al.* 2003a; Hebert *et al.* 2003b) are routinely employed to overcome taxonomic or identification problems.

Currently, there is no accepted system to determine the likelihood that a species is an SRE. The WA Museum applies four categories which were adopted in this assessment: confirmed, potential, uncertain and not SRE. Confirmed SREs are taxa for which the distribution is known to be less than 10,000 km^2, the taxonomy is well known and the group is well represented in collections and/ or via comprehensive sampling (WAM 2013). Potential SREs include those taxa for which there is incomplete knowledge of the geographic distribution of the group and its taxonomy, and the group is not well represented in collections.

2.2.4 Environmentally Sensitive Areas

Under Section 51B of the EP Act the Minister for Environment may declare by notice either a specified area of the State or a class of areas of the State to be Environmentally Sensitive Areas (ESAs). ESAs are declared in the *Environmental Protection (Environmentally Sensitive Areas) Notice 2005*, which was gazetted on 8 April 2005 (Government of Western Australia 2005).

ESAs are areas where the vegetation has high conservation value. Several types of areas are declared ESAs including:

- the area covered by vegetation within 50 m of Threatened flora, to the extent to which the vegetation is continuous with the vegetation in which the Threatened flora is located
- the area covered by a TEC
- a defined wetland (Ramsar wetlands, conservation category wetlands and nationally important wetlands) and the area within 50 m of the wetland
- Bush Forever sites.

3 EXISTING ENVIRONMENT

3.1 INTERIM BIOGEOGRAPHIC REGIONALISATION OF AUSTRALIA

The Interim Biogeographic Regionalisation of Australia (IBRA) classifies Australia's landscapes into large 'bioregions' and 'subregions' based on climate, geology, landform, native vegetation and species information (Department of the Environment and Energy 2016). The Study Area is located in the Roebourne (PIL4) subregion of the Pilbara bioregion (Figure 3-1) which is characterised as (Kendrick & Stanley 2001):

- Quaternary alluvial and older colluvial coastal and sub-coastal plains with a grass savannah of mixed bunch and hummock grasses, and dwarf shrub steppe of *Acacia stellaticeps* or *A. pyrifolia* and *A. inaequilatera*. Uplands are dominated by *Triodia* hummock grasslands. Ephemeral drainage lines support *Eucalyptus victrix* or *Corymbia hamersleyana* woodlands. Samphire, Sporobolus and mangal occur on marine alluvial flats and river deltas.
- Resistant linear ranges of basalts occur across the coastal plains, with minor exposures of granite. Islands are either Quaternary sand accumulations, or composed of basalt or limestone, or combinations of any of these three.

3.2 LAND SYSTEMS AND SURFACE GEOLOGY

Department of Primary Industries and Regional Development undertakes land system mapping for WA using a nesting soil-landscape mapping hierarchy (Schoknecht & Payne 2011). While the primary purpose of the mapping is to inform pastoral and agricultural land capability, it is also useful for informing biological assessments. Under this hierarchy, land systems are defined as areas with recurring patterns of landforms, soils, vegetation and drainage (Payne & Leighton 2004). The Study Area intersects two land systems (Table 3-1; Figure 3-2). It is dominated by the Uaroo System at 99.4%. The Study Area only intersects the Uaroo System.

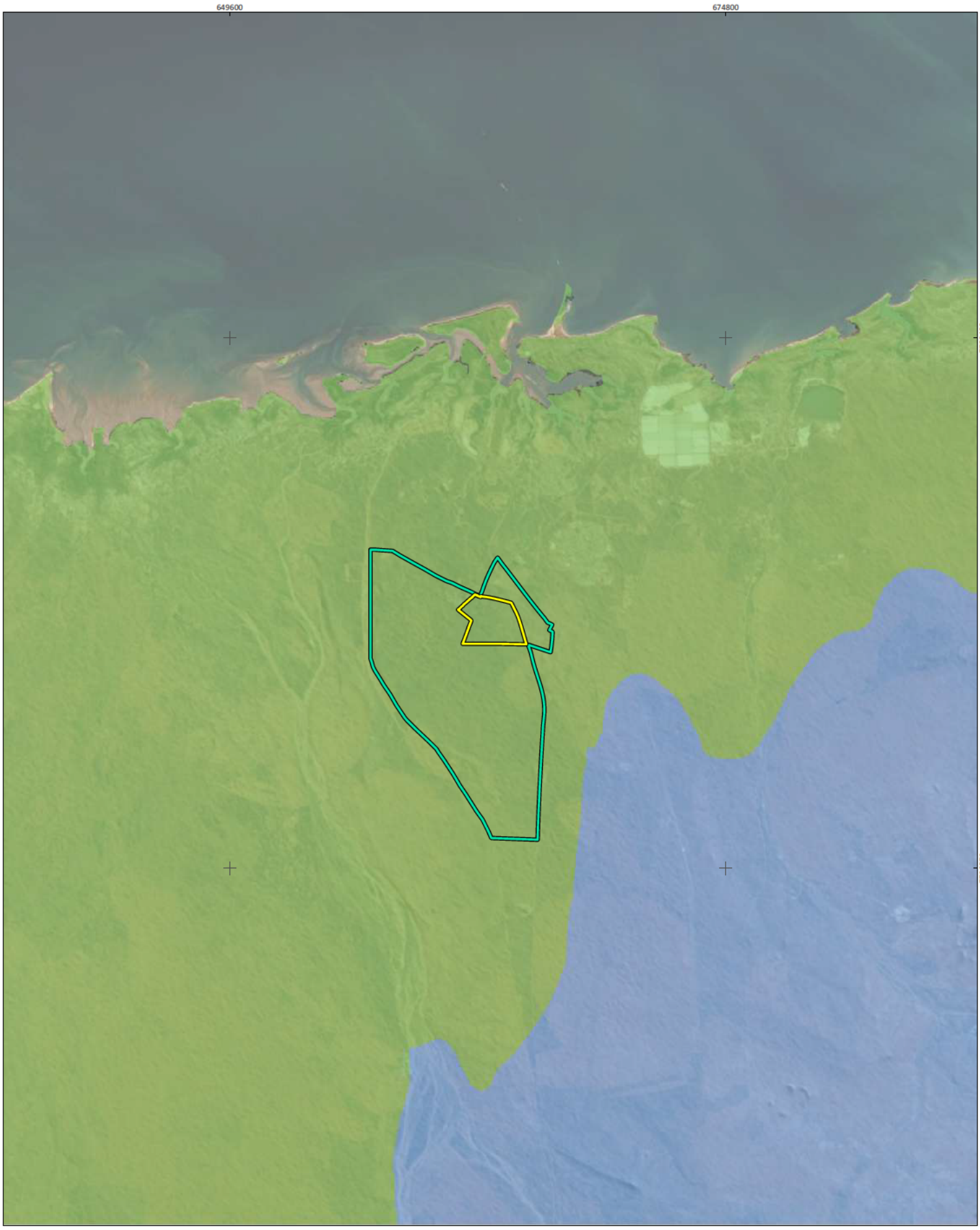
Table 3-1 Land systems and extent in Study Area

Land system	Description	Study Area (ha)	Study Area (%)
Uaroo System	Broad sandy plains, pebbly plains and drainage tracts supporting hard and soft spinifex hummock grasslands with scattered *Acacia* shrubs.	624.9	100
Total		**624.9**	**100**

According to the Surface Geology of Australia 1:1,000,000 scale, WA database (Stewart *et al.* 2008), the Study Area intersects one geological formation (Table 3-2; Figure 3-2).

Table 3-2 Surface geology of the Study Area, extent by deposit type

Surface geology	Abbreviation	Description	Study Area (ha)	Study Area (%)
Alluvium 38485	Qa	Channel and flood plain alluvium; gravel, sand, silt, clay, locally calcreted	624.9	100
Total			**624.9**	**100**



Western Australia

PERTH

Alinta Energy Pty Ltd via Preston Consulting
Port Hedland Solar Farm Project

Project No	1387
Date	29/10/2021
Drawn by	IN
Map author	SP

0 2.5 5
Kilometers

1 250,000 (at A4) GDA 1994 MGA Zone 50

Study Area

Targeted Bilby survey area

IBRA region and subregion

Pilbara, Chichester

Pilbara, Roebourne

Figure 3-1

Study Area and targeted Bilby survey area in relation to IBRA bioregions and subregions

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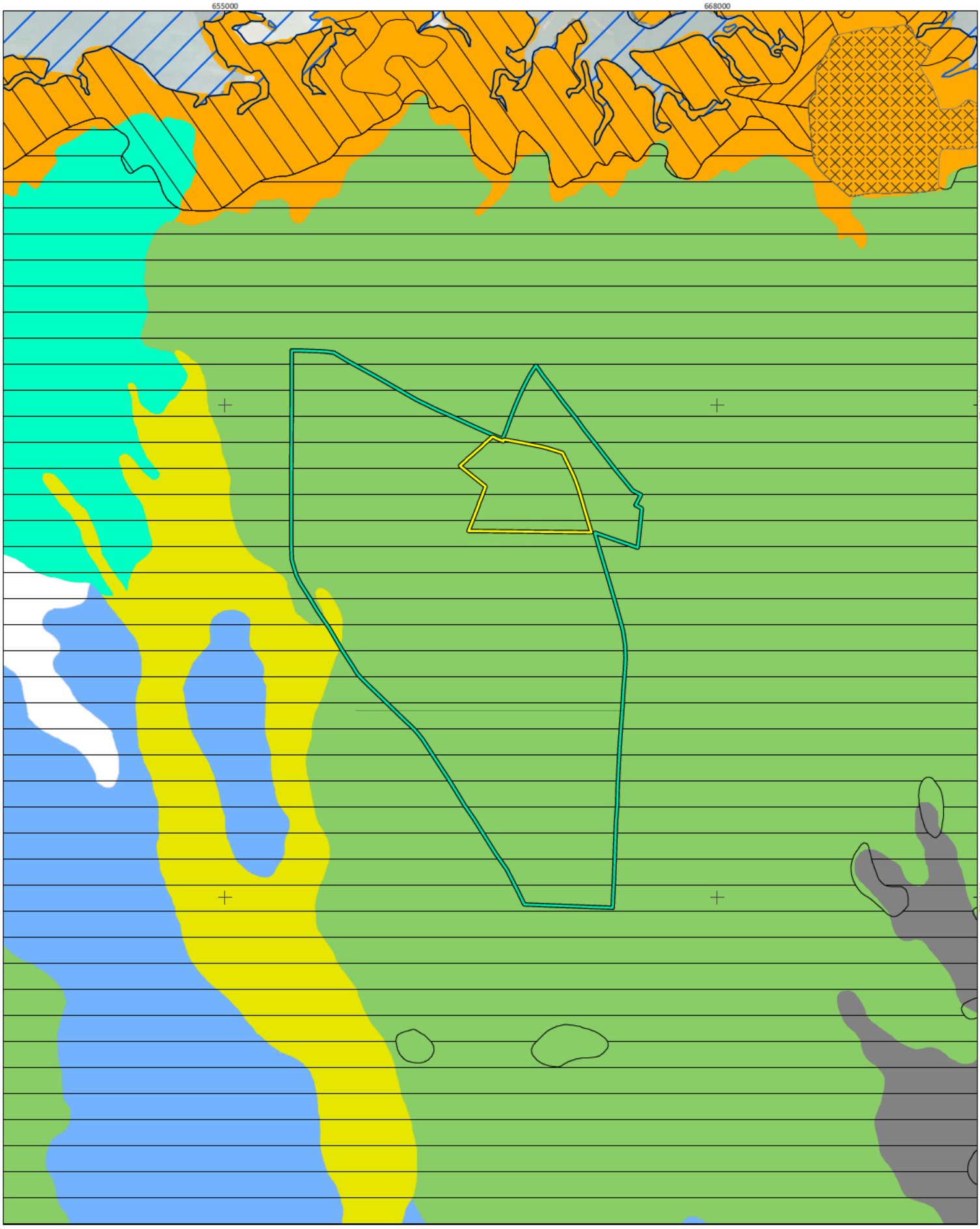

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Project No	1454
Date	29/10/2021
Drawn by	IN
Map author	SP

0 2.5 5
Kilometers

1 130,000 (at A4) GDA 1994 MGA Zone 50

Study Area
Targeted Bilby survey area

Land system
Littoral System
Macroy System
Mallina System
Paradise System
River System
Uaroo System
Yamerina System

Surface geology
Qa
Qdc
Qe
Qtm
water

Figure 3-2

Land systems and surface geology in the Study Area and targeted Bilby survey area

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3.3 CLIMATE AND WEATHER

The climate of the Roebourne (PIL4) subregion is described as arid (semi-desert) tropical with highly variable rainfall, falling mainly in summer. Cyclonic activity is significant, with several systems affecting the coast and hinterland annually (Kendrick & Stanley 2001). The nearest Bureau of Meteorology (BoM) weather station with comprehensive data collection and recent historic climate data is Port Hedland (no. 004032), Latitude: 20.37°S Longitude 118.63°E), located nine kilometres north-west of the Study Area.

Port Hedland records the highest mean maximum monthly temperature (36.9°C) in March (lowest in July, 27.4°C) and the lowest minimum mean monthly temperature (12.5°C) in July (highest in January, 25.7°C) (BoM 2021)(Figure 3-3). Average annual rainfall is 319.2 millimetres (mm) with January and February recording the highest monthly averages (89.3 and 62.6 mm respectively; Figure 3-3).

Phase one

Daily mean temperatures at Port Hedland in the 12 months preceding the detailed vertebrate and SRE survey were higher than average for most months. In the three months prior to the survey, mean temperatures were above historical averages. March had an average mean maximum temperature 1.6°C below below average (Figure 3-3) and a mean minimum temperature 0.2°C below average (Figure 3-4). The Study Area was slightly cooler than expected during the survey.

Records from Port Hedland show rainfall levels leading up to the survey were below average for every month except in December (70.1 mm above average) and February (24.7 mm above average) due to two tropical lows (02U and 12U) (Figure 3-3). The total rainfall level in the 12 months prior to the survey (226.8 mm) was 92.4 mm less than the historical annual average (319.2 mm). June and November experienced no rainfall. In the three months prior to the survey, there was a total of 209.8 mm of rain. The Study Area was likely wetter than expected, with recent rainfall levels above average (Figure 3-3).

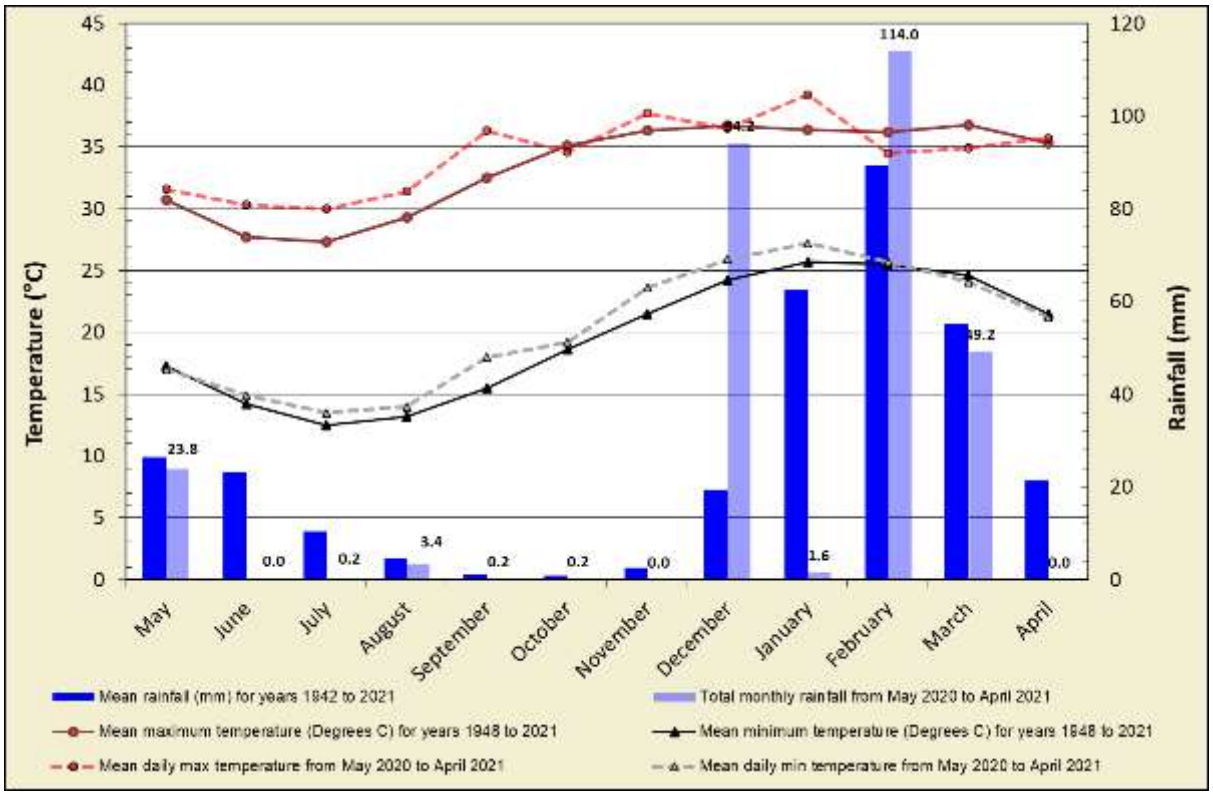


Figure 3-3 Annual climate and weather data for Port Hedland (no. 004032) and mean monthly data for 12 months preceding the phase one survey (BoM 2021)

Phase two

Daily mean temperatures at Port Hedland preceding the targeted Bilby survey were higher than average for most months. In the three months prior to the survey, mean temperatures were above historical averages. September had an average mean maximum temperature 1°C above average and a mean minimum temperature 1.2°C above average (Figure 3-4). The Study Area was likely warmer than expected leading up to and during the survey.

Records from Port Hedland show rainfall levels leading up to the survey were below average for every month except in December (70.1 mm above average), February (24.7 mm above average) and June (2.4 mm above average). The total rainfall level in the 12 months prior to the survey (295.1 mm) was 24.1 mm less than the historical annual average (319.2 mm). November and April experienced no rainfall. In the three months prior to the survey, there was a total of 2.6 mm of rain. The targeted Bilby survey area area was likely slightly drier than expected, with recent rainfall levels below average (Figure 3-4).

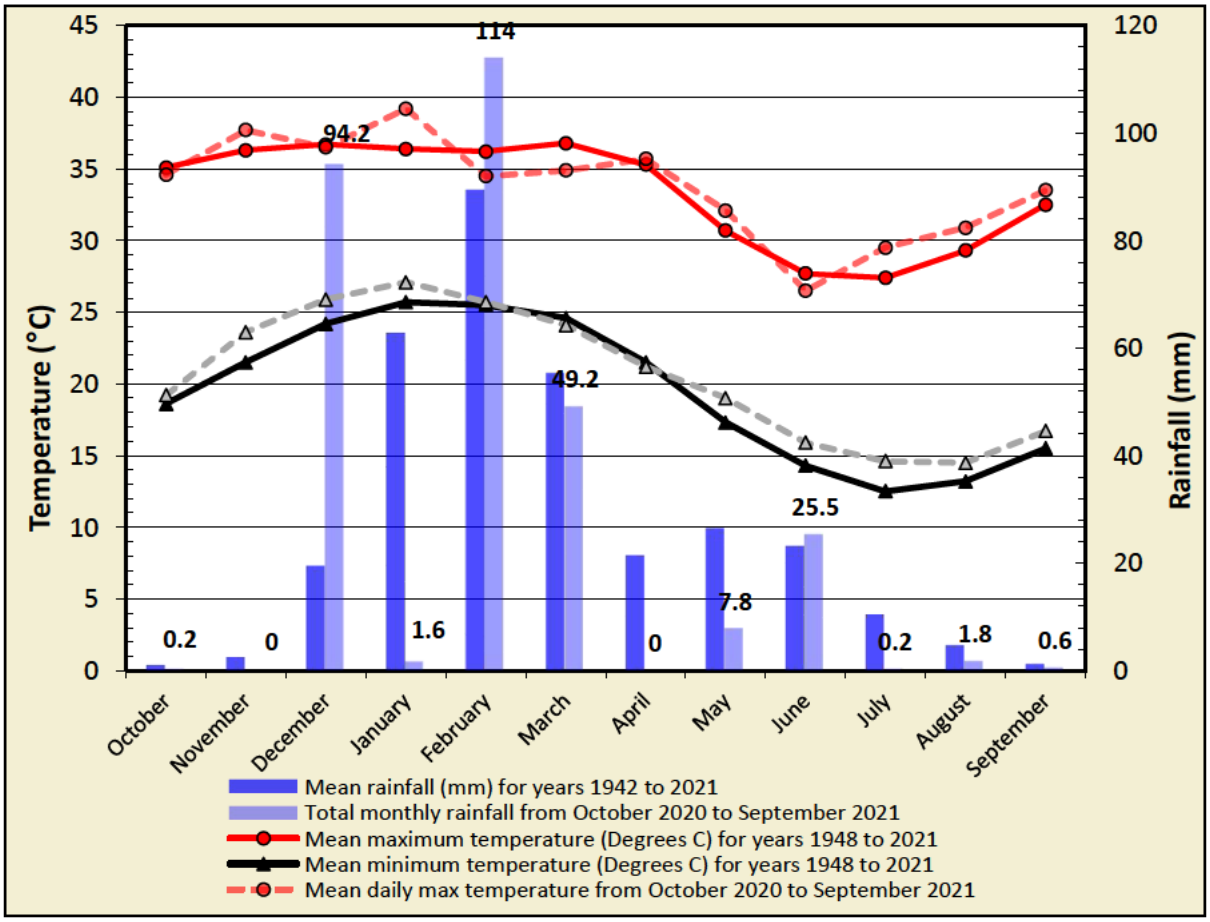


Figure 3-4 **Annual climate and weather data for Port Hedland (no. 004032) and mean monthly data for the 12 months preceding the targeted Bilby survey (BoM 2021)**

3.4 LAND USE

The land use statistics are derived from the Australian Bureau of Agriculture and Resource Economics and Sciences' (ABARES) Catchment Scale Land Use Mapping for WA 2018 dataset (ABARES 2018), for the IBRA SWA2 subregion. The dataset is a compilation derived from various vector datasets. The date (2008 to 2018) and scale (1:5,000 to 1:250,000) of each dataset, therefore, reflects the source data.

Land use is classified according to the Australian Land Use and Management Classification (v8); a three-tiered hierarchical structure.

The majority of the Study Area is used for production from relatively natural environments (grazing native vegetation and residual native cover).

3.5 CONSERVATION RESERVES AND ESAS

The nearest conservation reserve is Mungaroona Range Nature Reserve, located approximately 95.2 km south-south-west of the Study Area. Three ESAs are located 14 -17 km north and north-east of the approximate center of the PHSF Study Area. One of these is located along the coast and the other two are on offshore islands. These are all under the Register of the National Estate (RNE), which is no longer a statutory list under the EPBC Act (Figure 1-1). From 2007, places could no longer be added to, or removed from, the RNE (Department of Agriculture 2020). RNE places can be however, protected under the EPBC Act if they are also included in another Commonwealth statutory heritage list or are owned or leased by the Commonwealth. RNE is used on a non-statutory basis as an educational resource and publicly available archive (DAWE 2020).

4 METHODS

The detailed terrestrial fauna survey was conducted in accordance with relevant survey guidelines and guidance, including:

- EPA Environmental Factor Guideline: Terrestrial fauna (EPA 2016a)
- EPA Technical Guidance: Sampling of short-range endemic invertebrate fauna (EPA 2016c)
- EPA Technical Guidance: Terrestrial Vertebrate fauna surveys for environmental impact assessment (EPA 2020)
- DBCA Guideline for the survey and relocation of Bilby in Western Australia (DBCA 2018a)
- Monitoring the Abundance of Wild and Reintroduced Bilby Populations (Dziminski *et al.* 2020)
- Monitoring the Abundance of Greater Bilbies (DBCA 2021a)

4.1 DESKTOP REVIEW

Searches of several biological databases were undertaken to identify and prepare lists of significant fauna that may occur within the Study Area (Table 4-1). A literature search was conducted for accessible reports for biological surveys conducted within 40 km of the Study Area to build on the lists developed from the database searches (Table 4-2).

Table 4-1 Database searches conducted for the desktop review

Database	Target group/s	Search coordinates and extent
Protected Matters Search Tool (DAWE 2021)	EPBC Act Threatened Fauna	Approximate centre point of Study Area (-20.4408°S, 118.5621°E) with 40 km buffer
Threatened and Priority Fauna Database (DBCA 2021c)	Threatened and Priority Fauna	
DBCA Database (DBCA 2021b)	Fauna records	
Arachnid and Myriapod Database, Mollusca Database (WAM 2021)	Arachnid, myriapod and mollusc SREs	100 km^2 search area encompassing the Study Area between 19.10°S, 117.32°E (northwest corner) and 21.21°S, 119.13°E (southeast corner)

Table 4-2 Survey reports included in the desktop review

Report author	Survey description	Project
Mattiske Consulting (1994)	Detailed vertebrate fauna survey	Hedland Hot Briquetted Iron Project
Biota (2002a)	Detailed vertebrate fauna survey	Hope Downs Rail Corridor Weeli Wolli Siding to Port Hedland
Biota (2004)	Detailed terrestrial fauna survey	Proposed FMG Stage A - Rail Corridor
ENV and Phoenix (2009)	SRE survey	Outer Harbour Development and Goldsworthy Rail Duplication
ENV (2011)	Basic and targeted terrestrial fauna surveys	Port Hedland Regional Assessment
Bamford (2010)	Targeted vertebrate fauna survey	FMG Rail Duplication Cloudbreak to Port Hedland
Emerge Associates (2018)	Basic fauna survey	Port Hedland Airport - Highway Precinct 2

4.2 FIELD SURVEY

4.2.1 Survey timing

Field survey dates are provided in Table 4-3. As moisture degrades Deoxyribonucleic Acid (DNA) contained in scats, the survey timing of the targeted Bilby survey was based on dry conditions and no recent rainfall.

Table 4-3 Survey dates

Survey type	Season	Dates
Vertebrate and SRE Invertebrate Detailed survey	Autumn	22 March – 1 April 2021
Targeted Bilby survey	Spring	28 September – 3 October 2021

4.2.2 Terrestrial fauna

Phase one

A 'detailed' terrestrial vertebrate fauna survey was undertaken comprising a total of 14 survey sites (Figure 4-1; Appendix 1). This included five systematic trapping sites (Table 4-4; Figure 4-1), eight targeted species search transects (Table 4-5; Figure 4-2) and a single opportunistic site.

Table 4-4 Systematic terrestrial fauna survey effort

Site	Site type	Bucket (nights)	Pipe (nights)	Funnel (nights)	Elliot trap (nights)	Total trap-nights	Audio rec.	Ultrasonic rec.	Camera trap	Foraging (hrs)	Birding (hrs)	Foraging nocturnal (hrs)	SRE foraging (hrs)	Litter sieve (#)
Pit01	Fauna site	35	35	140	70	**280**		6		2	2	2	2	3
Pit02	Fauna site	35	35	140	70	**280**	6	6		2	2	2	2	3
Pit03	Fauna site	35	35	140	70	**280**			3	2	2	2	2	3
Pit04	Fauna site	35	35	140	70	**280**	6	6	15	2	2	2	2	3
Pit05	Fauna site	35	35	140	70	**280**				2	2	2	2	3
Total		**175**	**175**	**700**	**320**	**1,400**	**12**	**18**	**18**	**10**	**10**	**10**	**10**	**15**

Table 4-5 Targeted search transect effort conducted in phase one

Site	Site type	Distance per person (km)	Total distance (km)
Transect 01	Targeted fauna site	1.2	4.8
Transect 02	Targeted fauna site	1.2	4.8
Transect 03	Targeted fauna site	1.2	4.8
Transect 04	Targeted fauna site	1.2	4.8
Transect 05	Targeted fauna site	**1.2**	**4.8**
Transect 06	Targeted fauna site	**1.2**	**4.8**
Transect 07	Targeted fauna site	**1.2**	**4.8**
Transect 08	Targeted fauna site	**3**	**30**
	Total	11.4	63.6

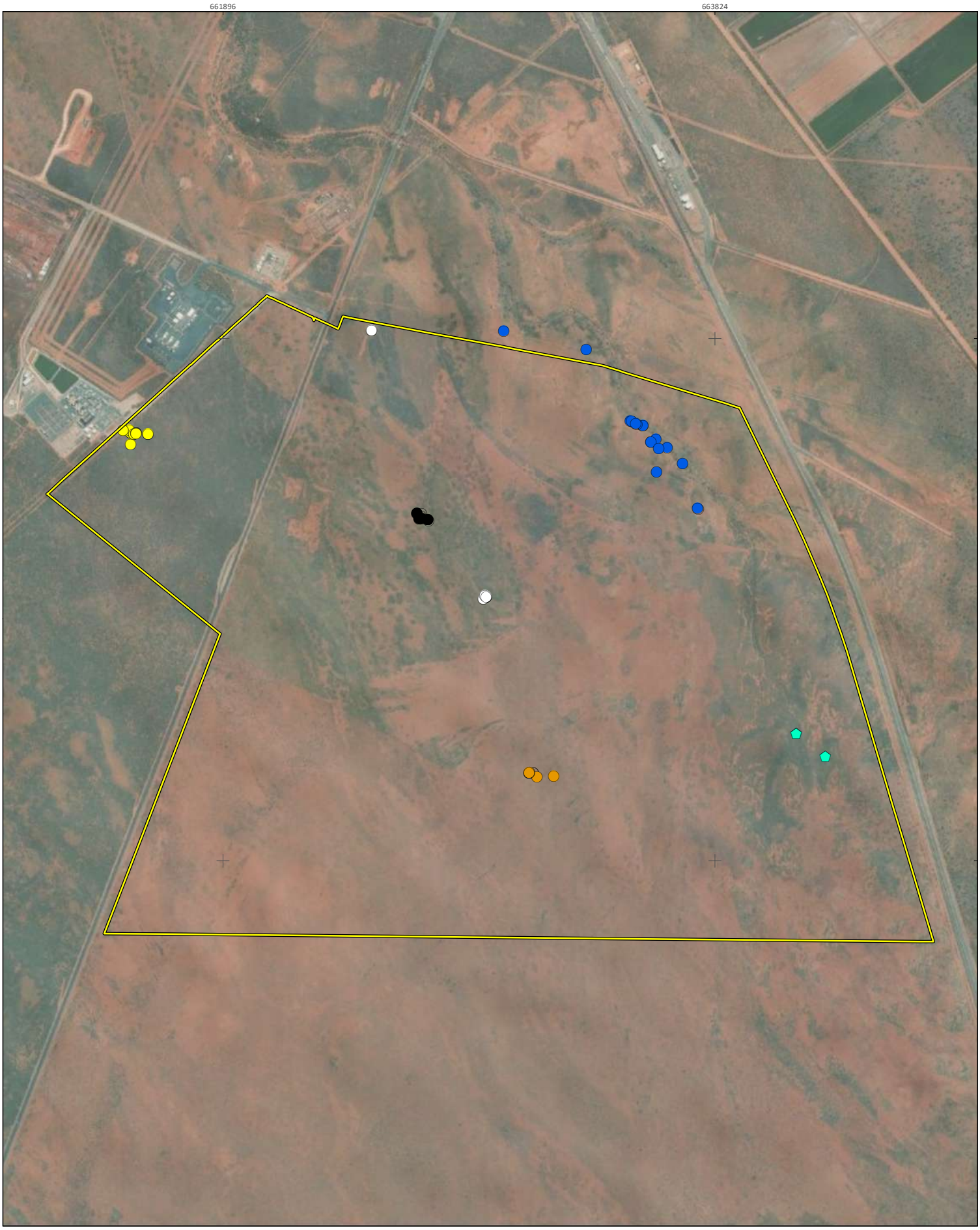
Phase two

A targeted Bilby survey was undertaken comprising a total of 49 targeted transect searches traversing a combined distance of 123.5 kms (**Table** 4-6 ;Figure 4-2).

Table 4-6 Targeted Bilby search transect effort conducted in phase two

Transect	Site type	Distance per person (km)	Total distance (km)
R01	Targeted fauna site	0.4	0.8
R02	Targeted fauna site	0.2	0.4
R03	Targeted fauna site	0.45	0.9
T01	Targeted fauna site	3.3	6.6
T02	Targeted fauna site	0.35	0.7
T03	Targeted fauna site	2.65	5.3
T04	Targeted fauna site	1.45	2.9
T05	Targeted fauna site	1.15	2.3
T06	Targeted fauna site	3.3	6.6
T07	Targeted fauna site	1.9	3.8
T08	Targeted fauna site	1.4	2.8
T09	Targeted fauna site	2.5	4.9
T10	Targeted fauna site	2.05	4.1
T11	Targeted fauna site	2.2	4.4
T12	Targeted fauna site	0.5	1.0
T13	Targeted fauna site	1.7	3.4
T14	Targeted fauna site	2.8	5.5
T15	Targeted fauna site	2.7	5.4
T16	Targeted fauna site	2.4	4.8
T17	Targeted fauna site	1.05	2.1

Transect	Site type	Distance per person (km)	Total distance (km)
T18	Targeted fauna site	2.7	5.3
T19	Targeted fauna site	1.6	3.2
T20	Targeted fauna site	0.75	1.5
T21	Targeted fauna site	1	2.0
T22	Targeted fauna site	0.7	1.4
T23	Targeted fauna site	0.45	0.9
T24	Targeted fauna site	1.35	2.7
T25	Targeted fauna site	0.85	1.7
T26	Targeted fauna site	0.95	1.9
T27	Targeted fauna site	0.95	1.9
T28	Targeted fauna site	0.95	1.9
T29	Targeted fauna site	0.25	0.5
T30	Targeted fauna site	1.4	2.7
T31	Targeted fauna site	1.3	2.5
T32	Targeted fauna site	0.65	1.3
T33	Targeted fauna site	0.8	1.6
T34	Targeted fauna site	1.2	2.4
T35	Targeted fauna site	1.3	2.6
T36	Targeted fauna site	1.7	3.3
T37	Targeted fauna site	1.3	2.6
T38	Targeted fauna site	1.9	3.8
T39	Targeted fauna site	0.35	0.7
T40	Targeted fauna site	1.0	2.0
T41	Targeted fauna site	0.15	0.3
T42	Targeted fauna site	0.8	1.6
T43	Targeted fauna site	0.4	0.8
T44	Targeted fauna site	0.4	0.8
T45	Targeted fauna site	0.15	0.3
T46	Targeted fauna site	0.25	0.5
Total		**61.8**	**123.5**



Alinta Energy Pty Ltd via Preston Consulting
Port Hedland Solar Farm Project

Project No	1388
Date	21/07/2021
Drawn by	IN
Map author	SP

0 250 500
Meters

1 19,290 (at A4) GDA 1994 MGA Zone 50

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Study Area

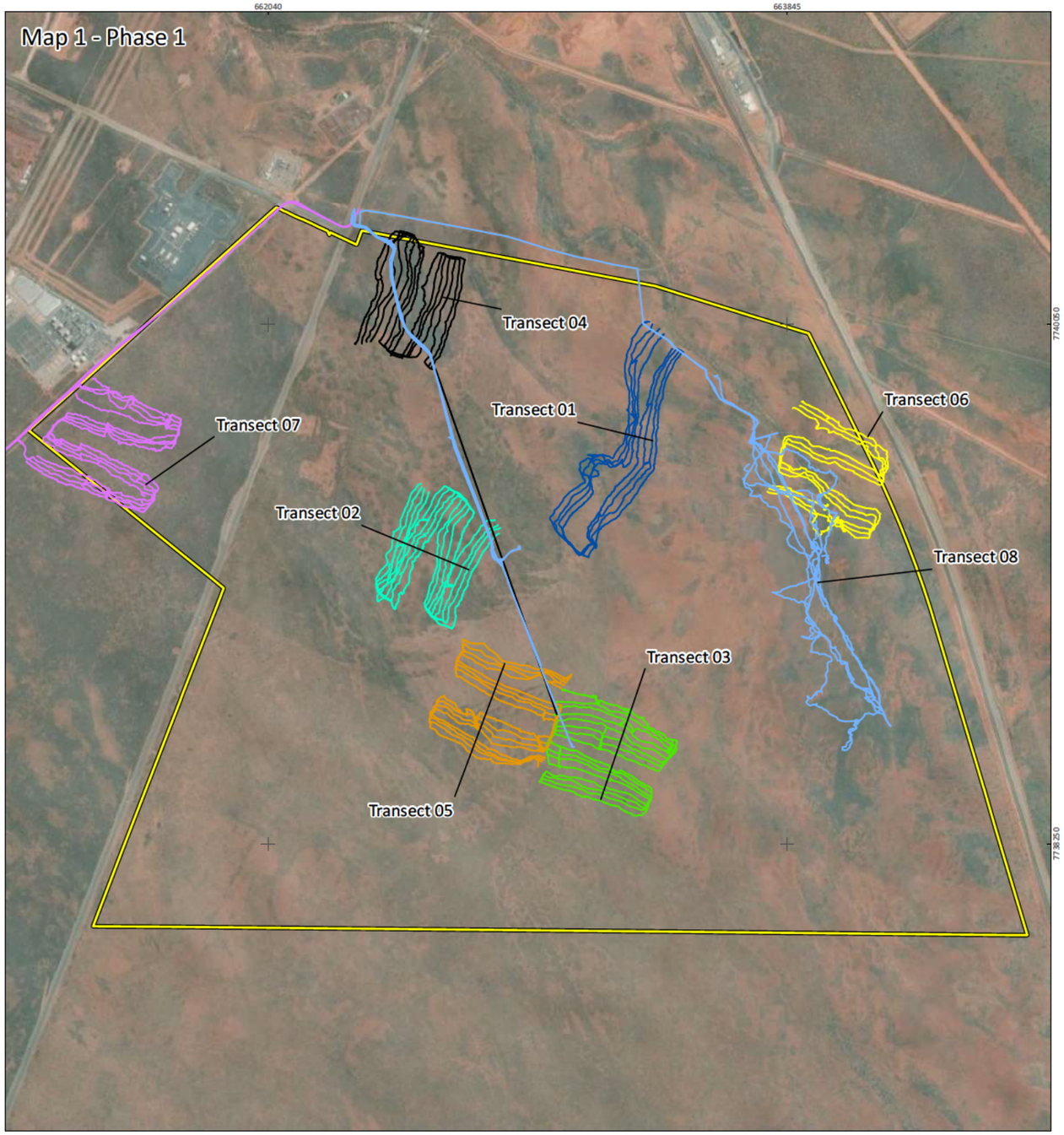
Site

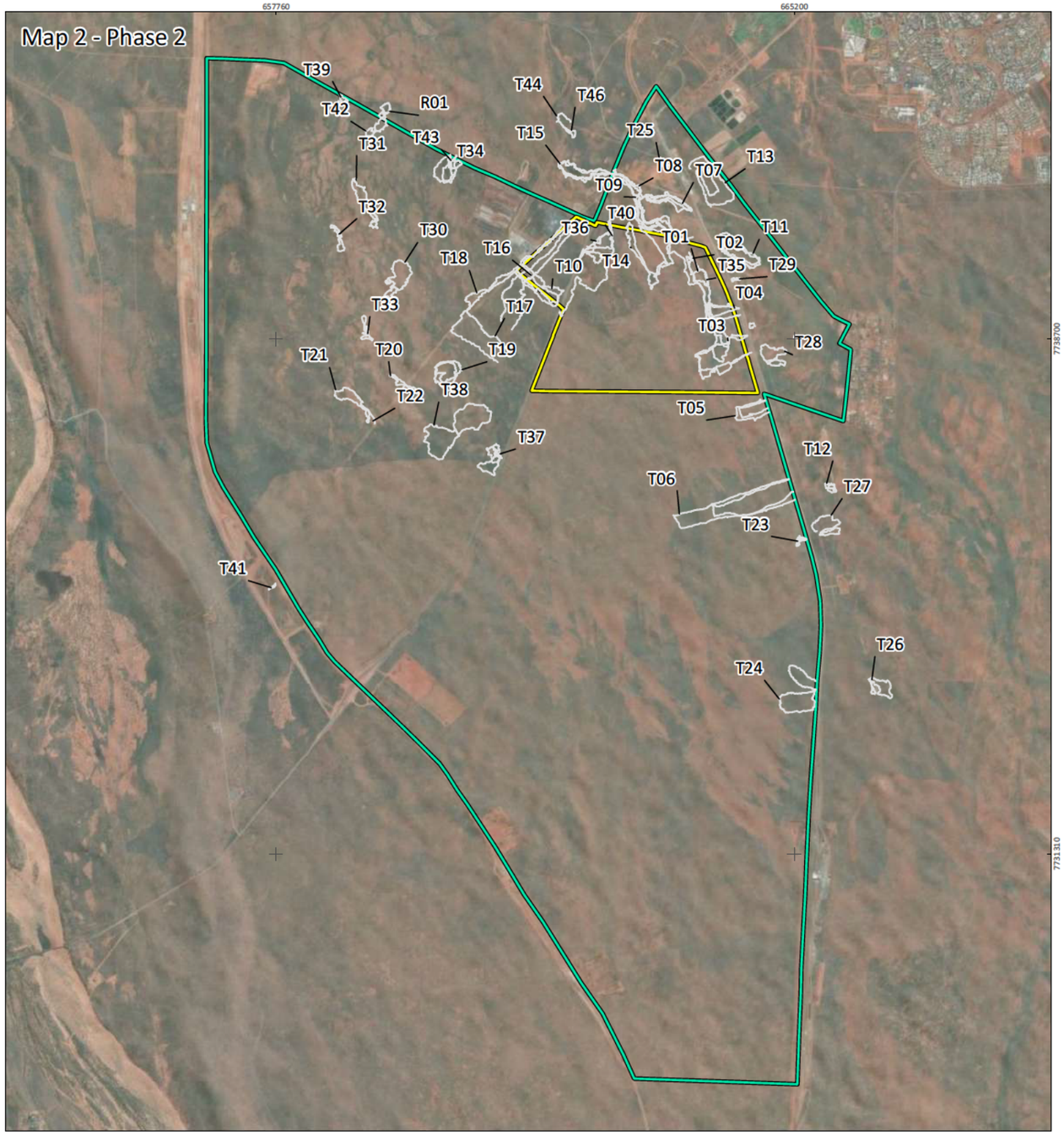
- Pit01
- Pit02
- Pit03
- Pit04
- Pit05
- Pundul

Figure 4-1

Terrestrial fauna survey sites

PHOENIX ENVIRONMENTAL SCIENCES





Alinta Energy Pty Ltd via Preston Consulting
Port Hedland Solar Farm Project

Project No	1454
Date	8/11/2021
Drawn by	IN
Map author	SP

Map 1
0 250 500
Meters

Map 2
0 1 2
Kilometers

1:18,000 (Map 1, at A3)
1:74,350 (Map 2, at A3)

GDA 1994 MGA Zone 50

P:\GIS\Projects\PortHedlandSolarFarm\1454-PHS-AE-VER\Mapping\MapDocuments\Figures\Figure_4_2_Targeted_search_transects_v3.mxd

Study Area

Targeted Bilby survey area

Map 1: Phoase 1

Targeted search line

Transect 01

Transect 02

Transect 03

Transect 04

Transect 05

Transect 06

Transect 07

Transect 08

Map 2: Phase 2

Targeted Bilby search transects

Figure 4–2

Targeted search transects conducted in phases one (Map 1) and two (Map 2)

PHOENIX ENVIRONMENTAL SCIENCES

Field methods undertaken during the phase one survey included:

- habitat assessment (4.2.2.1)
- systematic trapping (4.2.2.2)
- active diurnal and nocturnal searches (4.2.2.3)
- bird surveys (4.2.2.4)
- bat echolocation recordings (4.2.2.5)
- camera trapping (4.2.2.6)
- targeted searches for significant fauna (4.2.2.7)
- SRE potential habitat rating (4.5.1)
- SRE invertebrate sampling (4.5.2)

Field methods undertaken during the phase two survey included:

- targeted Bilby transect searches using a combination of linear search transects and two hectare sign plot technique (4.2.8.8).

4.2.2.1 Habitat assessment

Initial habitat characterisation was undertaken using various remote geographical tools, including aerial photography (Google Earth® 2021), land system maps and topographic maps. Habitats with the potential to support significant terrestrial fauna species were identified based on known habitats of such species within the Pilbara bioregion. Tentative sites were selected for the terrestrial fauna survey to represent all habitat types. Final survey site selection was conducted after ground-truthing of site characteristics.

At the broadest scale, site selection considered aspect, topography, and land systems. At the finer scale, consideration was given to proximity to water bodies (drainage lines and creek), vegetation complexes and condition and soil type. Sites were primarily chosen to represent the best example of distinct habitats within the broader habitat associations of the Study Area with a focus on significant fauna species.

Habitat assessments were conducted at a total of 14 sites including five systematic, one opportunistic and eight targeted sites (Table 4-4; Table 4-5; Figure 4-1; Appendix 2).

4.2.2.2 Systematic trapping

Five systematic fauna sites were installed to sample the assemblage of small to medium sized ground-dwelling fauna (Figure 4-1). Each site comprised five 'sub-sites' which consisted of a PVC pipe (15 cm diameter x 60 cm depth) and a 20 L bucket, four funnel traps (75 cm x 18 cm x 18 cm) and two small Elliot traps (9 cm x 10 cm x 33 cm). The pipes and buckets were installed flush with the substrate, with a 10 m long, 30 cm high aluminium drift fence bisecting each pit. One funnel trap was positioned at each end of the drift fence and two were placed side-by-side between the pipe and bucket. Two Elliot traps (9 cm x 10 cm x 33 cm) were placed at either end of each sub-site. Elliott traps were baited with a universal bait mixture consisting of oats, peanut butter, and sardines to attract small mammals. Elliott and funnel traps were shrouded with reflective closed cell insulation, rated at R2.5 (ICANZ 2010) to provide shade and protection for any captured animals. All traps were given as much shade as possible under/around vegetation. Styrofoam trays and leaf litter were used to provide protection from the elements in the bottom of all buckets. Traps were open for seven consecutive nights and checked within three hours (hrs) of sunrise. Baits were removed and replaced every second day.

Total vertebrate trapping effort was 1,400 trap-nights (Table 4-4) where a trap-night is defined as one trap remaining open for one night.

4.2.2.3 Active searches

Active searches were undertaken at each systematic and targeted fauna sites (Figure 4-1). Active searches primarily targeted diurnal reptiles and mammals from direct sightings and secondary evidence. Searches focused primarily on significant species identified in the desktop review as potentially occurring within the Study Area.

Searches were undertaken in observable microhabitats considered likely to support mammals, reptiles, and amphibians. Techniques included: raking leaf and bark litter, overturning logs, searching beneath the bark of trees, investigating dead trees and logs, investigating burrows, and identifying secondary evidence including tracks, diggings, scats, fur, or sloughs (shed skins), predation or feeding sites, and fauna constructed structures such as pebble mounds or nests. Two person hours were spent active searching at each systematic site for a total of person ten hours over the duration of the field survey (Table 4-4).

4.2.2.4 Bird surveys

Bird surveys were confined to the habitat type (up to two hectares) represented by each site to collect assemblage data for each habitat. Surveys were conducted throughout the day with a focus on periods of higher activity around sunrise and sunset. Species were identified from direct sightings and call recognition. Each systematic fauna was surveyed for a minimum of two person hours (Table 4-4). Opportunistic sightings were recorded during targeted searches while traveling. SongMeter SM4 recording devices were deployed at two sites (Pit02 and Pit04; Table 4-4; Figure 4-1). Devices were deployed for six nights and set to record from 30 minutes before sunset to 30 minutes after sunrise, in locations considered most suitable to support Night Parrot.

4.2.2.5 Bat echolocation recordings

SongMeter SM4Bat recording devices were used to record bat echolocation calls at three sites (Pit01, Pit02 and Pit04; Figure 4-1). Devices were deployed for six nights for approximately 12 hours of continuous recording per night (Table 4-4).

4.2.2.6 Camera trapping

Reconyx motion sensitive camera were used at two sites, Pit04 and Pit03. Three camera traps were deployed for six nights at Pit04, to detect species that forage, shelter or disperse along South West Creek (Table 4-4). One camera was deployed at Pit03 for six nights in front an unknown burrow (Table 4-4). Cameras were rebaited every two nights.

4.2.2.7 Targeted search transects

Seven targeted transects were walked in search of secondary evidence of Bilby (in adhere to DBCA 2018a) and Brush-tailed Mulgara. This involved four zoologists walking approximately 1.2 kms (Table 4-5), at a spacing of approximately 20 m in search of scats, diggings, burrows, and tracks of either species.

A minimum total distance of 4.8 km was searched per transect (1.2 km per person) conducted for a period of at least one person-hour. One extended search transect (Transect 08) was walked by the survey team with six Indigenous Rangers from the Kariyarra Aboriginal Corporation. Starting at Pit04, the survey team (of ten people) walked two, 1.5 km transects at a spacing of 15 – 20 m, traversing a total combined distance of 30 km (Table 4-5; Figure 4-2).

4.3 TARGETED BILBY SEARCHES (PHASE TWO)

The objective of the phase two TBS was to delineate the extent (boundary) and size (number of individuals) of the population recorded in the Study Area during the phase one by adopting methods developed by Dziminski *et al.* (2020) in line with DBCA's *Information sheet 102 / 2021*:

"a reliable technique to monitor Bilby abundance using non-invasively collected genetic material from faecal pellets (scats) combined with spatially explicit capture-recapture (SECR) analyses (DBCA 2021a)."

Dziminski *et al.* (2020) methods comprises three stages:

- population delineate and transect allocation
- scat collection
- DNA extraction, genotyping and SECR analysis.

Bilby populations are known to have moving home ranges (Dziminski *et al.* 2020). In order to evenly sample a population (via scat collection) the current extent (boundary) of activity of the target population must be delineated by plotting the extent of fresh Bilby sign. This can be achieved by walking linear transects, conducting standardised 2 ha plot searches, or a combination of both, as per DBCA's *Guideline for the survey and relocation of Bilby in Western Australia* (DBCA 2018a).

Linear transect searches are most effective when the area is smaller and where comparable, quantified data is not required (DBCA 2018a). Transects were selected in order to provide extensive and representative coverage of all suitable habitat types, with appropriate spacing to detect the presence of bilbies. The standardised 2 ha sign plot method involves searching multiple 2 ha plots for Bilby sign, for 25 minutes. As the project area size increases, plot spacing may be increased (DBCA 2018a).

Recently deposited scats (less than two weeks old), are required in order to yield sufficient DNA for genotyping (Dziminski *et al.* 2020). Individual bilbies deposit single or a small number of faecal pellets (usually two to five) in a discrete group usually on top of, or within, the sand-spoil of food diggings. Bilby scats are difficult to age just by visual inspection alone (Dziminski *et al.* 2020). Scats that are found on top of, or within, the sand-spoil of a digging, can be assessed by examining the state of decomposition of the associated digging. If the digging is very eroded and weathered, it is likely to have been created probably more than two weeks prior and are unlikely to yield sufficient DNA (Dziminski *et al.* 2020).

A total of 49 targeted search transects were traversed on foot, totalling a combined distance of 123.5km (Table 4-6; Figure 4-2). Only old scats (at least three months old) were recorded during phase two. As such genotyping and SECR analysis (to estimate population size) could not conducted. Representative photos of recorded scats are presented in Plate 5-1.

The location of all scats were recorded on GPS enabled devices and photographed (Plate 5-1; **Error! R eference source not found.**; Appendix 7).

4.4 LIKELIHOOD OF OCCURRENCE ASSESSMENT

Following the field survey, the likelihood of occurrence for each significant fauna species identified in the desktop review was assessed and assigned to one of four ratings:

- recorded – species recorded within the Study Area by previous or current survey
- likely – Study Area within current known range of species, suitable habitat within the Study Area and home range of species intersects Study Area based on known records
- possible – Study Area within current known range of species, suitable habitat within the Study Area and home range of species does not intersect Study Area based on known records

- unlikely – Study Area outside current known range of species or no suitable habitat present in Study Area.

4.5 ANALYSIS OF SURVEY ADEQUACY

Species accumulation curves were produced on a samples and abundance basis using Primer V6 (Clarke & Gorley 2006) to obtain an estimate of survey completeness, i.e. whether the collection adequately represents the vertebrate fauna assemblage of the Study Area. All sample types were aggregated per site and no data transformation was undertaken. The maximum permutations was set at 999.

4.5.1 SRE potential habitat rating

Potential SRE habitat mapping was rated as follows:

- Low - Vegetation is widespread within the Study Area and surrounds, does not contain landforms, soils, or vegetation likely to give rise to short-range endemism in the terrestrial invertebrate assemblage, may or may not have recorded Potential or Confirmed SRE taxa
- High – vegetation is locally restricted or regionally significant, contains landforms, soils or vegetation that acts to hold water in the landscape or is associated with surface water, likely to have recorded numerous Confirmed, Liekly or Potential SRE taxa.

4.5.2 SRE invertebrate sampling

Sampling for SRE invertebrates was conducted at all five systematic trapping sites (Table 4-4; Figure 4-1). Sampling comprised the following methods:

- dry pit trapping
- active foraging
- litter/soil sieving

Species representing potential SRE groups were collected from dry pitfall traps installed at systematic fauna sites (see section 4.2.2.2). Collected specimens were preserved in 100% ethanol and stored in the refrigerator to ensure the integrity of genetic material for identification.

Active foraging for SRE invertebrate groups comprised inspection of logs, larger plant debris, the underside of bark of larger trees and the underside of rocks. Methodical searches were conducted amongst the leaf litter of shade-bearing tall shrubs and trees, including raking of litter, and spinifex bases were inspected thoroughly.

A standardised approach was undertaken whereby each site was sampled for two person hours (concurrently with active searches for vertebrate fauna), for a total search effort of ten hours (Table 4-4).

Combined litter/soil sifts were undertaken at five sites, with up to three sifts conducted at each site dependent on abundance of leaf litter. In total, 15 sifts were undertaken. The collection of leaf litter samples was standardised volumetrically by the diameter and height (310 mm x 50 mm = 1.55 L) of the sieves which were filled with compressed litter and the upper layers of underlying soil. Samples were sieved through three stages of decreasing mesh size over a round tray and invertebrates were picked from the sieves and tray with forceps. These samples particularly targeted small spiders (Araneomorphae), pseudoscorpions, buthid scorpions, millipedes, centipedes (in particular Geophilomorpha and Cryptopidae), smaller species of molluscs (e.g. Pupillidae) and slaters.

4.5.3 Identification of SRE taxa

Specimens were identified to species level morphologically as a first pass. Specimens that were unable to be identified to species level were identified morphologically to the lowest level possible (usually family or genus) by a Phoenix invertebrate taxonomist, and then molecular sequencing was used to get a more definitive result.

Molecular sequencing was conducted for two mygalomorph specimens and one scorpion.

DNA was extracted from each specimen and the 658 base pair COI gene was amplified by Genotyping Australia using universal COI primers (Folmer *et al.* 1994). The data was subsequently compared to previously published sequences uploaded into GenBank using the BLAST function in Geneious Prime v11.1.5. Sequences were also compared inhouse, to Phoenix's molecular database, and previously sequenced specimens from past surveys (Ecologia 2009). The top blast hits for each major taxon were reported, the sequences from the survey were added, duplicate sequences were removed, and remaining sequences then analysed with a maximum likelihood phylogenetic analysis using a GTR+G model of evolution and 100 bootstraps (RAxML). Distances were calculated via tree-based estimates of identical bases in Geneious Prime.

Species delineation was determined through analysis of pairwise similarity matrices and RAxML trees showing clusters of specimens with similar DNA to those from the current survey and GenBank, and if other clusters were present but clearly forming a separate species. Confidence in determining conspecific species was highest for taxa with 97% pairwise similarity and above.

Comparison of sequences is the most effective way of determining if conspecific species have been collected from another source. GenBank stores the world's largest collection of publicly available DNA sequences, with contributions from both private and public organisations, including tertiary and government research institutions; however, it is up to the discretion of the owner to share the sequences to GenBank. While not everything that has been morphologically identified has been sequenced, and not everything that has been sequenced has been shared with GenBank, it is still the largest collection of data available and most likely to return similar species. Recently, there has been a shift to molecular identification of SREs and so the GenBank database is growing and becoming more accurate.

Notwithstanding the above, Species identification based on COI barcoding is not without problems as sequence divergence within species can be high and may exceed that between species in some taxa, including SRE target groups (Bond 2004; Boyer *et al.* 2007; Köhler & Johnson 2012). For example, sequence divergences of up to 10% may be considered to represent the same species in some genera of mygalomorph spiders and scorpions, with evidence of some groups displaying less than 5% divergence between species. In *Dampetrus* harvestmen and *Karaops* spiders however, intra-specific divergences extend only up to 6% and in millipedes less than 5% (Phoenix unpublished data).

4.5.4 Nomenclature

Nomenclature followed a number of taxon-specific references; however, many invertebrate species, including millipedes are currently unnamed requiring morphospecies designation. These are adopted from the nomenclatural systems developed by the WA Museum or other respective taxonomic authorities. Interim Phoenix specific codes are used for some of the species identified using molecular tools pending a code-designation by the WA Museum. Reference collections for these morphospecies generally reside with the WA Museum, as expected by the EPA (EPA 2016c).

4.6 SURVEY TEAM

The survey team involved in the surveys are listed in Table 4-7. All survey work was carried out under relevant licences issued by DBCA under the BC Act (Table 4-7).

Table 4-7 Survey team and relevant licences

Name	Permit	Qualifications	Role/s
Simon Pynt	Licence no. BA27000379	BSc Zoology	Project management, field survey (phase one & two), reporting
Michael Lohr		PhD Natural Sciences	Field survey
Caitlin Nagle		Ma Biol Sci. Conservation Biology	Field survey
Paula Strickland		Ma Sci. Tropical Biology & Conservation	Field survey
Jade Larkman	N/A	BSc Environmental Management	Field survey (phase 2), reporting

5 RESULTS

5.1 DESKTOP REVIEW

5.1.1 Terrestrial fauna

5.1.1.1 Vertebrate fauna

Eleven fauna habitats were identified (Table 5-1) from previous survey reports listed in Table 4-2. Of these 11 only two, sandplain habitat (5), which comprises the vast majority of the Study Area and minor drainage (4) were found to be relevant to this survey.

Table 5-1 Habitats recorded from surveys considered in the desktop review

	Description	Relevance to Study Area
1	Beach / Dune habitat includes the buffer zone between the sea and land. The vegetation of this habitat type is characterised by *Acacia* shrubs over tussock (Buffel) grassland.	Not relevant as not present
2	Tidal flats are dominated by the tides and is in constant transition between marine and terrestrial habitats. High tides inundate the area with seawater, although some areas of mudflat remain dry until the highest tides. The vegetation of this habitat type is characterised by scattered low shrubs over low open *Tecticornia* shrubland. Important habitat for Migratory shorebirds.	Not relevant as not present
3	Mangroves, like tidal flats is dominated by the tides. It differs from tidal flats by the fact that it is dominated by thick groves of mangrove trees. Mangroves create a range of microhabitats in the tree hollows and foliage for birds to forage, roost and nest. Support a unique faunal assemblage of mangrove specialists such as the Mangrove Golden Whistler, Mangrove Fantail, White-breasted Whistler, Collared Kingfisher and Dusky Gerygone.	Not relevant as not present
4	Riverine (inc. minor drainage) recorded by previous surveys include major rivers such as the Turner and Beebingarra and minor drainage lines. Riverine habitats contain important dispersal corridors for various species of birds, bats, large mammals, and wide-ranging reptiles.	Minor drainage relevant
5	Sandplain habitat was the most common fauna habitat recorded by previous reports included in the desktop review. The vegetation structure consists of low *Acacia* shrubland over spinifex hummock grasslands.	Highly relevant comprises much of the current Study Area
6	Billabong habitat comprises ephemeral or permanent water pools in otherwise dry habitat.	Not relevant as not present
7	Low Hill habitat includes low isolated rocky hills which provide small pockets of habitat for rock dwelling species, particularly reptiles.	Not relevant as not present
8	Granite Tor / Rockpile Isolated Stony habitats in areas dominated by flat sandy terrain.	Not relevant as not present
9	Quartz Hill habitat is similar to Granite Tor / Rockpile habitat and represents isolated rocky habitat suitable for rock dwelling species. Depending on the availability of suitable cracks, crevices and caverns for denning, this habitat is potentially occupied by Northern Quoll.	Not relevant as not present

	Description	Relevance to Study Area
10	Disturbed / Infrastructure habitat includes cleared land as well as tracks, laydown areas or otherwise disturbed habitat.	Present
11	Ocean habitat comprises the area beyond the intertidal zone off the coast and includes foraging habitat for pelagic birds, marine turtles, and obligate marine mammals.	Not relevant as not present

The desktop review identified records of 347 native and 15 introduced vertebrate taxa within the desktop search extent (Table 5-2). The list comprised 13 frogs, 87 reptiles (inc. two introduced), 217 birds (inc. two introduced) and 45 mammals (inc. 11 introduced; Table 5-2; Appendix 3). Due to the proximity of the Study Area to the coast (less than15 km) several species of obligate marine mammal were returned from various database outputs and were subsequently removed.

Table 5-2 Summary of terrestrial fauna desktop results

Class	Native	Introduced	Total
Amphibians	13	-	13
Reptiles	85	2	87
Birds	215	2	217
Mammals	34	11	45
Total	**347**	**15**	**362**

Sixty-two significant vertebrate fauna species were identified in the desktop review, comprising 59 species listed as Threatened, CD or SP under the EPBC and/or BC Act (Table 5-3). Records of 50 avifauna species are listed as Migratory under the EPBC Act and / or BC Act (Table 5-3). A further five species are listed as Priority by the DBCA (Table 5-3).

According to the DBCA Threatened and Priority Fauna Database, Brush-tailed Mulgara (*Dasycercus blythi*; P4; DBCA) was recorded 32 times in the Study Area in 2012 (DBCA 2021c) (Figure 5-1). Evidence of bilbies have been previously recorded in close proximity to the Study Area. Six DBCA Threatened and Priority Fauna Database records were previously recorded within 10 km of the Study Area, with the nearest record approximately 0.5 km to the east (Figure 5-1).

Table 5-3 Significant vertebrate fauna identified in the desktop review

Class Species name (64)	Common name	Status	Proximity to Study Area (kms)	Habitat
Reptiles (2)				
Liasis olivaceus barroni	Pilbara Olive Python	VU (EPBC & BC Acts)	29.2	Commonly found in rocky areas in association with watercourses and permanent pools near rocky habitats, such as gullies, gorges and rocky ranges or boulder sites (DSEWPaC 2008).
Ctenotus angusticeps	Airlie Island Ctenotus	P3 (DBCA list)	8.3	Known from approximately 12 locations in north-west WA (DoEE 2018). On the mainland it generally inhabits the landward fringe of salt marsh communities in samphire shrubland or marine couch grassland (Maryan *et al.* 2013) in the intertidal zone along mangrove (Grey Mangrove (*Avicennia marina*) with occasional Red Mangrove (*Rhizophora stylosa*) margins; however, subtle differences in vegetation/topography exist amongst sites where the species has been recorded (Biologic 2012). The Airlie Island Ctenotus is strongly associated with samphire species *Tecticornia halocnemoides* subsp. *tenuis* and *Suaeda arbusculoides*, which occur on clayey soils, and mixed herb and grass cover of *Muellerolimon salicorniaceum* and *Sporobolus virginicus*, which occur on sandy soils (Maryan *et al.* 2013).
Birds (55)				
Pandion cristatus	Osprey	Mig. (EPBC & BC Acts)	5.7	Mostly littoral and coastal habitats, sometimes in terrestrial wetlands or along major rivers (DoEE 2019; Johnstone & Storr 1998).
Apus pacificus	Fork-tailed Swift	Mig. (EPBC & BC Acts)	36.3	Non-breeding migrant in southern Summer, forages and roosts in flight so not limited by terrestrial habitat (DoEE 2019); flocks most often seen ahead of cyclones or during thunderstorms (Johnstone *et al.* 2013).
Charadrius leschenaultii	Greater Sand Plover	VU/Mig./VU (EPBC Act; BC Act)	7.2	Almost entirely coastal (littoral and estuarine) in Australia, mainly on beaches but occasionally saltmarsh habitats. Predominantly in northern Australia, a small proportion of the population winters in southern areas (DoEE 2019).

Class Species name (64)	Common name	Status	Proximity to Study Area (kms)	Habitat
Charadrius mongolus	Lesser Sand Plover	EN/Mig. (EPBC & BC Acts)	7.2	Non-breeding in Australia, may be present between September and May. Forages by day for small terrestrial and aquatic invertebrates; coastal, not recorded at inland sites (DoEE 2019).
Charadrius veredus	Oriental Plover	Mig. (EPBC & BC Acts)	13.6	Non-breeding visitor to Australia, widely distributed but most records are along the north-western coast between Exmouth Gulf and Derby. Inland habitats occupied by the species include sparsely vegetated plains or recently burnt open areas (DoEE 2019).
Pluvialis fulva	Pacific Golden Plover	Mig. (EPBC & BC Acts)	13.4	Most Australian sightings occur on coastal beaches, rocky shorelines and saltmarshes, also with some inland records that are mostly on major river systems (Marchant & Higgins 1990).
Pluvialis squatarola	Grey Plover	Mig. (EPBC & BC Acts)	2.3	Occurs mostly in coastal embankments, estuaries and lagoons with mudflats and sandflats, and occasionally on rocky coasts with wave-cut platforms or reef flats, or on reefs within muddy lagoons. They also occur around terrestrial wetlands such as near-coastal lakes and swamps, or salt-lakes (Marchant & Higgins 1990).
Falco hypoleucos	Grey Falcon	VU (BC Act)	10.6	In the Pilbara, mostly recorded from the coastal plain between the de Grey and Ashburton Rivers. Preferred habitat of this species comprises lightly wooded coastal and riverine plains (Johnstone & Storr 1998).
Falco peregrinus	Peregrine Falcon	OS (BC Act)	2.3	Preferred habitat includes cliffs and wooded watercourses. Nesting occurs mainly on cliff ledges, granite outcrops, quarries and in trees with old raven or Wedge-tailed Eagle nests (Johnstone & Storr 1998). Pilbara records mostly inland or on offshore islands (Johnstone *et al.* 2013).
Fregata ariel	Lesser Frigatebird	Mig. (EPBC & BC Acts)	13.1	Tropical and subtropical seabird, breeding on offshore islands and feeding mainly offshore (Johnstone *et al.* 2013).

Class Species name (64)	Common name	Status	Proximity to Study Area (kms)	Habitat
Glareola maldivarum	Oriental Pratincole	Mig. (EPBC & BC Acts)	0.03	Breeds in Asia, most of the global population overwintering in northern Australia (Oct-Apr); occurs in small groups to very large flocks on the Pilbara coast, found inland, usually over open plains with short grassland, samphire, or bare ground, feeding mostly aerially on insects. Large flocks often associated with thundery and cyclonic storms, as well as pre-departure aggregations (DoEE 2019; Johnstone *et al.* 2013).
Hirundo rustica	Barn Swallow	Mig. (EPBC & BC Acts)	1.7	Uncommon summer visitor to parts of northern Australia.
Oceanites oceanicus	Wilson's Storm Petrel	Mig. (EPBC & BC Acts)	14.4	Pelagic (DoEE 2019; Johnstone *et al.* 2013).
Anous stolidus	Common Noddy	Mig. (EPBC & BC Acts)	Unknown	No mainland records in the Pilbara (DoEE 2019; Johnstone *et al.* 2013).
Chlidonias leucopterus	White-winged Black Tern	Mig. (EPBC & BC Acts)	1.8	Non-breeding migrant in Australia (Sep-May), usually inhabiting coastal wetlands of varying salinity and vegetation types (DoEE 2019; Johnstone *et al.* 2013).
Onychoprion anaethetus	Bridled Tern	Mig. (EPBC & BC Acts)	13.1	Common summer visitor (Sep-Apr) on Pilbara islands, rarely recorded on the mainland (DoEE 2019; Johnstone *et al.* 2013).
Sterna caspia	Caspian Tern	Mig. (EPBC & BC Acts)	Unknown	Moderately common breeding resident, nesting on low islands, mainland beaches (including at Cape Preston) and terrestrial wetlands; forages in open wetlands including shallow margins of lakes and rivers, but also in open coastal waters (DoEE 2019; Johnstone *et al.* 2013).
Sterna hirundo	Common Tern	Mig. (EPBC & BC Acts)	13.1	Regular non-breeding summer visitor to Pilbara coast and islands (Aug-Apr) (DoEE 2019; Johnstone *et al.* 2013).
Sternula albifrons	Little Tern	Mig. (EPBC & BC Acts)	13.2	Uncommon to moderately common visitor to Pilbara coast, derived from two populations breeding in eastern Asia and the Kimberley, respectively. The preferred habitat of this species comprises sheltered seas, estuaries, and mangrove creeks. It is mainly a non-breeding visitor (all months, mostly Sep-Jun) (DoEE 2019; Johnstone *et al.* 2013).

Class Species name (64)	Common name	Status	Proximity to Study Area (kms)	Habitat
Sternula nereis subsp. nereis	Fairy Tern	VU (EPBC & BC Acts)	13.1	Coastal, moderately common visitor to the Pilbara coast. Preferred habitat for this species comprises sheltered seas, estuaries, and mangrove creeks. Non-breeding visitor to the Pilbara (all months, mostly Sep-Jun) (DoEE 2019; Johnstone *et al.* 2013).
Thalasseus bergii	Crested Tern	Mig. (BC Act)	2.3	Mainly resident in region, breeding on islands (Mar-May) but may also include migrants from Asia or southern areas; favours sheltered seas, estuaries and saltwork ponds, only rarely inland after storms (DoEE 2019; Johnstone *et al.* 2013).
Motacilla cinerea	Grey Wagtail	Mig. (EPBC & BC Acts)	Unknown	A rare summer vagrant to Australia (Nov-Apr) that inhabits fast flowing streams and rivers (IUCN 2019); the few Pilbara records are far inland (DBCA 2018b).
Motacilla flava	Yellow Wagtail	Mig. (EPBC & BC Acts)	14.4	Uncommon but regular visitor to Pilbara; primarily inhabits a range of damp or wet habitats with low vegetation including damp meadows, marshes, waterside pastures, and sewage farms (IUCN 2019; Johnstone *et al.* 2013).
Calonectris leucomelas	Streaked Shearwater	Mig. (EPBC & BC Acts)	Unknown	Pelagic species (Pilbara offshore records Mar-May) (DBCA 2018b; IUCN 2019).
Macronectes giganteus	Southern Giant Petrel	EN/Mig./Mig. (EPBC Act; BC Act)	Unknown	Breeds on subantarctic islands, feeds in coastal and pelagic waters around southern continents, occurring as far north as Carnarvon; not recorded from the Pilbara coast (Johnstone *et al.* 2013), but one inland record following a cyclone (DBCA 2018b; IUCN 2019).
Pezoporus occidentalis	Night Parrot	EN/CR (EPBC Act; BC Act)	Unknown	For roosting and nesting, Night Parrot appears to favour areas of dense vegetation comprising old-growth spinifex (*Triodia* spp.), especially hummocks that form rings (often more than 50 years unburnt). It is thought that spinifex hummocks that are less than 40-50 cm in height are not likely to provide adequate shelter for roosting and nesting (DPaW 2017). Such areas may also be associated with dense chenopod shrubs. Home range is up to 3000 ha (Murphy *et al.* 2017).
Rostratula australis	Australian Painted Snipe	EN (EPBC & BC Acts)	Unknown	WA records are almost exclusively from the south-west and the Kimberley (DBCA 2018b), but also inland parts of the Pilbara (Johnstone *et al.* 2013).

Class Species name (64)	Common name	Status	Proximity to Study Area (kms)	Habitat
Actitis hypoleucos	Common Sandpiper	Mig. (EPBC & BC Acts)	1.8	Breeds in temperate Eurasia during the northern hemisphere summer. A small population winters in Australia (3000 individuals). They are found across a wide range of wetlands, mostly coastal with some inland records (Geering *et al.* 2007).
Arenaria interpres	Ruddy Turnstone	Mig. (EPBC & BC Acts)	1.8	Non-breeding migrant, common on Pilbara coast mainly from late Aug – Apr, but may be present year-round as juvenile birds overwinter here (Johnstone *et al.* 2013).
Calidris acuminata	Sharp-tailed Sandpiper	Mig. (EPBC & BC Acts)	1.8	Mainly coastal, occasionally on large inland wetlands after significant rainfall; numbers in north-eastern Pilbara highest Sep-Nov, apparently moving further south for summer feeding, and not known to overwinter here (Johnstone *et al.* 2013).
Calidris alba	Sanderling	Mig. (EPBC & BC Acts)	7.2	Non-breeding visitor along coast, adults Sep-Apr but non-breeders may present in all months (Johnstone *et al.* 2013).
Calidris canutus	Red Knot	EN/Mig./EN (EPBC Act; BC Act)	7.2	Non-breeding visitor along coast, adults mostly Aug-Apr (Johnstone *et al.* 2013).
Calidris ferruginea	Curlew Sandpiper	CR/Mig./CR (EPBC Act; BC Act)	1.6	In Australia they are mostly found on the coast but can also forage inland, in open shallow wetlands; in the Pilbara mainly occur east from Karratha (Johnstone *et al.* 2013).
Calidris melanotos	Pectoral Sandpiper	Mig. (EPBC & BC Acts)	9.3	Found in wetlands, inland as well as on the coast. The species typically uses shallow fresh to saline wetlands such as coastal lagoons, estuaries, bays, swamps, lakes, inundated grasslands, saltmarshes, river pools, creeks, floodplains and artificial wetlands (DoEE 2019). In the Pilbara, regarded as a visitor to freshwater rather than coastal habitats (Johnstone *et al.* 2013).
Calidris ruficollis	Red-necked Stint	Mig. (EPBC & BC Acts)	1.8	Occurs in great numbers along the East Asian – Australasian Flyway: 325,000 individuals overall, 270.000 in Australia (Geering *et al.* 2007). Very common visitor on the Pilbara coast, present all months but mainly Aug-Apr (Johnstone *et al.* 2013); found across a wide range of open mudflat-like habitats in salt as well as in freshwater systems (DoEE 2019).

Class Species name (64)	Common name	Status	Proximity to Study Area (kms)	Habitat
Calidris subminuta	Long-toed Stint	Mig. (EPBC & BC Acts)	1.6	Uncommon visitor (Aug-Mar), reportedly restricted to freshwater habitats in the Pilbara and with no overwintering records (Johnstone *et al.* 2013).
Calidris tenuirostris	Great Knot	CR/Mig./CR (EPBC Act; BC Act)	7.2	Common visitor, especially to north-eastern part of Pilbara coast, mostly Aug-May but present in all months; favours tidal mud and sand flats and low-salinity saltwork ponds (Johnstone *et al.* 2013).
Gallinago stenura	Pin-tailed Snipe	Mig. (EPBC & BC Acts)	7.4	Uncommon visitor to freshwater habitats, mainly in northeast Pilbara (late Sep-Apr) (Johnstone *et al.* 2013).
Limicola falcinellus	Broad-billed Sandpiper	Mig. (BC Act)	14.6	Visitor to coast and coastal plains, present in all months but mostly Aug-Apr (Johnstone *et al.* 2013).
Limnodromus semipalmatus	Asian Dowitcher	Mig. (EPBC & BC Acts)	13.2	Very uncommon large, long-billed shorebird, nearly the size of a godwit, found in coastal **mudflats** and open marshes.
Limosa lapponica	Bar-tailed Godwit	Mig. (EPBC & BC Acts)	2.3	Only the Siberian subspecies is a regular migrant in Australia, occurring on the Pilbara coastline in all months but mostly Sep-Apr; forages on tidal mudflats, beaches, and low-salinity saltwork ponds (Johnstone *et al.* 2013).
Limosa lapponica subsp. menzbieri	Bar-tailed Godwit (northern Siberian)	CR/Mig./VU/Mig. (EPBC Act; BC Act)	15.5	Only the Siberian subspecies is a regular migrant in Australia, occurring on the Pilbara coastline in all months but mostly Sep-Apr; forages on tidal mudflats, beaches, and low-salinity saltwork ponds (Johnstone *et al.* 2013).
Limosa	Black-tailed Godwit	Mig. (BC Act)	15.4	Regular but uncommon migrant present on Pilbara coast Aug-Apr, not known to overwinter here; mainly at low-salinity saltwork ponds but also rocky and muddy coasts, and may roost/loaf on sandy beaches (Johnstone *et al.* 2013).
Numenius madagascariensis	Eastern Curlew	CR/Mig./CR (EPBC Act; BC Act)	2.3	Non-breeding visitor between October and February, when it is considered moderately common along tidal mudflats, reef flats, low-salinity saltwork ponds and sandy beaches of the Pilbara coast (Johnstone *et al.* 2013; Johnstone & Storr 1998).
Numenius minutus	Little Curlew	Mig. (EPBC & BC Acts)	1.6	Regular migrant to coast and coastal plain Sep-Apr, more common in northeast Pilbara and 'scarce' southwest of Port Hedland; samphire and grass flats, tidal mudflats (Johnstone *et al.* 2013).

Class Species name (64)	Common name	Status	Proximity to Study Area (kms)	Habitat
Numenius phaeopus	Whimbrel	Mig. (EPBC & BC Acts)	2.3	Rare visitor Aug-Apr, occurring offshore and on islands, mainland records mostly from Port Hedland saltworks including hypersaline ponds producing brine shrimp (Johnstone *et al.* 2013).
Phalaropus lobatus	Red-necked Phalarope	Mar/Mig. (EPBC Act; BC Act)	32.0	Regular migrant to coasts and larger islands, present in all months due to overwintering of non-breeding birds, but mainly Aug-Apr; mainly tidal mudflats, also sandy beaches and low-salinity saltwork ponds (Johnstone *et al.* 2013).
Philomachus pugnax	Ruff	Mig. (EPBC & BC Acts)	7.2	Rare visitor to northern WA wetlands with exposed mudflats (Johnstone *et al.* 2013).
Tringa brevipes	Grey-tailed Tattler	(Mig. EPBC & BC Acts; P4 DBCA list)	2.3	Moderately common migrant to coasts and islands, mainly Aug-Apr but present in all months; tidal mudflats, reef flats, mangrove creeks, sandy beaches, saltwork ponds, sewage ponds and brackish lagoons (Johnstone *et al.* 2013).
Tringa glareola	Wood Sandpiper	Mig. (EPBC & BC Acts)	1.7	Most abundant in north-west Australia, with all areas of national importance located in WA (Watkins 1993). It uses well-vegetated, shallow, freshwater wetlands, such as swamps, billabongs, lakes, pools and waterholes (DoEE 2019).
Tringa nebularia	Common Greenshank	Mig. (EPBC & BC Acts)	1.8	Found in a wide variety of inland wetlands and sheltered coastal habitats of varying salinity, including coastal mudflats, saltmarsh and mangroves; occurs in Pilbara Aug-Jun (DoEE 2019; Johnstone *et al.* 2013).
Tringa stagnatilis	Marsh Sandpiper	Mig. (EPBC & BC Acts)	13.1	Found on coastal and inland wetlands throughout Australia in the non-breeding season (Aug-Apr), but in WA less common and mainly found around the coast in small groups and occasionally flocks up to 200 (DoEE 2019; Johnstone *et al.* 2013).
Xenus cinereus	Terek Sandpiper	Mig. (EPBC & BC Acts)	3.7	Uncommon to scarce summer visitor to Australian coasts (rarely found inland) with no overwintering records in the Pilbara, found on tidal mudflats and low-salinity saltwork ponds (DoEE 2019; Johnstone *et al.* 2013).
Sula leucogaster	Brown Booby	Mig. (EPBC & BC Acts)	20.0	Pelagic species Off north-west WA, Brown Boobies are most abundant 18–36 km from land (Abbott 1979; Marchant & Higgins 1990).

Class Species name (64)	Common name	Status	Proximity to Study Area (kms)	Habitat
Plegadis falcinellus	Glossy Ibis	Mig. (EPBC & BC Acts)	13.6	Predominantly inhabits terrestrial wetlands, foraging in shallow water over soft substrate or on grassy or muddy verges of wetlands providing a variety of water depths. Inland, freshwater wetlands are preferred, especially permanent or ephemeral waterbodies on floodplains and shallow swamps with abundant aquatic flora (Johnstone *et al.* 2013; Marchant & Higgins 1990).
Mammals (7)				
Dasycercus blythi	Brush-tailed Mulgara	P4 (DBCA list)	0	Mulgara predominantly occur in spinifex hummock grasslands and shrublands on sandy soils (Menkhorst & Knight 2011). In the Pilbara region of WA, burrows have been observed with between two and nine entrances, tunnels mostly on a single level and to a depth of about 300 mm, shaped typically as an arch over a flat bottom with a height of 70-80 mm and width of 80-100 mm at the base. Internal tunnels are mostly 50-70 mm wide leading to grass lined nests.
Dasyurus hallucatus	Northern Quoll	EN (EPBC & BC Acts)	4.0	Potential denning / shelter habitat (considered critical for quoll survival) includes rocky gorges, gullies and escarpments associated with *Corymbia* woodland, boulder fields, termite mounds, and small caves. Foraging or dispersal habitat is considered to include any areas of predominantly native vegetation up to 2 km from denning habitat and drainage habitat (DSEWPaC 2011a).
Rhinonicteris aurantia (Pilbara)	Pilbara leaf-nosed bat	VU (EPBC & BC Acts)	24.8	The roosting site is often at depth in mines; in small crevices within caves, usually those ascending between sedimentary rock layers; and with associated groundwater seeps (Armstrong 2000). Foraging in the Pilbara has been observed in the following habitats: *Triodia* hummock grasslands covering low rolling hills and shallow gullies, with scattered *Eucalyptus camaldulensis* along the; over small watercourses amongst granite boulders and low shrubs in ironstone gorges.
Macroderma gigas	Ghost Bat	VU (EPBC & BC Acts)	24.9	Survival is critically dependent on natural roosts in caves, crevices, deep overhangs, and artificial roosts such as abandoned mine adits (Hall *et al*. 1997); the most suitable roosting locations in the Pilbara occur in the Marra Mamba Iron Formation (Armstrong & Kerry 2011).

Class Species name (64)	Common name	Status	Proximity to Study Area (kms)	Habitat
Mormopterus cobourgianus	North-western Free-tailed Bat	P1 (DBCA list)	10.1	Mangrove species (Milne 2008).
Pseudomys chapmani	Western Pebble-mound Mouse	P4 (DBCA list)	25.2	Restricted to non-coastal, central and eastern parts of the Pilbara where preferred habitat comprises gentle, sparsely vegetated slopes of rocky ranges (Morris & Burbidge 2008).
Macrotis lagotis	Bilby	VU (EPBC & BC Acts)	0.5	Bilby prefers hummock grassland in plains and alluvial areas, open tussock grassland on uplands and hills, and mulga woodland/shrubland on ridges and rises (DSEWPaC 2011b) but areas where it is now regionally extinct include many other (mostly open / exposed) habitat types.

646000 682000 7745500 7710000

Map 1 - All significant species records

639100 666200 7739800 7712400

Map 2 - Bilby records

Species, conservation status

♦ *Macrotis lagotis*, VU (EPBC Act, BC Act)

Alinta Energy Pty Ltd via Preston Consulting
Port Hedland Solar Farm Project

Project No	1454
Date	2/11/2021
Drawn by	IN
Map author	SP

Map 1 0 5 10 Kilometers

Map 2 0 5 10 Kilometers

1:363,000 (Map 1, at A3)
1:271,800 (Map 2, at A3)

GDA 1994 MGA Zone 50

P:\GIS\Projects\PortHedlandSolarFarm\1454-PHS-AE-VER\Mapping\MapDocuments\Figures\Figure_5_1_Desktop_records.mxd

Study Area

Targeted Bilby survey area

Map 1

Conservation status

- CR/Mig./CR (EPBC Act, BC Act)
- CR/Mig./VU/Mig. (EPBC Act, BC Act)
- EN (EPBC Act, BC Act)
- EN/Mig. (EPBC Act, BC Act)
- EN/Mig./EN (EPBC Act, BC Act)
- VU (BC Act)
- VU/Mig./VU (EPBC Act, BC Act)
- VU (EPBC Act, BC Act)
- Mig. (BC Act)
- Mar/Mig. (EPBC Act, BC Act)
- Mig. (EPBC Act, BC Act)
- Mig. (EPBC Act, BC Act), P4 (DBCA list)
- OS (BC Act)
- P1 (DBCA list)
- P3 (DBCA list)
- P4 (DBCA list)

Figure 5-1

Desktop records

PHOENIX ENVIRONMENTAL SCIENCES

5.1.1.2 SRE invertebrate fauna

The desktop review identified 1,706 individual records (1,310 Arachnida/Myriapoda, 134 Mollusca and 259 Crustacea) from a minimum of 117 distinct taxa (Table 5-5).

Of these taxa, 85 are potential SREs and 32 are of uncertain SRE status (Table 5-5; Figure 5-2). Only eight of the 85 potential SRE taxa are named species, the remaining 77 comprise taxa named only to morphospecies codes as applied by the WA Museum or are not identified to confirmed species level (i.e. "sp." or "cf.").

The majority of taxa of uncertain SRE status are unidentifiable (i.e. "sp. indet.", e.g. female or juvenile specimens) or could not be identified to species or morphospecies and may represent new species or other species listed in the same genus where records exist (Figure 5-2).

The records indicate that none of the SRE taxa have previously been recorded within the Study Area (Figure 5-2). The SRE assemblage is dominated by pseudoscorpions, mygalomorph spiders and scorpions which make up 24.6%, 19.7% and 18.9% respectively of the total number of taxa (Table 5-5).

Table 5-4 Summary of SRE taxa identified in the desktop review

Higher order	Families	Genera	Taxa	% of taxa
Chilopoda (centipedes)	2	4	4	**3.3**
Gastropods (snails)	3	8	8	**8.2**
Isopods (slaters)	2	5	17	**13.9**
Diplopoda (millipedes)	1	3	9	**7.4**
Mygalomorph (trap-door spiders)	5	11	24	**19.7**
Opiliones (harvestmen)	1	2	2	**1.6**
Pseudoscorpions	7	21	30	**24.6**
Scorpions	2	3	20	**18.9**
Selenopid (wall crab spiders)	1	1	3	**2.5**
Total	**24**	**58**	**117**	**100**

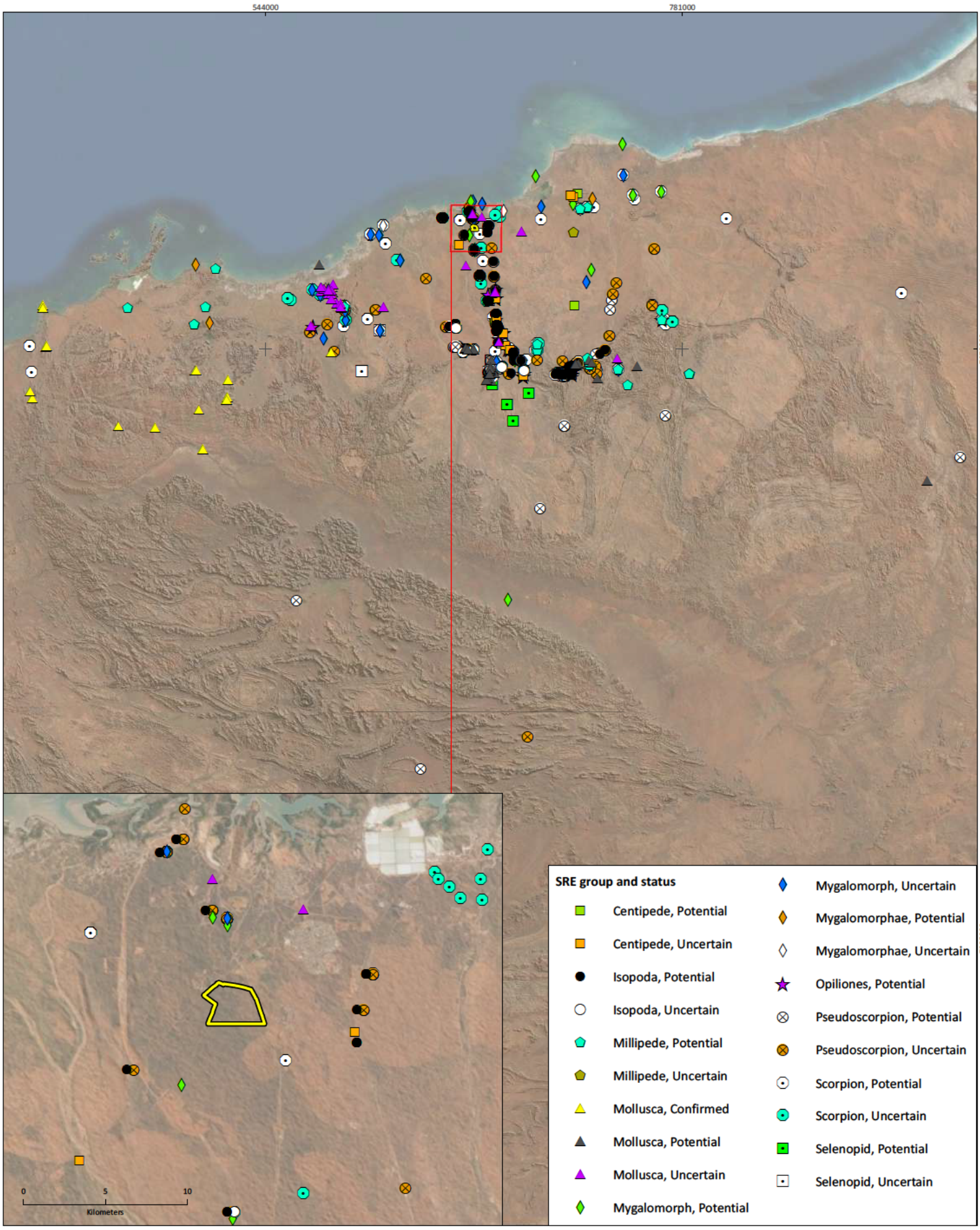
Table 5-5 SRE taxa identified in the desktop review

Higher taxon, family	Taxa	SRE status	Proximity to Study Area (km)
Class Arachnida, infraorder Araneomorphae			
Selenopidae	*Karaops* `aurizon`	Potential	74.3
Selenopidae	*Karaops kariyarra*	Potential	40.3
Selenopidae	*Karaops* `sp. indet`	Uncertain	52.2
Class Arachnida, infraorder Mygalomorphae (trap-door spiders)			
Actinopodidae	*Missulena* `sp. indet.`	Uncertain	13.0
Anamidae	*Aname* `MYG372`	Potential	76.6
Anamidae	*Aname* `MYG373`	Potential	3.9
Anamidae	*Aname* `MYG682`	Potential	75.9
Anamidae	*Aname* `sp. indet.`	Uncertain	3.9
Anamidae	*Aname frostorum*	Potential	88.4
Anamidae	*Aname mcalpinei*	Potential	3.6
Anamidae	`Genus indet.` `sp. indet.`	Uncertain	44.3
Anamidae	*Kwonkan* `MYG089`	Potential	53.0

Higher taxon, family	Taxa	SRE status	Proximity to Study Area (km)
Anamidae	*Kwonkan* `MYG092`	Potential	84.7
Anamidae	*Kwonkan* `MYG209`	Potential	11.4
Anamidae	*Kwonkan* `sp. indet.`	Uncertain	38.3
Anamidae	`MYGAAB` `sp. indet.`	Potential	44.3
Barychelidae	*Aurecocrypta* `MYG318`	Potential	93.8
Barychelidae	`Genus indet.` `sp. indet.`	Uncertain	75.9
Barychelidae	*Synothele* `MYG115`	Potential	90.3
Barychelidae	*Synothele* `MYG334`	Potential	94.5
Barychelidae	*Synothele* `sp. indet.`	Uncertain	44.4
Halonoproctidae	*Conothele* `MYG541`	Potential	13.8
Halonoproctidae	*Conothele* `MYG607`	Potential	68.5
Halonoproctidae	*Conothele* `sp. indet.`	Uncertain	94.0
Idiopidae	`Genus indet.` `sp. indet.`	Uncertain	17.8
Idiopidae	*Idiosoma* `MYG084`	Potential	11.5
Idiopidae	*Idiosoma* `sp. indet.`	Uncertain	67.7
Class Arachnida, order Opiliones (harvestmen)			
Assamiidae	*Dampetrus* `sp. indet.`	Potential	35.4
Assamiidae	`Genus indet.` `sp. indet.`	Potential	37.1
Class Arachnida, order Pseudoscorpiones			
Atemnidae	*Oratemnus* `PSE060`	Potential	67.5
Cheiridiidae	*Oratemnus* `sp. indet.`	Uncertain	19.9
Cheiridiidae	`Genus indet.` `sp. indet.`	Uncertain	82.4
Cheiridiidae	`PSEAAB` `sp. indet.`	Potential	78.2
Chernetidae	*Austrochernes* `sp. nov. 001`	Potential	54.7
Chernetidae	*Haplochernes* `sp. indet.`	Uncertain	71.0
Chernetidae	`PSEAAF` `sp. indet.`	Potential	86.0
Chernetidae	*Sundochernes* `PSE021`	Potential	55.3
Chthoniidae	`Genus indet.` `sp. NS`	Potential	94.3
Chthoniidae	*Tyrannochthonius* `abydos`	Potential	93.6
Chthoniidae	*Tyrannochthonius* `sp. AB A`	Potential	94.7
Chthoniidae	*Tyrannochthonius* `sp. AB B`	Potential	94.8
Chthoniidae	*Tyrannochthonius* `sp. indet. (macerated)`	Potential	54.7
Chthoniidae	*Tyrannochthonius* `sp. indet.`	Uncertain	94.7
Chthoniidae	*Tyrannochthonius* `sp. nov. near aridus`	Potential	56.3
Garypidae	*Synsphyronus* `PSE094, long chelal hand`	Potential	40.3
Garypidae	*Synsphyronus* `PSE128`	Potential	66.9
Garypidae	*Synsphyronus* `sp. indet.`	Uncertain	83.5
Olpiidae	*Beierolpium* `sp. indet. (juvenile 6/2) lge`	Potential	54.8
Olpiidae	*Beierolpium* `sp. indet. (juvenile 6/2) small`	Potential	54.7
Olpiidae	*Beierolpium* `sp. indet. (juvenile 7/3) large`	Potential	54.8
Olpiidae	*Beierolpium* `sp. indet. (juvenile 7/3, 6/2x3) lge`	Potential	69.7
Olpiidae	*Beierolpium* `sp. indet.`	Uncertain	8.5

Higher taxon, family	Taxa	SRE status	Proximity to Study Area (km)
Olpiidae	`Genus 7/4` `sp. indet.`	Potential	17.2
Olpiidae	`Genus indet.` `sp. indet.`	Uncertain	17.2
Olpiidae	*Indolpium* `long chelal hand`	Potential	79.5
Olpiidae	*Indolpium* `sp. indet.`	Uncertain	3.9
Olpiidae	`PSEAAA` `sp. indet.`	Potential	54.5
Sternophoridae	*Afrosternophorus* `sp. indet.`	Uncertain	55.3
Sternophoridae	`Genus indet.` `sp. indet.`	Uncertain	37.9
Class Arachnida, order Scorpiones			
Buthidae	*Isometroides* `sp. 2`	Potential	91.3
Buthidae	*Lychas* `adonis`	Potential	6.8
Buthidae	*Lychas* `bituberculatus complex`	Potential	55.3
Buthidae	*Lychas* `gracilimanus`	Potential	94.8
Buthidae	*Lychas* `hairy tail complex`	Potential	58.2
Buthidae	*Lychas* `macleod`	Potential	94.1
Buthidae	*Lychas* `sp. 1`	Potential	73.1
Buthidae	*Lychas* `sp. 2`	Potential	36.5
Buthidae	*Lychas* `sp. 4`	Potential	59.6
Buthidae	*Lychas* `sp. 5`	Potential	57.6
Buthidae	*Lychas* `sp. 6`	Potential	76.2
Buthidae	*Lychas* `sp. indet`	Uncertain	11.4
Urodacidae	*Urodacus* `armatus`	Potential	2.5
Urodacidae	*Urodacus* `micros`	Potential	95.1
Urodacidae	*Urodacus* `pilbara 13`	Potential	3.9
Urodacidae	*Urodacus* `pilbara 2`	Potential	72.3
Urodacidae	*Urodacus* `SCO035` pilbara 2`	Potential	76.6
Urodacidae	*Urodacus* `sp. 6`	Potential	90.3
Urodacidae	*Urodacus* `sp. 7`	Potential	49.8
Urodacidae	*Urodacus* `sp. indet`	Uncertain	8.5
Class Chilopoda (centipedes)			
Cryptopidae	*Cryptops* `sp. indet`	Uncertain	5.2
Cryptopidae	`Genus indet.` `sp. MN`	Potential	69.5
Cryptopidae	`Genus indet.` `sp. S3`	Potential	60.5
Geophilidae	`Genus indet.` `sp. indet.`	Uncertain	98.3
Subphylum Crustacea, order Isopoda			
Armadillidae	*Acanthodillo* `sp. indet`	Uncertain	11.4
Armadillidae	*Buddelundia* `sp. 10`	Potential	4.4
Armadillidae	*Buddelundia* `sp. 11`	Potential	93.5
Armadillidae	*Buddelundia* `sp. 13`	Potential	76.6
Armadillidae	*Buddelundia* `sp. 14`	Potential	5.8
Armadillidae	*Buddelundia* `sp. 14re`	Potential	55.3
Armadillidae	*Buddelundia* `sp. 17`	Potential	5.8
Armadillidae	*Buddelundia* `sp. 18`	Potential	93.5

Higher taxon, family	Taxa	SRE status	Proximity to Study Area (km)
Armadillidae	*Buddelundia* `sp. 19`	Potential	5.8
Armadillidae	*Buddelundia* `sp. 21`	Potential	54.5
Armadillidae	*Buddelundia* `sp. 31`	Potential	55.3
Armadillidae	*Buddelundia* `sp. 36`	Potential	67.6
Armadillidae	*Buddelundia* `sp. indet`	Uncertain	78.2
Armadillidae	`Genus indet.` `abydos`	Potential	93.9
Armadillidae	`Genus indet.` `sp. indet.`	Uncertain	56.3
Armadillidae	*Spherillo wodgina*	Potential	5.8
Philosciidae	*Laevophiloscia* `sp. indet`	Uncertain	79.1
Class Diplopoda, order Polydesmida (millipedes)			
Paradoxosomatidae	*Antichiropus* `DIP005, abydos`	Potential	93.8
Paradoxosomatidae	*Antichiropus* `DIP033, wodgina`	Potential	67.9
Paradoxosomatidae	*Antichiropus* `sp. indet`	Uncertain	40.0
Paradoxosomatidae	*Antichiropus apricus*	Potential	95.6
Paradoxosomatidae	*Antichiropus forcipatus*	Potential	73.1
Paradoxosomatidae	*Antichiropus salutus*	Potential	84.7
Paradoxosomatidae	*Antichiropus simmonsi*	Potential	59.6
Paradoxosomatidae	`DIPAAC` `DIP030`	Potential	84.7
Paradoxosomatidae	`Genus indet.` `sp. indet.`	Uncertain	54.5
Class Gastropoda (snails)			
Camaenidae	`Genus indet.` `sp. indet.`	Uncertain	14.4
Camaenidae	Gen. nov. cf. `Z` n.sp.	Potential	84.5
Camaenidae	Gen. nov. n.sp.	Potential	67.3
Camaenidae	Gen. nov. cf. `Mount Robinson` n.sp.	Potential	67.6
Camaenidae	*Quistrachia* `Depuch Island` n.sp.	Potential	89.0
Camaenidae	*Rhagada* aff. *Richardsonii*	Potential	95.4
Camaenidae	*Rhagada* `sp. indet`	Uncertain	6.1
Helicodiscidae	*Stenopylis* cf. *coarctata*	Potential	94.4



Alinta Energy Pty Ltd via Preston Consulting
Port Hedland Solar Farm Project

Project No	1388
Date	23/07/2021
Drawn by	IN
Map author	AJ

0 25 50
Kilometers

1 2,798,500 (at A4) GDA 1994 MGA Zone 50

Study Area

Figure 5-2

Desktop records of SRE invertebrates

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5.2 FIELD SURVEY

5.2.1 Vertebrate fauna

5.2.1.1 Fauna habitats

Two broad fauna habitats were identified in the Study Area, based on landform, soil type and vegetation structure:

- sandplain
- minor drainage.

Sandplain habitat comprises the majority of the Study Area (602.35 ha; 96.39%; Figure 5-6; Table 5-6) and comprises the following dominant vegetation complexes:

- spinifex hummock grasslands supported by scattered low *Acacia striaticeps* shrubs
- isolated patches of *Acacia tumida pilbarensis* tall shrubs over low to mid mixed *Acacia* shrubs with scattered stage one spinifex hummocks
- open tussock grassland with mixed low fire-ephemeral shrubs
- isolated patches of tall *Acacia tumida pilbaraensis* over mixed mid *Acacia* dominant shrubland with evenly scattered long-unburnt, stage three, four and five spinifex hummocks.

Minor drainage habitat comprises 13.59 ha (2.17%) of the Study Area (Figure 5-6; Table 5-6) and is characterised by (Table 5-6):

- low to mid, very open Eucalyptus woodland with dense low mixed *Acacia* shrubs, dense tussock grasses on lower slopes of drainage line and spinifex hummocks on upper slopes and adjacent plains.

Four systematic fauna sites were installed in sandplain habitat (Pit01, Pit02, Pit03 and Pit05), each targeting a different dominant vegetation structure (microhabitat).One systematic fauna site was installed in minor drainage habitat (Pit04; Figure 5-6; Table 5-6).

Substrate consistency within the sandplains is ideal for fossorial reptiles and burrowing mammals, which include significant species such as the Bilby and Brush-tailed Mulgara (Table 5-3). Minor drainage habitat supports a diverse assemblage of fauna, including a number of frog species, many of which require ephemeral pools to breed, and for the development of eggs into tadpoles (Cogger 2014).

The remaining 8.94 ha (1.35%) of the Study Area comprises 5.49 ha (0.88%) of road and infrastructure and 3.45 ha of cleared / disturbed areas (0.47%; Figure 5-6; Table 5-6).

Table 5-6 Extent and description of each fauna habitat and systematic sites in the Study Area

Habitat type	Vegetation structure	Site/s	Extent in Study Area and % of Study Area	Representative photograph
Sandplain	Isolated *Acacia* shrublands, patches of low *Acacia* shrublands, spinifex grasslands and open grasslands	Pit01,	Transect 01, Transect 02, Transect 03, Transect 04, Transect 05, Transect 07, Pundal 602.35 ha 96.39%	
Sandplain	Isolated *Acacia* shrublands, patches of low *Acacia* shrublands, spinifex grasslands and open grasslands	Pit02		
Sandplain	Isolated *Acacia* shrublands, patches of low *Acacia* shrublands, spinifex grasslands and open grasslands	Pit03		
Minor drainage	Open Eucalyptus woodland over scattered *Acacia* shrubs, dense tussock grasses and scattered spinifex grasses	Pit04	Transect 06, Transect 08 13.59 ha 2.17%	

Habitat type	Vegetation structure	Site/s	Extent in Study Area and % of Study Area	Representative photograph
Sandplain	Isolated *Acacia* shrublands, patches of low *Acacia* shrublands, spinifex grasslands and open grasslands	Pit05		
Disturbed / cleared	N/A	N/A	3.45 ha 0.47%	
Roads / infrastructure	N/A	N/A	5.49 ha 0.88%	

A large-scale fire was observed to have affected a large portion of the Study Area in recent years (Table 5-7 Figure 5-3). Subsequent review of historical aerial imagery has determined that in fact fire has occurred within the Study Area at least five times in the past 15 years, including within the minor drainage line habitat ten years ago.

Table 5-7 Fire history of the Study Area

Habitat	Date	Fire age	Site/s	Extent in Study Area and % of Study Area	Representative photograph
Sandplain	March 2020	less than 2 years	Pit03, Transect 03, Transect 05	300.13 ha 48.02%	
Sandplain & minor drainage	June 2018	3 years	Transect 06	40.61 ha 6.49%	
Sandplain	November 2015	6 years	Pit01, Pit02, Transect 02	119.18 ha 19.07%	
Sandplain and minor drainage	Nov 2011	10 years	Pit-4, Transect 06, Transect 08, Pundal	255.53 ha 40.89%	
Sandplain	Unknown	More than 15 years	Pit05, Transect 07	67.62 ha 10.82%	

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Project No	1388
Date	2/08/2021
Drawn by	IN
Map author	SP

0 250 500
Meters

1 18,500 (at A4) GDA 1994 MGA Zone 50

Study Area

Fire history
- less than 2 years
- less than 2 years; 6 years
- less than 2 years; 10 years
- 3 years
- 6 years
- 10 years
- greater than 15 years
- None

Figure 5-3
Fire history of the Study Area

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5.2.1.2 Assemblage

A total of 82 species representing 38 families and 62 genera were recorded from a total abundance of 1,209 individuals (Table 5-8; Appendix 3; Appendix 5). The assemblage includes 78 native and four introduced species and represents 22.46% of the assemblage identified by the desktop review (Table 5-8). However, the desktop list includes species records from surveys completed in areas that contain many habitats not present in the Study Area, including marine /coastal habitats (Table 4-2; Table 5-1).

Table 5-8 Number of vertebrate species recorded this survey compared to desktop results

Group	No. species identified in desktop review	No. species recorded in survey	Recorded (%)
Amphibians	13	6	46.15
Reptiles	87 (inc. 2 introduced)	36	40.09
Birds	217 (inc. 2 introduced)	25	11.52
Mammals	45 (inc. 11 introduced)	15 (inc. 4 introduced)	32.61
Total	**362**	**82**	**22.46**

Amphibians

Of the 13 species of amphibian identified in the desktop results, six species (46.15%) representing four families were recorded in the survey (Figure 5-4; Appendix 3; Appendix 5); all of which were burrowing frogs (Main's Frog, Spencer's Burrowing Frog, Desert Spadefoot and Northern Burrowing Frog; (Appendix 3; Appendix 5).

Reptiles

A total of 36 species of reptile representing ten families were recorded in the survey (Figure 5-4; Appendix 3; Appendix 5). The desktop survey indicated a potential 87 species (inc. two introduced) to occur in the vicinity of the Study Area; this survey recorded 41.37 % of them (Table 5-8; Figure 5-4; Appendix 3).

More than a third of the total reptile assemblage were represented by Skinks (13 species), followed by Monitors (five species), Diplodactylid Geckos (four species), Elapids (three species), Dragons (three species) True Geckos (two species), Blind Snakes (two species), Pygopods (two species) and Pythons (one species) (Appendix 3; Appendix 5). No significant reptile species were recorded (Appendix 3; Appendix 5).

Birds

A total of 25 bird species from 18 families were recorded in the Study Area (Appendix 3; Appendix 5), representing 11.52% of the 217 species (inc. two introduced) indicated as potentially occurring from the desktop review.

Site Pit04 recorded the most bird species with a total of 15 (Appendix 3; Appendix 5). Pit03 recorded the least, with only three species (Figure 5-4; Appendix 5). A total abundance of 238 birds were recorded from systematic sites of which more than half (146) were Zebra Finch recorded at Pit02 including a single flock of 112 (Appendix 5). Pit04, Pit05, Pit03 and Pit01 recorded abundances of 42, 42, eight and six respectively (Appendix 5). No significant bird species were recorded.

Mammals

A total of 11 native and four introduced mammals, representing nine families were recorded in the Study Area (Figure 5-4; Appendix 3; Appendix 5). This represents 32.61 % of the 34 native and 11 introduced species identified in the desktop review (Table 5-8; Appendix 3).

Three feral predators (Dog, Cat and Red Fox) and the European Cattle comprise the assemblage of introduced fauna in the Study Area (Appendix 3; Appendix 5).

Four species of bat were recorded every night for six nights at three sites (Pit01, Pit02 and Pit04; Appendix 3; Appendix 5), including one species of Mollisid (Greater Northern Freetail-bat) and three species of Vespertilionid (Gould's Wattled Bat, Little Broad-nosed Bat and Finlayson's Cave Bat (Appendix 3; Appendix 5).

Three species of Dasyurid (Lesser Hairy-footed Dunnart, Little Red Kaluta and Brush-tailed Mulgara (P4 DBCA list)), two Native Rodents (Spinifex Hopping Mouse and Sandy Inland Mouse), one Macropod (Red Kangaroo) and one Thylacomyid (Bilby, VU; EPBC & BC Act) were also recorded.

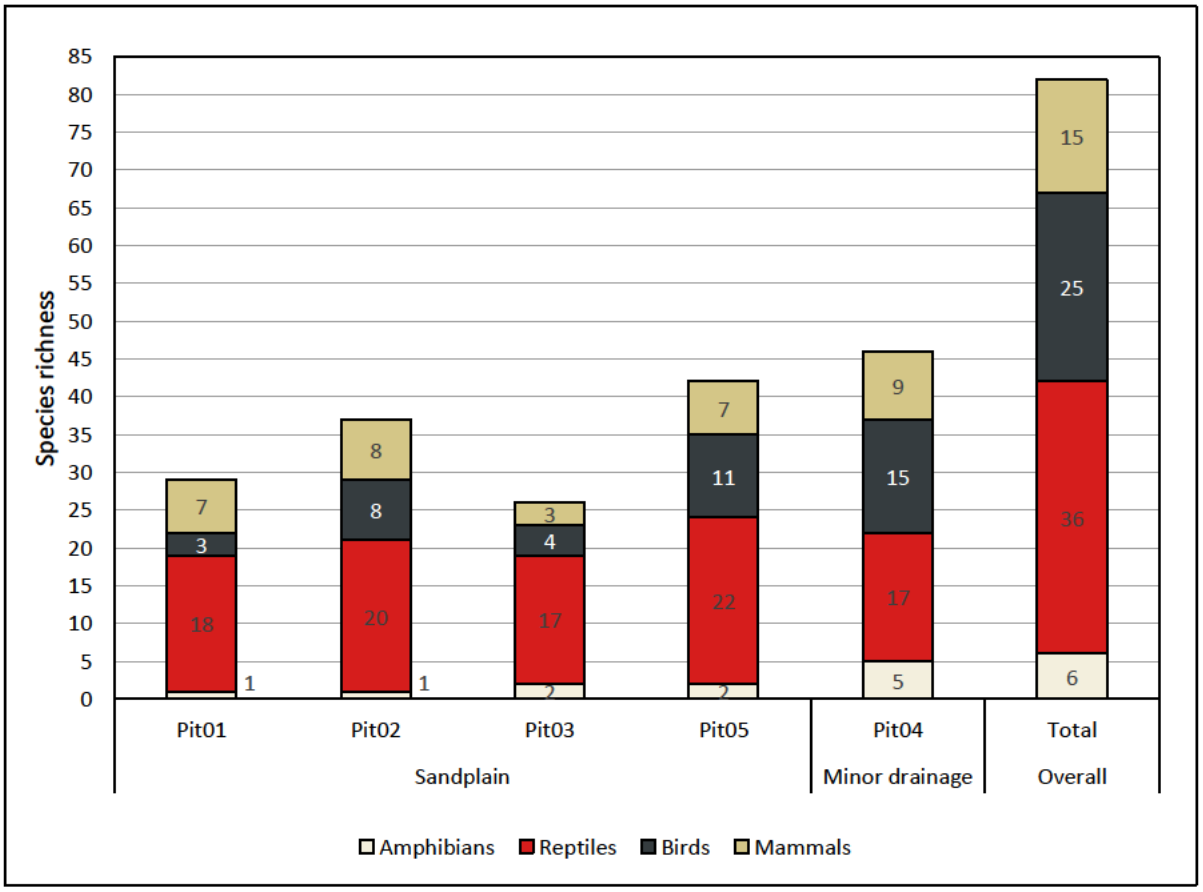


Figure 5-4 Species richness of systematic survey sites

Figure 5-5 plots the species accumulation for the five systematic survey sites. The four indices all indicate that the systematic survey effort was adequate for the Study Area in that few additional species were recorded by the fifth sample site and it is expected that few remain undetected. This is considered consistent with the lack of habitat diversity within the Study Area.

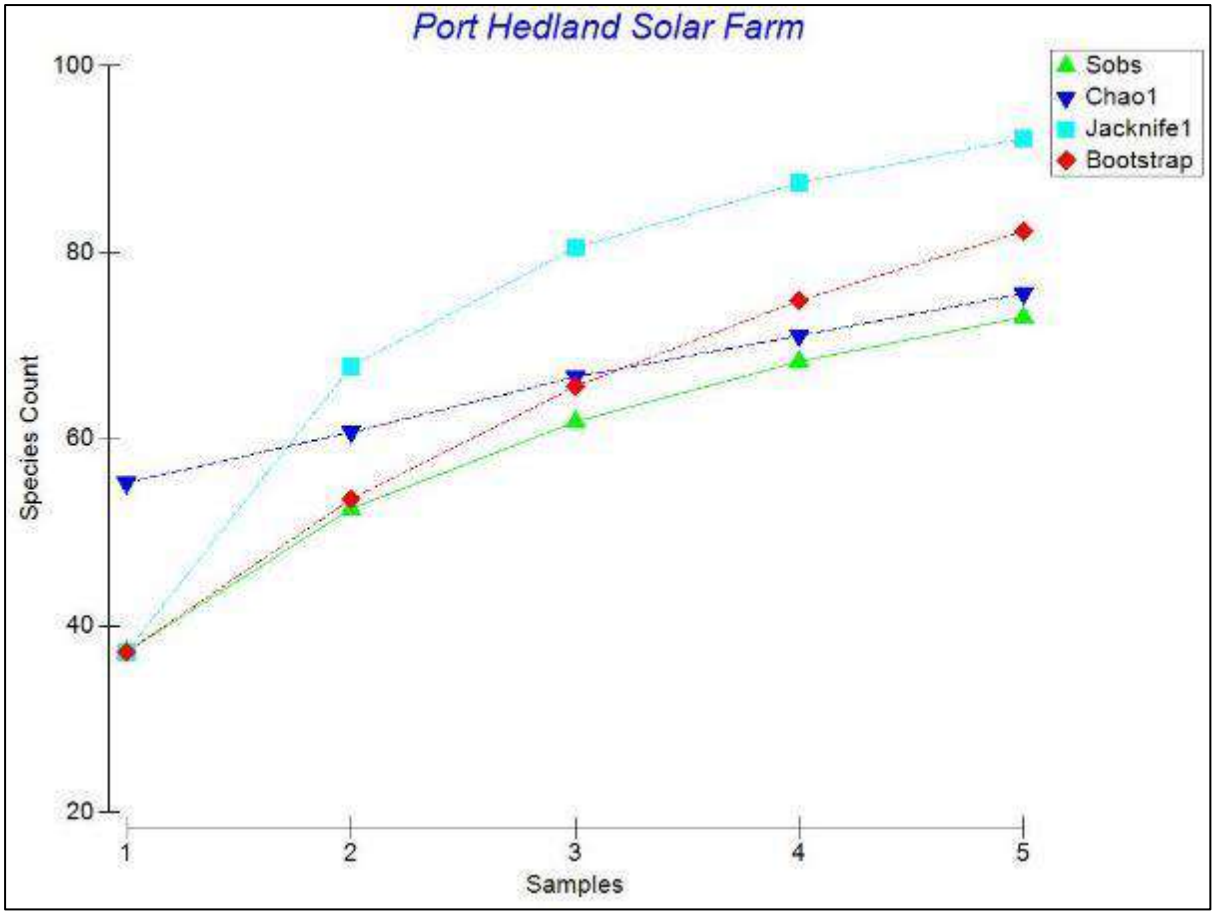


Figure 5-5 Species accumulation curves for the five systematic survey sites

5.2.1.3 Significant vertebrate fauna

One Threatened and one Priority species were recorded in the Study Area, including Bilby (VU; EPBC & BC Acts) and Brush-tailed Mulgara (P4; DBCA).

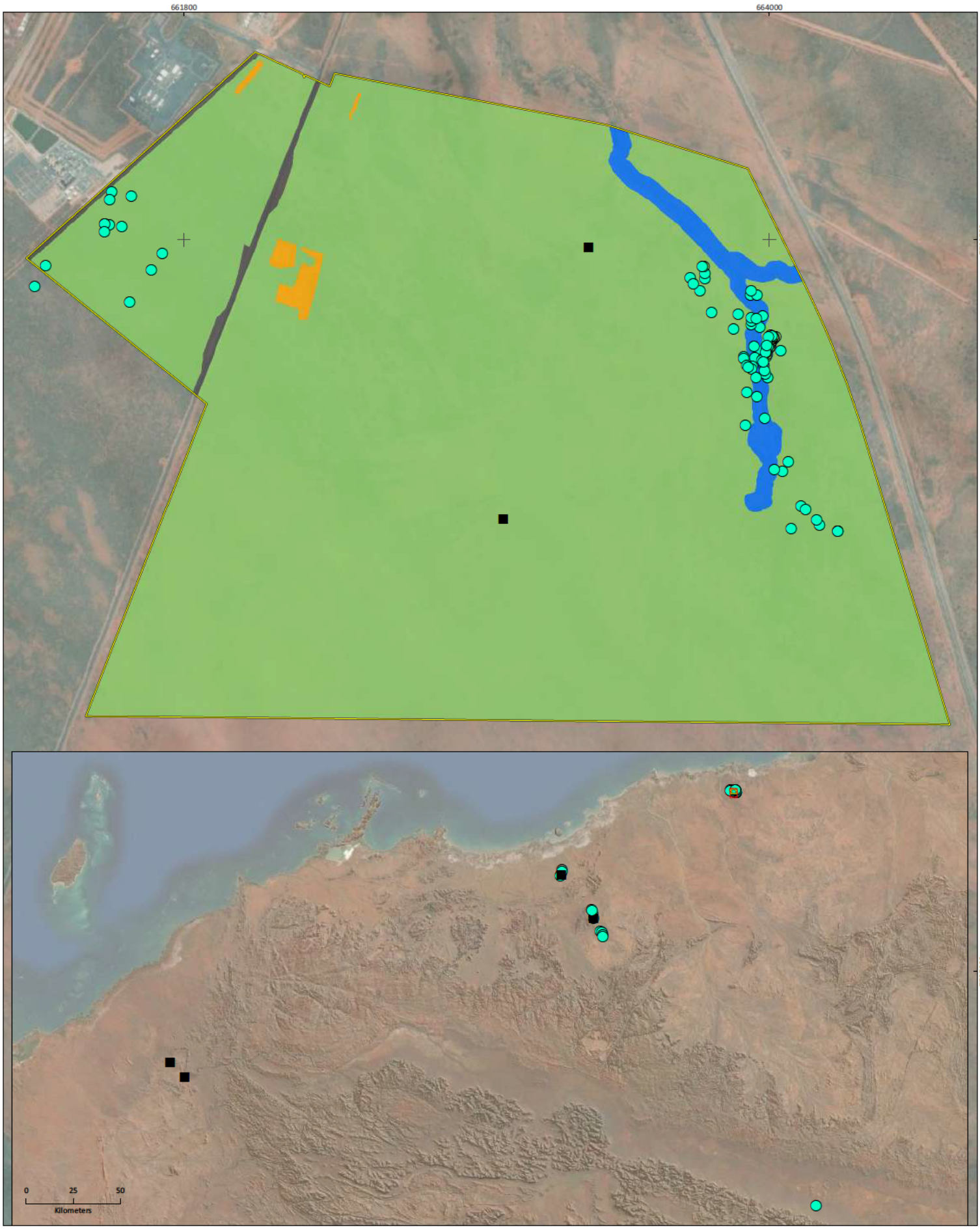
5.2.1.3.1 Brush-tailed Mulgara (P4; DBCA)

One track sequence and one burrow identified as Brush-tailed Mulgara were recorded from sandplain habitat (Figure 5-6; Figure 5-7; Appendix 5).

5.2.1.3.2 Bilby (VU; EPBC, BC Acts).

Secondary evidence of the Bilby was identified from 100 locations, of which 99 were recorded within the Study Area (Figure 5-6); The majority of these (86) were recorded in, or near (less than 300 m) minor drainage habitat in the eastern portion of the Study Area. Of these 86 records, 30 (24 scats and six diggings) were identified within minor drainage habitat last burnt 10 years ago in 2011 Figure 5-6; Figure 5-7; Table 5-9). A further 40 (35 scats, four diggings and one track) were recorded less than 50 m from minor drainage habitat (Figure 5-7; Table 5-9). Thirteen (10 scats, one digging and two tracks) were recorded between 50 m to 200 m and three records (one scat, one track and one digging) were 265 m away from minor drainage habitat (Figure 5-6; Figure 5-7; Table 5-9). No evidence of Bilby was recorded in the central and southern extents of the Study Area.

West of the highway, secondary evidence was identified at 14 locations (13 scats and one digging) in long-unburnt (more than 15 years) sandplain habitat. One record (scat) west of the highway was outside the Study Area approximately 65 m from the southwest boundary (Figure 5-6).



Alinta Energy Pty Ltd via Preston Consulting
Port Hedland Solar Farm Project

Project No	1388
Date	2/08/2021
Drawn by	IN
Map author	SP

0 250 500
Meters

1 18,500 (at A4) GDA 1994 MGA Zone 50

Study Area

Species, status

- *Dasycercus blythi*, P4 (DBCA list)
- *Macrotis lagotis*, VU (EPBC Act, BC Act)

Fauna habitat

- Sandplain
- Drainage line
- Disturbed area
- Road / Infrastructure

Figure 5-6

Fauna habitats and significant fauna records from the field survey

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Map 1: Records of Bilby sign from phase one

Map 2: Records of Bilby sign from both phases

T39 R01 T42 T44 T46 T43 R02 T31 T34 T15 T25 T13 T08 T09 T07 T32 T22 T11 T30 T40 T36 T02 R03 T01 T29 T10 T14 T35 T04 T18 T16 T33 T17 T45 T19 T03 T28 T20 T21 T38 T05 T37 T12 T06 T27 T23 T41 T26 T24

666200

7739800

Western Australia

PERTH

Alinta Energy Pty Ltd via Preston Consulting
Port Hedland Solar Farm Project

Project No	1454
Date	8/11/2021
Drawn by	IN
Map author	SP

Map 1: 0 240 480 Meters

Map 2: 0 0.5 1 Kilometers

1:17,501 (Map 1, at A3)
1:48,773 (Map 2, at A3)

GDA 1994 MGA Zone 50

P:\GIS\Projects\PortHedlandSolarFarm\1454-PHS-AE-VER\Mapping\MapDocuments\Figures\Figure_5_7_Records_of_bilby_sign.mxd

Study Area

Targeted Bilby survey area

Macrotis lagotis, VU (EPBC Act, BC Act)

Map 1: Phase 1

Transect 01

Transect 02

Transect 03

Transect 04

Transect 05

Transect 06

Transect 07

Transect 08

Figure 5-7

Records of Bilby sign from phase one (Map 1) and from both phases (Map 2)

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Table 5-9 Details of significant vertebrate fauna recorded during the phase one survey

Species	Status	Detail	Site, no. records	Photographs
Macrotis lagotis Bilby	VU (EPBC & BC Act)	Two clusters of records Minor drainage habitat Eighty-six records. Thirty within minor drainage (24 scat and six diggings), 40 (35 scat, four diggings and one track) less than 50 m, 13 (10 scats, one digging and two tracks) between 50 m to 200 m and three (one scat, one track and one digging) exactly 265 m from minor drainage (Appendix 6) No evidence of Bilby was recorded in the central and southern extent of the Study Area.	Pit04: 1 track Pit05: 2 scat Transect 06: 49 scats, 1 track, 7 digging Transect 07: 11 scats, 1 digging Transect 08: 20 scats, 1 track, 4 digging Pundul: 1 track, 1 scat, 1 digging	
Dasycercus blythi Brush-tailed Mulgara	P4 (DBCA)	A track sequence was recorded in spinifex grassland from Transect 01 and burrow in recently burnt grassland from Transect 05. Brush-tailed Mulgara are well documented from sandplain habitat in the Pilbara, predominantly in spinifex hummock grasslands and shrublands on sandy soils (Menkhorst & Knight 2011)	Transect 01: 1 track Transect 05: 1 burrow	

The likelihood of occurrence (LoO) assessment (see section 4.4) for the remaining significant species identified in the desktop review (Table 5-3; Appendix 3) determined that none were likely to occur in the Study Area, seven possibly occur and 55 are Unlikely to occur (Table 5-10).

Table 5-10 Likelihood of occurrence for significant vertebrate fauna identified in the desktop review not recorded in the survey

Species	Status	Habitat	LoO: Likely (0) Possible (7) Unlikely (55)
Reptiles (2)			
Ctenotus angusticeps Airlie Island Ctenotus	P3 (DBCA list)	Absence of suitable habitat (salt marsh communities, samphire shrubland, intertidal zone along the margins of mangroves).	Unlikely
Liasis olivaceus barroni Pilbara Olive Python	VU (EPBC & BC Acts)	Absence of suitable habitat (permanent water pools in rocky areas).	Unlikely
Birds (55)			
Pandion cristatus Osprey	Mig. (EPBC & BC Acts)	Absence of suitable habitat (littoral and coastal).	Unlikely
Apus pacificus Fork-tailed Swift	Mig. (EPBC & BC Acts)	Fly over visitor (ahead of tropical cyclones and storm fronts).	**Possible**
Charadrius leschenaultia Greater Sand Plover	VU/Mig./VU (EPBC Act; BC Act)	Absence of suitable habitat (littoral and estuarine).	Unlikely
Charadrius mongolus Lesser Sand Plover	EN/Mig. (EPBC & BC Acts)	Absence of suitable habitat (littoral and estuarine).	Unlikely
Charadrius veredus Oriental Plover	Mig. (EPBC & BC Acts)	Recently burnt open habitat present.	**Possible**
Pluvialis fulva Pacific Golden Plover	Mig. (EPBC & BC Acts)	Absence of suitable habitat (coastal beaches, rocky shorelines and saltmarshes or inland major river systems).	Unlikely
Pluvialis squatarola Grey Plover	Mig. (EPBC & BC Acts)	Absence of suitable habitat (coastal embankments, estuaries and lagoons with mudflats and sandflats, and terrestrial wetlands such as near-coastal lakes and swamps, or salt-lakes).	Unlikely

Species	Status	Habitat	LoO: Likely (0) Possible (7) Unlikely (55)
Falco hypoleucos Grey Falcon	VU (BC Act)	Lightly wooded drainage habitat present, Study Area potentially visited as part of wider foraging range. Unlikely resident due to lack of suitable nesting habitat.	**Possible**
Falco peregrinus Peregrine Falcon	OS (BC Act)	Absence of nesting habitat in Study Area potentially visited as part of wider foraging range.	**Possible**
Fregata ariel Lesser Frigatebird	Mig. (EPBC & BC Acts)	Absence of suitable habitat (strictly offshore).	Unlikely
Glareola maldivarum Oriental Pratincole	Mig. (EPBC & BC Acts)	Overwintering in northern Australia (Oct-Apr), open plains with short grassland, samphire, or bare ground, feeding mostly aerially on insects. Large flocks often associated with thundery and cyclonic storms.	**Possible**
Hirundo rustica Barn Swallow	Mig. (EPBC & BC Acts)	Uncommon summer visitor to parts of northern Australia.	Unlikely
Oceanites oceanicus Wilsons Storm Petrel	Mig. (EPBC & BC Acts)	Absence of suitable habitat (strictly pelagic).	Unlikely
Anous stolidus Common Noddy	Mig. (EPBC & BC Acts)	Absence of suitable habitat (offshore islands no mainland records).	Unlikely
Chlidonias leucopterus White-winged Black Tern	Mig. (EPBC & BC Acts)	Absence of suitable habitat (coastal wetlands).	Unlikely
Onychoprion anaethetus Bridled Tern	Mig. (EPBC & BC Acts)	Absence of suitable habitat (forages well offshore, rarely found on mainland coasts).	Unlikely
Sterna caspia Caspian Tern	Mig. (EPBC & BC Acts)	Absence of suitable habitat (low islands, mainland beaches and terrestrial wetlands).	Unlikely

Species	Status	Habitat	LoO: Likely (0) Possible (7) Unlikely (55)
Sterna hirundo Common Tern	Mig. (EPBC & BC Acts)	Absence of suitable habitat (sheltered seas, estuaries, and mangrove creeks).	Unlikely
Sternula albifrons Little Tern	Mig. (EPBC & BC Acts)	Absence of suitable habitat (sheltered seas, estuaries, and mangrove creeks).	Unlikely
Sternula nereis nereis Fairy Tern	VU (EPBC & BC Acts)	Absence of suitable habitat (damp or wet habitats with low vegetation including damp meadows, marshes, waterside pastures).	Unlikely
Thalasseus bergii Crested Tern	Mig. (BC Act)	Absence of suitable habitat (sheltered seas, estuaries, and mangrove creeks).	Unlikely
Motacilla cinerea Grey Wagtail	Mig. (EPBC & BC Acts)	Absence of suitable habitat (fast flowing streams and rivers, the few Pilbara records are far inland).	Unlikely
Motacilla flava Yellow Wagtail	Mig. (EPBC & BC Acts)	Absence of suitable habitat (damp or wet habitats with low vegetation including damp meadows, marshes, waterside pastures).	Unlikely
Calonectris leucomelas Streaked Shearwater	Mig. (EPBC & BC Acts)	Absence of suitable habitat (strictly pelagic and offshore islands).	Unlikely
Macronectes giganteus Southern Giant Petrel	EN/Mig./Mig. (EPBC Act; BC Act)	Absence of suitable habitat (strictly pelagic and offshore islands).	Unlikely
Pezoporus occidentalis Night Parrot	EN/CR (EPBC Act; BC Act)	Absence of suitable habitat (large more than 3000 ha areas of long-unburnt mature spinifex).	Unlikely
Rostratula australis (Australian Painted Snipe)	EN (EPBC & BC Acts)	Absence of suitable habitat (foraging and breeding habitats are in shallow water surrounded with dense vegetation).	Unlikely
Actitis hypoleucos Common Sandpiper	Mig. (EPBC & BC Acts)	Absence of suitable habitat (wetland species).	Unlikely

Species	Status	Habitat	LoO: Likely (0) Possible (7) Unlikely (55)
Arenaria interpres Ruddy Turnstone	Mig. (EPBC & BC Acts)	Absence of suitable habitat (coastal, occasionally on large inland wetlands).	Unlikely
Calidris acuminata Sharp-tailed Sandpiper	Mig. (EPBC & BC Acts)	Absence of suitable habitat (coastal, occasionally on large inland wetlands).	Unlikely
Calidris alba Sanderling *Calidris canutus*	Mig. (EPBC & BC Acts)	Absence of suitable habitat (coastline and shallow wetlands).	Unlikely
Calidris canutus Red Knot	EN/Mig./EN (EPBC Act; BC Act)	Absence of suitable habitat (coastline and shallow wetlands).	Unlikely
Calidris ferruginea Curlew Sandpiper	CR/Mig./CR (EPBC Act; BC Act)	Absence of suitable habitat (coastline and shallow wetlands).	Unlikely
Calidris melanotos Pectoral Sandpiper	Mig. (EPBC & BC Acts)	Absence of suitable habitat (coastline and shallow wetlands).	Unlikely
Calidris ruficollis Red-necked Stint	Mig. (EPBC & BC Acts)	Absence of suitable habitat (coastline and shallow wetlands).	Unlikely
Calidris subminuta Long-toed Stint	Mig. (EPBC & BC Acts)	Absence of suitable habitat (coastline and shallow wetlands).	Unlikely
Calidris tenuirostris Great Knot	CR/Mig./CR (EPBC Act; BC Act)	Absence of suitable habitat (tidal mud and sand flats and low-salinity saltwork ponds).	Unlikely
Gallinago stenura Pin-tailed Snipe	Mig. (EPBC & BC Acts)	Absence of suitable habitat (favours tidal mud and sand flats, uncommon to freshwater habitats).	Unlikely
Limicola falcinellus Broad-billed Sandpiper	Mig. (BC Act)	Absence of suitable habitat (coastline and shallow wetlands).	Unlikely

Species	Status	Habitat	LoO: Likely (0) Possible (7) Unlikely (55)
Limnodromus semipalmatus Asian Dowitcher	Mig. (EPBC & BC Acts)	Absence of suitable habitat (Coastal mudflats and open marshes).	Unlikely
Limosa lapponica Bar-tailed Godwit	Mig. (EPBC & BC Acts)	Absence of suitable habitat (tidal mud and sand flats and low-salinity saltwork ponds).	Unlikely
Limosa lapponica menzbieri Bar-tailed Godwit (Siberian)	CR/Mig./VU/Mig. (EPBC Act; BC Act)	Absence of suitable habitat (Coastlines, tidal mudflats, beaches, and low-salinity saltwork ponds).	Unlikely
0Limosa limosa Black-tailed Godwit	Mig. (BC Act)	Absence of suitable habitat (Coastlines, tidal mudflats, beaches, and low-salinity saltwork ponds).	Unlikely
Numenius madagascariensis Eastern Curlew	CR/Mig./CR (EPBC Act; BC Act)	Absence of suitable habitat (tidal mudflats, reef flats, low-salinity saltwork ponds and sandy beaches).	Unlikely
Numenius minutus Little Curlew	Mig. (EPBC & BC Acts)	Absence of suitable habitat (samphire and grass flats, tidal mudflats).	Unlikely
Numenius phaeopus Whimbrel	Mig. (EPBC & BC Acts)	Absence of suitable habitat (offshore islands, saltworks including hypersaline ponds).	Unlikely
Phalaropus lobatus Red-necked Phalarope	Mar/Mig. (EPBC Act; BC Act)	Absence of suitable habitat (tidal mudflats, also sandy beaches and low-salinity saltwork ponds).	Unlikely
Philomachus pugnax Ruff	Mig. (EPBC & BC Acts)	Absence of suitable habitat (refers fresh or brackish wetlands with exposed mudflats).	Unlikely
Tringa brevipes Grey-tailed Tattler	(Mig. EPBC & BC Acts; P4 DBCA list)	Absence of suitable habitat (mudflats, reef flats, mangrove creeks, sandy beaches, saltwork ponds, sewage ponds and brackish lagoons).	Unlikely
Tringa glareola Wood Sandpiper	Mig. (EPBC & BC Acts)	Absence of suitable habitat (well-vegetated, shallow, freshwater wetlands, such as swamps, billabongs, lakes, pools, and waterholes).	Unlikely

Species	Status	Habitat	LoO: Likely (0) Possible (7) Unlikely (55)
Tringa nebularia Common Greenshank	Mig. (EPBC & BC Acts)	Absence of suitable habitat (inland wetlands and sheltered coastal habitats of varying salinity, including coastal mudflats, saltmarsh, and mangroves).	Unlikely
Tringa stagnatilis Marsh Sandpiper	Mig. (EPBC & BC Acts)	Absence of suitable habitat (coastal wetlands and sheltered coastal habitats of varying salinity, including coastal mudflats, saltmarsh, and mangroves).	Unlikely
Xenus cinereus Terek Sandpiper	Mig. (EPBC & BC Acts)	Absence of suitable habitat (tidal mudflats and low-salinity saltwork ponds).	Unlikely
Sula leucogaster Brown Booby	Mig. (EPBC & BC Acts)	Absence of suitable habitat (strictly pelagic and offshore island habitat).	Unlikely
Plegadis falcinellus Glossy Ibis	Mig. (EPBC & BC Acts)	Absence of suitable habitat (inhabits terrestrial wetlands).	Unlikely
Mammals (5)			
Dasyurus hallucatus Northern Quoll	EN (EPBC & BC Acts)	Absence of suitable denning habitat (rocky ranges, outcrops, and boulder piles), suitable dispersal habitat present in minor drainage habitat.	**Possible**
Rhinonicteris aurantia (Pilbara) Pilbara leaf-nosed bat	VU (EPBC & BC Acts)	Absence of suitable roosting (deep fissures and caves) and foraging (permanent pools) habitat.	Unlikely
Macroderma gigas Ghost Bat	VU (EPBC & BC Acts)	Absence of suitable roosting habitat. Possible visitor as part of wider foraging range of nearby resident.	**Possible**
Mormopterus cobourgianus North-western Free-tailed Bat	P1 (DBCA list)	Absence of suitable habitat (strictly mangrove species).	Unlikely
Pseudomys chapmani Western Pebble-mound Mouse	P4 (DBCA list)	Absence of suitable habitat (restricted to lower slopes of rocky hills with suitable sized).	Unlikely

5.2.2 Targeted Bilby survey (phase two)

5.2.2.1 Bilby (VU; EPBC, BC Acts)

A total of 206 Bilby scats were recorded from 31 of the 49 transect searches conducted. traversing a combined total distance of 123.5 km (Figure 4-2, Map 2; Table 4-6; Table 5-11; Appendix 7). No recent scats were recorded during the survey. All recorded scats were clearly degraded or broken up (Plate 5-1).

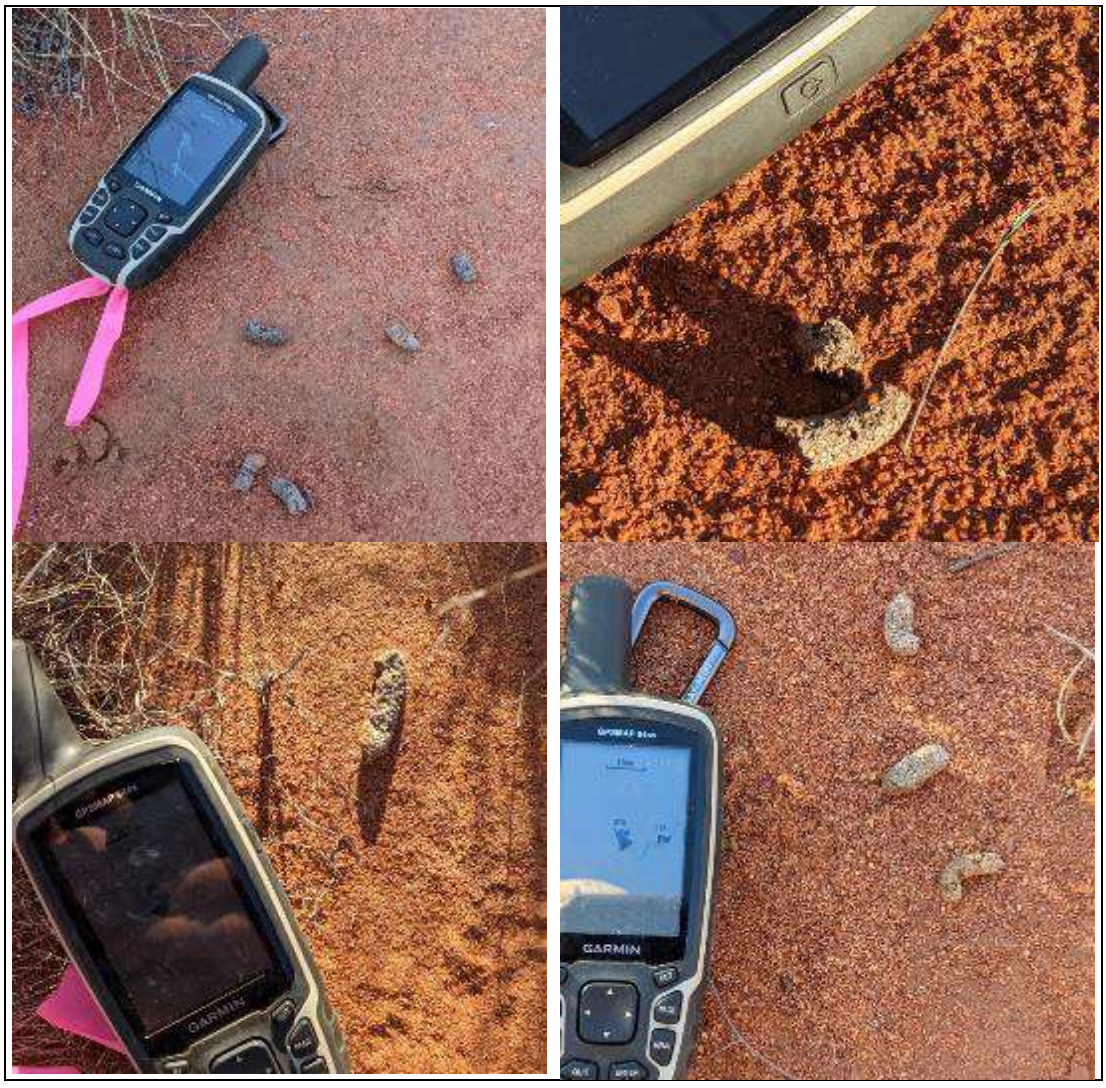

Plate 5-1 Representative photos of Bilby scats recorded during phase two.

Forty-eight scats were recorded in the Study Area during phase two. Based on the extent of decay, these scats are likely to be the remains of Bilby activity recorded during phase one, approximately six months prior (March 2021).

Forty scats were recorded along the minor drainage line (T07, T08, T09, T15, T44 and T46) north of the Study Area, from where it intersects the north-eastern boundary of the Study Area, north-west and then west under the GNH. Twenty-five of these were recorded west of the GNH (Figure 5-8).

Twelve scats were recorded immediately east of the GNH in the area last burnt in November 2015 (Table 5-7), Eight of these were recorded less than 85 m away from the GNH, the closest of which was recorded less than 25 m away (from the GNH; Figure 4-2; Map 2; Table 4-6; Table 5-11).

Transect T04 recorded the highest abundance of scats with a total of 22 identified from 2.9 kms traversed (Figure 4-2; Table 5-11). The majority of these were recorded amongst an isolated patch of *Acacia* shrubs situated low (30 – 50 cm high) sand dune, approximately 160 m west of FMG's railway line. No scats were recorded south of transect T04 between the GNH and FMG's railway line from the five transect searches (T03, T05, T06, T23 and T24) totalling 19.6 km (Figure 4-2: Map 2 ; Table 5-11).

Some old and degraded diggings were observed during the survey but they were too eroded to positively attribute to Bilby. As such, they were not recorded.

No old, recent or active Bilby burrows were recorded during phase two.

Table 5-11 Number of Bilby scats recorded per transect

Transect name	Scats recorded
R01	1
T04	22
T07	10
T08	2
T09	3
T10	3
T11	2
T14	6
T15	17
T16	4
T17	4
T18	8
T19	15
T20	8
T21	10
T25	4
T26	2
T27	1
T30	8
T31	9
T32	3
T33	3
T34	15
T35	7
T36	12
T37	1
T38	4
T39	2
T42	12
T44	8
Total	**206**

5.2.2.2 Feral predators

Three species of feral predators (Cat, Dog and Fox) were recorded from secondary evidence (scats and tracks) at a total of 36 locations during the TBS. Of these, the Cat was the most common and widespread species with two scats and 22 tracks recorded, followed by the Fox (two scats and six tracks) and Dog (one scat and three tracks) (Table 5-12).

Table 5-12 Number and type of evidence (secondary) of feral predators during phase two

	Recorded evidence			
Species	**Scats (#)**	**Tracks (#)**	**Total (#)**	**Representative photo**
Cat *Felis catus*	2	22	24	
Dog *Canis familiaris*	1	3	4	
Fox *Vulpes vulpes*	2	6	8	
Total	4	32	36	-

5.2.3 SRE invertebrate fauna

Two SRE invertebrate fauna habitats were identified in the Study Area comprising 96.39% of the Study Area, with the remaining 1.44% comprising cleared areas unsuitable for SREs. The sandplain habitat was the overwhelmingly dominant habitat. It occupies 96.39% of the Study Area and was bisected by the a minor drain line, which occupies 2.17% of the Study Area (Figure 5-6; Table 5-13).

Table 5-13 Extent and description of each SRE habitat in the Study Area

Habitat	Potential SRE habitat rating	Habitat description	Site/s	Extent in Study Area (ha and %)
Sandplain	Low	Isolated *Acacia* shrublands, patches of low *Acacia* shrublands, spinifex grasslands and open grasslands	Pit01, Pit02, Pit03, Pit05	602.35 ha (96.39%)
Minor drainage	Moderate	Open Eucalyptus woodland over scattered *Acacia* shrubs, dense tussock grasses and scattered spinifex grasses	Pit04	13.59 ha (2.17%)
Roads / infrastructure	None	N/A	N/A	3.45 ha (0.47%)
Cleared / disturbed	None	N/A	N/A	5.49 (0.88%)

A total of four species from four SRE groups were collected within the Study Area, comprising of one representative from the Mygalomorphae, Scorpiones, Isopoda and Coleoptera SRE groups (Table 5-14). Of these, three are potential SREs and one is widespread. One species was recorded only from the sandplain habitat (*Aname* 'Phoenix0068'), one species was recorded only from the minor drainage habitat (*Lychas* 'SCO039/glauerti') and one species was recorded from both the sandplain and minor drainage habitat (*Buddelundia* '14re').

Table 5-14 SRE invertebrates recorded from the Study Area

Family	Species	SRE status	Site(s)	Habitat
Class: Arachnida; Infraorder: Mygalomorphae (trap-door spider)				
Anamidae	*Aname* 'Phoenix0068'	Potential	Pit01, Pit05	sandplain
Class: Arachnida; Order: Scorpiones (scorpion)				
Buthidae	*Lychas* 'SCO039/glauerti'	Potential	Pit01, Pit04	minor drainage
Class: Crustacea; Order: Isopoda (slater)				
Armadillidae	*Buddelundia* '14re'	Potential	Pit04	sandplain, minor drainage
Class: Insecta; Order: Coleoptera (beetle)				
Carabidae	*Cicindela masteri*	Widespread	Pit04	minor drainage

Both habitat types recorded two species each of potential SRE invertebrates with only the Isopod, *Buddelundia* '14re', recorded from both habitats.

Aname 'Phoenix0068' was collected from two sites within the sandplain habitat, Pit01 and Pit04. All three specimens were males that were collected in dry pitfall traps. Molecular and morphological identification techniques both failed to match this species with any other specimens within the WA Museum reference collection or GenBank. The nearest genetically similar species to this is *Aname*

'MYG331' (KJ744902) which was 10.6% divergent and located 225 km south of the Study Area. The specimens from the survey had a maximum divergence of 0.7%.

Lychas 'SCO039/glauerti' is a scorpion known from Barrow Island and adjacent mainland areas, including 'Eramurra', 25 km south of Karratha. This record is a singular female specimen from the minor drainage line habitat type and represents a northern range extension for this species. Both morphologic and molecular identification techniques placed this specimen as *L*. 'SCO039/glauerti', however the nearest genetic match has an 8.2% divergence, which is considered conservatively conspecific. This specimen may be a sister species to Lychas 'SCO039/glauerti' and should still be considered a potential SRE.

Buddelundia '14re' was recorded in abundance from dry pitfall traps and foraging collection methods from one site, Pit04, the minor drainage line. This species was also recorded from the desktop review, and its distribution records extends evenly 70 km south of the Study Area. Its currently distribution, strictly speaking means it is an SRE (i.e. less than 10,000km^2).

Cicindela masteri is a tiger beetle which was collected from a single specimen in the minor drainage habitat type, adjacent to a salt lake. Tiger beetles are considered SRE taxa because they are specialist salt lake inhabitants. This specimen belongs to a widespread species distributed throughout Australia.

Alinta Energy Pty Ltd via Preston Consulting
Port Hedland Solar Farm Project

Project No	1388
Date	8/11/2021
Drawn by	IN
Map author	AJ

0 260 520
Meters

1 20,000 (at A4) GDA 1994 MGA Zone 50

Study Area

SRE taxa

- 1, *Aname* 'Phoenix0068', Potential
- 2, *Buddelundia* '14re', Potential
- 3, *Lychas* 'SCO039', Potential

SRE habitat rating

- High
- Low
- None

Figure 5-8

SRE habitats and recorded SRE taxa

PHOENIX ENVIRONMENTAL SCIENCES

5.3 SURVEY LIMITATIONS

The limitations of the phase one and two surveys have been considered in accordance with EPA (2020) (Table 5-15).

Table 5-15 Consideration of potential limitations of the phase one and two surveys

Limitation	Relevant	Reason
Competency/experience of the consultant carrying out the survey.	No	All members of the survey team have had appropriate training, experience and mentoring in identification of Pilbara fauna species, targeted Bilby survey methods and SRE collecting methods.
Scope (what faunal groups were sampled and were some sampling methods not able to be employed because of constraints.)	No	All faunal groups were sampled using systematic methods. Substantial targeted search efforts were made to assess the presence of significant fauna species thought most likely to occur based on desktop records. The objective of the phase two survey included collecting recent scats for DNA extraction and genotyping in order to estimate population size. Only old, degraded and broken up scats were recorded during the field survey and thus genotyping and population estimates were not conducted. This is not regarded as a limitation as it is evident that the population no longer resides in the vicinity of the Study Area.
Proportion of fauna identified, recorded and/or collected.	No	The species accumulation indices generated for the five systematic survey sites suggest the vast majority of the assemblage was detected.
Sources of information e.g. previously available information (whether historic or recent) as distinct from new data.	No	Substantial survey effort has been conducted within the vicinity of the study.
The proportion of the task achieved and further work which might be needed.	No	Both survey phases are considered complete. While the target Bilby population was not located during phase two. Sufficient evidence of the species and available dispersal habitat was identified outside the Study Area to inform impact assessment.

Limitation	Relevant	Reason
Timing/weather/season/cycle.	No	Phase one post-wet season 'Autumn' survey timing and conditions were optimal for vertebrate and SRE fauna. Phase two pre-wet season 'Spring' survey timing was in line with recommended methodogy; more than two weeks after rain during the dry season.
Disturbances (e.g. fire, flood, accidental human intervention etc.) which affected results of survey.	No	As documented in the report fire appears to be an ecological feature of the Study Area (and surrounds) with five fires of variable extent being identified in the last 15 years. Despite a large portion of the Study Area recovering from the last fire two years ago, survey sites sufficiently sampled a range of fire ages. No disturbances affected the results of the phase two survey.
Intensity (in retrospect, was the intensity adequate).	No	The objectives of the phase one survey were met and well documented in this report. The target Bilby population extent was not delineated within the TBS Area. This is not attributed to a lack of survey effort which exceeded the guidance for detecting the species (DBCA 2018a).
Completeness (e.g. was relevant area fully surveyed).	No	During phase one all fauna habitats and assemblages within the Study Area were surveyed in detail and are well documented in the report. During phase two, the extensive targeted survey effort was conducted for Bilby both within and outside of the Study Area.
Resources (e.g. degree of expertise available in animal identification to taxon level).	No	Resources for both survey phases were adequate, conducted by a competent experienced survey team (4.6). Phase one was conducted over 11 days totalling 44 person days. Six days were spent in the field totalling 12 person days for phase two.
Remoteness and/or access problems.	No	Approximately 5 km south of South Hedland. All parts of the Study Area were easily accessible during both survey phases.
Availability of contextual (e.g. biogeographic) information on the region.	No	Abundant. The Roebourne subregion has been surveyed extensively to support numerous large-scale port and rail infrastructure projects.

6 DISCUSSION

6.1 FAUNA HABITAT

All habitat types identified are typical of the Roebourne subregion and Uaroo land system (Table 3-1; Figure 3-2). Characterised by "broad sandy plains, pebbly plains and drainage tracts supporting hard and soft spinifex hummock grasslands with scattered *Acacia* shrubs (Payne & Leighton 2004)," it represents more than 5 % (7.02%) of the of the Pilbara Bioregion. Less than 1 % of this (0.31%) is currently cleared for 'intensive use', 16% is in the conservation estate and 83.5% is used for pastoral activities (in the Pilbara Bioregion – Uaroo extends outside this region also). Thus the fauna habitat within the Study Area is abundant and widespread throughout the Pilbara. No regionally restricted habitat types are present. Nor any locally restricted, isolated or 'island' habitats known to support high endemism and genetical distinct populations.

The Study Area is dissected in the west by the GNH, and traversed in the east by a minor drainage line entering the Study Area in the north-east and continues south and fans out into a broad floodplain just north of the southern boundary (of the Study Area) (Figure 5-6). The constant flow of heavy transport vehicles along the GNH functions as a significant barrier to dispersal for local fauna. On the other hand, the minor drainage line provides a dispersal corridor under the GNH just north of the Study Area.

Fire throughout most of the Study Area has led to the concentration of higher fauna values, specifically driven by the presence of Bilby. Secondary evidence the species was concentrated within minor drainage habitat in the east (Figure 5-6) and in long-unburnt mixed *Acacia* shrubland west of the GNH (Figure 5-3; Figure 5-7).

These habitats are considered somewhat locally restricted in the short term, depending on climate driven regrowth and future fires (frequency and extent). On a broad scale, wildfire plays an important role in the ecology of native fauna including Bilby, which have large moving home ranges in order to respond to fluctuating availability of food resources (Southgate *et al.* 2005). The small size of the Study Area (less than 1000 ha), represents a small fraction of the area that would comprise the long term range typically occupied by individuals of the species.

6.2 FAUNA ASSEMBLAGE

Survey conditions were close to ideal owing to significantly higher than average rainfall in the months preceding the survey (Figure 3-3). This is supported by the high total recorded abundance of 1193 individuals representing 82 species (Appendix 5).

While the recorded fauna assemblage only represents 22.59% of the desktop assemblage (Table 5-8), this is accounted for by the small size (less than 1000 ha) and low diversity of fauna habitats present in the Study Area, compared to the desktop search extent, which included numerous habitats such as pelagic and coastal, mangrove, mud / salt flats, estuarine, wetland, granite outcrop, banded ironstone ranges, major rivers and offshore island environments.

Specifically, of the 217 bird species identified in the desktop review, just 11.57% were recorded (Table 5-8). However, as above, the desktop assemblage is considerably inflated by species confined to coastal and marine habitats from the families Anatidae (9), Anhingidae (1), Ardiedae (8), Burhinidae (2), Charadriidae (8), Ciconiidae (1), Dicruridae (3), Glareolidae (2), Gruidae (1), Haematopodidae (2) Laridae (12), Phalacrocoracidae (4), Podicipedidae (3), Procellariidae (2), Rallidae (5) Recurvirostridae (3), Rostratulidae (2), Scolopacidae (26), Sturnidae (1), Sulidae (1) and Threskiornithidae (4)(Appendix 3).

Reptile diversity and abundance was the highest of the major fauna groups (Table 5-8). This is not surprising given the complex fire history of the Study Area. Multiple fires occurring in predominantly

different parts of the Study Area over a 10–15 year period has resulted in the well documented phenomenon of a 'patchwork' of microhabitats in various stages of succession/recovery. This is identified by Pianka and Goodyear (2012) as being the main driver of reptile diversity in sandplain habitats throughout the WA arid zone.

Further, evidence of low habitat diversity on a broad scale is evident from the assemblage of microbats, with the same four species recorded, irrespective of habitat type and fire age (Appendix 5). McKenzie and Bullen (2009) demonstrated how echolocation frequency is a reflection of habitat structural complexity, and thus habitat relationships and foraging niches of Pilbara microbats. The uniformity of microbat assemblages recorded thus strongly indicates low habitat diversity within the Study Area.

6.3 BILBY (VU; EPBC AND BC ACTS)

Phase one

The most important results of the phase one survey were the 100 records of Bilby (Figure 5-6; Figure 5-7; Table 5-9). Regarded as a habitat generalist, the Bilby historically occupied 70% of Australia (Southgate *et al.* 2019). However, following the introduction of feral predators, such as the Dog, Cat and Red Fox, all of which were recorded in the Study Area, the Bilby has largely disappeared from open habitats within its historical range (Southgate *et al.* 2019).

Secondary evidence of Bilby activity was tightly bound in the east to the more structurally complex and productive minor drainage line with its dense low shrublands and unburnt grasslands (Figure 5-6); and in the west where mature, long-unburnt mixed *Acacia* shrublands, which appear to have been protected from more recent fires by the barrier effect of the GNH (Table 5-7; Figure 5-6).

Feral predators are widespread in the Study Area (Table 5-12). Accordingly, it is no surprise that no evidence of Bilby was recorded within the recently burnt central and southern extents. It is likely that Bilby will utilise portion of the Study Area, in the future when the vegetation regenerates sufficiently to provide suitable shelter from feral predators.

Despite extensive and targeted effort during the phase one survey, no burrows were located.

Phase two

No recent Bilby activity was detected in the Study Area during phase two. Similarly, despite widespread records of old and degraded scats, no recent activity was recorded in the wider TBS Area. There are two possible explanations for this:

- the target population has been wiped out by feral predators, or
- the target population has dispersed to where food resources are more readily available.

Estimates of abundance conducted by Dziminski *et al.* (2020) indicate that wild Bilby populations in the Pilbara are isolated and consist of a small number of individuals. As a result, they are more susceptible to large or frequent wildfires and predation (Cramer *et al.* 2017; Dziminski *et al.* 2020; Southgate *et al.* 2019). Given the widespread occurrence of feral predators throughout the Study Area, as evident from the 36 locations of secondary evidence (Table 5-12), it is possible that the target population has been wiped out in the six months between survey phases. The frequent fire history of the Study Area, the most recent of which affected approximately 300 ha (48%) of vegetation within the central and southern extents, adds further weight to this explanation. Fire creates favourable conditions for predators as it destroys suitable cover for prey species (Dziminski *et al.* 2020).

The relationship between Bilby and fire is complex and paradoxical. Bilby have been reported to occur in a range of fire ages in WA (Cramer *et al.* 2017), though their persistence in recently burnt habitats is contingent on proximity of long-unburnt refugia (Browne-Cooper & Bamford 2010; Cramer *et al.* 2017; Thompson & Thompson 2008) and intensive control or eradication of cats and foxes (Cramer *et al.* 2017). While fire destroys important food resources in the short term, after sufficient rainfall these areas can become highly productive for the species with the proliferation of fire-ephemeral plants

(Cramer *et al.* 2017). Bilby have been observed moving into areas after recent fire, in response to this increased availability of food resources (Dziminski *et al.* 2020).

It is likely that core range of the target population is west of the GNH, given the widespread records of old scats (Figure 5-7; Table 5-11). Furthermore, the 45 old scats recorded along the minor drainage line that traverses under the GNH heading into the Study Area is strong evidence of dispersal both into and out of the Study Area (cross references).

The results of transect searches conducted south of the minor drainage habitat in the Study Area (and further south outside the Study Area) indicates the target population is unlikely to have dispersed to the south (Figure 5-1). This is attributed to the lack of suitable refuge (mature vegetation) present owing to the recent fire (between November 2018 and March 2020) (Figure 5-3; Figure 5-7) and the widespread occurrence of feral predators (Table 5-12).

6.4 BRUSH-TAILED MULGARA (P4; DBCA LIST)

According to the DBCA (2021c) Threatened and Priority Fauna Database, the Brush-tailed Mulgara was recorded 32 times in 2012. It was only recorded twice in the phase one survey, from secondary evidence (Table 5-7; Figure 5-6). Koertner *et al.* (2007) concluded that Mulgara do not select for dense cover of mature spinifex, observing that burrows and home ranges include both mature and regrowth spinifex grasslands. However, Koertner *et al.* (2007) also indicated that Mulgara are likely to suffer from increased predation following fire. We therefore conclude that their relative absence in 2021, compared with 2012, is a likely a result of the high frequency and extent of fires within the study since 2012. While the species may return to the Study Area after sufficient regeneration of spinifex grasslands, suitable habitat for the species is abundant both locally (within the Roebourne subjection and Uaroo land system) and regionally throughout the Pilbara bioregion. As such, the relatively small area of suitable habitat present within the Study Area is not regarded as high value to the species.

6.5 OTHER SIGNIFICANT FAUNA

Seven other significant fauna species were identified as possibly occurring in the Study Area (Table 5-10). Of these the Peregrine Falcon (OS; BC Act), Grey Falcon (VU; BC Act) and Ghost Bat (VU; EPBC and BC Acts) were identified as potential visitors to the Study Area as part of a wide foraging ranges but are unlikely to occur as resident species in the absence of suitable nesting or roosting habitat (Table 5-10). Similarly, the Northern Quoll (EN; EPBC and BC Acts) may possibly occur along minor drainage habitat during dispersal events but is unlikely to occupy the Study Area as a resident.

Fork-tailed Swift (Migratory; EPBC and BC Acts) is migratory and is possible to occur sporadically while foraging above all habitat types during the summer (Table 5-10). Oriental Plover and Oriental Pratincole (Migratory; EPBC and BC Acts) are both Migratory species that may forage in open, recently burnt grassland of the Study Area very infrequently during summer months. Both species are certainly not residents (Table 5-10).

6.6 SRE INVERTEBRATE FAUNA

Three potential SRE species were recoded from the survey. Of these, only one is known only from the Study Area, *Aname* 'Phoenix0068'. This species was identified using both morphological and molecular techniques and does not morphologically or genetically match any other specimen lodged with the WA Museum or with GenBank. The specimens were recorded from the overwhelmingly dominant habitat type, a habitat with low SRE habitat potential. i.e. it is widespread locally and regionally and there appears to be little to no geographical barrier to dispersal.

Another species of note is *Lychas* SCO039/glauerti. This species is known from Barrow Island and a few locations from the adjacent mainland. Given this species was morphologically identified as *L.*

'SCO039/glauerti' but had a genetic divergence from its nearest relative of 8.2% (which is nearing the intra-specific divergence threshold), it is considered conservatively conspecific.

The specimen from the survey represents a northern range extension. The Barrow Island and mainland populations occur approximately 300 km east of the Study Area, however this distribution is linear and therefore, strictly speaking within the defined 10,000km^2 distribution limit of an SRE. Other records of this species are from sandy substrates (WAM 2021), similar to those of the Study Area. The largely continuous sandy habitats that occur along this stretch of coastline would suggest connectivity, thus conspecifity with the other mainland populations.

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Appendix 1 Survey site location

Sitename	Site type	Latitude	Longitude
Opp01	Individual specimen (fauna)		
Opp02	Individual specimen (fauna)		
Pit01	Fauna site	-20.435238	118.55954
Pit02	Fauna site	-20.438031	118.561655
Pit03	Fauna site	-20.44416	118.563435
Pit04	Fauna site	-20.43167722	118.5671142
Pit05	Fauna site	-20.432267	118.548561
Pundul	Targeted fauna species site	-20.44267	118.573461
Transect 01	Transect (fauna)	-20.433902	118.565503
Transect 02	Transect (fauna)	-20.437405	118.560567
Transect 03	Transect (fauna)	-20.445385	118.562376
Transect 04	Transect (fauna)	-20.432387	118.558742
Transect 05	Transect (fauna)	-20.441528	118.561229
Transect 06	Transect (fauna)	-20.433246	118.571128
Transect 07	Transect (fauna)	-20.434746	118.544889
Transect 08	Transect (fauna)	-20.441458	118.57255

Site details			
Site	**Pit01**	**Position (WGS84)**	-20.435238, 118.55954
Topography	plain	**Soil texture**	sand, sandy loam
Slope	negligible	**Rock type**	none
Soil colour	red-orange	**Rock cover (%)**	0

Sample and effort summary

Visit	Sample method	Sample quant. (hrs)	Date start	Date stop
1	Birding	2.00	27 Mar 2021	27 Mar 2021
1	Bucket	840.00	22 Mar 2021	29 Mar 2021
1	Elliot trap (small)	1,680.00	22 Mar 2021	29 Mar 2021
1	Foraging	2.00	27 Mar 2021	27 Mar 2021
1	Foraging nocturnal	4.20	27 Mar 2021	27 Mar 2021
1	Funnel	3,362.00	22 Mar 2021	29 Mar 2021
1	Litter sieve	0.00	27 Mar 2021	27 Mar 2021
1	Pipe	840.00	22 Mar 2021	29 Mar 2021
1	Site description	0.00	22 Mar 2021	22 Mar 2021
1	SRE foraging	2.00	27 Mar 2021	27 Mar 2021
1	Ultrasonic recording	144.00	25 Mar 2021	31 Mar 2021

Site description - visit 1 (22 Mar 2021)

Low acacia stellaticeps with scattered eremophilla and solanum lasiophyllum over soft stage two and three triodia hummock grassland on red-orange sandplain

Habitat	grassland		
Disturbance	Evidence of feral animals		
Vegetation condition	Very Good	**Fire age**	moderate (>5 years)
Total veg. cover (%)	75	**Litter distribution**	none
Tree cover (%)	1	**Litter depth(cm)**	0
Shrub cover (%)	35	**Litter cover (%)**	0
Grass cover (%)	65		
Herb cover (%)	0.1		

Site details			
Site	**Pit02**	**Position (WGS84)**	-20.438031, 118.561655
Topography	plain	**Soil texture**	sand, sandy loam
Slope	negligible	**Rock type**	none
Soil colour	red-orange	**Rock cover (%)**	0

Sample and effort summary

Visit	Sample method	Sample quant. (hrs)	Date start	Date stop
1	Site description	0.00	23 Mar 2021	23 Mar 2021

Site description - visit 1 (23 Mar 2021)

Acacia tumida pilbarensis shubland over low acacia stellaticeps with scattered eremophilla and solanum lasiophyllum over soft stage two and three triodia hummock grassland on red-orange sandplain

Habitat	shrubland		
Disturbance	Evidence of feral animals		
Vegetation condition	Very Good	**Fire age**	moderate (>5 years)
Total veg. cover (%)	90	**Litter distribution**	under vegetation
Tree cover (%)	40	**Litter depth(cm)**	1
Shrub cover (%)	30	**Litter cover (%)**	25
Grass cover (%)	45		
Herb cover (%)	0.1		

Site details			
Site	**Pit02**	**Position (WGS84)**	-20.428563, 118.557361
Topography		**Soil texture**	
Slope		**Rock type**	
Soil colour		**Rock cover (%)**	

Sample and effort summary

Visit	Sample method	Sample quant. (hrs)	Date start	Date stop
1	Litter sieve	0.00	27 Mar 2021	27 Mar 2021
1	SRE foraging	2.00	27 Mar 2021	27 Mar 2021

Site details			
Site	**Pit02**	**Position (WGS84)**	-20.437946, 118.561761
Topography		**Soil texture**	
Slope		**Rock type**	
Soil colour		**Rock cover (%)**	

Sample and effort summary

Visit	Sample method	Sample quant. (hrs)	Date start	Date stop
1	Audio recording	144.00	25 Mar 2021	31 Mar 2021
1	Birding	0.50	29 Mar 2021	29 Mar 2021
1	Bucket	840.00	20 Mar 2021	27 Mar 2021
1	Elliot trap (small)	1,680.00	23 Mar 2021	30 Mar 2021
1	Foraging	2.00	27 Mar 2021	27 Mar 2021
1	Funnel	3,360.00	23 Mar 2021	30 Mar 2021
1	Pipe	840.00	23 Mar 2021	30 Mar 2021
1	Ultrasonic recording	144.00	25 Mar 2021	31 Mar 2021

Site details			
Site	**Pit03**	**Position (WGS84)**	-20.44416, 118.563435
Topography	plain	**Soil texture**	sand, sandy loam
Slope	negligible	**Rock type**	none
Soil colour	red-orange	**Rock cover (%)**	0

Sample and effort summary

Visit	Sample method	Sample quant. (hrs)	Date start	Date stop
1	Birding	1.00	30 Mar 2021	30 Mar 2021
1	Bucket	840.00	23 Mar 2021	30 Mar 2021
1	Camera trap	120.00	26 Mar 2021	31 Mar 2021
1	Elliot trap (small)	1,680.00	23 Mar 2021	30 Mar 2021
1	Foraging	2.00	26 Mar 2021	26 Mar 2021
1	Foraging nocturnal	4.80	26 Mar 2021	26 Mar 2021
1	Funnel	3,360.00	23 Mar 2021	30 Mar 2021
1	Litter sieve	0.00	27 Mar 2021	27 Mar 2021
1	Pipe	840.00	23 Mar 2021	30 Mar 2021
1	Site description	0.00	23 Mar 2021	23 Mar 2021
1	SRE foraging	2.00	27 Mar 2021	27 Mar 2021

Site description - visit 1 (23 Mar 2021)

Isolated Acacia inequalatera and Hakea lorea tall shrubs over scattered Acacia stellaticeps, eremophilla, Solanum lasiophyllum, Sebania cannabina over tussock grassland on red-orange sandplain

Habitat	grassland		
Disturbance	Evidence of feral animals		
Vegetation condition	Very Good	**Fire age**	relatively recent (1-5 years)
Total veg. cover (%)	55	**Litter distribution**	none
Tree cover (%)	0	**Litter depth(cm)**	0
Shrub cover (%)	20	**Litter cover (%)**	0
Grass cover (%)	35		
Herb cover (%)	2		

Site details			
Site	**Pit04**	**Position (WGS84)**	-20.431735, 118.567093
Topography	drainage line	**Soil texture**	sand, sandy clay, loam
Slope	negligible	**Rock type**	chert, ferrous - Banded Iron Formation, quartz, siltstone / mudstone
Soil colour	red-orange	**Rock cover (%)**	0

Sample and effort summary

Visit	Sample method	Sample quant. (hrs)	Date start	Date stop
1	Audio recording	144.00	25 Mar 2021	31 Mar 2021
1	Birding	1.80	27 Mar 2021	27 Mar 2021
1	Bucket	840.00	24 Mar 2021	31 Mar 2021
1	Camera trap	360.02	26 Mar 2021	31 Mar 2021
1	Elliot trap (small)	1,680.00	24 Mar 2021	31 Mar 2021
1	Foraging	2.00	26 Mar 2021	26 Mar 2021
1	Foraging nocturnal	4.53	25 Mar 2021	25 Mar 2021
1	Funnel	3,360.00	24 Mar 2021	31 Mar 2021
1	Litter sieve	0.00	27 Mar 2021	27 Mar 2021
1	Pipe	840.00	24 Mar 2021	31 Mar 2021
1	Site description	0.00	24 Mar 2021	24 Mar 2021
1	SRE foraging	2.00	27 Mar 2021	27 Mar 2021
1	Transect	0.00	30 Mar 2021	30 Mar 2021
1	Ultrasonic recording	144.00	25 Mar 2021	31 Mar 2021

Site description - visit 1 (24 Mar 2021)

Open Eucalyptus woodland over Acacia tumida pilbarensis shrubs over low Acacia stellaticeps. Dense tussock grasses on edges of creek and stage two and three soft spinifex hummock grasses on adjacent sand plains

Habitat	open woodland		
Disturbance	Evidence of feral animals		
Vegetation condition	Very Good	**Fire age**	old (5-10 years)
Total veg. cover (%)	60	**Litter distribution**	under vegetation
Tree cover (%)	15	**Litter depth(cm)**	1
Shrub cover (%)	20	**Litter cover (%)**	10
Grass cover (%)	30		
Herb cover (%)	1		

Site details			
Site	**Pit05**	**Position (WGS84)**	-20.432267, 118.548561
Topography	plain	**Soil texture**	sand, sandy loam
Slope	negligible	**Rock type**	none
Soil colour	red-orange	**Rock cover (%)**	0

Sample and effort summary

Visit	Sample method	Sample quant. (hrs)	Date start	Date stop
1	Birding	3.15	31 Mar 2021	31 Mar 2021
1	Bucket	840.00	24 Mar 2021	31 Mar 2021
1	Elliot trap (small)	1,680.00	24 Mar 2021	31 Mar 2021
1	Foraging	2.00	25 Mar 2021	25 Mar 2021
1	Foraging nocturnal	7.53	29 Mar 2021	29 Mar 2021
1	Funnel	3,360.33	24 Mar 2021	31 Mar 2021
1	Litter sieve	0.00	26 Mar 2021	26 Mar 2021
1	Pipe	840.00	24 Mar 2021	31 Mar 2021
1	Site description	0.00	24 Mar 2021	24 Mar 2021
1	SRE foraging	2.00	26 Mar 2021	26 Mar 2021

Site description - visit 1 (24 Mar 2021)

Acacia tumida pilbarensis, isolated Hakea lorea and Acacia inequalatera tall shrubs over Acacia stellaticeps shrubland, scattered eremophilla and Solanum lasiophyllum shrubs over soft stage three and four and five spinifex hummock grass on red-orange sandplain

Habitat	shrubland		
Disturbance	Evidence of feral animals		
Vegetation condition	Very Good	**Fire age**	long-unburnt (>10 years)
Total veg. cover (%)	90	**Litter distribution**	under vegetation
Tree cover (%)	0.5	**Litter depth(cm)**	0.1
Shrub cover (%)	45	**Litter cover (%)**	1
Grass cover (%)	45		
Herb cover (%)	0.1		

Site details			
Site	**Pundul**	**Position (WGS84)**	-20.44267, 118.573461
Topography	plain	**Soil texture**	sandy loam
Slope	negligible	**Rock type**	none
Soil colour	red-orange	**Rock cover (%)**	0

Sample and effort summary

Visit	Sample method	Sample quant. (hrs)	Date start	Date stop
1	Birding	0.53	31 Mar 2021	31 Mar 2021
1	Foraging	0.53	31 Mar 2021	31 Mar 2021
1	Site description	0.00	31 Mar 2021	31 Mar 2021

Site description - visit 1 (31 Mar 2021)

Isolated pundul tree Owenia reticulata, Acacia tumida pilbarenses over low Acacia stellaticeps over soft, stage and two, three and four spinifex hummock grassland on red-orange sandplain

Habitat	spinifex grassland		
Disturbance	Evidence of feral animals		
Vegetation condition	Very Good	**Fire age**	moderate (>5 years)
Total veg. cover (%)	60	**Litter distribution**	
Tree cover (%)	1	**Litter depth(cm)**	
Shrub cover (%)	20	**Litter cover (%)**	
Grass cover (%)	45		
Herb cover (%)	0.1		

Site details			
Site	**Transect 01**	**Position (WGS84)**	-20.43632, 118.564638
Topography	plain	**Soil texture**	sand, sandy loam
Slope	negligible	**Rock type**	none
Soil colour	red-orange	**Rock cover (%)**	0

Sample and effort summary

Visit	Sample method	Sample quant. (hrs)	Date start	Date stop
1	Site description	0.00	25 Mar 2021	25 Mar 2021
1	Transect	4.00	25 Mar 2021	25 Mar 2021

Site description - visit 1 (25 Mar 2021)

Patches of low Acacia striaticeps shrubs and isolated Acacia tumida pilbarences shrubs over stage one and two spinifex hummock grassland

Habitat	grassland		
Disturbance			
Vegetation condition	Very Good	**Fire age**	relatively recent (1-5 years)
Total veg. cover (%)	40	**Litter distribution**	none
Tree cover (%)	1	**Litter depth(cm)**	0
Shrub cover (%)	15	**Litter cover (%)**	0
Grass cover (%)	35		
Herb cover (%)	0.1		

Site details			
Site	**Transect 02**	**Position (WGS84)**	-20.437405, 118.560567
Topography	plain	**Soil texture**	sand, sandy loam
Slope	negligible	**Rock type**	none
Soil colour	red-orange	**Rock cover (%)**	0

Sample and effort summary

Visit	Sample method	Sample quant. (hrs)	Date start	Date stop
1	Site description	4.00	26 Mar 2021	26 Mar 2021
1	Transect	0.00	26 Mar 2021	26 Mar 2021

Site description - visit 1 (26 Mar 2021)

Isolated Acacia tumida pilbarensis shrubs over isolated to scattered Acacia stellaticepts low shrubs over stage two and three soft triodia hummock grassland on red-orange sandplain

Habitat	grassland		
Disturbance	Evidence of feral animals		
Vegetation condition	Very Good	**Fire age**	moderate (>5 years)
Total veg. cover (%)	80	**Litter distribution**	under vegetation
Tree cover (%)	1	**Litter depth(cm)**	0
Shrub cover (%)	30	**Litter cover (%)**	1
Grass cover (%)	45		
Herb cover (%)	1		

Site details			
Site	**Transect 03**	**Position (WGS84)**	-20.445385, 118.562376
Topography	plain	**Soil texture**	sand, sandy loam
Slope	negligible	**Rock type**	none
Soil colour	red-orange	**Rock cover (%)**	0

Sample and effort summary

Visit	Sample method	Sample quant. (hrs)	Date start	Date stop
1	Site description	0.00	27 Mar 2021	27 Mar 2021
1	Transect	5.00	27 Mar 2021	27 Mar 2021

Site description - visit 1 (27 Mar 2021)

Isolated to scattered Acacia tumida pilbarensis shrubs over scattered mixed low shrubs over stage one and two soft spinifex hummock grassland on red-orange sandplain

Habitat	grassland		
Disturbance	Evidence of feral animals		
Vegetation condition	Very Good	**Fire age**	relatively recent (1-5 years)
Total veg. cover (%)	60	**Litter distribution**	none
Tree cover (%)	0.1	**Litter depth(cm)**	0
Shrub cover (%)	35	**Litter cover (%)**	0
Grass cover (%)	35		
Herb cover (%)	5		

Site details			
Site	**Transect 04**	**Position (WGS84)**	-20.432387, 118.558742
Topography	plain	**Soil texture**	sand, sandy loam
Slope	negligible	**Rock type**	none
Soil colour	red-orange	**Rock cover (%)**	0

Sample and effort summary

Visit	Sample method	Sample quant. (hrs)	Date start	Date stop
1	Site description	0.00	27 Mar 2021	27 Mar 2021
1	Transect	0.00	27 Mar 2021	27 Mar 2021

Site description - visit 1 (27 Mar 2021)

Isolated to scattered Acacia tumida pilbarensis shrubs over Acacia stellaticepts low shrubs over stage two and three soft triodia hummock grassland on red-orange sandplain

Habitat	grassland		
Disturbance	Evidence of feral animals		
Vegetation condition		**Fire age**	relatively recent (1-5 years)
Total veg. cover (%)	55	**Litter distribution**	none
Tree cover (%)	1	**Litter depth(cm)**	0
Shrub cover (%)	5	**Litter cover (%)**	0
Grass cover (%)	55		
Herb cover (%)	0.1		

Site details			
Site	**Transect 05**	**Position (WGS84)**	-20.441528, 118.561229
Topography	plain	**Soil texture**	sand, sandy loam
Slope	negligible	**Rock type**	none
Soil colour	red-orange	**Rock cover (%)**	0

Sample and effort summary

Visit	Sample method	Sample quant. (hrs)	Date start	Date stop
1	Site description	0.00	28 Mar 2021	28 Mar 2021
1	Transect	2.93	28 Mar 2021	28 Mar 2021

Site description - visit 1 (28 Mar 2021)

Isolated to scattered Acacia tumida pilbarensis shrubs over Acacia stellaticepts low shrubs over stage two and three soft triodia hummock grassland on red-orange sandplain

Habitat	grassland		
Disturbance	Evidence of feral animals		
Vegetation condition	Very Good	**Fire age**	relatively recent (1-5 years)
Total veg. cover (%)	50	**Litter distribution**	none
Tree cover (%)	1	**Litter depth(cm)**	0
Shrub cover (%)	25	**Litter cover (%)**	0
Grass cover (%)	50		
Herb cover (%)	0.1		

Site details			
Site	**Transect 06**	**Position (WGS84)**	-20.433246, 118.571128
Topography	plain	**Soil texture**	sand, sandy loam
Slope	negligible	**Rock type**	none
Soil colour	red-orange	**Rock cover (%)**	0

Sample and effort summary

Visit	Sample method	Sample quant. (hrs)	Date start	Date stop
1	Transect	0.00	31 Mar 2021	31 Mar 2021
1	Site description	0.00	28 Mar 2021	28 Mar 2021
1	Transect	0.00		

Site description - visit 1 (28 Mar 2021)

Isolated Acacia tumida pilbarensis shrubs over patches of dense low Acacia stellaticepts shrubs over stage two and three soft triodia hummock grassland on red-orange sandplain - crosses minor drainage

Habitat	grassland		
Disturbance	Evidence of feral animals		
Vegetation condition	Very Good	**Fire age**	relatively recent (1-5 years)
Total veg. cover (%)	75	**Litter distribution**	none
Tree cover (%)	0.1	**Litter depth(cm)**	0
Shrub cover (%)	25	**Litter cover (%)**	0
Grass cover (%)	65		
Herb cover (%)	0.1		

Site details			
Site	**Transect 07**	**Position (WGS84)**	-20.434746, 118.544889
Topography	plain	**Soil texture**	sandy loam
Slope	negligible	**Rock type**	none
Soil colour	red-orange	**Rock cover (%)**	0

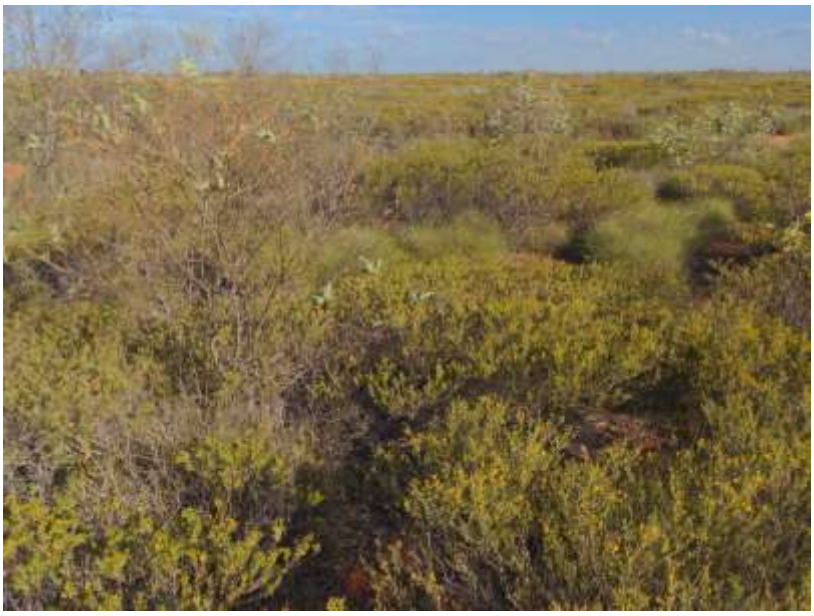
Sample and effort summary

Visit	Sample method	Sample quant. (hrs)	Date start	Date stop
1	Transect	0.00	31 Mar 2021	31 Mar 2021
1	Site description	0.00	29 Mar 2021	29 Mar 2021
1	Transect	0.00	29 Mar 2021	29 Mar 2021

Site description - visit 1 (29 Mar 2021)

Acacia tumida pilbarensis, isolated Hakea lorea and Acacia inequalatera tall shrubs over Acacia stellaticeps, scattered eremophilla and solanum lasiophyllum shrubs over soft stage three and four and five triodia hummock grassland on red-orange sandplain

Habitat	shrubland		
Disturbance	Evidence of feral animals		
Vegetation condition	Very Good	**Fire age**	relatively recent (1-5 years)
Total veg. cover (%)	80	**Litter distribution**	under vegetation
Tree cover (%)	2	**Litter depth(cm)**	1
Shrub cover (%)	55	**Litter cover (%)**	5
Grass cover (%)	40		
Herb cover (%)	1		



Site details			
Site	**Transect 08**	**Position (WGS84)**	-20.437269, 118.57151
Topography	plain	**Soil texture**	sandy loam
Slope	negligible	**Rock type**	none
Soil colour	red-orange	**Rock cover (%)**	0

Sample and effort summary

Visit	Sample method	Sample quant. (hrs)	Date start	Date stop
1	Transect	0.00	31 Mar 2021	31 Mar 2021
1	Site description	0.00	31 Mar 2021	31 Mar 2021
1	Transect	0.00	31 Mar 2021	31 Mar 2021

Site description - visit 1 (31 Mar 2021)

Patches of dense Acacia striaticeps low shrubs over stage two and three spinifex hummock grassland adjacent to minor drainage line

Habitat	spinifex grassland		
Disturbance			
Vegetation condition	Very Good	**Fire age**	long-unburnt (>10 years)
Total veg. cover (%)	65	**Litter distribution**	none
Tree cover (%)	0.1	**Litter depth(cm)**	0
Shrub cover (%)	15	**Litter cover (%)**	0
Grass cover (%)	60		
Herb cover (%)	0.1		

Appendix 3 Vertebrate fauna desktop and field survey results

Species (364)	Common name	Status	Introd.	EPBC	NatureMap	DBCA Threatened Fauna	Unpubl. reports	This survey
Amphibians (13)								
Platyplectrum spenceri	Centralian Burrowing Frog				✓			✓
Cyclorana australis	Giant Frog				✓			
Cyclorana maini	Sheep Frog				✓			✓
Litoria caerulea	Green Tree Frog				✓		✓	
Litoria rothii	Northern Laughing Tree Frog				✓			
Litoria rubella	Little Red Tree Frog				✓		✓	✓
Neobatrachus aquilonius	Northern Burrowing Frog				✓			✓
Neobatrachus sutor	Shoemaker Frog				✓			
Notaden nichollsi	Desert Spadefoot				✓			✓
Uperoleia glandulosa	Glandular Toadlet				✓			✓
Uperoleia russelli	Northwest Toadlet				✓			
Uperoleia saxatilis	Pilbara Toadlet				✓			
Uperoleia talpa	Ratcheting Toadlet				✓			
Reptiles (90)								
Amphibolurus gilberti	Ta-ta				✓			
Amphibolurus longirostris	Long-nosed Dragon				✓		✓	✓

Species (364)	Common name	Status	Introd.	EPBC	NatureMap	DBCA Threatened Fauna	Unpubl. reports	This survey
Ctenophorus caudicinctus	Ring-tailed Dragon				✓		✓	
Ctenophorus isolepis	Crested Dragon				✓		✓	✓
Ctenophorus nuchalis	Central Netted Dragon				✓		✓	✓
Ctenophorus reticulatus	Western Netted Dragon				✓			
Diporiphora paraconvergens	Grey-striped Western Desert Dragon				✓			
Diporiphora pindan					✓			
Diporiphora valens	Southern Pilbara Tree Dragon				✓			
Diporiphora vescus	Northern Pilbara Tree Dragon				✓			
Pogona minor	Dwarf Bearded Dragon				✓			
Antaresia perthensis	Pygmy Python				✓			
Antaresia stimsoni	Stimson's Python				✓			
Aspidites melanocephalus	Black-headed Python				✓		✓	✓
Aspidites ramsayi	Woma				✓		✓	
Liasis olivaceus barroni	Pilbara Olive Python	VU (EPBC & BC Acts)		✓	✓	✓		
Nephrurus levis	Smooth Knob-tailed Gecko				✓			
Nephrurus levis pilbarensis								✓
Fordonia leucobalia	White-bellied Mangrove Snake				✓			
Diplodactylus bilybara	Western Fat-tailed Gecko						✓	✓

Species (364)	Common name	Status	Introd.	EPBC	NatureMap	DBCA Threatened Fauna	Unpubl. reports	This survey
Diplodactylus conspicillatus	Fat-tailed Gecko				✓			
Lucasium stenodactylum					✓		✓	✓
Rhynchoedura ornata	Western Beaked Gecko				✓			✓
Strophurus ciliaris					✓			✓
Strophurus elderi					✓			
Strophurus jeanae					✓			
Acanthophis pyrrhus	Desert Death Adder				✓			
Brachyurophis approximans	North-western Shovel-nosed Snake				✓			
Demansia psammophis	Yellow-faced Whipsnake				✓			
Demansia rufescens	Rufous Whipsnake				✓			✓
Furina ornata	Moon Snake				✓		✓	
Pseudechis australis	Mulga Snake				✓		✓	✓
Pseudonaja mengdeni	Western Brown Snake				✓		✓	✓
Pseudonaja modesta	Ringed Brown Snake				✓			
Pseudonaja nuchalis	Gwardar				✓			
Simoselaps anomalus	Desert Banded Snake				✓		✓	
Suta punctata	Spotted Snake				✓		✓	
Gehyra pilbara					✓			

Species (364)	Common name	Status	Introd.	EPBC	NatureMap	DBCA Threatened Fauna	Unpubl. reports	This survey
Gehyra punctata	Spotted Dtella				✓		✓	
Gehyra purpurascens					✓			
Gehyra variegata	Variegated Dtella				✓		✓	✓
Hemidactylus frenatus	Asian House Gecko		✓	✓	✓			
Heteronotia binoei	Bynoe's Gecko				✓		✓	✓
Heteronotia spelea	Desert Cave Gecko				✓			
Delma butleri	Unbanded Delma				✓			
Delma haroldi					✓		✓	
Delma nasuta					✓			
Delma pax	Peace Delma				✓		✓	✓
Delma tincta	Excitable Delma				✓			✓
Lialis burtonis	Burton's Legless Lizard				✓		✓	
Pygopus nigriceps					✓		✓	
Carlia munda	Shaded-litter Rainbow Skink				✓		✓	
Carlia triacantha	Desert Rainbow Skink				✓			✓
Cryptoblepharus buchananii					✓			
Cryptoblepharus plagiocephalus	Peron's Snake-eyed Skink				✓			
Ctenotus angusticeps	Airlie Island Ctenotus	P3 (DBCA list)			✓	✓		

Species (364)	Common name	Status	Introd.	EPBC	NatureMap	DBCA Threatened Fauna	Unpubl. reports	This survey
Ctenotus duricola					✓			✓
Ctenotus dux					✓			
Ctenotus grandis	Grand Ctenotus				✓			✓
Ctenotus hanloni	Nimble Ctenotus				✓			✓
Ctenotus helenae	Clay-soil Ctenotus				✓		✓	✓
Ctenotus pantherinus	Leopard Ctenotus				✓		✓	✓
Ctenotus piankai					✓			✓
Ctenotus rufescens					✓			✓
Ctenotus saxatilis	Rock Ctenotus				✓		✓	✓
Ctenotus serventyi					✓			✓
Egernia depressa	Southern Pygmy Spiny-tailed Skink				✓		✓	
Eremiascincus isolepis	Northern Bar-lipped Skink				✓			
Eremiascincus musivus	Mosaic Desert Skink				✓		✓	
Eremiascincus pallidus	Western Narrow-banded Skink				✓			
Eremiascincus richardsonii	Broad-banded Sand Swimmer				✓			
Lerista bipes	North-western Sandslider				✓		✓	✓
Lerista clara	Sharp-blazed Three-toed Slider				✓			
Lerista muelleri	Wood Mulch-slider				✓			

Species (364)	Common name	Status	Introd.	EPBC	NatureMap	DBCA Threatened Fauna	Unpubl. reports	This survey
Menetia greyii	Common Dwarf Skink				✓			✓
Morethia ruficauda					✓		✓	✓
Notoscincus ornatus					✓			
Proablepharus reginae					✓			
Tiliqua multifasciata	Central Blue-tongue				✓		✓	
Anilios grypus								✓
Anilios pilbarensis								✓
Indotyphlops braminus			✓	✓				
Varanus acanthurus	Spiny-tailed Monitor				✓		✓	✓
Varanus brevicauda	Short-tailed Pygmy Monitor				✓		✓	✓
Varanus bushi	Pilbara Mulga Monitor				✓			
Varanus eremius	Pygmy Desert Monitor				✓		✓	✓
Varanus giganteus	Perentie				✓			
Varanus gouldii	Bungarra or Sand Monitor				✓		✓	✓
Varanus panoptes	Yellow-spotted Monitor				✓			✓
Varanus pilbarensis	Pilbara Rock Monitor				✓			
Birds (217)								
Gerygone tenebrosa	Dusky Gerygone				✓			

Species (364)	Common name	Status	Introd.	EPBC	NatureMap	DBCA Threatened Fauna	Unpubl. reports	This survey
Smicrornis brevirostris	Weebill				✓			
Accipiter cirrocephalus	Collared Sparrowhawk				✓			
Accipiter fasciatus	Brown Goshawk				✓			
Aquila audax	Wedge-tailed Eagle				✓			
Circus approximans	Swamp Harrier				✓			
Circus assimilis	Spotted Harrier				✓			
Elanus caeruleus	Black-shouldered Kite				✓			
Haliaeetus leucogaster	White-bellied Sea-Eagle			✓	✓			
Haliastur indus	Brahminy Kite				✓			✓
Haliastur sphenurus	Whistling Kite				✓			
Hieraaetus morphnoides	Little Eagle				✓			
Milvus migrans	Black Kite				✓			
Pandion cristatus	Osprey	Mig. (EPBC & BC Acts)		✓	✓	✓		
Aegotheles cristatus	Australian Owlet-nightjar				✓			
Mirafra javanica	Horsfield's Bushlark				✓		✓	✓
Anas gracilis	Grey Teal				✓		✓	
Anas rhynchotis	Australasian Shoveler				✓			
Anas superciliosa	Pacific Black Duck				✓			

Species (364)	Common name	Status	Introd.	EPBC	NatureMap	DBCA Threatened Fauna	Unpubl. reports	This survey
Aythya australis	Hardhead				✓			
Chenonetta jubata	Australian Wood Duck				✓			
Cygnus atratus	Black Swan				✓			
Dendrocygna arcuata	Wandering Whistling Duck				✓			
Dendrocygna eytoni	Plumed Whistling Duck				✓		✓	
Malacorhynchus membranaceus	Pink-eared Duck				✓			
Anhinga novaehollandiae	Australasian Darter				✓			
Apus pacificus	Fork-tailed Swift	Mig. (EPBC & BC Acts)		✓	✓	✓		
Ardea garzetta	Little Egret				✓			
Ardea ibis	Cattle Egret			✓	✓		✓	
Ardea intermedia	Intermediate Egret				✓			
Ardea modesta	Great Egret			✓	✓		✓	
Ardea novaehollandiae	White-faced Heron				✓			
Ardea pacifica	White-necked Heron				✓		✓	
Ardea sacra	Eastern Reef Egret						✓	
Butorides striata	Striated Heron				✓		✓	
Nycticorax caledonicus	Rufous Night Heron				✓			
Artamus cinereus	Black-faced Woodswallow				✓		✓	✓

Species (364)	Common name	Status	Introd.	EPBC	NatureMap	DBCA Threatened Fauna	Unpubl. reports	This survey
Artamus cyanopterus	Dusky Woodswallow				✓			
Artamus leucorynchus	White-breasted Woodswallow				✓		✓	
Artamus personatus	Masked Woodswallow				✓			
Artamus superciliosus	White-browed Woodswallow				✓			
Burhinus grallarius	Bush Stone-curlew				✓		✓	
Esacus magnirostris	Beach Stone-curlew				✓			
Coracina novaehollandiae	Black-faced Cuckoo-shrike				✓		✓	✓
Lalage tricolor	White-winged Triller				✓		✓	
Eurostopodus argus	Spotted Nightjar				✓		✓	
Centropus phasianinus	Pheasant Coucal				✓			
Charadrius leschenaultii	Greater Sand Plover	VU/Mig./VU (EPBC Act; BC Act)		✓	✓	✓		
Charadrius mongolus	Lesser Sand Plover	EN/Mig. (EPBC & BC Acts)		✓	✓	✓		
Charadrius ruficapillus	Red-capped Plover			✓	✓		✓	
Charadrius veredus	Oriental Plover	Mig. (EPBC & BC Acts)		✓	✓	✓		
Elseyornis melanops	Black-fronted Dotterel				✓		✓	
Erythrogonys cinctus	Red-kneed Dotterel				✓		✓	
Pluvialis fulva	Pacific Golden Plover	Mig. (EPBC & BC Acts)		✓	✓	✓		
Pluvialis squatarola	Grey Plover	Mig. (EPBC & BC Acts)		✓	✓	✓	✓	

Species (364)	Common name	Status	Introd.	EPBC	NatureMap	DBCA Threatened Fauna	Unpubl. reports	This survey
Vanellus miles	Masked Lapwing				✓			
Vanellus tricolor	Banded Lapwing						✓	
Ephippiorhynchus asiaticus	Black-necked Stork				✓		✓	✓
Cinclosoma castaneothorax	Chestnut-breasted Quail-thrush				✓			
Columba livia	Domestic Pigeon		✓	✓	✓		✓	
Geopelia cuneata	Diamond Dove				✓		✓	✓
Geopelia humeralis	Bar-shouldered Dove				✓			
Geopelia striata	Zebra Dove				✓			
Geopelia striata placida	Peaceful Dove						✓	
Geophaps plumifera	Spinifex Pigeon				✓			
Ocyphaps lophotes	Crested Pigeon				✓		✓	✓
Phaps chalcoptera	Common Bronzewing				✓		✓	✓
Phaps histrionica	Flock Bronzewing				✓			
Corvus bennetti	Little Crow				✓		✓	
Corvus coronoides	Australian Raven				✓			
Corvus orru	Torresian Crow				✓		✓	✓
Cracticus nigrogularis	Pied Butcherbird				✓		✓	
Cracticus tibicen	Australian Magpie				✓			

Species (364)	Common name	Status	Introd.	EPBC	NatureMap	DBCA Threatened Fauna	Unpubl. reports	This survey
Cacomantis pallidus	Pallid Cuckoo				✓		✓	
Chrysococcyx basalis	Horsfield's Bronze Cuckoo				✓		✓	
Chrysococcyx osculans	Black-eared Cuckoo			✓				
Cuculus optatus	Oriental Cuckoo			✓				
Dicaeum hirundinaceum	Mistletoebird				✓			
Grallina cyanoleuca	Magpie-lark				✓		✓	✓
Rhipidura albiscapa	Grey Fantail				✓			
Rhipidura leucophrys	Willie Wagtail				✓		✓	✓
Rhipidura phasiana	Mangrove Grey Fantail				✓			
Dromaius novaehollandiae	Emu				✓		✓	
Emblema pictum	Painted Finch				✓			
Heteromunia pectoralis	Pictorella Mannikin				✓			
Neochmia ruficauda	Star Finch				✓			
Taeniopygia guttata	Zebra Finch				✓		✓	✓
Falco berigora	Brown Falcon				✓			✓
Falco cenchroides	Australian Kestrel				✓			✓
Falco hypoleucos	Grey Falcon	VU (BC Act)		✓	✓	✓		
Falco longipennis	Australian Hobby				✓			

Species (364)	Common name	Status	Introd.	EPBC	NatureMap	DBCA Threatened Fauna	Unpubl. reports	This survey
Falco peregrinus	Peregrine Falcon	OS (BC Act)			✓	✓		
Fregata ariel	Lesser Frigatebird	Mig. (EPBC & BC Acts)		✓	✓	✓		
Glareola maldivarum	Oriental Pratincole	Mig. (EPBC & BC Acts)		✓	✓	✓		
Stiltia isabella	Australian Pratincole			✓	✓			
Grus rubicunda	Brolga				✓			
Haematopus fuliginosus	Sooty Oystercatcher				✓		✓	
Haematopus longirostris	Pied Oystercatcher				✓			
Dacelo leachii	Blue-winged Kookaburra				✓		✓	
Todiramphus chloris	Collared Kingfisher				✓			
Todiramphus pyrrhopygius	Red-backed Kingfisher				✓		✓	
Todiramphus sanctus	Sacred Kingfisher				✓		✓	
Cheramoeca leucosterna	White-backed Swallow				✓		✓	
Hirundo neoxena	Welcome Swallow				✓			
Hirundo rustica	Barn Swallow	Mig. (EPBC & BC Acts)		✓	✓	✓		
Petrochelidon ariel	Fairy Martin				✓		✓	✓
Petrochelidon nigricans	Tree Martin				✓		✓	
Oceanites oceanicus	Wilson's Storm Petrel	Mig. (EPBC & BC Acts)			✓	✓		
Anous stolidus	Common Noddy	Mig. (EPBC & BC Acts)		✓				

Species (364)	Common name	Status	Introd.	EPBC	NatureMap	DBCA Threatened Fauna	Unpubl. reports	This survey
Chlidonias leucopterus	White-winged Black Tern	Mig. (EPBC & BC Acts)			✓	✓		
Hydroprogne caspia	Caspian Tern	Mig. (EPBC & BC Acts)				✓		
Larus novaehollandiae	Silver Gull				✓		✓	
Onychoprion anaethetus	Bridled Tern	Mig. (EPBC & BC Acts)			✓	✓		
Sterna albifrons	White-shafted Little Tern	Mig. (BC Act)			✓			
Sterna bengalensis	Lesser Crested Tern				✓			
Sterna caspia	Caspian Tern	Mig. (EPBC & BC Acts)			✓		✓	
Sterna hirundo	Common Tern	Mig. (EPBC & BC Acts)			✓	✓		
Sterna hybrida	Whiskered Tern				✓			
Sternula albifrons	Little Tern	Mig. (EPBC & BC Acts)				✓		
Sternula nereis nereis	Fairy Tern	VU (EPBC & BC Acts)				✓		
Thalasseus bergii	Crested Tern	Mig. (BC Act)			✓	✓		
Malurus lamberti	Variegated Fairy-wren				✓		✓	
Malurus leucopterus	White-winged Fairy-wren				✓		✓	✓
Stipiturus ruficeps	Rufous-crowned Emu-wren				✓			
Epthianura aurifrons	Orange Chat				✓			
Epthianura tricolor	Crimson Chat				✓			
Gavicalis virescens	Singing Honeyeater				✓		✓	✓

Species (364)	Common name	Status	Introd.	EPBC	NatureMap	DBCA Threatened Fauna	Unpubl. reports	This survey
Lichmera indistincta	Brown Honeyeater				✓		✓	
Manorina flavigula	Yellow-throated Miner				✓		✓	✓
Melithreptus gularis	Black-chinned Honeyeater				✓			
Ptilotula penicillata	White-plumed Honeyeater				✓		✓	✓
Merops ornatus	Rainbow Bee-eater			✓	✓		✓	✓
Anthus australis	Australian Pipit				✓		✓	
Motacilla cinerea	Grey Wagtail	Mig. (EPBC & BC Acts)		✓				
Motacilla flava	Yellow Wagtail	Mig. (EPBC & BC Acts)		✓	✓	✓		
Ardeotis australis	Australian Bustard				✓			
Colluricincla harmonica	Grey Shrike-thrush				✓		✓	
Oreoica gutturalis	Crested Bellbird				✓			
Pachycephala lanioides	White-breasted Whistler				✓		✓	
Pachycephala melanura	Mangrove Golden Whistler				✓			
Pachycephala rufiventris	Rufous Whistler				✓			
Pardalotus rubricatus	Red-browed Pardalote				✓		✓	
Pardalotus striatus	Striated Pardalote				✓			
Passer montanus	Eurasian Tree Sparrow		✓	✓	✓			
Pelecanus conspicillatus	Australian Pelican				✓		✓	

Species (364)	Common name	Status	Introd.	EPBC	NatureMap	DBCA Threatened Fauna	Unpubl. reports	This survey
Eopsaltria pulverulenta	Mangrove Robin				✓			
Petroica goodenovii	Red-capped Robin				✓			
Phalacrocorax carbo	Great Cormorant				✓			
Phalacrocorax melanoleucos	Little Pied Cormorant				✓			
Phalacrocorax sulcirostris	Little Black Cormorant				✓			
Phalacrocorax varius	Pied Cormorant				✓		✓	
Coturnix ypsilophora	Brown Quail				✓			
Podargus strigoides	Tawny Frogmouth				✓			
Podiceps cristatus	Great Crested Grebe				✓			
Poliocephalus poliocephalus	Hoary-headed Grebe				✓			
Tachybaptus novaehollandiae	Australasian Grebe				✓		✓	
Pomatostomus superciliosus	White-browed Babbler				✓			
Pomatostomus temporalis	Grey-crowned Babbler				✓			
Calonectris leucomelas	Streaked Shearwater	Mig. (EPBC & BC Acts)		✓				
Macronectes giganteus	Southern Giant Petrel	EN/Mig./Mig. (EPBC Act; BC Act)		✓				
Cacatua roseicapilla	Galah				✓		✓	✓
Cacatua sanguinea	Little Corella				✓		✓	
Melopsittacus undulatus	Budgerigar				✓		✓	✓

Species (364)	Common name	Status	Introd.	EPBC	NatureMap	DBCA Threatened Fauna	Unpubl. reports	This survey
Nymphicus hollandicus	Cockatiel				✓		✓	✓
Pezoporus occidentalis	Night Parrot	EN/CR (EPBC Act; BC Act)		✓				
Platycercus spurius	Red-capped Parrot				✓			
Platycercus zonarius	Australian Ringneck				✓		✓	
Ptilonorhynchus maculatus guttatus	Western Bowerbird				✓			
Fulica atra	Eurasian Coot				✓			
Gallirallus philippensis	Buff-banded Rail				✓			
Porphyrio porphyrio	Purple Swamphen				✓			
Porzana fluminea	Australian Spotted Crake				✓			
Tribonyx ventralis	Black-tailed Native-hen				✓			
Cladorhynchus leucocephalus	Banded Stilt				✓		✓	
Himantopus himantopus	Black-winged Stilt			✓	✓		✓	
Recurvirostra novaehollandiae	Red-necked Avocet			✓	✓			
Rostratula australis	Australian Painted Snipe	EN (EPBC & BC Acts)		✓				
Rostratula benghalensis	Painted Snipe			✓				
Actitis hypoleucos	Common Sandpiper	Mig. (EPBC & BC Acts)		✓	✓	✓		
Arenaria interpres	Ruddy Turnstone	Mig. (EPBC & BC Acts)		✓	✓	✓	✓	
Calidris acuminata	Sharp-tailed Sandpiper	Mig. (EPBC & BC Acts)		✓	✓	✓		

Species (364)	Common name	Status	Introd.	EPBC	NatureMap	DBCA Threatened Fauna	Unpubl. reports	This survey
Calidris alba	Sanderling	Mig. (EPBC & BC Acts)		✓	✓	✓		
Calidris canutus	Red Knot	EN/Mig./EN (EPBC Act; BC Act)		✓	✓	✓		
Calidris ferruginea	Curlew Sandpiper	CR/Mig./CR (EPBC Act; BC Act)		✓	✓	✓		
Calidris melanotos	Pectoral Sandpiper	Mig. (EPBC & BC Acts)		✓	✓	✓		
Calidris ruficollis	Red-necked Stint	Mig. (EPBC & BC Acts)		✓	✓	✓	✓	
Calidris subminuta	Long-toed Stint	Mig. (EPBC & BC Acts)		✓	✓	✓		
Calidris tenuirostris	Great Knot	CR/Mig./CR (EPBC Act; BC Act)		✓	✓	✓		
Gallinago stenura	Pin-tailed Snipe	Mig. (EPBC & BC Acts)			✓	✓		
Limicola falcinellus	Broad-billed Sandpiper	Mig. (BC Act)		✓	✓	✓		
Limnodromus semipalmatus	Asian Dowitcher	Mig. (EPBC & BC Acts)		✓	✓	✓		
Limosa lapponica	Bar-tailed Godwit	Mig. (EPBC & BC Acts)		✓	✓	✓	✓	
Limosa lapponica menzbieri	Bar-tailed Godwit (northern Siberian)	CR/Mig./VU/Mig. (EPBC Act; BC Act)		✓	✓	✓		
Limosa limosa	Black-tailed Godwit	Mig. (BC Act)		✓	✓	✓		
Numenius madagascariensis	Eastern Curlew	CR/Mig./CR (EPBC Act; BC Act)		✓	✓	✓		
Numenius minutus	Little Curlew	Mig. (EPBC & BC Acts)		✓	✓	✓		
Numenius phaeopus	Whimbrel	Mig. (EPBC & BC Acts)		✓	✓	✓	✓	
Phalaropus lobatus	Red-necked Phalarope	Mar/Mig. (EPBC Act; BC Act)		✓	✓	✓		
Philomachus pugnax	Ruff	Mig. (EPBC & BC Acts)				✓		

Species (364)	Common name	Status	Introd.	EPBC	NatureMap	DBCA Threatened Fauna	Unpubl. reports	This survey
Tringa brevipes	Grey-tailed Tattler	(Mig. EPBC & BC Acts; P4 DBCA list)		✓	✓	✓	✓	
Tringa glareola	Wood Sandpiper	Mig. (EPBC & BC Acts)		✓	✓	✓		
Tringa nebularia	Common Greenshank	Mig. (EPBC & BC Acts)		✓	✓	✓		
Tringa stagnatilis	Marsh Sandpiper	Mig. (EPBC & BC Acts)		✓	✓	✓		
Xenus cinereus	Terek Sandpiper	Mig. (EPBC & BC Acts)		✓	✓	✓		
Ninox connivens	Barking Owl				✓			
Gelochelidon nilotica	Gull-billed Tern	Mig. (BC Act)			✓	✓	✓	
Sula leucogaster	Brown Booby	Mig. (EPBC & BC Acts)				✓		
Eremiornis carteri	Spinifex-bird				✓		✓	✓
Megalurus cruralis	Brown Songlark						✓	
Megalurus mathewsi	Rufous Songlark						✓	
Platalea flavipes	Yellow-billed Spoonbill				✓			
Platalea regia	Royal Spoonbill				✓			
Plegadis falcinellus	Glossy Ibis	Mig. (EPBC & BC Acts)			✓	✓		
Threskiornis spinicollis	Straw-necked Ibis				✓			
Turnix velox	Little Button-quail				✓		✓	✓
Tyto alba	Barn Owl				✓			
Zosterops luteus	Yellow White-eye				✓		✓	

Species (364)	Common name	Status	Introd.	EPBC	NatureMap	DBCA Threatened Fauna	Unpubl. reports	This survey
Mammals (46)								
Bos taurus	European Cattle		✓		✓		✓	✓
Capra hircus	Goat		✓		✓			
Camelus dromedarius	Dromedary		✓	✓				
Canis familiaris	Dog		✓	✓	✓		✓	✓
Vulpes vulpes	Red Fox		✓	✓	✓		✓	✓
Antechinomys laniger	Kultarr				✓			
Dasycercus blythi	Brush-tailed Mulgara	P4 (DBCA list)			✓	✓		✓
Dasykaluta rosamondae	Little Red Kaluta				✓		✓	✓
Dasyurus hallucatus	Northern Quoll	EN (EPBC & BC Acts)		✓	✓	✓		
Ningaui timealeyi	Pilbara Ningaui				✓			
Planigale ingrami	Long-tailed Planigale				✓			
Pseudantechinus woolleyae	Woolley's Pseudantechinus				✓			
Sminthopsis macroura	Stripe-faced Dunnart				✓			
Sminthopsis youngsoni	Lesser Hairy-footed Dunnart				✓		✓	✓
Saccolaimus flaviventris	Yellow-bellied Sheath-tailed Bat				✓		✓	
Taphozous georgianus	Common Sheath-tailed Bat				✓		✓	
Equus asinus	Donkey		✓	✓				

Species (364)	Common name	Status	Introd.	EPBC	NatureMap	DBCA Threatened Fauna	Unpubl. reports	This survey
Equus caballus	Horse		✓	✓	✓			
Felis catus	Cat		✓	✓	✓		✓	✓
Rhinonicteris aurantia (Pilbara)	Pilbara leaf-nosed bat	VU (EPBC & BC Acts)		✓	✓	✓		
Oryctolagus cuniculus	Rabbit		✓		✓			
Lagostrophus fasciatus	Banded Hare-wallaby				✓			
Macropus robustus	Euro				✓		✓	
Macropus rufus	Red Kangaroo				✓			✓
Osphranter robustus	Euro				✓			
Petrogale rothschildi	Rothschild's Rock-wallaby				✓			
Macroderma gigas	Ghost Bat	VU (EPBC & BC Acts)		✓	✓	✓		
Chaerephon jobensis	Greater Northern Freetail-bat				✓			✓
Mormopterus cobourgianus	North-western Free-tailed Bat	P1 (DBCA list)				✓		
Mus musculus	House Mouse		✓	✓	✓		✓	
Notomys alexis	Spinifex Hopping-mouse				✓			✓
Pseudomys chapmani	Western Pebble-mound Mouse	P4 (DBCA list)			✓	✓		
Pseudomys delicatulus	Delicate Mouse				✓		✓	
Pseudomys desertor	Desert Mouse				✓			
Pseudomys hermannsburgensis	Sandy Inland Mouse				✓		✓	✓

Species (364)	Common name	Status	Introd.	EPBC	NatureMap	DBCA Threatened Fauna	Unpubl. reports	This survey
Pseudomys nanus	Western Chestnut Mouse				✓			
Rattus rattus	Black Rat		✓		✓			
Zyzomys argurus	Common Rock-rat				✓			
Sus scrofa	Pig		✓	✓				
Tachyglossus aculeatus	Short-beaked Echidna				✓			
Macrotis lagotis	Bilby	VU (EPBC & BC Acts)		✓	✓	✓		✓
Chalinolobus gouldii	Gould's Wattled Bat				✓		✓	✓
Nyctophilus arnhemensis	Arnhem Land Long-eared Bat				✓			
Nyctophilus geoffroyi	Lesser Long-eared Bat				✓			
Scotorepens greyii	Little Broad-nosed Bat				✓		✓	✓
Vespadelus finlaysoni	Finlayson's Cave Bat				✓		✓	✓

Appendix 4 Short-range endemic invertebrate desktop results

DATASET TO LARGE TO PROVIDERE HERE - TO BE PROVIDED SEPARATELY ON REQUEST.

Appendix 5 Fauna species by site matrix

Class	Scientific name	Common name	Opp01	Opp02	Pit01	Pit02	Pit03	Pit04	Pit05	Pundul	Transect 01	Transect 02	Transect 03	Transect 04	Transect 05	Transect 06	Transect 07	Transect 08
Amphibia	*Platyplectrum spenceri*	Centralian Burrowing Frog						1	1									
Amphibia	*Cyclorana maini*	Sheep Frog						1								1		
Amphibia	*Litoria rubella*	Little Red Tree Frog						1										
Amphibia	*Neobatrachus aquilonius*	Northern Burrowing Frog					1											
Amphibia	*Notaden nichollsi*	Desert Spadefoot			1	1	1	1	1									
Amphibia	*Uperoleia glandulosa*	Glandular Toadlet						1										
Reptilia	*Amphibolurus longirostris*	Long-nosed Dragon						1	1									
Reptilia	*Ctenophorus isolepis*	Crested Dragon			1	1	1	1	1		1	3	1	1		1	1	
Reptilia	*Ctenophorus nuchalis*	Central Netted Dragon					1	1									1	
Reptilia	*Aspidites melanocephalus*	Black-headed Python																1
Reptilia	*Nephrurus levis pilbarensis*				1	1			1									
Reptilia	*Diplodactylus bilybara*	Western Fat-tailed Gecko			1	1	1	1	1									
Reptilia	*Lucasium stenodactylum*				1	1	1		1									

Class	Scientific name	Common name	Opp01	Opp02	Pit01	Pit02	Pit03	Pit04	Pit05	Pundul	Transect 01	Transect 02	Transect 03	Transect 04	Transect 05	Transect 06	Transect 07	Transect 08
Reptilia	*Rhynchoedura ornata*	Western Beaked Gecko			1		1		1									
Reptilia	*Strophurus ciliaris*								1									
Reptilia	*Demansia rufescens*	Rufous Whipsnake							1									
Reptilia	*Pseudechis australis*	Mulga Snake						1										
Reptilia	*Pseudonaja mengdeni*	Western Brown Snake							1									
Reptilia	*Gehyra variegata*	Variegated Dtella				1	1	1										
Reptilia	*Heteronotia binoei*	Bynoe's Gecko						1										
Reptilia	*Delma pax*	Peace Delma							1									
Reptilia	*Delma tincta*	Excitable Delma																1
Reptilia	*Carlia triacantha*	Desert Rainbow Skink			1	1		2										
Reptilia	*Ctenotus duricola*				1	1	1	1										
Reptilia	*Ctenotus grandis*	Grand Ctenotus			0	1	1	0	1									
Reptilia	*Ctenotus hanloni*	Nimble Ctenotus			1	1	1	1	1									
Reptilia	*Ctenotus helenae*	Clay-soil Ctenotus					1		1									
Reptilia	*Ctenotus pantherinus*	Leopard Ctenotus			1	1		1	1									
Reptilia	*Ctenotus piankai*				1	1		1										
Reptilia	*Ctenotus rufescens*				1	1	1		1									
Reptilia	*Ctenotus saxatilis*	Rock Ctenotus				1	1	1	1									

Class	Scientific name	Common name	Opp01	Opp02	Pit01	Pit02	Pit03	Pit04	Pit05	Pundul	Transect 01	Transect 02	Transect 03	Transect 04	Transect 05	Transect 06	Transect 07	Transect 08
Reptilia	*Ctenotus serventyi*				1	0	1	1	0									
Reptilia	*Lerista bipes*	North-western Sandslider			1	1	1	1	1									
Reptilia	*Menetia greyii*	Common Dwarf Skink				1			2									
Reptilia	*Morethia ruficauda*					1		1										
Reptilia	*Anilios grypus*				1	1			1									
Reptilia	*Anilios pilbarensis*				1		1		1									
Reptilia	*Varanus acanthurus*	Spiny-tailed Monitor			1	1	1		1									
Reptilia	*Varanus brevicauda*	Short-tailed Pygmy Monitor			1													
Reptilia	*Varanus eremius*	Pygmy Desert Monitor							1									
Reptilia	*Varanus gouldii*	Bungarra or Sand Monitor				1	1				1						1	
Reptilia	*Varanus panoptes*	Yellow-spotted Monitor															1	
Aves	*Ephippiorhynchus asiaticus*	Black-necked Stork							2					1				
Aves	*Geopelia cuneata*	Diamond Dove				1		1			3							
Aves	*Ocyphaps lophotes*	Crested Pigeon	1															
Aves	*Phaps chalcoptera*	Common Bronzewing							1									
Aves	*Merops ornatus*	Rainbow Bee-eater				3		1	2							1	1	1

Class	Scientific name	Common name	Opp01	Opp02	Pit01	Pit02	Pit03	Pit04	Pit05	Pundul	Transect 01	Transect 02	Transect 03	Transect 04	Transect 05	Transect 06	Transect 07	Transect 08
Aves	*Haliastur indus*	Brahminy Kite				1												
Aves	*Falco berigora*	Brown Falcon						2										
Aves	*Falco cenchroides*	Australian Kestrel							2									
Aves	*Mirafra javanica*	Horsfield's Bushlark			2	1							3					
Aves	*Artamus cinereus*	Black-faced Woodswallow		1				1	3		2						1	
Aves	*Coracina novaehollandiae*	Black-faced Cuckoo-shrike						3						1				
Aves	*Corvus orru*	Torresian Crow						1	3									
Aves	*Grallina cyanoleuca*	Magpie-lark						1	1									
Aves	*Rhipidura leucophrys*	Willie Wagtail						1										
Aves	*Taeniopygia guttata*	Zebra Finch			6	112	0	12	1			3	6	1		1	1	
Aves	*Petrochelidon ariel*	Fairy Martin							8		2							
Aves	*Malurus leucopterus*	White-winged Fairy-wren			3	1	1	1	1		2	2	3			2		
Aves	*Gavicalis virescens*	Singing Honeyeater			2	1		1	1		1		1					
Aves	*Manorina flavigula*	Yellow-throated Miner						3										
Aves	*Ptilotula penicillata*	White-plumed Honeyeater						1										
Aves	*Eremiornis carteri*	Spinifex-bird								1						1		
Aves	*Cacatua roseicapilla*	Galah						1										

Class	Scientific name	Common name	Opp01	Opp02	Pit01	Pit02	Pit03	Pit04	Pit05	Pundul	Transect 01	Transect 02	Transect 03	Transect 04	Transect 05	Transect 06	Transect 07	Transect 08
Aves	*Melopsittacus undulatus*	Budgerigar				3		1			6							
Aves	*Nymphicus hollandicus*	Cockatiel					6											
Aves	*Turnix velox*	Little Button-quail			1		1		1		1	1	3	1	4			
Mammalia	*Bos taurus*	European Cattle												1				
Mammalia	*Canis familiaris*	Dog									1	1		1				
Mammalia	*Vulpes vulpes*	Red Fox																1
Mammalia	*Felis catus*	Cat						1	1			1		1		1	1	1
Mammalia	*Chaerephon jobensis*	Greater Northern Freetail-bat			1	1		1										
Mammalia	*Chalinolobus gouldii*	Gould's Wattled Bat			1	1		1										
Mammalia	*Scotorepens greyii*	Little Broad-nosed Bat			1	1		1										
Mammalia	*Vespadelus finlaysoni*	Finlayson's Cave Bat			1	1		1										
Mammalia	*Dasycercus blythi*	Brush-tailed Mulgara									1				1			
Mammalia	*Dasykaluta rosamondae*	Little Red Kaluta						1	1									
Mammalia	*Sminthopsis youngsoni*	Lesser Hairy-footed Dunnart			1	1	1		1									
Mammalia	*Macropus rufus*	Red Kangaroo			1	1		1	1		1	1				1	1	

Class	Scientific name	Common name	Opp01	Opp02	Pit01	Pit02	Pit03	Pit04	Pit05	Pundul	Transect 01	Transect 02	Transect 03	Transect 04	Transect 05	Transect 06	Transect 07	Transect 08
Mammalia	*Macrotis lagotis*	Bilby						1	1	1						1	1	1
Mammalia	*Notomys alexis*	Spinifex Hopping-mouse			1	1	1	1	1			1	1		1	1		
Mammalia	*Pseudomys hermannsburgensis*	Sandy Inland Mouse			1	1	1	1	1									

Appendix 6 Distance (m) of Bilby records to minor drainage habitat

Record	Site name	Record evidence	Distance to minor drainage habitat (m)
1	Transect 06	scat	0.00
2	Transect 06	scat	0.00
3	Transect 06	scat	0.00
4	Transect 06	scat	0.00
5	Transect 06	scat	0.00
6	Transect 06	scat	0.00
7	Transect 06	scat	0.00
8	Transect 08	digging	0.00
9	Transect 06	scat	0.00
10	Transect 08	digging	0.00
11	Transect 06	scat	0.00
12	Transect 06	scat	0.00
13	Transect 06	scat	0.00
14	Transect 06	digging	0.00
15	Transect 06	scat	0.00
16	Transect 06	scat	0.00
17	Transect 08	scat	0.00
18	Transect 08	scat	0.00
19	Transect 08	scat	0.00
20	Transect 08	scat	0.00
21	Transect 08	digging	0.00
22	Transect 08	scat	0.00
23	Transect 08	scat	0.00
24	Transect 08	scat	0.00
25	Transect 08	scat	0.00
26	Transect 08	scat	0.00
27	Transect 06	digging	0.00
28	Transect 06	scat	0.00
29	Transect 06	scat	0.00
30	Transect 06	digging	0.00
31	Transect 06	scat	1.28
32	Transect 06	scat	1.31
33	Transect 06	scat	1.38
34	Transect 08	scat	1.80
35	Transect 06	digging	2.43
36	Transect 06	scat	2.47
37	Transect 06	scat	3.56
38	Transect 06	scat	4.10
39	Transect 06	scat	4.24
40	Transect 06	scat	4.66

Record	Site name	Record evidence	Distance to minor drainage habitat (m)
41	Transect 08	scat	4.79
42	Transect 06	scat	11.35
43	Transect 06	scat	14.85
44	Transect 06	scat	15.36
45	Transect 06	digging	17.08
46	Transect 08	scat	17.66
47	Transect 08	track	18.62
48	Transect 06	scat	18.68
49	Transect 06	scat	19.67
50	Transect 08	scat	19.87
51	Transect 08	scat	20.11
52	Transect 08	scat	20.36
53	Transect 06	digging	21.07
54	Transect 06	scat	22.12
55	Transect 06	scat	22.23
56	Transect 06	scat	24.01
57	Transect 06	scat	28.37
58	Transect 06	digging	30.53
59	Transect 06	scat	30.82
60	Transect 06	scat	32.90
61	Transect 06	scat	34.13
62	Transect 06	scat	35.40
63	Transect 06	scat	37.99
64	Transect 06	scat	38.60
65	Transect 08	scat	38.85
66	Transect 06	scat	40.01
67	Transect 06	scat	42.63
68	Transect 06	scat	43.66
69	Transect 06	scat	43.88
70	Transect 06	scat	44.44
71	Transect 06	scat	51.18
72	Pit04	track	52.60
73	Transect 06	scat	55.84
74	Transect 06	track	66.55
75	Transect 06	scat	104.45
76	Transect 08	scat	106.89
77	Transect 06	scat	110.23
78	Transect 06	scat	110.73
79	Transect 06	scat	111.63
80	Transect 08	digging	113.13
81	Transect 08	scat	126.65
82	Transect 08	scat	175.71

Record	Site name	Record evidence	Distance to minor drainage habitat (m)
83	Transect 08	scat	193.17
84	Pundul	track	265.83
85	Pundul	digging	265.83
86	Pundul	scat	265.83
		Average	**35.04**

Appendix 7 Location of Bilby scats recorded during the phase two survey

Record	Transect name	latitude	longitude
22	R01	-20.4141	118.527
156	T04	-20.4389	118.5746
157	T04	-20.4386	118.5747
158	T04	-20.4386	118.5747
159	T04	-20.4385	118.5747
160	T04	-20.4385	118.5747
161	T04	-20.4385	118.5747
162	T04	-20.4384	118.5746
163	T04	-20.4384	118.5745
164	T04	-20.4386	118.5744
165	T04	-20.4387	118.5744
166	T04	-20.4387	118.5745
167	T04	-20.4394	118.5745
168	T04	-20.4394	118.5746
169	T04	-20.4393	118.5746
43	T04	-20.4387	118.5745
44	T04	-20.4387	118.5744
45	T04	-20.4388	118.5744
46	T04	-20.4387	118.5717
47	T04	-20.4389	118.5717
48	T04	-20.4394	118.5717
49	T04	-20.44	118.5718
50	T04	-20.4402	118.5748
51	T07	-20.4245	118.5636
52	T07	-20.4248	118.5637
53	T07	-20.4248	118.5637
54	T07	-20.4248	118.5637
55	T07	-20.4248	118.5638
56	T07	-20.4248	118.5639
57	T07	-20.4248	118.564
58	T07	-20.4248	118.5642
59	T07	-20.4247	118.5671
60	T07	-20.4254	118.5681

Record	Transect name	latitude	longitude
61	T08	-20.4239	118.5623
62	T08	-20.4237	118.561
63	T09	-20.428	118.5662
64	T09	-20.4265	118.5628
65	T09	-20.4247	118.5627
66	T10	-20.4345	118.5474
67	T10	-20.4372	118.5479
68	T10	-20.4371	118.548
69	T11	-20.4306	118.5735
70	T11	-20.4327	118.5787
14	T14	-20.4343	118.5646
15	T14	-20.433	118.5658
71	T14	-20.4287	118.5605
72	T14	-20.4362	118.5639
73	T14	-20.4341	118.565
74	T14	-20.43	118.5663
16	T15	-20.4218	118.5566
17	T15	-20.4223	118.5537
18	T15	-20.4223	118.5535
19	T15	-20.4218	118.5517
75	T15	-20.4218	118.557
76	T15	-20.4225	118.5553
77	T15	-20.4225	118.5552
78	T15	-20.4224	118.554
79	T15	-20.4224	118.554
80	T15	-20.4223	118.554
81	T15	-20.4224	118.5538
82	T15	-20.4224	118.5537
83	T15	-20.4225	118.5535
84	T15	-20.4224	118.5532
85	T15	-20.4221	118.5522
86	T15	-20.4221	118.5521
87	T15	-20.4214	118.5515
88	T16	-20.437	118.5459
89	T16	-20.4375	118.5463
90	T16	-20.4376	118.5463
20	T16	-20.4332	118.5482
91	T17	-20.4449	118.5443
92	T17	-20.4456	118.5429
93	T17	-20.4441	118.5393
94	T17	-20.4431	118.5378
95	T18	-20.4389	118.5389
96	T18	-20.4389	118.5389

Record	Transect name	latitude	longitude
97	T18	-20.4363	118.5421
98	T18	-20.435	118.5441
99	T18	-20.4336	118.5459
100	T18	-20.4312	118.5488
101	T18	-20.4308	118.5492
21	T18	-20.438	118.5401
121	T19	-20.4491	118.5348
122	T19	-20.4491	118.5344
123	T19	-20.448	118.5343
124	T19	-20.4479	118.5344
125	T19	-20.448	118.5344
126	T19	-20.4473	118.5344
127	T19	-20.447	118.5343
128	T19	-20.447	118.5343
129	T19	-20.4468	118.5345
130	T19	-20.4467	118.5346
131	T19	-20.4467	118.5346
132	T19	-20.4464	118.5357
23	T19	-20.4487	118.5361
24	T19	-20.4471	118.5343
25	T19	-20.4468	118.5346
133	T20	-20.4495	118.529
134	T20	-20.449	118.529
135	T20	-20.449	118.529
136	T20	-20.4486	118.5288
137	T20	-20.4484	118.5285
138	T20	-20.4484	118.5285
139	T20	-20.4481	118.5283
140	T20	-20.4488	118.5295
141	T21	-20.4522	118.5244
142	T21	-20.4522	118.5243
143	T21	-20.4508	118.5204
144	T21	-20.4513	118.5215
145	T21	-20.4512	118.5221
146	T21	-20.4512	118.5221
147	T21	-20.4516	118.523
26	T21	-20.454	118.525
27	T21	-20.454	118.5251
28	T21	-20.4538	118.5252
170	T25	-20.4206	118.5654
171	T25	-20.4205	118.5653
172	T25	-20.4204	118.5654
173	T25	-20.4204	118.5653

Record	Transect name	latitude	longitude
29	T26	-20.488	118.5948
174	T26	-20.4871	118.5957
175	T27	-20.467	118.5898
30	T30	-20.437	118.5281
31	T30	-20.4369	118.5281
176	T30	-20.4362	118.5277
177	T30	-20.4362	118.5277
178	T30	-20.4361	118.5275
179	T30	-20.4361	118.5274
180	T30	-20.4361	118.5274
181	T30	-20.4367	118.5284
32	T31	-20.4281	118.526
33	T31	-20.4279	118.5259
34	T31	-20.4281	118.5258
35	T31	-20.4281	118.526
182	T31	-20.4281	118.526
183	T31	-20.427	118.5255
184	T31	-20.4258	118.5254
185	T31	-20.4277	118.5254
186	T31	-20.4277	118.5255
36	T32	-20.4293	118.5206
187	T32	-20.4314	118.5206
188	T32	-20.4299	118.5209
189	T33	-20.4418	118.5246
190	T33	-20.4415	118.5245
191	T33	-20.4417	118.5245
37	T34	-20.4222	118.5363
38	T34	-20.4224	118.5361
192	T34	-20.4219	118.5367
193	T34	-20.4218	118.5367
194	T34	-20.4226	118.5364
195	T34	-20.4229	118.5363
196	T34	-20.4229	118.5363
197	T34	-20.423	118.5362
198	T34	-20.423	118.5362
199	T34	-20.4231	118.5351
200	T34	-20.4229	118.5351
201	T34	-20.423	118.5347
202	T34	-20.4223	118.5338
203	T34	-20.4219	118.5338
204	T34	-20.4202	118.5348
205	T35	-20.4324	118.5693
206	T35	-20.4361	118.5715

Record	Transect name	latitude	longitude
207	T35	-20.4361	118.5715
208	T35	-20.4361	118.5715
209	T35	-20.4361	118.5715
210	T35	-20.4361	118.5715
211	T35	-20.436	118.5715
116	T36	-20.4296	118.5585
117	T36	-20.4296	118.5584
118	T36	-20.4297	118.5585
119	T36	-20.4298	118.5585
120	T36	-20.4316	118.5549
212	T36	-20.4353	118.5539
213	T36	-20.4352	118.5538
214	T36	-20.4352	118.5537
215	T36	-20.4367	118.5532
216	T36	-20.4387	118.5524
217	T36	-20.4395	118.552
218	T36	-20.4398	118.5518
39	T37	-20.4574	118.5423
219	T38	-20.4562	118.533
220	T38	-20.4561	118.533
221	T38	-20.4561	118.533
222	T38	-20.4555	118.5333
102	T39	-20.4131	118.5206
103	T39	-20.4131	118.5206
104	T42	-20.4166	118.5257
105	T42	-20.4166	118.5257
106	T42	-20.4166	118.5257
107	T42	-20.4165	118.5257
108	T42	-20.4162	118.5266
109	T42	-20.4162	118.5267
110	T42	-20.4162	118.5268
111	T42	-20.4162	118.5268
112	T42	-20.4161	118.5268
113	T42	-20.4158	118.5273
114	T42	-20.4156	118.5272
115	T42	-20.4142	118.5271
148	T44	-20.4156	118.5514
149	T44	-20.4155	118.5514
150	T44	-20.4151	118.551
151	T44	-20.4148	118.5509
152	T44	-20.4146	118.5508
153	T44	-20.414	118.5513
154	T44	-20.4143	118.5517

Record	Transect name	latitude	longitude
155	T44	-20.4143	118.5517