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Baseline Terrestrial Fauna Survey for the Napier Downs Irrigation Project

Prepared for Australian Capital Equity

July 2024

Final

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Prepared for Australian Capital Equity

Version history

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Phoenix Environmental Sciences Pty Ltd
2/3 King Edward Road OSBORNE PARK WA 6017
P: 08 6323 5410
E: admin@phoenixenv.com.au
Project code: 1452-NAP-ACE-FAU

EXECUTIVE SUMMARY

Australian Capital Equity Pty Ltd (ACE) is seeking to develop the Napier Downs Irrigation Project (the Project) located on Napier Downs Station, approximately 77 km east of Derby, Western Australia (WA). The Project will entail the development of centre irrigation pivots which will be used to produce fodder crops for cattle stocked on Napier Downs and nearby stations, with water sourced from the Grant Group Aquifer.

In March 2019 Phoenix Environmental Sciences Pty Ltd (Phoenix) was commissioned by ACE to undertake a desktop assessment of terrestrial vertebrate fauna and short-range endemic (SRE) invertebrate fauna in accordance with relevant EPA guidance. The desktop review identified a total of 42 significant vertebrate species, including 20 listed under either the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) or the *Biodiversity Conservation Act 2016* (BC Act) as Threatened or Specially Protected, 18 listed as migratory (Mig.) under both the EPBC Act and BC Act, and 9 listed as Priority by the Department of Biodiversity, Conservation and Attractions (DBCA). None of the species identified had previously been recorded inside the study area. The closest records were from Hawkstone Creek (5.4 km east of the study area) where Northern Quoll (Endangered, EN), Gull-billed Tern (Mig.), Glossy Ibis (Mig.), Common Greenshank (Mig.), and Freshwater Crocodile (Other Specially Protected) were all recorded in 2013.

Based on the findings of the desktop assessment, Phoenix was then commissioned in August 2021 to undertake a baseline terrestrial fauna survey for the Project, which was completed between June-August 2022. This survey included both broad-scale fauna habitat mapping (within the study area plus a 1 km buffer) and sampling methods targeting several significant species identified in the previously completed desktop as potentially occurring inside the 586.5 ha study area.

The main field survey was completed between 27 June – 5 July 2022, with a secondary survey completed between 14-16 August 2022 to retrieve wet pitfall traps deployed for potential short-range endemic (SRE) invertebrate taxa. The survey involved 8 systematic trapping sites made up of Sheffield cages and Elliot box traps used to sample small mammals, as well as 2 ultrasonic recorders used to sample bats, active searches for reptiles and potential SRE taxa, avifauna surveys to sample the birds present inside the study area and the wet pitfall traps for SREs.

The survey identified 3 broad fauna habitat types based on substrate, topography, vegetation structure and composition, briefly referred to as:

- Open woodland over open shrubland over grassland
- Shrubland over grassland
- Open woodland over mixed herbs and grasses surrounding seasonally inundated depression.

The dominant fauna habitat type was the shrubland over grassland which made up over 70% of the total mapped area, while the open woodland over mixed herbs and grasses surrounding seasonally inundated depression made up less than 1% of the total mapped area.

During the survey, 114 terrestrial species were recorded, which equated to approximately 35% of the species identified in the desktop review. Additionally, 7 of the species recorded during the survey were not identified during the desktop. This was attributed to recent changes in the case of the cane toad that has moved into the region over the last decade, and incomplete contextual information due to the limited knowledge we have regarding the distribution of a number of species in the region, such as the Black Grasswren (P4) and the Northwest Kimberley Two-lined Dragon, both of which were shown in this survey to be distributed further south than previously thought.

Likelihood of occurrence was estimated for significant vertebrate species based on desktop and field data. Golden Bandicoot (VU) was the only significant species recorded inside the study area. Black Grasswren (P4) and Gouldian Finch (EN/P4) were recorded within 5 km of the study area. Based on the proximity of the Gouldian Finch records and presence of suitable habitat, this species was considered likely to occur in the study area. The Black Grasswren was assigned possible likelihood of

occurrence due to the proximity of the record; however, the study area does not contain typical habitat, and therefore is unlikely to represent important habitat for, the Black Grasswren.

An additional 15 species identified in the desktop were assigned the category 'may possibly occur' inside the study area, and the remaining 24 were assigned the category 'unlikely to occur' based on relevant habitat requirements.

The vertebrate faunal assemblage of the study area is broadly typical of the woodland and shrubland habitats in the region and consists mostly of species distributed throughout much of the Kimberley. The fauna habitats inside the study area are widespread across much of the region. Based on the location of the study area relative to the known distribution of Golden Bandicoot, the population is considered to be important given it is on the southern edge of the species' range.

As the habitats inside the study area are relatively continuous in terms of vegetation structure and landform attributes, it is unlikely that any invertebrate taxa are restricted to the study area. Vegetation composition was notably different in one small seasonally inundated depression; however, the topography and connectivity of the vegetation structure mean that this area was not considered to be suitable for supporting SRE taxa.

Three invertebrate taxa collected during the survey have been assigned potential SRE status, two of which are new to science (*Aname* 'MYG771' and *Cubaris* sp. indet. 'Napier') and one is from a species complex which is thought to contain multiple species. Given the relatively small size of the study area, the extent of SRE habitats it intersects, data obtained from the desktop review and the taxonomists that identified the specimens, this is likely a reflection of the limited information we have on the distribution of these invertebrates, and not a reflection of their scarcity.

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1 INTRODUCTION

Australian Capital Equity Pty Ltd (ACE) is seeking to develop the Napier Downs Irrigation Project (the Project) located on Napier Downs Station, approximately 77 km east of Derby, Western Australia (WA; Figure 1-1). The Project will entail the development of centre irrigation pivots which will be used to produce fodder crops for cattle stocked on Napier Downs and nearby stations. Water will be sourced from the Grant Group Aquifer.

In August 2021, Phoenix Environmental Sciences Pty Ltd (Phoenix) was commissioned by ACE to undertake a baseline terrestrial fauna survey for the Project. The purpose of the survey was to inform environmental approvals for the Project.

The study area is located in the Shire of Derby-West Kimberley and the Fitzroy Trough subregion (DAL01) of the Dampierland bioregion and the Northern Botanical Province as defined by EPA (2016b).

1.1 BACKGROUND

Phoenix (2019) was engaged by ACE in March 2019 to conduct a desktop assessment of terrestrial vertebrate fauna and short-range endemic (SRE) invertebrate fauna in accordance with relevant EPA guidance (Department of Mines and Petroleum 2016; EPA 2016a, d). The original desktop review was undertaken for 2 previous options for the irrigation area (Option 1 and Option 2; Figure 1-2); with a desktop addendum later prepared specifically for a third option located in Scrubby Paddock (Option 3; Figure 1-2) (Phoenix 2020).

The objective of the desktop reviews was to identify the following:

- potential significant fauna values that may be present in the study areas
- any potential values that may represent significant constraints for the Project
- proposed scope of field survey requirements for the Project.

The current study area falls partially outside the Option 3 area (Figure 1-2); however, the desktop review for Option 3 was still considered valid for the current study area.

The desktop review identified that several significant terrestrial fauna species were considered to have the potential to occur within in the study area, including 10 mammal and 16 bird species. Several SRE records were found proximal to study area, therefore, it was considered possible that SRE taxa were also present in the study area.

Based on the desktop findings, Phoenix recommended a detailed survey to verify fauna habitats and assess suitability of the study area for species identified in the desktop review (Phoenix 2020). Field verification of the potential value of the study area to SREs, particularly land snails, was also deemed required. The proposed detailed survey involved:

- detailed habitat assessment and mapping
- targeted survey for significant mammals that may occur (Bilby, Northern Quoll, Golden Bandicoot, Kimberley Brush-tailed Phascogale, Northern Brushtail Possum and Northern Short-tailed Mouse), including:
    - plot sampling for Bilby within and adjacent to the study area
    - camera trapping within the study area and along Hawkstone Creek
    - searches for signs of presence
- acoustic recordings for the significant bat species and Night Parrot
- avifauna surveys

- targeted survey for SRE invertebrates, including systematic sampling and characterisation and mapping of SRE habitats.

Discussions of desktop assessment results and proposed survey methodology with the Department of Water and Environmental Regulation (DWER) were undertaken and it was agreed that the proposed survey appeared adequate to inform environmental impact assessment for the study area (Ryan Mincham, letter dated 29/1/2021, to James McMahon).

In addition to the detailed survey carried out in the study area, additional reconnaissance surveys were undertaken at three locations within the potential zone of groundwater drawdown for the Project in late June and early July 2022. These areas included: Ngooderoodyne Spring, Hawkstone Creek and the Lennard River. Desktop findings and survey works discussed in this report were conducted for terrestrial fauna species and were specific to the study area, and the three potential groundwater drawdown sites.

1.2 SCOPE OF WORK

The scope of work for the baseline terrestrial fauna survey was as follows:

- Targeted detailed terrestrial fauna survey, including:
    - detailed habitat assessment and mapping within the study area; mapping within a wider 1 km buffer of the study area for context, to inform the environmental impact assessment
    - identification and mapping of habitat for significant fauna species within the study area and 1 km buffer
    - targeted survey for Threatened and Priority mammal species - Bilby *Macrotis lagotis* (Vulnerable (VU)), Northern Quoll *Dasyurus hallucatus* (Endangered), Golden Bandicoot *Isoodon auratus auratus* (VU), Northern Short-tailed Mouse *Leggadina lakedownensis* (Priority (P) 4), Kimberley Brush-tailed Phascogale *Phascogale tapoatafa kimberleyensis* (VU) and Northern Brushtail Possum *Trichosurus vulpecula arnhemensis* (VU)[1], including trapping, plot sampling and camera trapping within the study area and 1 km buffer, with emphasis on the study area
    - daytime searches for signs of significant fauna activity, nocturnal spotlighting where possible
    - acoustic recordings for significant bat species – Northern Leaf-nosed Bat *Hipposideros stenotis* (P2), Ghost Bat *Macroderma gigas* (VU), Orange Leaf-nosed Bat *Rhinonicteris aurantia* (P4), Bare-rumped Sheath-tailed Bat *Saccolaimus saccolaimus nudicluniatus* (P3) and Yellow-lipped Cave Bat *Vespadelus douglasorum* (P2)
    - habitat assessment and, if required, acoustic recordings for Night Parrot *Pezoporus occidentalis* (EN *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act); Critically Endangered (CR) under the *Biodiversity Conservation Act 2016* (BC Act)
    - avifauna surveys for significant bird species within the study area and adjacent riparian habitats within 1 km buffer, and avifauna census generally

[1] Two other significant mammals identified in the desktop review – West Kimberley Black-footed Rock-wallaby *Petrogale lateralis subsp. (West Kimberley)* (VU EPBC Act; EN BC Act) and Rock Ringtail Possum *Petropseudes dahli* (P3) – were considered unlikely to occur in the study area. The survey will collect sufficient habitat data to confirm the study area is unsuitable for these species.

  - Level 2 survey for SRE invertebrates, including characterisation and mapping of SRE habitats and systematic sampling in SRE prospective habitats within the study area
  - searches for presence of any pools or other surface water features in the study area and adjacent toward Hawkstone Creek that may serve as refuges for the Freshwater Sawfish.
- prepare a technical report on the findings of the surveys.

1.3 STUDY AREA

The study area is approximately 586.5 ha and located within Scrubby Paddock on Napier Downs pastoral lease (LPL N049855; Figure 1-1). The fauna habitat assessments and mapping encompass the study area plus an additional 1 km buffer around the study area. Including the buffer, the total mapped area (referred to hereafter as 'habitat mapping area') is approximately 1,846 ha (Figure 1-1). Additionally, basic fauna assessments were also conducted at pools and other surface water features in the area surrounding the study area.

602800
691600
8176000
8092000
8008000

Lalang-garram / Camden Sound Marine Park
Prince Regent National Park
Tanner Island Nature Reserve
Lalang-garram / Horizontal Falls Marine Park
Wilinggin Indigenous Protected Area
Miluwindi Conservation Park (Sthn Bunuba part only)
Wilinggin Indigenous Protected Area
DERBY GIBB RIVER RD
The West Kimberley
Wilinggin Indigenous Protected Area
Windjana Airstrip
DERBY GIBB RIVER RD
DERBY HWY
Dimalurru National Park
Balili Conservation Park (Devonian Reef)
GREAT NORTHERN HWY

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Napier Downs Irrigation Project

Project No	1452
Date	11/01/2023
Drawn by	BK
Map author	BQ

0 10 20
Kilometers

1:750,000 (at A3) GDA 1994 MGA Zone 51

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- Study area
- Habitat mapping area
- Napier Downs Station
- Indigenous Protected Areas
- Environmentally sensitive areas
- DBCA managed land
- Lakes
- West Kimberley National Heritage Place

Figure 1-1

Project location and study area

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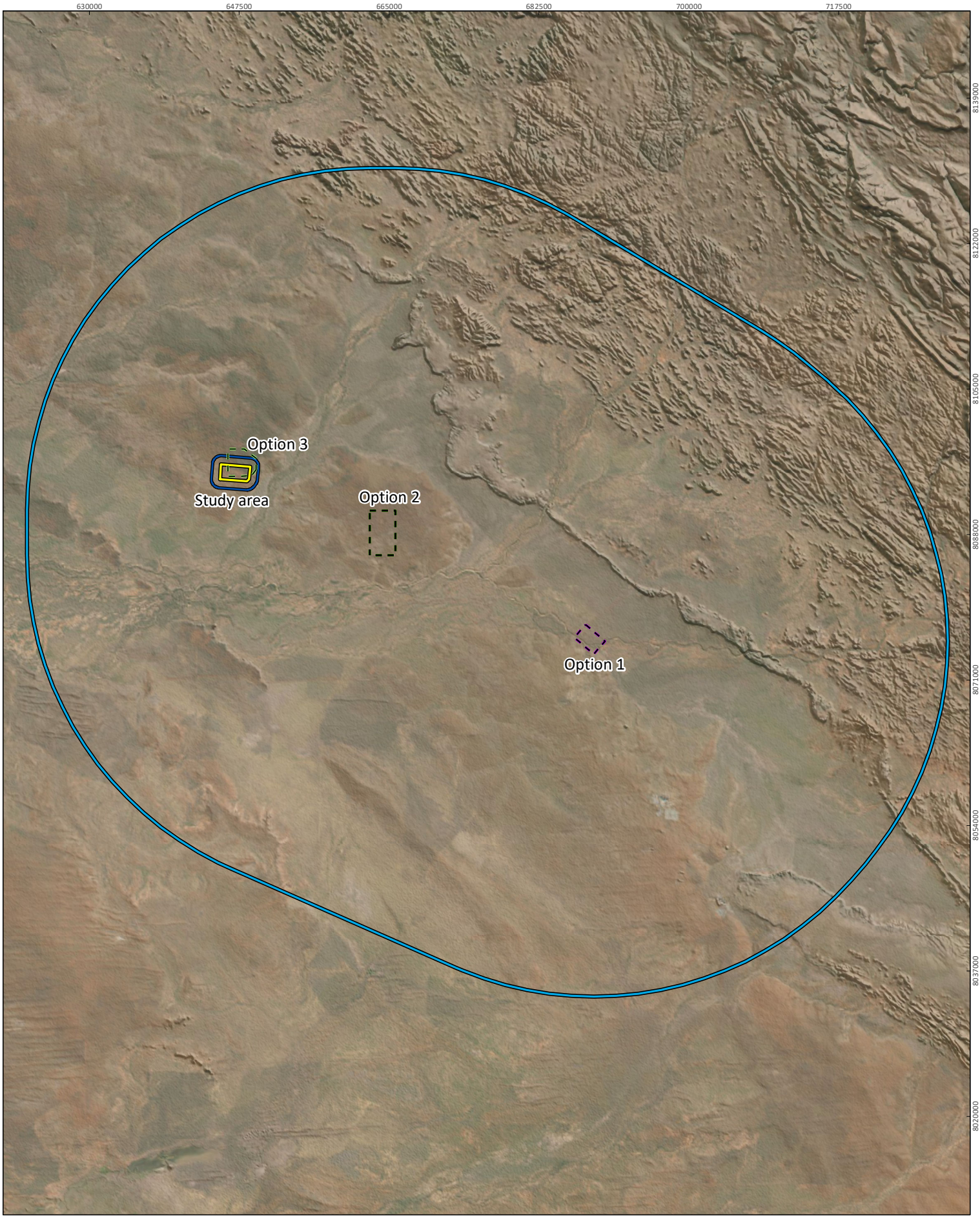

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- Study area
- Option 1
- Option 2
- Option 3
- Habitat mapping area
- 40 km desktop study area

Figure 1-2

Study area in relation to previous desktop areas

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2. LEGISLATIVE CONTEXT

The protection of fauna in WA is principally governed by 3 acts:

- Commonwealth EPBC Act
- State BC Act
- 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* (WC Act).

2.1 COMMONWEALTH

The EPBC Act is administered by the Federal Department of Climate Change, Energy, the Environment and Water (DCCEEW). The EPBC Act provides for the listing of Threatened fauna as matters of National Environmental Significance (NES). Under the EPBC Act, actions that have, or are likely to have, a significant impact on a matter of NES, 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)[2] – 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)[2] – 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 matters of NES under several international agreements:

- Japan-Australia Migratory Bird Agreement (JAMBA)
- China-Australia Migratory Bird Agreement (CAMBA)
- Convention on the Conservation of Migratory Species of Wild Animals (Bonn)
- Republic of Korea-Australia Migratory Bird Agreement (ROKAMBA).

2.2 STATE

2.2.1 Threatened and Priority species

In WA, the BC Act provides for the listing of Threatened fauna species (Government of Western Australia 2018a, b)[3] in the following categories:

[2] Species listed as Extinct and Conservation Dependent are not matters of NES and therefore do not trigger the EPBC Act.

[3] 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[4]
- Endangered (EN) – species facing a very high risk of extinction in the wild in the near future[4]
- Vulnerable (VU) – species facing a high risk of extinction in the wild in the medium term future[4].

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 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 TEC and its listing is otherwise in accordance with the ministerial guidelines.

2.2.3 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 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 metres (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.

2.2.4 Short-range endemic invertebrates

Short-range endemic (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

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

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 2 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, 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.

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 (DoEE 2016). The study area is located in the Fitzroy Trough subregion (DL1) of the Dampierland bioregion (Figure 3-1). The Fitzroy Trough subregion comprised of four basic components, described as (Graham 2001b):

- Quaternary sandplain overlying Jurassic and Mesozoic sandstones with Pindan, with hummock grasslands on hills
- Quaternary marine deposits on coastal plains, with mangal, samphire – *Sporobolus* spp. Grasslands, *Melaleuca alsophila* low forests, and *Spinifex* spp. – *Crotalaria* spp., strand communities
- Quaternary alluvial plains associated with the Permian and Mesozoic sediments of Fitzroy Trough support tree savannahs of ribbon grass (*Chrysopogon* spp.), bluegrass (*Dichanthium* spp.) and Mitchell grass (*Astrebla* spp.) scattered coolabah (*Eucalyptus microtheca*) – *Bauhinia cunninghamii*, with riparian forests of river red gum (*Eucalyptus camaldulensis*) and Cadjeput (*Melaleuca* spp.) fringe drainages
- Devonian reef limestones in the north and east supporting sparse tree steppe over lobed spinifex (*Triodia intermedia*) and limestone spinifex (*T. wiseana*) hummock grasses.

The subregion experiences a dry hot tropical and semi-arid climate with summer rainfall, with average rainfall between 500–800 mm, often, often influenced by cyclonic activity in the northwest of WA.

3.2 LAND SYSTEMS AND SURFACE GEOLOGY

DPIRD 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 three land systems but falls predominantly within one of these (Table 3-1; Figure 3-2).

Table 3-1 Land systems and extent in study area

Land system	Description	Area (ha)	% of study area
Sisters System	Low sandy plateaux and lower slopes supporting pindan woodlands with acacias and eucalypts and curly spinifex-ribbon grass, and valley plains supporting mixed woodlands with ribbon grass.	537.0	91.6
Wanganut System	Sandplains and linear dunes supporting pindan woodlands with acacias and bloodwoods and curly spinifex- ribbon grass, and broad low-lying swales supporting bloodwood-grey box woodlands with curly spinifex-ribbon grass.	0.7	0.1
Yeeda System	Red sandplains supporting pindan vegetation with dense acacia shrubs, scattered bloodwood and grey box trees and curly spinifex and ribbon grass.	48.8	8.3
	Total	**586.5**	**100**

According to the Surface Geology of Australia 1:1,000,000 scale, Western Australia database (Stewart *et al.* 2008), the study area intersects a single geological formation (Figure 3-2); Sand plain 38499 (Czs), which is described as 'Sand or gravel plains; quartz sand sheets commonly with ferruginous pisoliths or pebbles, minor clay; local calcrete, laterite, silcrete, silt, clay, alluvium, colluvium, aeolian sand'.

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Study area
Habitat mapping area

Region, subregion

Central Kimberley, Mount Eliza
Dampierland, Fitzroy Trough
Northern Kimberley, Mitchell

Figure 3-1

Study area in relation to IBRA bioregions and subregions

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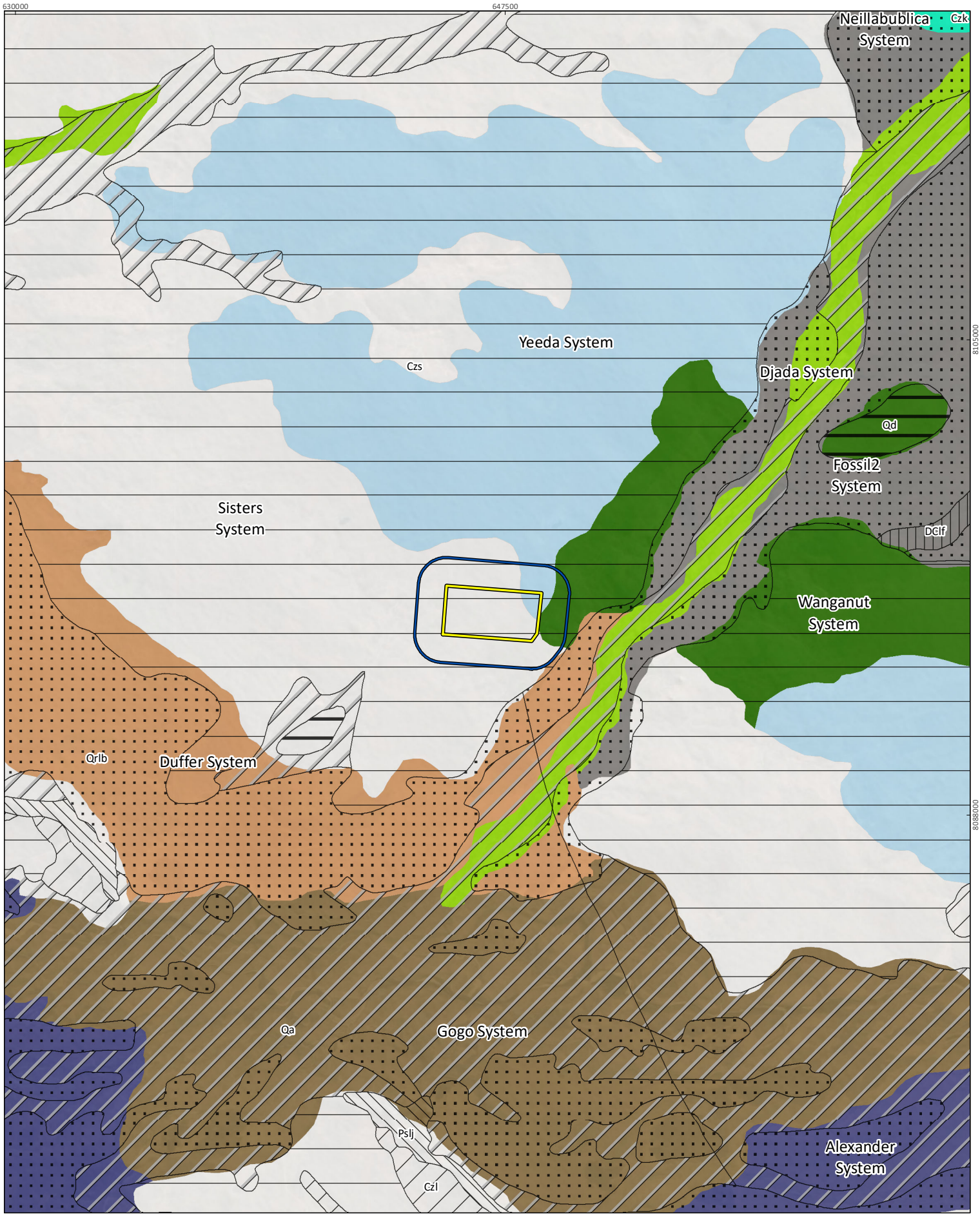

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Study area
Habitat mapping area

Surface geology
Czl
Czs
DClf
Pslj
Qa
Qd
Qrlb

Land system
Alexander System
Djada System
Duffer System
Fossil2 System
Gogo System
Neillabublica System
Sisters System
Wanganut System
Yeeda System

Figure 3-2

Land systems and surface geology in the study area

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3.3 CLIMATE AND WEATHER

The climate of the Fitzroy Trough subregion is described as dry hot tropical and semi-arid with summer rainfall. The average annual rainfall is between 500 – 800 mm (Graham 2001a). The nearest Bureau of Meteorology (BoM) weather station with comprehensive data collection and recent historic climate data is Derby Airport (no. 003032), Latitude: 17.39°S Longitude 123.68°E), located 77 km west of the study area.

Derby Airport records the highest mean maximum monthly temperature (38.3°C) in November (lowest in June, 30.8°C) and the lowest minimum mean monthly temperature (14.6°C) in July (highest in December, 26.3°C; Figure 3-3). Median annual rainfall is 706.2 mm with January and February recording the highest monthly median (172.2 and 169.0 mm respectively; Figure 3-3).

Daily mean maximum temperatures recorded at Derby Airport in the months preceding the survey were slightly above the long-term averages. Daily minimum temperatures were consistent with long-term averages, except for July when the survey took place in which the minimum temperature was 3°C cooler than the long-term average (Figure 3-3).

Records from Derby Airport indicate that most of the wet season's rainfall was later in the season than usual, with February being the wettest month and March receiving 40% more rainfall than the long-term median. Rainfall also continued into May and June, both of which typically receive far less rainfall as the median for both those months is less than 1 mm (Figure 3-3).

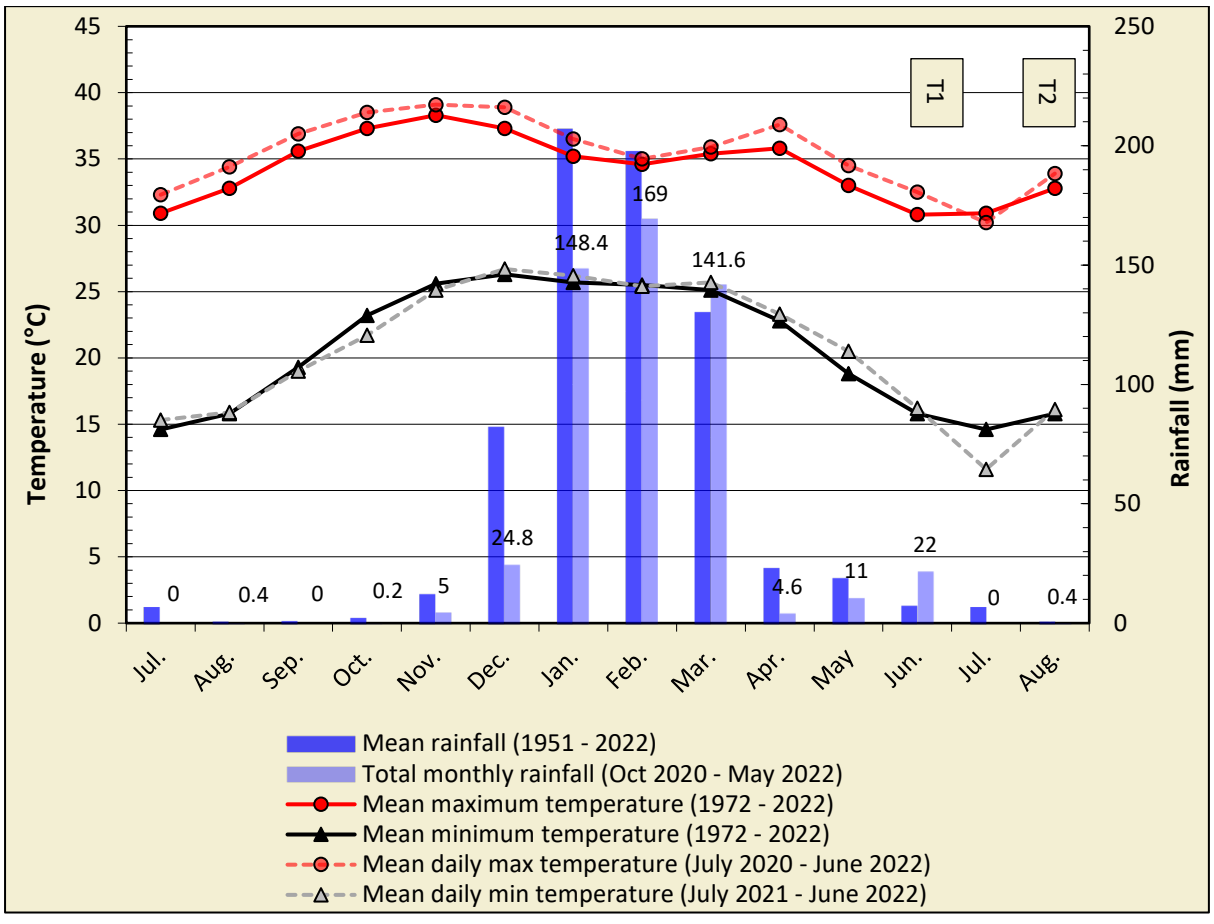


Figure 3-3 **Annual climate and weather data for Derby Airport (no. 003032) and mean monthly data for the 12 months preceding the survey (BoM 2022)**

3.4 LAND USE

The dominant land uses in the Fitzroy Trough subregion are native pasture grazing, conservation reserves and unallocated crown land (Graham 2001a). The study area occurs entirely within the Napier Downs pastoral lease.

3.5 NATIONAL HERITAGE PLACES, CONSERVATION RESERVES AND ESAS

The study area is not situated within any conservation reserves or Environmentally Sensitive Areas (ESAs); however, an Indigenous Protected Area (IPA) called Wilinggin is located 3 km to the east (Figure 1-1). The closest conservation reserve, King Leopold Ranges Conservation Park, is situated 58 km northeast and the closest ESA is 33.5 km northeast of the study area (Figure 1-1).

The study area is situated within the West Kimberley National Heritage Place, which is listed on the National Heritage List and therefore a matter of National Environmental Significance (NES; Figure 1-1). This listing is vast in extent, covering 949.9 km^2 of the Kimberley region, and is recognised as nationally significant under several criteria (DoEE 2019), with many specific significant features identified, including (but not limited to):

- the King Leopold orogen, Kimberley ria coast, Lennard Shelf – for geological significance
- the Devonian Reefs, Gogo fossil sites, Dampier Coast – for evolutionary/fossil record
- northern Kimberley coast and islands, the Kimberley Plateau and the west Kimberley Devonian reefs – for their rich biodiversity
- vine thickets – for endemic invertebrates
- river systems (the Drysdale, Prince Regent, Roe, Moran, Carson, Isdell, Mitchell and King Edward Rivers) – as refuges for freshwater fish species
- Roebuck Bay – for Migratory shorebird habitat
- Kimberley coast from the Buccaneer Archipelago to King George River, Mitchell River National Park, King George Falls, King George River, Geiki Gorge Conservation Park, Geikie Gorge National Park, Windjana Gorge National Park, King Leopold Ranges and the Kimberley coast from the Buccaneer Archipelago to King George River – for aesthetic landscape values
- numerous indigenous heritage sites of national significance.

While the study area is situated over the King Leopold Orogen geological province; it does not intersect any of the other specific features described in the West Kimberley National Heritage Place; the Monsoon vine thickets and Camaenid land snails of limestone ranges (Napier Range) Priority Ecological Community (PEC) is the closest, located approximately 20.8 km to the northeast.

4. METHODS

The 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)
- *Interim guideline for preliminary surveys of Night Parrot (Pezoporus occidentalis) in Western Australia* (DPaW 2017)
- *Approved conservation advice for Pezoporus occidentalis (Night Parrot)* (DSEWPaC 2008)
- *EPBC Act referral guideline for the endangered Northern Quoll Dasyurus hallucatus* (DoE 2016)
- *Guideline for the survey and relocation of bilby in Western Australia (draft)* (DBCA 2018)
- *Survey guidelines for Australia's threatened mammals. Guidelines for detecting mammals listed as threatened under the EPBC Act* (DSEWPaC 2011a)
- *Survey guidelines for Australia's threatened birds. Guidelines for detecting birds listed as threatened under the EPBC Act* (DSEWPaC 2010)
- *Survey guidelines for Australia's threatened reptiles. Guidelines for detecting reptiles listed as threatened under the EPBC Act* (DSEWPaC 2011b).

4.1 DESKTOP REVIEW

The results of the previous desktop assessments (Phoenix 2019, 2020) were used to inform this survey. The study area lies inside the 40 km buffer applied for database searches conducted for the Phoenix (2019) desktop assessment. Subsequently, the results of the database searches were applicable to the current study area. Database search buffers are therefore not of a precise length around the perimeter of the study area.

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). The desktop results from the previous assessment for Option 3 (Phoenix 2020) were updated for the current study area, and these results are presented in this report.

Table 4-1 Database searches conducted for the desktop review

Database	Target group/s	Search coordinates and extent
Protected Matters Search Tool (DCCEEW 2022a)	EPBC Act Threatened flora, fauna, and ecological communities	Centre point of study area with a 40 km buffer
DBCA Threatened and Priority Fauna Database (DBCA 2019b)	Threatened and Priority fauna	Centre point of Option 1 and Option 2 plus a 40 km buffer
DBCA Threatened and Priority Ecological Communities Database (DBCA 2019c)	TECs and PECs	Centre point of Option 1 and Option 2 plus a 40 km buffer
DBCA NatureMap Database (DBCA 2019a)	Flora and fauna records	Centre point of Option 1 and Option 2 plus a 40 km buffer
BirdLife Birdata (Birdlife Australia 2019)	Avifauna	Centre point of Option 1 and Option 2 plus a 40 km buffer

Database	Target group/s	Search coordinates and extent
WA Museum Arachnid and Myriapod Database, Mollusca Database (WAM 2019)	Arachnid, myriapod and mollusc SREs	Centre point of Option 1 and Option 2 plus a 100 km buffer

4.2 FIELD SURVEY

4.2.1 Survey timing

Field survey dates are provided in Table 4-2.

Table 4-2 Survey dates

Survey type	Season	Dates
Field survey (trip 1) – Detailed and reconnaissance survey	Winter	27 June – 5 July 2022
Field survey (trip 2) – SRE pit trap retrieval	Winter	14 – 16 August 2022

4.2.2 Field methods

The terrestrial fauna survey comprised of a combination of reconnaissance assessment, systematic sampling for fauna assemblage and targeted methods for significant fauna considered to have potential to occur, as identified in the desktop review (Phoenix 2020).

Field methods for the fauna survey of the study area included:

- initial reconnaissance (see 4.2.2.1)
- habitat assessments and mapping (see 4.2.2.2)
- active diurnal and nocturnal searches (see 4.2.2.3)
- systematic trapping (4.2.2.4)
- targeted survey for Bilby (4.2.2.5)
- bat echolocation recordings (4.2.2.6)
- habitat assessment for Night Parrot (see 4.2.2.7)
- avifauna surveys (4.2.2.8)
- opportunistic records (see 4.2.2.9)
- SRE invertebrate sampling (4.2.2.11)
- SRE potential habitat rating (4.2.2.12).

A total of 9 survey sites were sampled within the study area, and 7 sites outside the study area at pools and other surface water features within 20 km of the study area (Figure 4-1; Appendix A).

4.2.2.1 Initial reconnaissance

An initial reconnaissance assessment was conducted throughout the study area at the start of the survey to identify suitable habitat resources for significant fauna species, including shelter sites such as tree hollows and tree species (for arboreal mammals), rocky habitats, caves, and water resources. Information gathered in the reconnaissance was used to refine and finalise the survey plan, methods, and site locations.

4.2.2.2 Habitat assessment and mapping

Initial habitat characterisation was undertaken using various remote geographical tools, including aerial photography (Google Earth®), 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 Dampierland 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 species of conservation significance identified in the desktop review. Habitat descriptions and characteristics were recorded at all survey sites within the study area, and at pools and other surface water features in the surrounding area (Figure 4-1;Table 4-3).

Mapping of broad fauna habitats was undertaken based on mapped vegetation types, site-based habitat assessments and additional habitat data points collected during the field survey. Mapping within a 1 km buffer was extrapolated from the detailed mapping within the study area. Mapping of habitat for significant fauna was derived for broad fauna habitat classifications.

Table 4-3 Terrestrial fauna survey effort

Site name	Site type	Birding (hours)	Large cage trap (trap nights)	Large Elliot trap (trap nights)	Active searching (hours)	Ultrasonic recording (nights)	Wet pitfall trap (trap nights)
SITE01	Systematic fauna site	2.5	35	35	1.5	3	198
SITE02	Systematic fauna site	1	35	35	1.4		198
SITE03	Systematic fauna site	1	35	35	2		
SITE04	Systematic fauna site	1	35	35	2		198
SITE05	Systematic fauna site	0.6	35	35	1.5		
SITE06	Systematic fauna site	1	35	35	1.5		
SITE07	Systematic fauna site	1.5	35	35	2		
SITE08	Systematic fauna site	2	35	35	2.2	3	198
SITE09	Opportunistic fauna site	1.5	7	7	1		
SITE10	Regional fauna site	0.5			1		
SITE11	Regional fauna site	0.5			1		
SITE12	Regional fauna site	0.7			1		
SITE13	Regional fauna site	0.5			1		
SITE14	Regional fauna site	0.5			2		
SITE15	Regional fauna site	1			3		
SITE16	Regional fauna site	2			3		

4.2.2.3 Active diurnal and nocturnal searches

Active searches were undertaken at all 16 fauna sites (Figure 4-1). Active searches primarily targeted diurnal herpetofauna 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, including Northern Quoll, Golden Bandicoot, Northern-short-tailed Mouse, Bilby, Western Kimberley Black-footed Rock-wallaby, Rock Ringtail Possum, Kimberley Brush-tailed Phascogale and Northern Brushtail Possum.

Searches were undertaken in any 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, investigating infrastructure ruins or disused building materials and identifying any 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. A minimum of 1 person hour was spent active searching at each site for a total of 27.1 hours over the duration of the field survey (Table 4-3).

4.2.2.4 Systematic trapping

Eight systematic trapping sites were established to capture terrestrial mammals, reptiles, and amphibians (Figure 4-1). Each site contained 5 Sheffield cage traps (60 cm x 20 cm x 20 cm), and 5 aluminium box Elliott traps spaced approximately 20 m apart in a straight line. The 2 trap types were alternated across the line, and all traps were baited with a universal bait mixture consisting of oats, peanut butter, and sardines.

Elliott and Sheffield traps were shrouded with reflective closed cell insulation (R2.5 rated) to provide shade and protection for any captured animals. All traps were given as much shade as possible under/around vegetation.

Traps were open for 7 consecutive nights and checked within 3 hours of sunrise each day. Baits were removed and replaced every second day. The total vertebrate trapping effort for the 8 systematic trapping sites during the surveys was 280 trap-nights (Table 4-3), where a trap-night is defined as one trap remaining open for one night.

In addition to the 8 systematic trapping sites, an opportunistic ninth site (SITE09) containing just one Sheffield and one Elliott was set up near a large termite mound close to where the field team camped each night. The traps were set in the same manner as the systematic trapping sites and were deployed for the same duration.

4.2.2.5 Targeted survey for Bilby

Suitability of habitat for Bilby was assessed at all sites based on substrate, vegetation structure and density. In the event suitable habitat was found, standardised plot surveys were to be conducted over 2 ha plots (~142 m x 142 m) to systematically search for signs of Bilby presence including tracks, scats, foraging diggings and/or burrows. As no highly suitable habitat was found, no plot surveys were conducted; however, alternative search effort was conducted for Bilby, as follows:

- active searches at 16 sites for a minimum of 1 hour each (total search time of 27.1 hours), which included searches for secondary evidence (diggings, scats and footprints)
- traverses throughout the study area looking for evidence of presence. Track logs were not recorded for the whole survey, but GPS tracks from 1, 2 and 4 July show the relative intensity of searches conducted throughout the study area (Appendix B).

4.2.2.6 Bat echolocation recordings

Song Meter SM2 recording devices were used to record bat echolocation calls at 2 sites during the field survey (SITE01 and SITE08; Figure 4-1). Recording devices were deployed for 3 nights of continuous recording between 30 minutes prior to sunset to 30 minutes after sunrise (Table 4-3). Devices were aimed at a 45° angle to the ground. The Song Meters were positioned in areas of habitat likely to have increased insect activity and provide foraging areas, movement corridors or potential roosting sites for bats.

4.2.2.7 Habitat assessment for Night Parrot

Habitat assessments for Night Parrot was conducted throughout the study area. Song Meter SM4 acoustic recording devices were to be deployed in areas identified as providing suitable roosting habitat as defined by DPaW (2017), i.e. old spinifex grassland with ring-forming hummocks greater than 50 cm in height. No suitable habitat was identified across the study area and so no recording devices were deployed.

4.2.2.8 Avifauna surveys

Avifauna surveys were undertaken at each systematic site (Figure 4-1;Table 4-3). Each avifauna survey encompassed an area of 2 ha and was confined to a single habitat type. All avifauna surveys were a minimum of 20 minutes. These surveys were undertaken throughout the day with a focus on periods of higher activity around sunrise and sunset. Surveys consisted of bird recordings from visual sightings and call recognition. A total of 17.8 person hours of avifauna surveys was undertaken during the field survey (Table 4-3). Additional avifauna observations were also recorded opportunistically while other field work was completed, including observations made during travel and active searches.

4.2.2.9 Opportunistic records

All vertebrate fauna observed while traversing the study area and sites surrounding the study area were recorded.

4.2.2.10 Analysis of survey completeness

A species accumulation curve was produced on a samples and abundance basis to obtain an estimate of survey completeness (i.e. whether the collection adequately represents the vertebrate fauna assemblage of the study area) for the systematic methods (vertebrate fauna trapping using Sheffield cage and Elliott aluminium box traps and avifauna surveys at the 8 systematic trapping sites) completed within the study area. All sample types were aggregated by day and no data transformation was undertaken.

4.2.2.11 SRE invertebrate sampling

Sampling for SRE invertebrates was conducted at 4 systematic SRE sites across the study area (Figure 4-1), in areas identified as suitable habitat for SREs. Sampling comprised the following methods:

- wet pit trapping
- active foraging.

Four wet pitfall trapping sites were established, each comprising of 5 one litre plastic containers with a 70 mm diameter dug in flush with the surface in suitable microhabitats at each site. Pit traps were half-filled with a 50:50 mixture of propylene glycol and alcohol. All traps were covered with a plastic

lid elevated 25 mm above the trap with wooden blocks to minimise by-catch of vertebrates where possible. Traps remained open following the setup and were retrieved 6 weeks later.

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. Rocks and rock crevices were inspected, particularly for pseudoscorpions.

A standardised approach was undertaken whereby each site was sampled for one person hour (concurrently with active searches for vertebrate fauna), a total search effort of approximately 27.1 hours (Table 4-3). Trapdoor spider burrows identified during the searches were excavated if they were considered inhabited. Excavation involved removing soil from around the burrow to carefully expose the burrow chamber and remove the spider.

4.2.2.12 SRE potential habitat rating

Fauna habitat was assessed for its potential to support endemic SRE species and communities. Potential SRE habitat was rated as follows:

- High – defined/known areas of habitat that contain elements that often give rise to specialisation or dependency in invertebrate fauna, such as aspect (e.g. south-facing slopes, geological features (e.g. granite), soil types that retain water (e.g. clay, loam). These habitats may also include habitat isolates which have the capacity to restrict dispersal.
- Low – areas of largely in-tact native vegetation that occur broadly across the landscape, are less incised and typically link more restricted habitats. This may include land that was cleared but has since been rehabilitated or is in the process of being rehabilitated.
- None – land that has been previously cleared for other uses that no longer contains native vegetation.

4.2.2.13 SRE status rating

Currently, there is no accepted system to determine the likelihood that a species is an SRE. The WA Museum applies 3 categories: confirmed, potential, and widespread. 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. Phoenix applies 4 categories based on the WA Museum criteria (Table 4-4).

Table 4-4 Short-range endemic categories

SRE category	Criteria
Confirmed	Distribution <10,000 km^2. Taxonomy of the group is well known (but not necessarily published); group is well represented in collections, in particular from the region in question; high levels of endemism exist in documented species; inference is often possible from immature specimens.
Potential	Distribution <10,000 km^2. Taxonomically poorly resolved group; patchy distribution, often common in certain micro-habitats, but no other regional records; congeners (= species in the same genus) both widespread and restricted in distribution.
Widespread	Distribution >10,000 km^2.

Uncertain	Taxonomy cannot be resolved to species level (i.e. indeterminate species designations due to sex, life stage or damage) and therefore species distribution remains uncertain).

4.2.2.14 SRE Taxonomy

Initial higher-level (class, order, family) identifications of specimens are undertaken by Phoenix staff in Phoenix' invertebrate laboratory. Final specials designations are allocated using specialist morphological and/or molecular sequencing (Table 4-5).

Where possible identifications are on compared with reference material from the WA Museum and/or taxonomist reference collections.

Table 4-5 Specialist taxonomists

Person	Title	Taxa
Dr Erich S. Volschenk	Taxonomic consultant, Alacran	Scorpiones, Pseudoscorpiones
Dr Simon Judd	Taxonomic consultant	Isopoda
Dr Mark Harvey	Taxonomist, WA Museum	Mygalomorph spiders

Genomic analysis was undertaken for all specimens for which morphological identification didn't provide sufficient taxonomic resolution. A total of 45 specimens were sent for molecular analyses, comprising 11 mygalomorph spiders, 2 scorpions, 8 pseudoscorpions, and 3 isopods. Of these, only one species of spider, one species of isopod, 2 species of spider and 3 species of pseudoscorpion were successfully sequenced. Tissue from each specimen was obtained in Phoenix' laboratory and sequenced by Genotyping Australia.

Sequences were edited and analysed using Genius 2022.2. Sequences for comparison were sourced from GenBank (Benson *et al.* 2012) and Phoenix's DNA database using the megablast search function in Geneious. For each sequence, the most similar ten matches were retrieved. In cases where the retrieved sequences represented a species more than twice, then the two longest sequences were retained, and the shorter conspecific sequences discarded. Where megablast results yielded families differing from the morphological assessment, then additional sequences were obtained from GenBank, representing the morphological taxonomic assessment. If all the resulting blast sequences represented organisms from a different taxonomic class, sequences were discarded as likely contamination.

SRE specimens collected during the survey have been lodged with the WA Museum.

4.2.2.15 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:

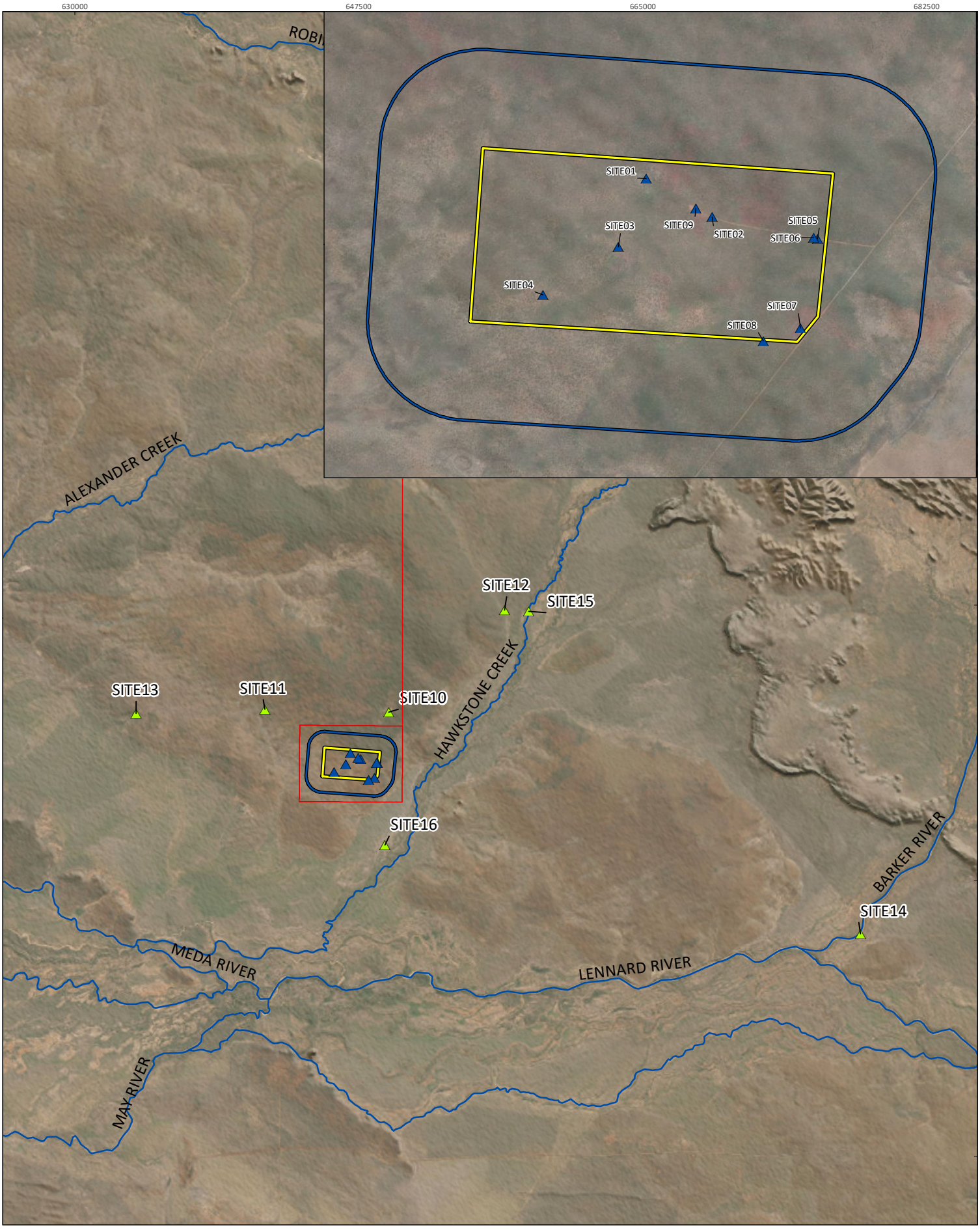
- recorded – species recorded within the study area by previous or current survey
- likely – study area within current known range of species, suitable habitat within the study area and home range of species intersects study area based on known records
- possible – study area within current known range 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.

4.2.3 Survey personnel

The personnel involved in the surveys are listed in Table 4-6. All survey work was carried out under relevant licences issued by DBCA under the BC Act, and DPIRD under the *Animal Welfare Act 2002* (AW Act; Table 4-6).

Table 4-6 Survey personnel

Name	Permit	Qualifications	Role/s
Floyd Holmes	Fauna taking (biological assessment) licence no. BA27000620	PhD, Hons (Biological Sciences), BSc (Physics & Conservation Biology)	Project manager, field survey, reporting
Simon Pynt	TFA (authorisation to take or disturb threatened species) no. 2022-0030 Scientific Use Licence no. U304/2022-2024	BSc (Zoology)	Field survey
Brooke Quick		BSc (Environmental Science)	Reporting, taxonomy & lab work
Lachlan Petersen		BSc (Environmental Science)	Taxonomy & lab work



Australian Capital Equity
Napier Downes Irrigation Project

Project No	1452
Date	1/11/2023
Drawn by	BK
Map author	BQ

0 5 10
Kilometers

1:303,400 (at A4) GDA 1994 MGA Zone 51

Study area
Habitat mapping area
Major watercourses
Sites outside study area
Sites inside study area

Figure 4-1

Terrestrial fauna survey sites

PHOENIX ENVIRONMENTAL SCIENCES

All information within this map is current as of 1/11/2023. This product is subject to COPYRIGHT and is property of Phoenix Environmental Sciences (Phoenix). While Phoenix has taken care to ensure the accuracy of this product, Phoenix make no representations or warranties about its accuracy, completeness or suitability for any particular purpose.

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5. RESULTS

5.1 DESKTOP REVIEW

5.1.1 Vertebrate fauna

A total of 42 significant species were identified in the desktop review, comprising 20 species listed under the EPBC Act and/or BC Act as Threatened (CR, EN, VU) or Specially Protected (OS) (Table 5-1; Figure 5-1; Appendix C). A further 18 species are listed as Migratory under the EPBC Act and BC Act, and 9 species are listed as Priority by the DBCA (Table 5-1). This assemblage included those species where suitable habitats may be present within the search extent and is not indicated by definitive records of the species.

No desktop records were returned for any significant fauna species within the study area; however, 5 significant species were recorded in 2013 from a flood plain site on the eastern side of Hawkstone Creek, 5.4 km east of the study area; Northern Quoll (EN), Gull-billed Tern (Mig.), Glossy Ibis (Mig.), Common Greenshank (Mig.) and Freshwater Crocodile (OS).

Table 5-1 Significant fauna identified in the desktop review

Species	Status[1]	Proximity to study area[2]	Habitat
Reptiles			
Crocodylus johnstoni Freshwater Crocodile	OS (BC Act)	5.4 km E	Freshwater Crocodiles inhabit various freshwater environments such as rivers, creeks, pools, billabongs, lagoons, and swamps. During the wet seasons as habitats become inundated with water, crocodiles can move throughout flood plains. During the dry season, crocodiles congregate to larger and deeper water bodies and will usually return to the same water body between years (Australian Museum 2020a).
Crocodylus porosus Salt-water Crocodile	OS (BC Act)	*	The Salt-water Crocodile is found in Australian coastal waters, estuaries, lakes, inland swamps and marshes (Webb *et al.* 1987). Despite the species' common name, the Salt-water Crocodile can persist in freshwater bodies (DCCEEW 2022b).
Birds			
Actitis hypoleucos Common Sandpiper	Mig (EPBC & BC Act)	42.4 km SE	Found across all Australian states, the Common Sandpiper never occurs in large flocks, mostly singly. In WA, the species is mostly coastal with some inland records (Geering *et al.* 2007). They are found across a wide range of wetlands: small ponds, large inlets and mudflats where they forage on the shore usually close to vegetation (DoEE 2020).
Apus pacificus Fork-tailed Swift	Mig (EPBC & BC Act)	*	The Fork-tailed Swift is a non-breeding visitor to all states and territories of Australia (Higgins 1999). It occurs in a wide range of dry or open habitats across most of WA and is uncommon to moderately common in the north-west (DoEE 2020).
Botaurus poiciloptilus Australasian Bittern	EN (EPBC & BC Act)	59.4 km SE	Found in freshwater or brackish swamps with dense vegetation (McKilligan 2005).
Calidris acuminata Sharp-tailed Sandpiper	Mig (EPBC & BC Act)	31.8 km S	Occurs on saline wetlands such as coastal lagoons, estuaries, bays, swamps, lakes, inundated grasslands, saltmarshes, river pools, creeks, floodplains and artificial wetlands (DCCEEW 2022b).
Calidris ferruginea Curlew Sandpiper	CR/Mig (EPBC Act) CR (BC Act)	*	Mainly occur on intertidal mudflats in sheltered coastal areas, also around non-tidal swamps, lakes, and lagoons near the coast. Less often inland around ephemeral and permanent lakes and waterholes, usually with bare edges of mud or sand (DCCEEW 2022b).
Calidris melanotos Pectoral Sandpiper	Mig (EPBC & BC Act)	*	Found in wetlands, inland as well as on the coast. Occurs on shallow fresh to saline wetlands, usually coastal or near-coastal but occasionally further inland. Prefers wetlands that have open fringing mudflats and low, emergent or fringing vegetation (DCCEEW 2022b).

Species	Status[1]	Proximity to study area[2]	Habitat
Cecropis daurica Red-rumped Swallow	Mig (EPBC & BC Act)	*	Irregular visitor to Australia during its non-breeding seasons. Builds mud nests in mountains, sea cliffs and on buildings and other structures. Forages over open areas (Johnstone *et al.* 2013).
Charadrius veredus Oriental Plover	Mig (EPBC & BC Act)	24.5 km S	Inhabits coastal habitats such as estuarine mudflats and sandbanks, sandy or rocky ocean beaches or nearby reefs, or in near-coastal grasslands, before dispersing further inland where they inhabit flat, open, semi-arid or arid grasslands (DCCEEW 2022b).
Erythrotriorchis radiatus Red Goshawk	VU (EPBC & BC Act)	*	In the Kimberley area, Red Goshawks are most often found in extensive open forest, open woodlands and riparian vegetation dominated by mature *Eucalyptus tetrodonta*, *E. miniata* (woollybutt), and *Melaleuca leucadendron* (cadjeputs) (Queensland Department of Environment and Resource Management 2012).
Erythrura gouldiae Gouldian Finch	EN (EPBC Act) P4 (DBCA)	30.4 km E	In WA, the species only occurs in the Kimberley. It inhabits open woodlands with favoured annual and perennial grasses (especially sorghum), a nearby source of surface water and, in the breeding season, unburnt hollow-bearing *Eucalyptus* trees (DoEE 2020).
Falco hypoleucos Grey Falcon	VU (EPBC & BC Act)	60.4 km SE	The Grey Falcon is a widespread but rare species inhabiting much of the semi-arid interior of Australia. Its distribution is centred on inland drainage systems. It has a large foraging range extending from timbered plains, such as *Acacia* shrublands, into open grasslands (Garnett & Crowley 2000b).
Falco peregrinus Peregrine Falcon	OS (BC Act)	27.8 km SW	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).
Gelochelidon nilotica Gull-billed Tern	Mig (EPBC & BC Act)	5.4 km E	Occur in freshwater swamps, salt lakes, beaches, mudflats and sewage farms, and are rarely found over the ocean (DCCEEW 2022b).
Glareola maldivarum Oriental Pratincole	Mig (EPBC & BC Act)	*	In Australia, inhabits open plains, floodplains and grasslands, often with extensive bare areas (DCCEEW 2022b).
Hirundo rustica Barn Swallow	Mig (EPBC & BC Act)	*	Occurs in open country in coastal lowlands, an uncommon visitor to Australia (DCCEEW 2022b).
Motacilla cinerea Grey Wagtail	Mig (EPBC & BC Act)	*	Vagrant visitor to Australia that inhabits fast flowing streams and rivers (IUCN 2019).
Motacilla flava Yellow Wagtail	Mig (EPBC & BC Act)	*	Uncommon but regular visitor to the Kimberley; 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).

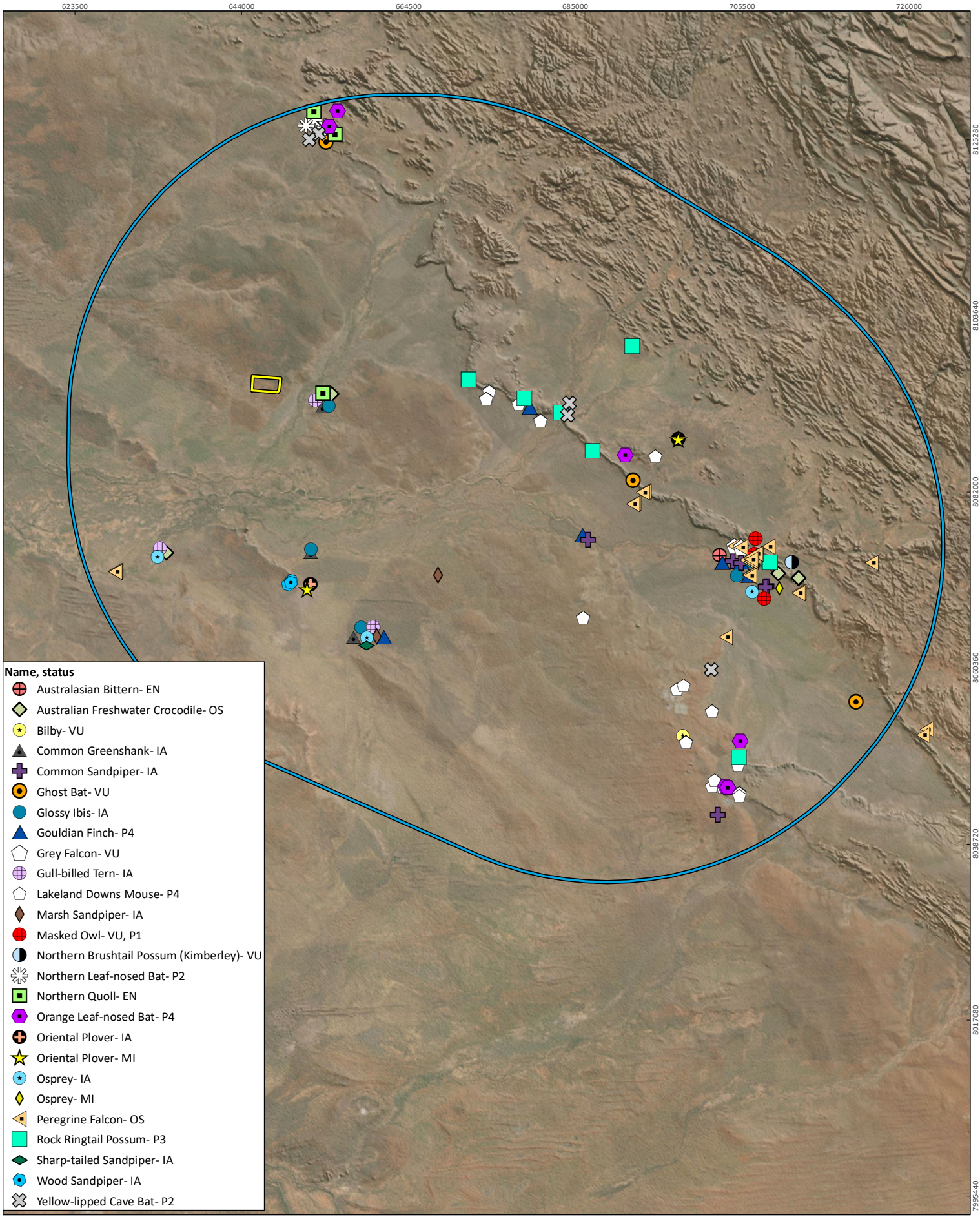
Species	Status[1]	Proximity to study area[2]	Habitat
Numenius madagascariensis Eastern Curlew	CR/Mig (EPBC Act) CR (BC Act)	*	Occurs mainly on intertidal mudflats, on exposed seagrass beds or mudflats (Geering *et al.* 2007). Also utilises sand spits of estuaries, mangroves, lake shores and ocean beaches.
Pandion cristatus Osprey	Mig (EPBC & BC Act)	23.0 km SSE	Mostly found in coastal areas, where they require extensive areas of water for foraging (DCCEEW 2022b).
Pezoporus occidentalis Night Parrot	EN (EPBC Act) CR (BC Act)	*	Rare and cryptic species most frequently associated with *Triodia* hummock grass and chenopod shrubs (samphire, saltbush etc), particularly where these occur together as a mosaic or along a boundary (ecotone). Suitability of habitat is thought to depend on particular stages of regeneration after fire (DoEE 2020).
Plegadis falcinellus Glossy Ibis	Mig (EPBC & BC Act)	5.4 km E	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)
Polytelis alexandrae Princess Parrot	VU (EPBC Act) P4 (DBCA)	*	Princess Parrots inhabit sandy deserts where they feed on seeds and flowers (Garnett & Crowley 2000a). They also occur in riverine/ littoral areas, or open savanah woodlands and shrublands that usually consist of scattered strands of *Eucalyptus, Casuarina* or *Allocasuarina* trees; an understorey of shrubs and groundcover dominated by *Triodia* species (DCCEEW 2022b).
Rostratula australis Australian Painted Snipe	EN (EPBC & BC Act)	*	Generally, inhabits shallow terrestrial freshwater (occasionally brackish) wetlands, including temporary and permanent lakes, swamps and claypans. Typical sites include those with rank emergent tussocks of grass, sedges, rushes or reeds, or samphire; often with scattered clumps of *Muehlenbeckia* (lignum) or canegrass or sometimes *Melaleuca* (tea-tree) (DoEE 2020).
Tringa glareola Wood Sandpiper	Mig (EPBC & BC Act)	23.5 km S	Prefers the shallows of wooded lakes or swamps with trees. It also inhabits freshwater swamps, lakes, flooded pastures and occasionally, mangroves (Morcombe 2004).
Tringa nebularia Common Greenshank	Mig (EPBC & BC Act)	5.4 km E	Mostly on the coast but sometimes inland; uses permanent and ephemeral terrestrial wetlands, including rivers and creeks (DCCEEW 2022b).
Tringa stagnatilis Marsh Sandpiper	Mig (EPBC & BC Act)	30.1 km SE	Inhabits coastal and inland wetlands, estuarine and mangrove mudflats, beaches, swamps, lakes and several other types of wetlands (Morcombe 2004).

Species	Status[1]	Proximity to study area[2]	Habitat
Tyto novaehollandiae kimberli Masked Owl	VU (EPBC Act) P1 (DBCA)	62.1 km SE	In northern Australia, the Masked Owl has been recorded from riparian forest, rainforest, open forest, *Melaleuca* swamps and the edges of mangroves, as well as along the margins of sugar cane fields (DoEE 2020).
Mammals			
Dasyurus hallucatus Northern Quoll	EN (EPBC & BC Act)	5.4 km E	Most commonly found in rocky areas, with rugged rocky habitats such as gorges, gullies, escarpments, boulder fields and small caves critical for denning and shelter (DCCEEW 2022b).
Hipposideros stenotis Northern Leaf-nosed Bat	P2 (DBCA)	31.2 km N	The Northern Leaf-nosed Bat is a secretive bat, with most records of this species being from cracks and caves in the western escarpment of the Arnhem Land plateau, in sandstone cliffs, gorges and water holes bordered by paperbark trees. The species has been recorded in WA, and NW Queensland, as well as a range of offshore islands (Menkhorst & Knight 2011).
Isoodon auratus auratus Golden Bandicoot	VU (EPBC & BC Act)	*	The Golden Bandicoot previously occurred throughout central Australia but is now restricted to the Kimberley (offshore islands and the mainland) and Marchinbar Island (offshore Arnhem Land). During the day it rests in dense vegetation or other shelter (DCCEEW 2022b).
Leggadina lakedownensis Northern Short-tailed Mouse / Lakeland Downs Mouse	P4 (DBCA)	25.8 km E	Occurs on sandy soils and cracking clays in WA. Occupies a diverse range of environments from the monsoon tropical coast to semiarid climates, including spinifex and tussock grasslands, samphire and sedgelands, *Acacia* shrublands, tropical *Eucalyptus* and M*elaleuca* woodlands and stony ranges (DEC 2012; Moro & Kutt 2008).
Macroderma gigas Ghost Bat	VU (EPBC & BC Act)	31.2 km N	Australia's only carnivorous bat (Van Dyck & Strahan 2008), and the largest microbat. Ghost bats are dependent on diurnal roosts in caves, crevices, deep overhangs, and artificial roosts such as underground mines (Hourigan 2011a). They are known to forage in productive plain areas with thin mature woodland over patchy tussock or hummock grass, or waterholes and riparian zones (Bullen 2021).
Macrotis lagotis Bilby	VU (EPBC & BC Act)	65.8 km SE	Bilby prefers hummock grassland in plains and alluvial areas, open tussock grassland on uplands and hills, and mulga woodland/shrubland on ridges and rises (DCCEEW 2022b). Areas where it is now regionally extinct include open and exposed habitat types.
Petrogale lateralis subsp. (West Kimberley) West Kimberley Black-footed Rock-wallaby	VU (EPBC Act) EN (BC Act)	*	The species is patchily distributed across the western half of Australia. Populations are scattered and restricted to sites with suitable rocky habitat with caves and crevices (DCCEEW 2022b).

Species	Status[1]	Proximity to study area[2]	Habitat
Petropseudes dahli Rock Ringtail Possum	P3 (DBCA)	23.4 km E	Rock Ringtail Possums are found in northern Australia, where they shelter in rocky or sandstone outcrops during the day. At night they forage in trees close to their dens. These rocky areas are usually surrounded by flat, lowland areas (Strahan 1995).
Phascogale tapoatafa kimberleyensis Kimberley Brush-tailed Phascogale	VU (EPBC & BC Act)	*	Inhabits bunch grasslands with a savanna woodland structure, dominated by *Eucalyptus* and *Corymbia* species with old growth and dead trees to provide nesting hollows (Threatened Species Scientific Committee 2017).
Rhinonicteris aurantia Orange Leaf-nosed Bat	P4 (DBCA)	31.5 km N	This distinctive, bright orange bat occurs across northern Australia, as well as a distinct form from the Kimberley. Roosting in colonies from 20 to 20,000 this species emerges at dusk to feed on a range of invertebrates, such as termites, flies, wasps, and cockroaches, and fly with a fast zig- zag pattern, usually within 1 m of the ground, foraging over open grasslands and sparse tree and shrub savannah (Hourigan 2011b).
Saccolaimus saccolaimus nudicluniatus Bare-rumped Sheath-tailed Bat	VU (EPBC) P3 (DBCA)	*	The Bare-rumped Sheath-tail Bat occurs mostly in lowland areas, typically in a range of woodland, forest and open environments. In Australia, they roost in tree hollows and forage over habitat edges such as the edges of forest clearings or rainforests (DCCEEW 2022b).
Trichosurus vulpecula arnhemensis Northern Brushtail Possum	VU (EPBC & BC Act)	65.2 km SE	Occurs discontinuously from the Gulf of Carpentaria hinterland, NT (Woinarski J. *et al.* 2011) to the Kimberley region (Kerle and How 2008, in (Van Dyck & Strahan 2008). Occurs mainly in tall eucalypt open forests, particularly where the understorey includes some shrubs that bear fleshy fruits, also in some mangrove communities and rainforests (Friend & Taylor 1985; Menkhorst & Woinarski 1992; Woinarski J. *et al.* 2011). Needs hollow bearing trees.
Vespadelus douglasorum Yellow-lipped Cave Bat	P2 (DBCA)	31.3 km N	Occur in regions with high rainfall (over 800 mm), in tropical woodlands along waterways and in adjacent open woodlands. Yellow-lipped Cave Bats roost in sandstone and limestone caves (Australian Museum 2020b).

[1] CR – Critically Endangered; EN – Endangered; VU – Vulnerable; OS – Specially Protected; Mig – Migratory; P1–4 – Priority 1–4.

[2] * – EPBC Protected Matters Search does not return species record locations and may include instances where suitable habitat may occur, but the species has not necessarily been observed.



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Study area
Desktop study area

Figure 5-1

Desktop records of significant vertebrate fauna

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5.1.2 SRE invertebrate fauna

Four terrestrial invertebrates listed as Threatened under the BC Act and 5 Priority species were identified in the desktop review (Table 5-2). All are molluscs (land snails) in the family Camaenidae and are Confirmed SREs; the records are associated with rocky habitats of the surrounding ranges, mainly Napier Range (Figure 5-2). Two PECs are associated with the SRE invertebrates: Invertebrate community of Napier Range Cave, located 27 km east of the study area, and Monsoon vine thickets and Camaenid land snails of limestone ranges, 20 km northeast (Figure 5-2).

Records of a further 30 confirmed (all land snails) and 13 potential terrestrial SRE species were identified through the WA Museum database searches (Figure 5-2; Figure 5-2). None of these are from within the study area but there is one record of an opilione (Assamiidae sp., potential SRE) 1.7 km west of the study area. No habitat information is provided for this record but the site is within the same broad vegetation association (Shepherd *et al.* 2002) as the study area, adjacent to a drainage line.

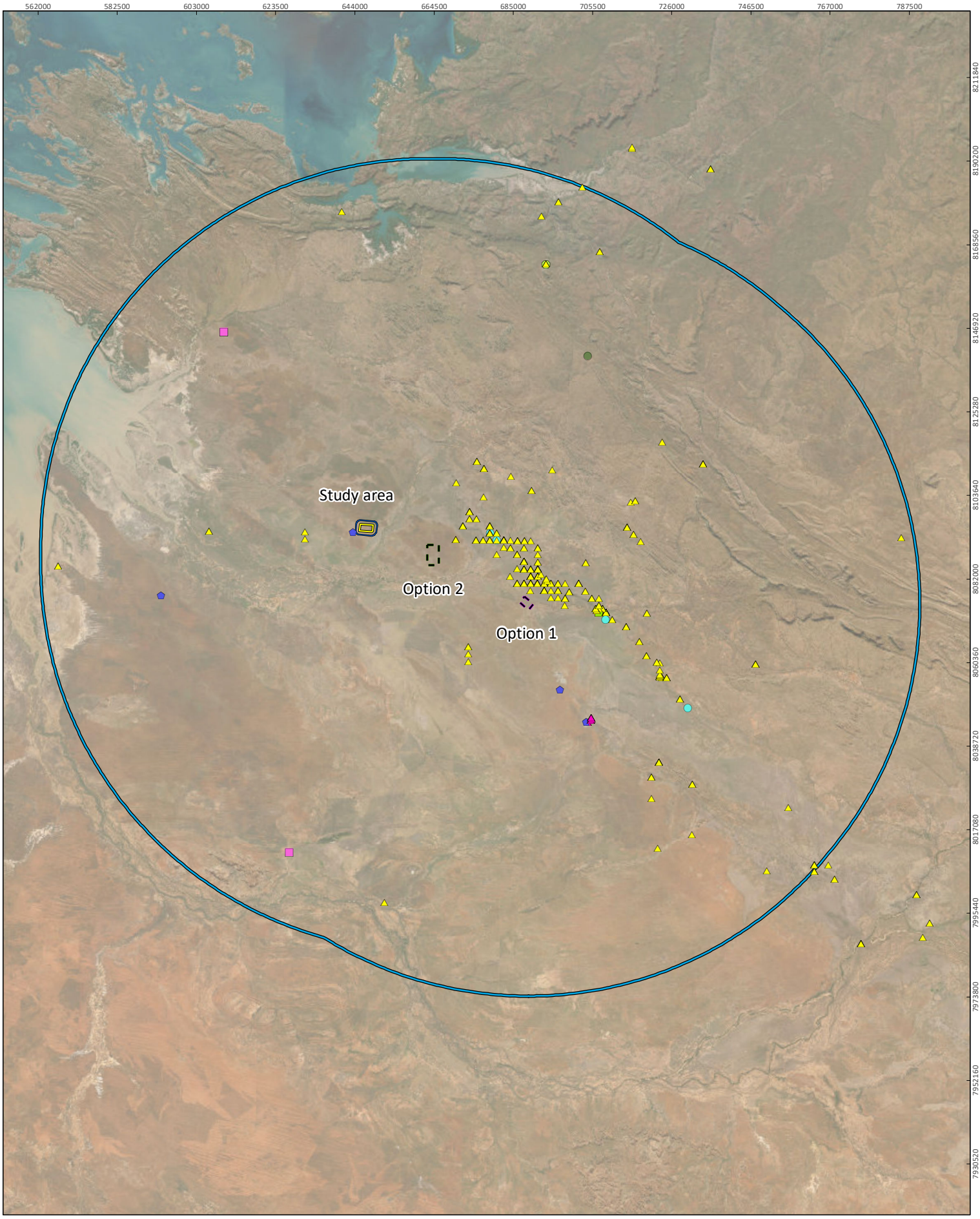
The SREs have been collected from a wide range of habitat types, including rocky habitats (rocky outcrops, limestone outcrops, rock piles, boulders, rubble, rock crevices, rock/scree slopes, rocky gullies, bases of escarpments and cliffs), on plains under spinifex, open woodlands, caves/cave entrances, embarkments, vine thickets and on roots, creek beds, trunk and/or branches of trees (boabs).

Habitat of the study area is unlikely to support any of the Threatened or Priority camaenids or the invertebrate associated PECs. However, there is potential for other SRE taxa to occur, based on the habitat descriptions above.

Table 5-2 Terrestrial SRE invertebrates identified in the desktop review

Higher taxon, Family	Species	Conservation status	SRE status
Arachnida - Mygalomorphae (trapdoor spiders)			
Euagridae	*Cethegus* `sp. nov.`		Potential
Halonoproctidae	*Conothele* `MYG542`		Potential
Halonoproctidae	*Conothele* sp.		Potential
Idiopidae	*Idiosoma `occidentalis* sp. group`		Potential
Arachnida - Araneomophae (modern spiders)			
Selenopidae	*Karaops jenniferae*		Potential
Sparassidae	*Heteropoda cavernicola*		Potential
Arachnida - Opiliones (harvestmen)			
Assamiidae	*Dampetrus* sp.		Potential
Assamiidae	Assamiidae sp.		Potential
Arachnida - Pseudoscorpiones (pseudoscorpions)			
Chthoniidae	*Austrochthonius `minutissimus`*		Potential
Diplopoda (millipedes)			
Paradoxosomatidae	*Helicopodosoma* `Mt Hart`		Potential
Malacostraca - Isopoda (isopods)			
Armadillidae	*Kimberleydillo waldockae*		Potential
Gastropoda - Pulmonata (land snails)			
Camaenidae	*Amplirhagada carinata*		Confirmed

Higher taxon, Family	Species	Conservation status	SRE status
Camaenidae	*Amplirhagada napierana*		Confirmed
Camaenidae	*Amplirhagada* (*Tenuiragada*) *percita*		Confirmed
Camaenidae	*Kendrickia ignivenatus*		Confirmed
Camaenidae	*Kimboraga mccorryi*		Confirmed
Camaenidae	*Kimboraga micromphala*	P2 (DBCA)	Confirmed
Camaenidae	*Kimboraga yammerana*	P1 (DBCA)	Confirmed
Camaenidae	*Mouldingia occidentalis*	CR (BC Act)	Confirmed
Camaenidae	*Rhagada basedowana*		Confirmed
Camaenidae	*Rhagada gatta*		Confirmed
Camaenidae	*Rhagada construa*		Confirmed
Camaenidae	*Rhagada gibbensis*	P1 (DBCA)	Confirmed
Camaenidae	*Rhagada mimika*		Confirmed
Camaenidae	*Rhagada sutra*		Confirmed
Camaenidae	*Kimberleytrachia* (*Torresitrachia*) *crawfordi*		Confirmed
Camaenidae	*Westraltrachia alterna*	VU (BC Act)	Confirmed
Camaenidae	*Westraltrachia* (*Parrhagada*) *commoda* (P. ferrosa)		Confirmed
Camaenidae	*Westraltrachia cunicula*		Confirmed
Camaenidae	*Westraltrachia derbyi* (*Trachia orthocheila*)		Confirmed
Camaenidae	*Westraltrachia* (*Trachia*) *froggatti froggatti*		Confirmed
Camaenidae	*Westraltrachia froggatti complanata*		Confirmed
Camaenidae	*Westraltrachia inopinata*	VU (BC Act)	Confirmed
Camaenidae	*Westraltrachia institа*		Confirmed
Camaenidae	*Westraltrachia lievreana*	P2 (DBCA)	Confirmed
Camaenidae	*Westraltrachia limbana*		Confirmed
Camaenidae	*Westraltrachia rotunda*		Confirmed
Camaenidae	*Westraltrachia* sp.1		Potential
Camaenidae	*Westraltrachia* sp.2		Potential
Camaenidae	*Westraltrachia subtila*	P2 (DBCA)	Confirmed
Camaenidae	*Westraltrachia tropida*		Confirmed
Camaenidae	*Westraltrachia turbinata*	VU (BC Act)	Confirmed
Camaenidae	*Westraltrachia woodwardi* (*Parrhagada detecta*)		Confirmed



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Study area

- Option 1
- Study area
- Option 2
- Habitat mapping area
- 100 km buffer

SRE status

- Araneomorph spider, Potential
- Harvestman spider, Potential
- Land snail, Confirmed
- Land snail, Potential
- Millipede, Potential
- Mygalomorph spider, Potential
- Mygalomorph spider, uncertain
- Pseudoscorpion, Potential

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 Habitats

Three broad fauna habitat types were identified in the habitat mapping area (Table 5-3; Figure 5-3). These habitats comprised of the following:

- shrubland over grassland
- open woodland over open shrubland over grassland
- open woodland (shrubby regrowth) over mixed herbs and grasses surrounding a seasonally inundated depression.

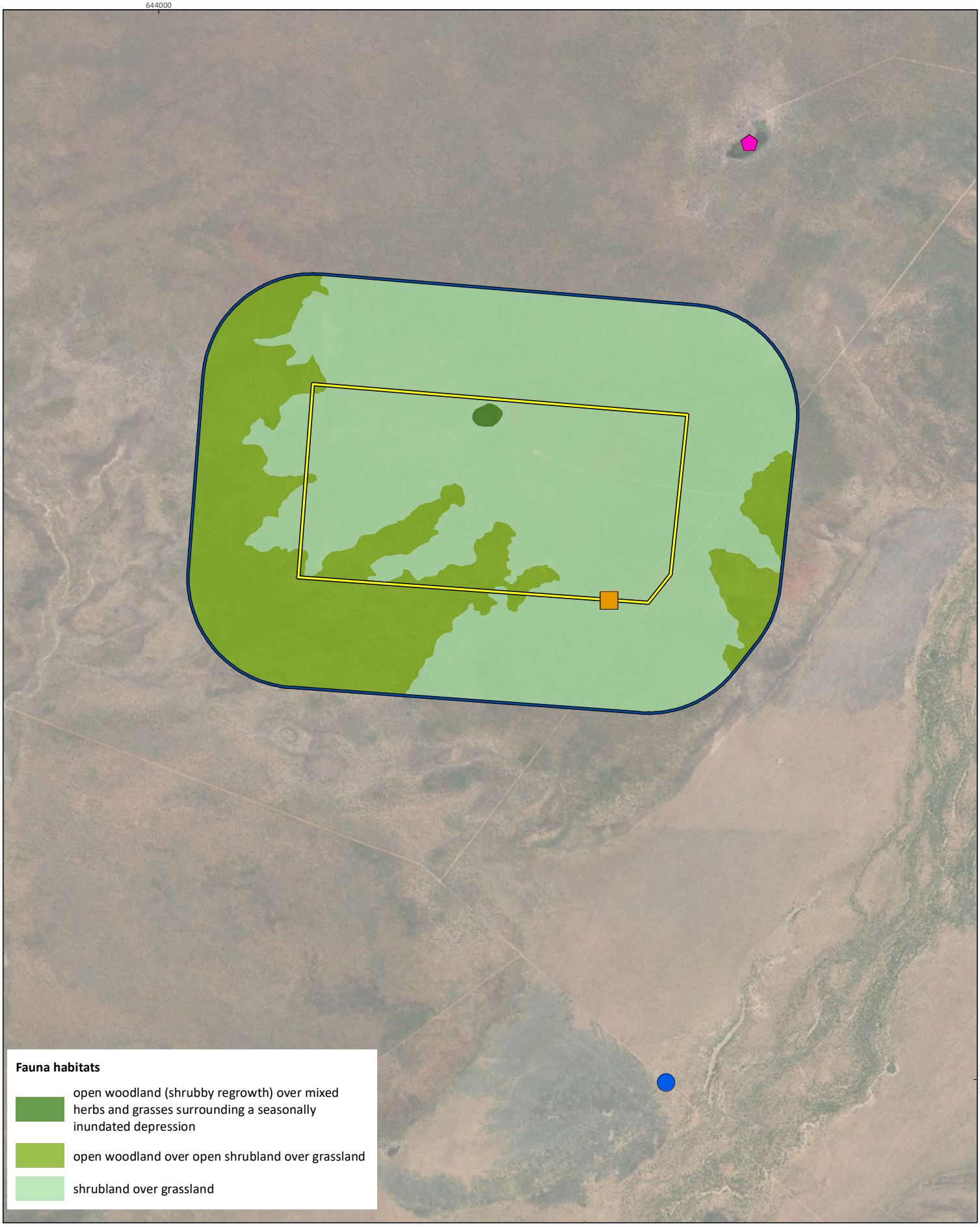
The shrubland over grassland habitat type made up most of the habitat mapping area (1,354.5 ha; 70.8%) and surrounded one small seasonally inundated depression (4.3 ha; 0.2%) located inside the study area. The seasonally inundated depression comprised of open woodland (shrubby regrowth) over mixed herbs and grasses. The shrubland habitat type contained fewer large trees and fallen timber than the open woodland habitat, and typically formed dense mid and lower story vegetation cover. It contained the majority of *Isoodon* (bandicoot) diggings (see section 5.2.1.3 for more information).

The seasonally inundated depression likely provides a valuable source of water during periods where surface water is present. The overall species diversity at the site located in the open woodland (shrubby regrowth) over mixed herbs and grasses surrounding a seasonally inundated depression was the second highest of all 16 fauna sites, largely due to the large number of bird species observed at this site.

The open woodland over open shrubland over grassland covered the remaining 26.4% (487.7 ha) of the habitat mapping area and was found widely fringing drainage lines located outside the perimeter of the habitat mapping area, in areas such as Hawkstone Creek. This habitat type had the highest abundance of fallen logs and tree hollows suitable for fauna refugia.

Table 5-3 Extent and description of each fauna habitat in the study area

Habitat type	Site/s	Extent in habitat mapping area	Extent in study area	Representative photograph
Open woodland over open shrubland over grassland Mid *Corymbia, Eucalyptus* and *Acacia* open woodland over mixed open shrubland over *Sorghum stipoideum*, *Chrysopogon* and *Triodia* grassland.	SITE03, SITE04, Opp-Isoodon-01, Opp-Isoodon-03, Opp-Isoodon-09, Opp-Isoodon-10,	487.7 ha 26.4%	75.9 ha 13%	
Shrubland over grassland Sparse *Corymbia* and *Eucalyptus* open woodland over mixed open shrubland over *Sorghum* grassland.	SITE02, SITE05, SITE06, SITE07, SITE08, SITE09, Opp-02, Opp-03, Opp-08, Opp-09, Opp-15, Opp-16, Opp-Isoodon-02, Opp-Isoodon-04, Opp-Isoodon-05, Opp-Isoodon-06, Opp-Isoodon-07, Opp-Isoodon-08, Opp-Isoodon-11, Opp-Isoodon-12, Opp-Isoodon-13,	1,354.5 ha 70.8%	506.2 ha 86.3%	
Open woodland (shrubby regrowth) over mixed herbs and grasses surrounding a seasonally inundated depression Open *Melaleuca* and *Corymbia* woodland (primarily shrubby regrowth) over mixed herbs and grasses.	SITE01	4.3 ha 0.2%	4.3 ha 0.7%	



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Study area

Habitat mapping area

Species, status

Amytornis housei, P4 (DBCA list)

Erythrura gouldiae, P4 (DBCA list)

Isoodon auratus auratus, VU (EPBC & BC Acts)

Figure 5-3

Fauna habitats and significant fauna records from the field survey

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5.2.1.2 Assemblage

A total of 114 terrestrial vertebrate species were recorded in the study area and 1 km buffer during the field survey (Table 5-4; Appendix C; Appendix D). This equated to approximately one third of the 330 species identified in the desktop review, including 5 introduced species (Table 5-4).

Table 5-4 Number of vertebrate species recorded in survey and desktop results

Group	No. species identified in desktop review	No. species recorded in survey	% recorded
Amphibians	16	3 (inc. 1 introduced)	18.75
Reptiles	48	6	12.5
Birds	223	89	40
Mammals	43 (inc. 4 introduced)	16 (inc. 3 introduced)	37
Total	**330**	**114**	**35**

Of the 3 species of amphibians recorded during the survey, only the Northern Laughing Tree Frog had been previously identified in the desktop review. The other two included one native species, the Northern Toadlet, and one introduced species, the Cane Toad. It is likely that the absence of these species from the desktop is due to the scarcity of survey work in the area, and the recent movement of Cane Toads, as the population has expanded its distribution with a western direction out of the Northern Territory into WA. None of the amphibians identified in the desktop or field survey are listed as significant species.

Reptiles recorded during the survey included one species of snake, the Olive Python, and 5 species of lizard, all skinks from the family Scincidae. The only reptiles of significance identified in the desktop were the two crocodile species the Australian Freshwater Crocodile and the Salt-water Crocodile (listed as OS under the BC Act), neither of which were detected during the field survey.

The bird assemblage was the most comprehensively catalogued, with 40% of the species identified in the desktop review being recorded during the field survey. Many of the bird species identified in the desktop but not the field survey are unlikely to occur in the study area as they are associated with aquatic habitats, such as marine and riparian environments, that are absent from the study area. This includes various ducks and other waterbirds and 21 species of migratory birds.

Mammals were the second most comprehensively catalogued taxonomic group, with 37% of the species identified in the desktop being recorded during the field survey. The only significant vertebrate identified inside the study area was the Golden Bandicoot (VU under the BC and EPBC Acts). Three of the 4 introduced mammals identified in the desktop were also identified inside the study area, including European Cattle, Dog, and Cat.

A species accumulation curve by trapping night confirms that the survey adequately captured the fauna richness of the study area at the time the survey was conducted (Figure 5-4).

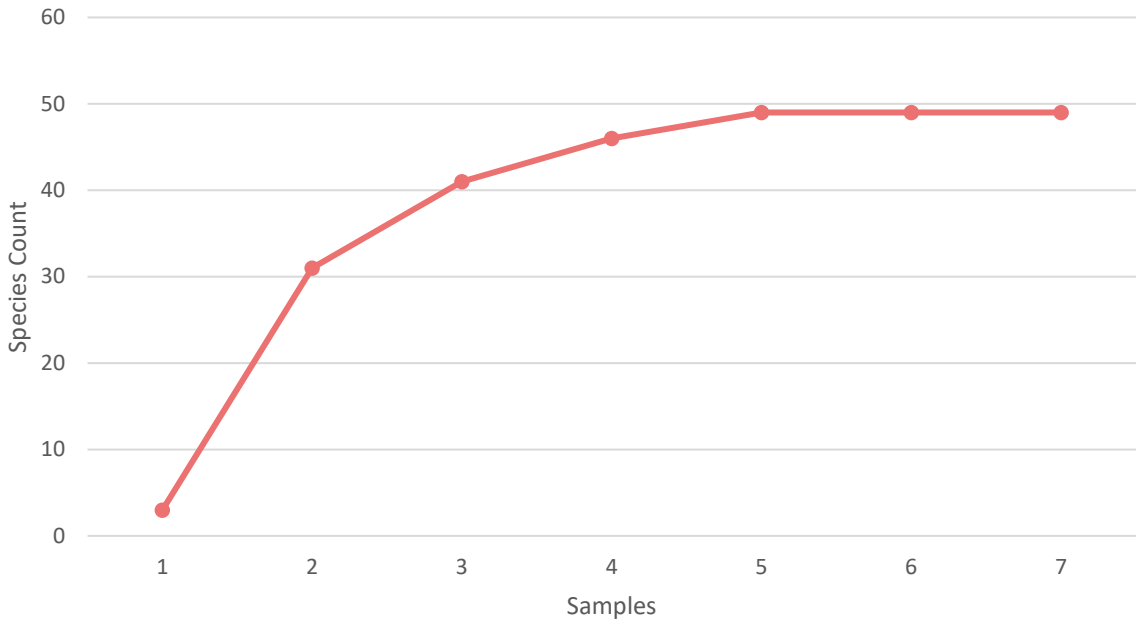


Figure 5-4 Species accumulation curve for vertebrate fauna

5.2.1.3 Significant vertebrate fauna

One Threatened, one Priority, and one Threatened / Priority species of vertebrate fauna were recorded during the survey, Golden Bandicoot (VU), Black Grasswren (P4) and Gouldian Finch (EN & P4) (Table 5-5; Figure 5-3). Only one of these, the bandicoot, was recorded within the study area, with the latter two observed elsewhere opportunistically during the survey.

Golden Bandicoot were detected at one of the trapping sites (Site 08) in the study area. Additionally, secondary evidence of bandicoot activity (digging) was recorded at an additional 15 sites across the study area and adjacent areas of open woodland and shrubland. As there are two species of bandicoot known to occur inside the study area based on the trapping data (Golden and Northern Brown Bandicoot), it was not possible to determine whether the secondary evidence was the significant Golden Bandicoot, or the Northern Brown Bandicoot which is not listed. It is likely that both species forage inside the study area and the surrounding area.

A single Black Grasswren was observed along an access track in hummock grassland, 4.5 km south of the study area while the team were on route to Long Pool. Given the proximity of the record to the study area and the presence of similar habitat in the study area to the location of the bird, likelihood of occurrence was assigned as possible for the species; however, the study area is outside the known distribution for Black Grasswren, and it was not identified in the desktop assessment. The bird was observed in atypical habitat for the species; it is mainly associated with tumbled sandstone, sometimes with light woodland and ground cover usually comprising large spinifex tussocks (Menkhorst et al). The study area also does not contain typical habitat and is unlikely to represent important habitat for the species.

Gouldian Finches were observed coming in to drink at a cattle watering station located 2.5 km north of the study area. Due to the proximity of the records and the presence of suitable habitat, Gouldian Finches may also occur inside the study area.

The likelihood of occurrence assessment (section 4.2.2.14) for the remaining significant species identified in the desktop review (section 5.1.1) determined one other species was likely to occur in the study area, 15 may possibly occur and the remaining 24 are unlikely to occur (Table 5-6).

Table 5-5 Details of significant vertebrate fauna recorded during the field survey

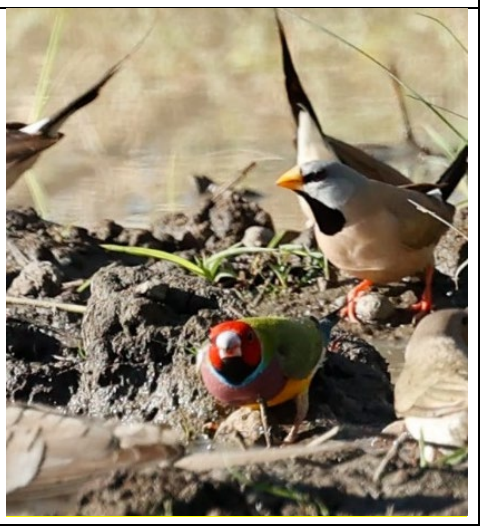
Species	Distribution and ecology	Survey records	Photograph
Isoodon auratus auratus Golden Bandicoot (VU under EPBC and BC Act)	Previously occurred throughout central Australia but is now restricted to the Kimberley (offshore islands and the mainland) and Marchinbar Island (offshore Arnhem Land) (DCCEEW 2022b). Golden Bandicoot can occupy a wide range of habitats including: Hummock and tussock grasslands on sand-dunes and sand plains in the arid zone, acacia and eucalypt woodlands in tropical semi-arid the zone, vine thickets, heath and woodlands in rugged sandstone, and volcanic country in the subhumid tropics (Palmer *et al.* 2003).	One male in breeding condition, and one female with 2 juvenile offspring were recorded on separate days at Site 08. Additionally, secondary evidence of *Isoodon sp.* diggings were recorded across the study area in additional 15 locations. These diggings were likely made by both Golden Bandicoot and the similar Northern Brown Bandicoot which was also captured at Site 08.	
Amytornis housei; Black Grasswren (P4, DBCA list)	Known to occur to the north of the study area at Prince Regent National Park and the Mitchell Plateau, in habitats containing large rocky sandstone boulders and dense hummock and spinifex grasslands.	One bird of unknown gender was observed opportunistically while travelling through the hummock grassland to the south of the study area.	No photo taken
Erythrura gouldiae Gouldian Finch EN (EN under EPBC Act, P4, DBCA lst)	In WA, the species only occurs in the Kimberley. It inhabits open woodlands with favoured annual and perennial grasses (especially Sorghum), a nearby source of surface water and, in the breeding season, unburnt hollow-bearing *Eucalyptus* trees (DoEE 2020).	Three Gouldian Finches were observed drinking in a mixed flock at a cattle watering station 2.5 km north of the study area.	

Table 5-6 Likelihood of occurrence for significant vertebrates identified in the desktop

Species	Status[1]	Likelihood of occurrence	Habitat in the study area
Reptiles			
Crocodylus johnstoni Freshwater Crocodile	OS (BC Act)	Unlikely	Absence of suitable riparian/river habitat within the study area.
Crocodylus porosus Salt-water Crocodile	OS (BC Act)	Unlikely	Absence of suitable riparian/river habitat within the study area.
Birds			
Actitis hypoleucos Common Sandpiper	Mig (EPBC & BC Act)	Unlikely	Absence of suitable riparian/river habitat within the study area.
Apus pacificus Fork-tailed Swift	Mig (EPBC & BC Act)	Possible	Not limited by habitat type and therefore a possible visitor to the study area.
Botaurus poiciloptilus Australasian Bittern	EN (EPBC & BC Act)	Unlikely	Absence of suitable riparian/river habitat within the study area.
Calidris acuminata Sharp-tailed Sandpiper	Mig (EPBC & BC Act)	Unlikely	Absence of suitable riparian/river habitat within the study area.
Calidris ferruginea Curlew Sandpiper	CR/Mig (EPBC Act) VU/Mig (BC Act)	Unlikely	Absence of suitable riparian/river habitat within the study area.
Calidris melanotos Pectoral Sandpiper	Mig (EPBC & BC Act)	Unlikely	Absence of suitable riparian/river habitat within the study area.
Cecropis daurica Red-rumped Swallow	Mig (EPBC & BC Act)	Unlikely	Rare Australian vagrant occasionally recorded in Northern Australia.
Charadrius veredus Oriental Plover	Mig (EPBC & BC Act)	Unlikely	Absence of suitable riparian/river habitat within the study area.
Erythrotriorchis radiatus Red Goshawk	VU (EPBC & BC Act)	Possible	Due to large foraging ranges, Red Goshawk may occur within the study area to forage. Typically associated with river systems in Northern Australia. The red goshawk rarely breeds in areas with fragmented native vegetation (Aumann & Baker-Gabb 1991) The stick nests, in which 1–2 eggs are laid, are restricted to trees that are taller than 20 m and within 1 km of a watercourse or wetland (Aumann & Baker-Gabb 1991).

Species	Status[1]	Likelihood of occurrence	Habitat in the study area
Erythrura gouldiae Gouldian Finch	P4 (BC Act) EN (EPBC Act)	Likely	Suitable breeding habitat in the Eucalypt woodland stands, and access to surface water in the seasonally inundated depression. Gouldian Finch were also recorded approximately 3 km to the north of the study area during the survey.
Falco hypoleucos Grey Falcon	VU (EPBC & BC Act)	Possible	Due to large foraging ranges, Grey Falcon may occur within the study area to forage and nest. Typically forages in open habitats, and nests in tall trees and infrastructure towers.
Falco peregrinus Peregrine Falcon	OS (BC Act)	Possible	Due to large foraging ranges, Peregrine Falcon may occur within the study area to forage. Typically nests on cliffs and in trees.
Gelochelidon nilotica Gull-billed Tern	Mig (EPBC & BC Act)	Unlikely	Absence of suitable costal/marine habitats. Rarely observed in inland environments.
Glareola maldivarum Oriental Pratincole	Mig (EPBC & BC Act)	Possible	Not limited by habitat type and therefore a possible visitor to the study area. Typically associated with open habitats.
Hirundo rustica Barn Swallow	Mig (EPBC & BC Act)	Possible	Not limited by habitat type and therefore a possible visitor to the study area.
Motacilla cinerea Grey Wagtail	Mig (EPBC & BC Act)	Unlikely	Absence of suitable open grassland or riparian habitat within the study area.
Motacilla flava Yellow Wagtail	Mig (EPBC & BC Act)	Unlikely	Absence of suitable open grassland or riparian habitat within the study area.
Numenius madagascariensis Eastern Curlew	CR/Mig (EPC Act) VU/Mig (BC Act)	Unlikely	Absence of suitable coastal/marine habitats. Rarely observed in inland environments.
Pandion cristatus Osprey	Mig (EPBC & BC Act)	Unlikely	Absence of suitable costal/marine habitats. Typically associated with coastal areas.
Pezoporus occidentalis Night Parrot	EN (EPBC Act) CR (BC Act)	Unlikely	Absence of old growth spinifex within the study area.
Plegadis falcinellus Glossy Ibis	Mig (EPBC & BC Act)	Unlikely	Absence of suitable riparian/river habitat within the study area.
Polytelis alexandrae Princess Parrot	VU (EPBC Act) P4 (DBCA)	Unlikely	Typically occurs in arid environments in central Australia.
Rostratula australis Australian Painted Snipe	EN (EPBC & BC Act)	Unlikely	Absence of suitable riparian/river habitat within the study area.

Species	Status[1]	Likelihood of occurrence	Habitat in the study area
Tringa glareola Wood Sandpiper	Mig (EPBC & BC Act)	Unlikely	Absence of suitable riparian/river habitat within the study area.
Tringa nebularia Common Greenshank	Mig (EPBC & BC Act)	Unlikely	No suitable coastal, drainage, wetland or salt lake habitat in the study area.
Tringa stagnatilis Marsh Sandpiper	Mig (EPBC & BC Act)	Unlikely	Absence of suitable riparian/river habitat within the study area.
Tyto novaehollandiae Kimberli Masked Owl	VU (EPBC Act) P1 (DBCA)	Possible	Nests in a variety of habitats, provided there are large hollows present. Open woodland habitats inside the study area may contain suitable breeding habitat.
Mammals			
Dasyurus hallucatus Northern Quoll	EN (EPBC & BC Act)	Possible	Previously recorded 5.4 km east of the study area in riparian habitat. No suitable rocky denning habitat within study area. Study area may provide foraging habitat.
Hipposideros aurantia Northern Leaf-nosed Bat	P2 (DBCA)	Possible	No suitable breeding or roosting habitat, but whole of study area contains potential foraging habitat.
Leggadina lakedownensis Northern Short-tailed Mouse	P4 (DBCA)	Likely	Occurs across a diverse range of environments from the monsoon tropical coast to semi-arid climates including grasslands, shrublands, and woodlands.
Macroderma gigas Ghost Bat	VU (EPBC & BC Act)	Possible	No suitable roost habitat, but whole of study area contains potential foraging habitat
Macrotis lagotis Bilby	VU (EPBC & BC Act)	Possible	Occurs across a range of vegetation types including grassland, shrubland and woodland habitats like those found inside the study area. However, the study area is located beyond the northern extent of their known distribution and survey results indicate Bilby is unlikely to be actively using the study area as core habitat given lack of any signs of presence despite extensive active searching.
Petrogale lateralis subsp. (West Kimberley) West Kimberley Black-footed Rock-wallaby	VU (EPBC Act) EN (BC Act)	Unlikely	Absence of suitable rocky habitats with complex caves or crevices, and permanent water.
Petropseudes dahli Rock Ringtail Possum	P3 (DBCA)	Unlikely	Absence of suitable rocky habitats with large boulders and deeply fissured rocks.

Species	Status[1]	Likelihood of occurrence	Habitat in the study area
Phascogale tapoatafa kimberleyensis Kimberley Brush-tailed Phascogale	VU (EPBC & BC Act)	Possible	Restricted to eucalypt forests where it is highly arboreal, although has been recorded foraging on the ground as well as in trees. Requires tree hollows for nesting and refuge during the day. May occur in the open woodland habitats.
Rhinonicteris aurantia Orange Leaf-nosed Bat	P4 (DBCA)	Possible	No suitable breeding or roosting habitat, but whole of study area contains potential foraging habitat.
Saccolaimus saccolaimus nudicluniatus Bare-rumped Sheath-tailed Bat	P3 (DBCA) VU (BC Act)	Possible	Forages over the tops of trees of a variety of forest types like those present in the open woodland habitats. Typically roosts in caves which are absent in the study area but can also utilise tree hollows for roosting habitat which is present in the woodland areas.
Trichosurus vulpecula arnhemensis Northern Brushtail Possum	VU (EPBC & BC Act)	Possible	Typically occur in wooded areas in the tropical regions of Northern Australia. Displays a low specificity for habitat selection occurring in both rural and urban areas.
Vespadelus douglasorum Yellow-lipped Cave Bat	P2(DBCA)	Unlikely	Roosts in caves and forages over streams, neither of which are present inside the study area.

[1] CR – Critically Endangered; EN – Endangered; VU – Vulnerable; OS – Specially Protected; Mig – Migratory; P1–4 – Priority 1–4.

5.2.2 SRE invertebrate fauna

5.2.2.1 Habitats

The 3 fauna habitats mapped in the study area (section 5.2.1.1) were all classified as Low potential habitat for SRE invertebrates (Table 5-7; Figure 5-5). None of these represent High potential SRE habitats due to the lack of isolating habitat features such as rocky outbreaks or drainage systems. With the exception of the seasonally inundated depression which comprised a unique flora assemblage not seen elsewhere in the study area, the native flora species recorded extend throughout the study area and much of the surrounding landscape, and do not impose barriers for fauna dispersal.

Table 5-7 Extent and description of each SRE habitat in the study area

Habitat code	Habitat type	Sites	SRE habitat rating	Extent in study area and % of study area
1	Open woodland over open shrubland over grassland	SITE04	Low	553.2 ha 28.9%
2	Shrubland over grassland	SITE02, SITE08	Low	1,354.5 ha 70.8%
3	Open woodland (shrubby regrowth) over mixed herbs and grasses surrounding a seasonally inundated depression	SITE01	Low	4.3 ha 0.3%

5.2.2.2 SRE records

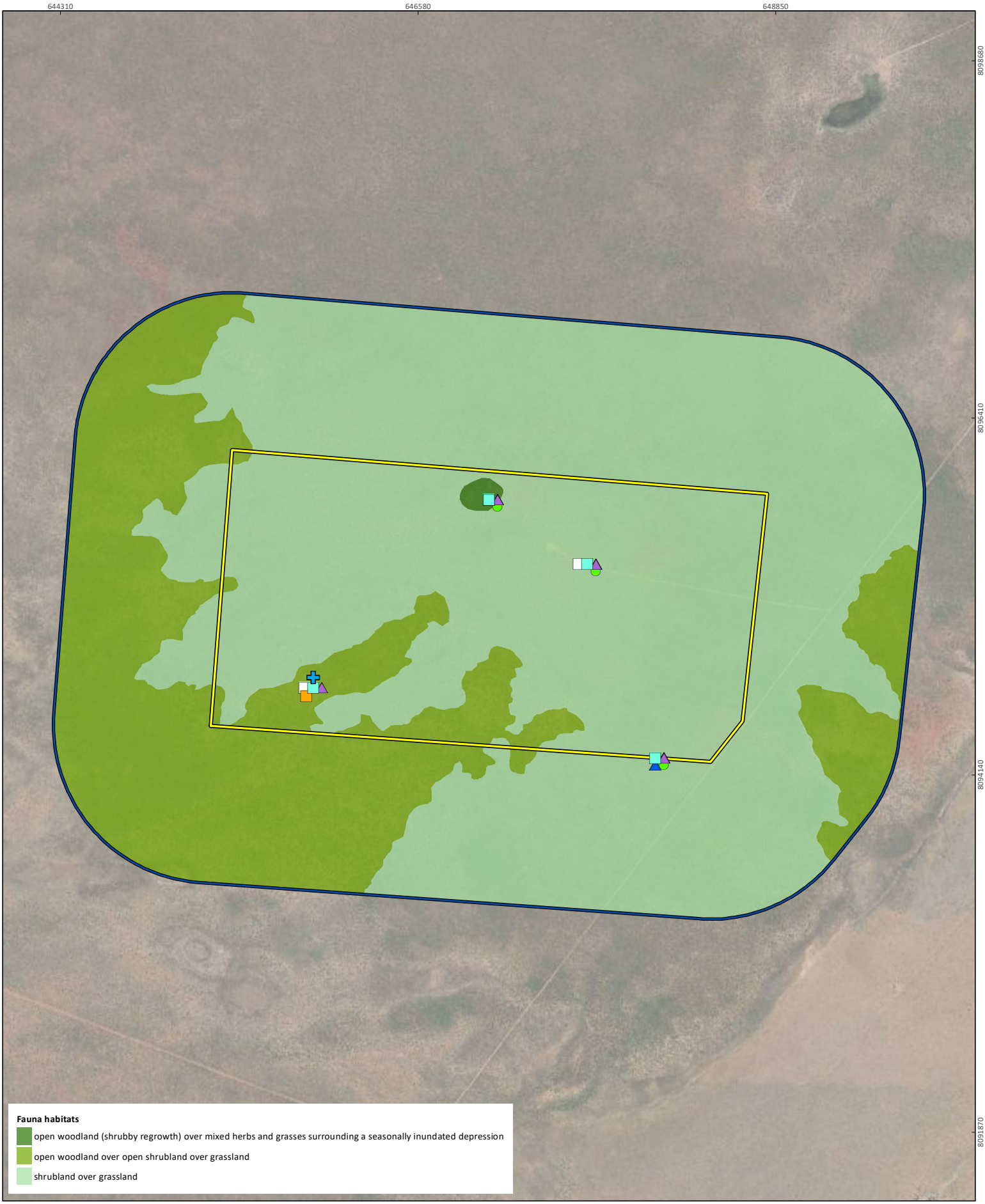
A total of 45 specimens from four SRE groups were collected within the study area (Figure 5-5; Table 5-8). These comprise of 3 species of pseudoscorpions, 2 species of mygalomorph spider, and one species of scorpion and isopod.

Of these, 3 are Potential SREs, 2 are widespread species and 2 are of Uncertain SRE status due to poor taxonomic resolution. The 3 Potential SREs are:

- *Aname* 'MYG771' – a mygalomorph spider collected from all 4 survey sites (in and out of the study area) and in all 3 habitat types. This species has not been recorded previously.
- *Cubaris* sp. indet. – an isopod (slater) collected from 3 sites (in and out of the study area) within 2 habitats (Shrubland over grassland and Open woodland (shrubby regrowth) over mixed herbs and grasses surrounding a seasonally inundated depression).
- *Lychas* '*annulatus* group' – a scorpion which belongs to a species complex has a distribution throughout Australia. The specimens collected from the survey are similar in appearance to the widespread 'central deserts form' (pers. comm. Dr. Erich Volschenk) and were collected from one site in one habitat (Open woodland over open shrubland over grassland).

Table 5-8 Specimens from SRE groups recorded in the field survey

Group	Taxa	Sites	Habitats	No. specimens	SRE status
Mygalomorph spider	*Aname* 'MYG771'	SITE01, SITE02, SITE04, SITE08	1, 2, 3	10	Potential
	Selenotholus 'MYG381'	SITE08	2	1	Widespread
Scorpion	*Lychas* 'annulatus grp'	SITE04	1	2	Potential
Pseudoscorpion	*Austrohorus* sp. indet.	SITE02, SITE04	1, 2	2	Uncertain
	Beierolpium 'sp. 8/4'	SITE04	1	1	Widespread
	Indolpium sp. indet.	SITE01, SITE02, SITE04, SITE08	1, 2, 3	20	Uncertain
Isopod (slater)	*Cubaris* sp. indet. 'Napier'	SITE01, SITE02, SITE08	2, 3	9	Potential



Australian Capital Equity
Napier Downes Irrigation Project

Project No	1452
Date	1/12/2023
Drawn by	BK
Map author	AJ

0 0.5 1
Kilometers

1:30,723 (at A4) GDA 1994 MGA Zone 51

Study area
Habitat mapping area

Species, SRE status

Lychas 'annulatus grp', Potential SRE

Pseudoscorpion

Austrohorus sp. indet, Uncertain

Beierolpium 'sp. 8/4', Potential SRE

Indolpium sp. indet, Uncertain

Isopod

Cubaris sp. indet, Potential SRE

Mygalomorph spider

Aname 'MYG771', Potential SRE

Selenotholus 'MYG381', Widespread

Figure 5-5

SRE habitats and recorded SRE taxa

PHOENIX ENVIRONMENTAL SCIENCES

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5.3 SURVEY LIMITATIONS

The limitations of the terrestrial fauna survey have been considered in accordance with EPA (2016b, d) (Table 5-9).

Table 5-9 Consideration of potential survey limitations

Limitations	Comments
Availability of contextual information at a regional and local scale	Limited contextual information was available at both the regional and local scale.
Competency/experience of the team carrying out the survey	Field surveys were led by a zoologist with over 10 years' experience conducting surveys in WA who has conducted numerous surveys in the Kimberley bioregion.
Scope and completeness	The scope was completed.
Proportion of flora and fauna recorded and/or collected, any identification issues	All recorded fauna identified, except some invertebrates with indeterminate morphology. Approximately one third of the vertebrate species identified in the desktop review were detected. Assemblage results were unsurprising, and not considered a limitation, due to the limited habitat diversity in the study area compared with the wider desktop study area. The SRE assemblage recorded during the survey was expected both in terms of taxa and abundance, including both known and previously unknown taxa.
Access within the study area	The study area was fully accessible at the time of the survey.
Timing, rainfall, season	Timing was not optimal as it was outside of the wet season. This was due to restricted access into the study area caused by late wet season rainfall, delaying the start of the survey by several months.
Disturbance that may have affected the results of the survey	There was no disturbance that would have affected the results of the survey.

6. DISCUSSION

The surveys have documented a diverse assemblage of vertebrate fauna species across the study area, including several that were not on any of the database searches conducted for the desktop assessment. This is partially due to the limited availability of survey data, and highly diverse assemblage of fauna for this area, including seasonal migrants and occasional vagrant species as well as residents.

The fauna assemblage in the Kimberley has been surveyed far less thoroughly than areas such as the Pilbara and Goldfields of WA in recent years. As such, it is unsurprising that several of the species detected during this survey did not come up in the desktop review. Additionally, as the desktop review included numerous habitat types that were absent from the study area, many of the species identified in the desktop were absent from the field survey.

Although habitat quality has been impacted through human activities involving agriculture and groundwater modification, as well as predation and poisoning by introduced species such as cats and cane toads, the regions vertebrate communities remain relatively intact and do not appear to be undergoing a high extinction rate.

The most notable species detected during the field survey that were not identified in the desktop assessment were the invasive Cane Toad, which is a recent addition to the assemblage as the population has dispersed out of the NT and into WA, and the significant Black Grasswren (P4), which is known to occur in isolated locations to the north of the study area. Far less is known about the invertebrate fauna of the region, particularly in those groups with limited dispersal abilities resulting in the precautionary SRE status of many taxa.

6.1 VERTEBRATE FAUNA

The habitat types identified and mapped in the study area match those in the surrounding vicinity Table 5-3, Figure 5-3) and are widespread in the Kimberley region. Restricted habitats in the region that would provide core habitat for significant vertebrates include major drainages, rocky cliffs and gorges, and sand dunes, none of which occur within the study area.

The areas containing open woodland over mixed herbs and grasses surrounding a seasonally inundated depression have a relatively restricted distribution within the landscape, and represent habitat for significant vertebrates such as the Gouldian Finch, as well as invertebrates (see next section).

The desktop review identified 333 vertebrate taxa potentially occurring in the vicinity of the study area, of which 42 are listed in significant categories (section 5.1.1, Table 5-1). The surveys recorded 108 terrestrial vertebrate species, 8 of which were not identified in the desktop review. Three significant vertebrate taxa were recorded during the surveys; Golden Bandicoot (VU), Black Grasswren (P4) and Gouldian Finch (P4/EN); however, only the Golden Bandicoot was recorded inside the study area.

Additionally, 5 significant species were recorded in 2013 from a flood plain site on the eastern side of Hawkstone Creek, 5.4 km east of the study area; Northern Quoll (EN), Gull-billed Tern (Mig.), Glossy Ibis (Mig.), Common Greenshank (Mig.) and Freshwater Crocodile (OS). With the exception of the Northern Quoll, all of the species from Hawkstone Creek are unlikely to occur in the study area as they are all strongly associated with aquatic habitats.

No vertebrate species are restricted (endemic) to the study area or the Fitzroy Trough subregion, and each of the significant species that may occur has its main area of distribution outside the subregion. For example, Gouldian Finch require eucalypt tree hollows for breeding, *Sorghum spp.* and similar seeds for feeding, and water within about 4 km of the nest site (Tidemann 1996) which is present only in the woodland areas of the study area, and is present across much of the Kimberley region.

Similarly, Golden Bandicoot historically occupied much of northern Australia from central WA to western QLD and a number of islands along the Kimberley and Pilbara coast, spanning a diverse range of habitat types. The species has severely declined since European settlement, which has been attributed to the introduction of predators such as feral cats, and changes to fire regimes causing habitat loss and degradation (Ringma *et al.* 2018). The study area is located towards the south-western extent of the Golden Bandicoots currently known distribution. As such, this population is considered important based on its location relative to the currently known distribution of Golden Bandicoot.

Two Golden Bandicoot were captured during the survey, one male and one female. Both were in breeding condition, and the female had two juveniles still attached. Additionally, the extensive bandicoot digging observed across the study area indicates that Golden Bandicoot are likely resident in the area and use the available habitats for foraging and are reproducing in and around the study area. The shrubland habitat contained the highest number of bandicoot diggings. The shrubland habitats may provide the best protection from predators, as they typically had the densest understory of the habitat types present inside the study area, and likely contained an abundance of arthropods, small vertebrates, and plant materials for the bandicoots to eat. This habitat type is relatively common in the region, making up approximately 86% of the study area, and 70% of the mapped area.

Northern Quoll have been recorded approximately 5.4 km to the east of the study area at a nearby riparian habitat. It is possible they may also move through the study area as it would likely provide suitable foraging habitat, however it is unlikely the Northern Quoll would breed inside the study area as there are no rocky habitats containing caves suitable for denning habitat. None of the habitat inside the study area would be considered critical habitat for Northern Quoll, but all habitats present may be used for dispersal and foraging.

While potential presence of Bilby in the study area cannot be categorically ruled out (therefore warranting the precautionary likelihood of occurrence assignment of 'possible'), the study area is not considered to be important habitat for Bilby considering the lack of any signs of presence despite extensive searches, and as the study area is outside the currently modelled distribution.

6.2 SRE INVERTEBRATE FAUNA

The habitats within the study are considered to be relatively continuous and contain overlapping vegetation structure, and landform attributes. Aside from one habitat displaying a higher incidence of moisture/inundation (at site 01), this was not considered enough to create a habitat isolate for SREs. The Yeeda land system, which occupies the majority of the study area and includes all four survey sites, extends uninterrupted 66 km to the west, and is also well represented immediately east of the Hawkstone River and south of the Lennard River. The larger rivers, and the Napier Ranges to the north, may be potential barriers to dispersal, along with any major changes to vegetation and soils.

Three potential SREs were recorded from the study area, of which two are new to science (*Aname* 'MYG771' and *Cubaris* sp. indet. 'Napier') and one is from a species complex which is thought to contain multiple species:

- *Aname* 'MYG771' – Several other undescribed species of *Aname* are known from the Kimberley region (Pers. comm Dr. Mark Harvey, WA Museum); however, this is the first record of *Aname* 'MYG771' and is therefore currently only known from the study area. Considering this mygalomorph species was collected from widespread and unrestrictive habitat types, it is likely to occur more broadly in the general area within similar habitats
- *Cubaris* sp. indet. 'Napier' – *Cubaris* isopods are from the Armadillidae family of isopods which are uncommon in the Kimberly region. Several highly endemic taxa have been recorded from the region e.g. *Filippinodillo kimberleyensis*, *Acanthodillo agasketos* (both from one location in wet pitfall traps) (Lewis 1998), and *Kimberleydillo waldockensis* (one location – cave entrance) (Dalens 1993), indicating this species is likely to also be endemic. Given this species

was recorded from 3 locations within 2 habitat types, including a widespread habitat, it is likely to occur more broadly in the general area within similar habitats.

- *Lychas* '*annulatus* group' – Many morphologically distinct species are known from this scorpion group, but some display high levels of cryptic speciation and thus taxonomy of this group is not well resolved. Given this taxon was collected from a widespread habitat type, it is likely to occur more broadly in the general area within similar habitat.

The 2 uncertain SREs are both pseudoscorpions from genera which have generally poor taxonomic resolution. *Indolpium* and *Austrohorus*, both from the Olpiidae family of pseudoscorpions occur widely throughout WA; however, few species have been described. The two widespread species, *Beierolpium* 'sp. 8/4' and *Selenothelus* 'MYG381' are known to occur in arid and northern Australia.

The habitats within the study area are not considered suitable for the confirmed SREs returned in the desktop review due to absence of typical isolated habitat types these are known from (e.g. rocky outcrops, limestone outcrops, rock piles, boulders, rubble, rock crevices, rock/scree slopes, rocky gullies, bases of escarpments and cliffs), cave entrances, embarkments, vine thickets and on roots, creek beds, trunk and/or branches of trees (boabs).

6.3 CONCLUSION

The faunal assemblage of the study area is broadly typical of the woodland and shrubland habitats in the region and consists mostly of species with large distributions across northern WA and the NT. All the fauna habitats present inside the study area are relatively common in the surrounding region.

The Golden Bandicoot was the only significant vertebrate species recorded inside the study area and was also recorded as several sites to the south of the study area, which was unsurprising given the small size of the study area, and the habitats inside the study area being relatively common in the surrounding area.

The SRE invertebrate records from the survey comprise of a mixture of new, potentially range restricted SRE invertebrates, and known widespread species. The habitats in the study area are of only low habitat potential for SREs and do not contain any distinct isolating features that may create physical barriers to invertebrate dispersal. It is highly unlikely that any SRE taxa would be restricted to the study area.

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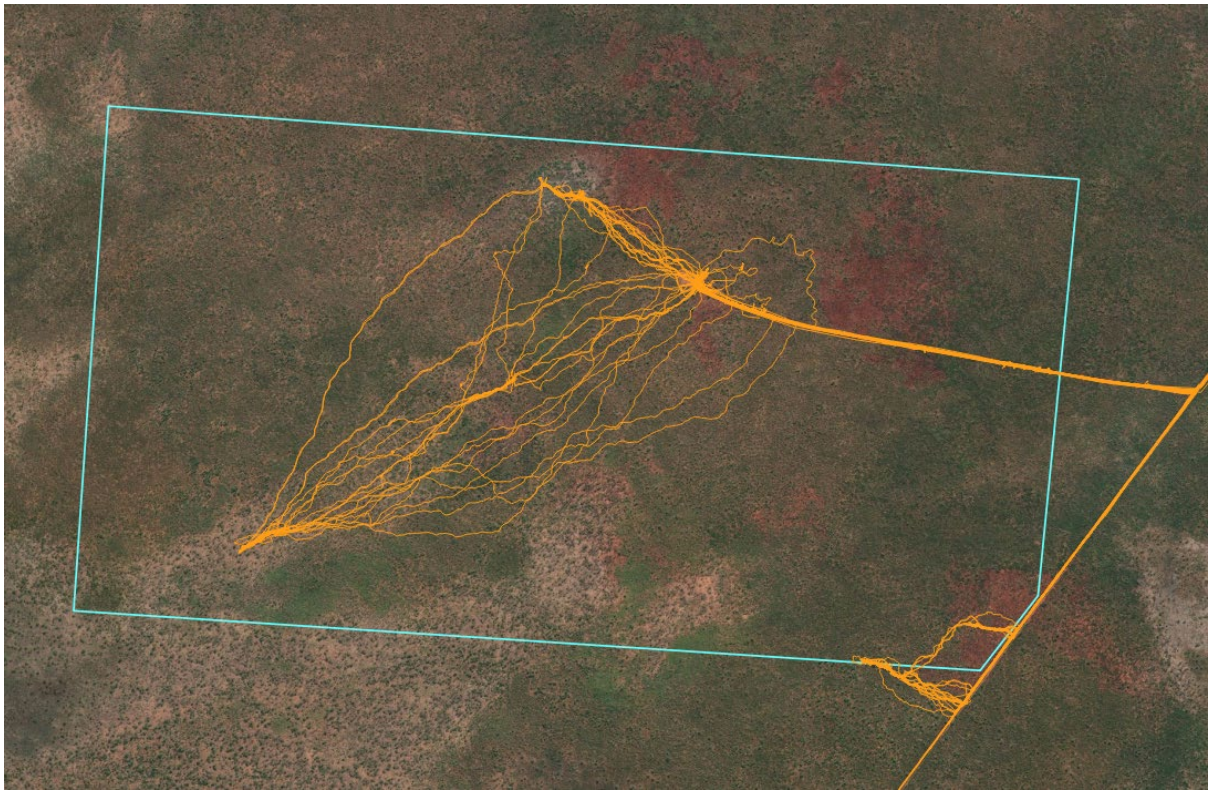
Appendix A Survey site locations

Site name	Latitude	Longitude
SITE01	-17.2174	124.3829
SITE02	-17.2208	124.3884
SITE03	-17.2235	124.38
SITE04	-17.2279	124.3729
SITE05	-17.222	124.3937
SITE06	-17.2225	124.3976
SITE07	-17.2309	124.3965
SITE08	-17.2322	124.3932
SITE09	-17.22	124.3869
SITE10	-17.1944	124.4045
SITE11	-17.1932	124.3327
SITE12	-17.1371	124.471
SITE13	-17.196	124.258
SITE14	-17.3169	124.6778
SITE15	-17.1376	124.4851
SITE16	-17.2687	124.4025
Opp-Isoodon-01	-17.2253	124.3775
Opp-Isoodon-02	-17.2246	124.3841
Opp-Isoodon-03	-17.2264	124.3774
Opp-Isoodon-04	-17.219	124.3802
Opp-Isoodon-05	-17.2262	124.3811
Opp-Isoodon-06	-17.2262	124.3801
Opp-Isoodon-07	-17.2265	124.3795
Opp-Isoodon-08	-17.2249	124.3804
Opp-Isoodon-09	-17.2265	124.3774
Opp-Isoodon-10	-17.225	124.376
Opp-Isoodon-11	-17.2223	124.3953
Opp-Isoodon-12	-17.2205	124.3865
Opp-Isoodon-13	-17.2333	124.3949

Site name	Latitude	Longitude
Opp-01	-17.3037	124.6909
Opp-02	-17.2266	124.4007
Opp-03	-17.2334	124.3953
Opp-04	-17.1371	124.4721
Opp-05	-17.2911	124.6634
Opp-06	-17.1369	124.4716
Opp-07	-17.1769	124.561
Opp-08	-17.2232	124.4034
Opp-09	-17.2228	124.398
Opp-10	-17.2439	124.3873
Opp-11	-17.1849	124.4335
Opp-12	-17.1393	124.5001
Opp-13	-17.2476	124.6234
Opp-14	-17.292	124.7723
Opp-15	-17.2237	124.403
Opp-16	-17.2264	124.4009
Opp-17	-17.1427	124.5303
Opp-18	-17.2463	124.6211
Opp-19	-17.302	124.6736
Opp-20	-17.1778	124.4392
Opp-21	-17.2715	124.398
Opp-22	-17.2232	124.379

Appendix B Partial track logs from transect searches showing relative intensity of survey effort throughout study area

Tracks only recorded on 1, 2 and 4 July, GPS tracking was not turned on for the other days



Appendix C Vertebrate fauna desktop and field survey results

Family	Species	Common name	BC Act	EPBC Act	TPFA	ALA	Nature Map	PMST	Birdlife Bird Data	This Survey
FISHES (1)										
Pristidae	Pristis pristis	Freshwater Sawfish	MI & P3	VU & MI				•		
FROGS (18)										
Bufonidae	Rhinella marina	Cane Toad								•
Limnodynastidae	Notaden nichollsi	Desert Spadefoot					•			
Limnodynastidae	Platyplectrum ornatum	Ornate Burrowing Frog				•	•			
Myobatrachidae	Uperoleia aspera	Derby Toadlet				•	•			
Myobatrachidae	Uperoleia borealis	Northern Toadlet								•
Myobatrachidae	Uperoleia lithomoda	Stonemason Toadlet					•			
Myobatrachidae	Uperoleia mjobergii	West Kimberley Toadlet					•			
Pelodryadidae	Cyclorana australis	Giant Frog					•			
Pelodryadidae	Cyclorana cryptotis	Hidden-ear Frog				•	•			
Pelodryadidae	Cyclorana longipes	Long-footed Frog				•	•			
Pelodryadidae	Litoria caerulea	Green Tree Frog					•			
Pelodryadidae	Litoria inermis	Bumpy Rocket Frog					•			
Pelodryadidae	Litoria meiriana	Rockhole Frog					•			
Pelodryadidae	Litoria pallida	Pale Rocket Frog				•	•			
Pelodryadidae	Litoria rothii	Northern Laughing Tree Frog				•	•			
Pelodryadidae	Litoria rubella	Little Red Tree Frog				•	•			
Pelodryadidae	Litoria splendida	Splendid Tree Frog					•			
Pelodryadidae	Litoria tornieri	Black-shinned Rocket Frog				•				
REPTILES (52)										
Agamidae	Lophognathus gilberti	Top End Ta-Ta Dragon					•			
Agamidae	Chlamydosaurus kingii	Frill-necked Lizard				•	•			
Agamidae	Ctenophorus caudicinctus	Ring-tailed Dragon					•			

Family	Species	Common name	BC Act	EPBC Act	TPFA	ALA	Nature Map	PMST	Birdlife Bird Data	This Survey
Agamidae	Ctenophorus nuchalis	Central Netted Dragon					•			
Agamidae	Diporiphora lalliae	Northern Deserts Dragon					•			
Agamidae	Diporiphora magna	Yellow-sided Two-lined Dragon				•	•			
Agamidae	Diporiphora margaretae	Northwest Kimberley Two-lined Dragon								•
Agamidae	Diporiphora pindan	Pindan Dragon					•			
Agamidae	Pogona minor	Northwestern Bearded Dragon					•			
Boidae	Liasis olivaceus	Olive Python								•
Carphodactylidae	Nephrurus sheai	Northern Knob-tailed Gecko					•			
Colubridae	Boiga irregularis	Brown Tree Snake					•			
Crocodylidae	Crocodylidae	Australian freshwater crocodile	OS		•		•			
Crocodylidae	Crocodylus porosus	Salt-water Crocodile				•		•		
Diplodactylidae	Crenadactylus ocellatus	Clawless Gecko					•			
Diplodactylidae	Lucasium stenodactylus	Western Sandplain Gecko				•				
Diplodactylidae	Strophurus ciliaris	Northern Spiny-tailed Gecko				•	•			
Diplodactylidae	Strophurus taeniatus	Northern Phasmid Gecko					•			
Elapidae	Furina ornata	Moon Snake					•			
Gekkonidae	Gehyra montium	Central Rock Dtella				•				
Gekkonidae	Gehyra nana	Northern Spotted Rock Dtella					•			
Gekkonidae	Gehyra occidentalis	Kimberley Plateau Dtella				•	•			
Gekkonidae	Gehyra pilbara	Pilbara Dtella					•			
Gekkonidae	Gehyra punctata	Spotted Dtella					•			
Gekkonidae	Heteronotia binoei	Bynoe's Gecko					•			
Gekkonidae	Heteronotia planiceps	North-west Prickly Gecko				•	•			
Pygopodidae	Delma borea	Rusty-topped Delma				•	•			
Pygopodidae	Delma nasuta	Sharp-snouted Delma					•			
Pygopodidae	Lialis burtonis	Burton's Legless Lizard					•			

Family	Species	Common name	BC Act	EPBC Act	TPFA	ALA	Nature Map	PMST	Birdlife Bird Data	This Survey
Pythonidae	Aspidites melanocephalus	Black-headed Python					•			
Scincidae	Carlia munda	Shaded-litter Rainbow Skink					•			
Scincidae	Cryptoblepharus megastictus	Blotched Snake-eyed Skink					•			
Scincidae	Cryptoblepharus metallicus	Metallic Snake-eyed Skink					•			
Scincidae	Cryptoblepharus ruber	Tawny Snake-eyed Skink				•				
Scincidae	Cryptoblepharus tytthos	Pygmy Snake-Eyed Skink					•			
Scincidae	Ctenotus inornatus	Plain Ctenotus				•	•			
Scincidae	Ctenotus serventyi	North-western Sandy-loam Ctenotus					•			
Scincidae	Cyclodomorphus melanops	Slender Blue-tongue					•			
Scincidae	Eremiascincus isolepis	Northern Bar-lipped Skink					•			•
Scincidae	Lerista bipes	North-western Sandslider								•
Scincidae	Lerista borealis	Northern Slider					•			
Scincidae	Lerista greeri	South-eastern Kimberley Sand Slider				•				
Scincidae	Menetia greyii	Common Dwarf Skink					•			
Scincidae	Morethia ruficauda	Lined Firetail Skink					•			
Scincidae	Proablepharus tenuis	Slender Snake-eyed Skink					•			
Scincidae	Tiliqua scincoides	Eastern Blue-tongue				•				
Scincidae	Tiliqua scincoides	Common Blue-tongue					•			
Varanidae	Varanus acanthurus	Spiny-tailed Monitor					•			
Varanidae	Varanus gouldii	Bungarra or Sand Monitor					•			
Varanidae	Varanus panoptes	Yellow-spotted Monitor					•			
Varanidae	Varanus scalaris	Spotted Tree Monitor				•	•			
Varanidae	Varanus storri	Storr's Monitor				•				

Family	Species	Common name	BC Act	EPBC Act	TPFA	ALA	Nature Map	PMST	Birdlife Bird Data	This Survey
Birds (221)										
Acanthizidae	Gerygone olivacea	White-throated Gerygone				•	•		•	
Acanthizidae	Smicrornis brevirostris	Weebill				•	•		•	•
Acanthizidae	Gerygone chloronota	Green-backed Gerygone					•		•	
Accipitridae	Aquila audax	Wedge-tailed Eagle				•	•		•	•
Accipitridae	Circus approximans	Swamp Harrier				•	•		•	•
Accipitridae	Circus assimilis	Spotted Harrier				•	•		•	
Accipitridae	Erythrotriorchis radiatus	Red Goshawk						•		
Accipitridae	Haliaeetus leucogaster	White-bellied Sea-Eagle				•			•	
Accipitridae	Haliastur sphenurus	Whistling Kite				•	•		•	•
Accipitridae	Hamirostra isura	Square-tailed Kite				•			•	
Accipitridae	Hamirostra melanosternon	Black-breasted Buzzard				•	•		•	•
Accipitridae	Accipiter cirrocephalus	Collared Sparrowhawk				•	•		•	•
Accipitridae	Accipiter fasciatus	Brown Goshawk				•	•		•	•
Accipitridae	Accipiter novaehollandiae	Grey Goshawk							•	
Accipitridae	Elanus caeruleus	Black-shouldered Kite					•		•	
Accipitridae	Milvus migrans	Black Kite				•	•		•	
Accipitridae	Hieraaetus morphnoides	Little Eagle				•	•		•	•
Acrocephalidae	Acrocephalus orientalis	Oriental Reed Warbler						•		
Aegothelidae	Aegotheles cristatus	Australian Owlet-nightjar				•	•		•	
Alaudidae	Mirafra javanica	Horsfield's Bushlark				•	•		•	
Alcedinidae	Dacelo leachii	Blue-winged Kookaburra				•	•		•	•
Alcedinidae	Todiramphus sanctus	Sacred Kingfisher				•	•		•	•
Alcedinidae	Todiramphus pyrrhopygius	Red-backed Kingfisher				•	•		•	•
Alcedinidae	Ceyx azureus	Azure Kingfisher				•	•		•	•

Family	Species	Common name	BC Act	EPBC Act	TPFA	ALA	Nature Map	PMST	Birdlife Bird Data	This Survey
Anatidae	Anas gracilis	Grey Teal				•	•		•	
Anatidae	Anas superciliosa	Pacific Black Duck				•	•		•	•
Anatidae	Aythya australis	Hardhead				•	•		•	•
Anatidae	Cygnus atratus	Black Swan				•	•			
Anatidae	Dendrocygna eytoni	Plumed Whistling Duck				•	•		•	
Anatidae	Malacorhynchus membranaceus	Pink-eared Duck				•	•		•	
Anatidae	Nettapus pulchellus	Green Pygmy-goose				•	•		•	
Anatidae	Stictonetta naevosa	Freckled Duck				•				
Anhingidae	Anhinga novaehollandiae	Australasian Darter				•	•		•	
Anseranatidae	Anseranas semipalmata	Magpie Goose				•			•	•
Apodidae	Apus pacificus	Fork-tailed Swift						•		
Ardeidae	Ardea novaehollandiae	White-faced Heron				•	•		•	•
Ardeidae	Ardea pacifica	White-necked Heron				•	•		•	•
Ardeidae	Ardea alba	Great Egret				•				•
Ardeidae	Ardea garzetta	Little Egret				•	•		•	
Ardeidae	Ardea ibis	Cattle Egret				•				•
Ardeidae	Ardea intermedia	Intermediate Egret				•	•		•	•
Ardeidae	Ixobrychus flavicollis	Black Bittern				•			•	
Ardeidae	Nycticorax caledonicus	Rufous Night Heron				•	•		•	•
Ardeidae	Botaurus poicilopilus	Australasian Bittern	EN	EN	•					
Ardeidae	Ardea modesta	Great Egret				•	•		•	
Artamidae	Artamus minor	Little Woodswallow				•	•		•	•
Artamidae	Artamus personatus	Masked Woodswallow				•	•		•	•
Artamidae	Cracticus nigrogularis	Pied Butcherbird				•	•		•	•
Artamidae	Artamus cinereus	Black-faced Woodswallow				•	•		•	•
Artamidae	Artamus leucorynchus	White-breasted Woodswallow				•	•		•	•

Family	Species	Common name	BC Act	EPBC Act	TPFA	ALA	Nature Map	PMST	Birdlife Bird Data	This Survey
Artamidae	Cracticus tibicen	Australian Magpie				•	•		•	•
Artamidae	Cracticus torquatus	Grey Butcherbird					•		•	
Burhinidae	Burhinus grallarius	Bush Stone-curlew					•		•	•
Cacatuidae	Nymphicus hollandicus	Cockatiel				•	•		•	
Cacatuidae	Cacatua galerita	Sulphur-crested Cockatoo				•	•		•	•
Cacatuidae	Cacatua roseicapilla	Galah				•	•		•	•
Cacatuidae	Cacatua sanguinea	Little Corella				•	•		•	•
Cacatuidae	Calyptorhynchus banksii	Red-tailed Black-Cockatoo				•	•		•	•
Campephagidae	Coracina maxima	Ground Cuckoo-shrike							•	
Campephagidae	Lalage tricolor	White-winged Triller				•	•		•	•
Campephagidae	Coracina novaehollandiae	Black-faced Cuckoo-shrike				•	•		•	•
Campephagidae	Coracina papuensis	White-bellied Cuckoo-shrike				•	•		•	
Campephagidae	Lalage leucomela	Varied Triller					•		•	
Caprimulgidae	Eurostopodus argus	Spotted Nightjar				•	•		•	•
Casuariidae	Dromaius novaehollandiae	Emu				•				
Charadriidae	Charadrius veredus	Oriental Plover	MI	MI	•	•	•	•	•	
Charadriidae	Erythrogonys cinctus	Red-kneed Dotterel				•	•		•	
Charadriidae	Charadrius leschenaultii	Greater Sand Plover				•		•		
Charadriidae	Vanellus miles	Masked Lapwing				•	•		•	•
Charadriidae	Elseyornis melanops	Black-fronted Dotterel				•	•		•	•
Ciconiidae	Ephippiorhynchus asiaticus	Black-necked Stork				•	•		•	•
Cisticolidae	Cisticola exilis	Golden-headed Cisticola				•	•		•	
Climacteridae	Climacteris melanurus	Black-tailed Treecreeper				•			•	
Columbidae	Chalcophaps indica subsp. longirostris	Emerald Dove							•	

Family	Species	Common name	BC Act	EPBC Act	TPFA	ALA	Nature Map	PMST	Birdlife Bird Data	This Survey
Columbidae	Geopelia cuneata	Diamond Dove				•	•		•	•
Columbidae	Geopelia humeralis	Bar-shouldered Dove				•	•		•	•
Columbidae	Geopelia striata subsp. placida	Peaceful Dove				•	•		•	
Columbidae	Geophaps plumifera	Spinifex Pigeon					•		•	
Columbidae	Ocyphaps lophotes	Crested Pigeon				•	•		•	•
Columbidae	Phaps chalcoptera	Common Bronzewing				•			•	
Columbidae	Petrophassa albipennis	White-quilled Rock Pigeon							•	
Columbidae	Geophaps smithii	Partridge Pigeon						•		
Coraciidae	Eurystomus orientalis	Dollarbird				•	•		•	
Corvidae	Corvus bennetti	Little Crow					•		•	
Corvidae	Corvus orru	Torresian Crow				•	•		•	•
Cuculidae	Chrysococcyx basalis	Horsfield's Bronze Cuckoo				•	•		•	•
Cuculidae	Chrysococcyx osculans	Black-eared Cuckoo				•			•	
Cuculidae	Cacomantis variolosus	Brush Cuckoo				•	•		•	
Cuculidae	Centropus phasianinus	Pheasant Coucal				•	•		•	
Cuculidae	Eudynamys scolopacea	Common Koel					•			
Cuculidae	Scythrops novaehollandiae	Channel-billed Cuckoo					•		•	
Cuculidae	Cacomantis pallidus	Pallid Cuckoo				•	•		•	•
Cuculidae	Cuculus optatus	Oriental Cuckoo						•		
Cuculidae	Eudynamys orientalis	Pacific Koel					•		•	
Dicaeidae	Dicaeum hirundinaceum	Mistletoebird				•	•		•	
Estrildidae	Emblema pictum	Painted Finch					•		•	
Estrildidae	Erythrura gouldiae	Gouldian Finch	P4	EN	•	•	•	•		•
Estrildidae	Heteromunia pectoralis	Pictorella Mannikin				•	•		•	
Estrildidae	Poephila acuticauda	Long-tailed Finch				•	•		•	•

Family	Species	Common name	BC Act	EPBC Act	TPFA	ALA	Nature Map	PMST	Birdlife Bird Data	This Survey
Estrildidae	Neochmia phaeton	Crimson Finch				•			•	•
Estrildidae	Neochmia ruficauda	Star Finch				•	•		•	•
Estrildidae	Poephila personata	Masked Finch							•	•
Estrildidae	Taeniopygia guttata	Zebra Finch				•	•		•	•
Estrildidae	Taeniopygia bichenovii	Double-barred Finch				•	•		•	•
Falconidae	Falco hypoleucos	Grey Falcon	VU		•	•		•	•	
Falconidae	Falco subniger	Black Falcon				•	•		•	
Falconidae	Falco berigora	Brown Falcon				•	•		•	•
Falconidae	Falco cenchroides	Australian Kestrel				•	•		•	•
Falconidae	Falco longipennis	Australian Hobby				•			•	•
Falconidae	Falco peregrinus	Peregrine Falcon	OS		•	•	•		•	
Falcunculidae	Falcunculus frontatus	Crested Shrike-tit						•		
Glareolidae	Glareola maldivarum	Oriental Pratincole						•		
Gruidae	Grus rubicunda	Brolga				•	•		•	•
Gruidae	Grus antigone	Sarus Crane				•				
Hirundinidae	Hirundo rustica	Barn Swallow						•		
Hirundinidae	Cecropis daurica	Red-rumped Swallow						•		
Hirundinidae	Petrochelidon ariel	Fairy Martin				•	•		•	•
Hirundinidae	Petrochelidon nigricans	Tree Martin				•	•		•	•
Jacanidae	Irediparra gallinacea	Comb-crested Jacana							•	
Laridae	Sterna hybrida	Whiskered Tern				•			•	
Laridae	Gelochelidon nilotica	Gull-billed Tern	MI	MI	•	•				
Locustellidae	Cincloramphus mathewsi	Rufous Songlark				•			•	
Locustellidae	Megalurus timoriensis	Tawny Grassbird					•		•	•
Maluridae	Malurus coronatus	Purple-crowned Fairy-wren				•				
Maluridae	Malurus lamberti	Variegated Fairy-wren				•	•		•	•

Family	Species	Common name	BC Act	EPBC Act	TPFA	ALA	Nature Map	PMST	Birdlife Bird Data	This Survey
Maluridae	Malurus melanocephalus	Red-backed Fairy-wren				•	•		•	•
Maluridae	Amytornis housei	Black Grasswren	P4							•
Meliphagidae	Cissomela pectoralis	Banded Honeyeater				•	•		•	•
Meliphagidae	Conopophila rufogularis	Rufous-throated Honeyeater				•	•		•	
Meliphagidae	Manorina flavigula	Yellow-throated Miner				•	•		•	
Meliphagidae	Melithreptus albogularis	White-throated Honeyeater				•	•		•	•
Meliphagidae	Ramsayornis fasciatus	Bar-breasted Honeyeater				•	•		•	
Meliphagidae	Lichmera indistincta	Brown Honeyeater				•	•		•	•
Meliphagidae	Melithreptus cyanotis	Blue-faced Honeyeater							•	
Meliphagidae	Melithreptus gularis	Black-chinned Honeyeater				•	•		•	•
Meliphagidae	Myzomela erythrocephala	Red-headed Honeyeater							•	
Meliphagidae	Philemon argenticeps	Silver-crowned Friarbird				•	•		•	
Meliphagidae	Philemon citreogularis	Little Friarbird				•	•		•	•
Meliphagidae	Gavicalis virescens	Singing Honeyeater				•			•	•
Meliphagidae	Ptilotula flavescens	Yellow-tinted Honeyeater				•	•		•	•
Meliphagidae	Stomiopera unicolor	White-gaped Honeyeater				•	•		•	•
Meliphagidae	Ptilotula plumula	Grey-fronted Honeyeater				•			•	
Meropidae	Merops ornatus	Rainbow Bee-eater				•	•		•	•
Monarchidae	Grallina cyanoleuca	Magpie-lark				•	•		•	•
Monarchidae	Myiagra inquieta	Restless Flycatcher				•	•		•	•
Monarchidae	Myiagra rubecula	Leaden Flycatcher				•			•	
Monarchidae	Myiagra ruficollis	Broad-billed Flycatcher							•	
Motacillidae	Anthus australis	Australian Pipit				•			•	
Motacillidae	Motacilla flava	Yellow Wagtail						•		
Motacillidae	Motacilla cinerea	Grey Wagtail						•		
Neosittidae	Daphoenositta chrysoptera	Varied Sittella				•	•		•	

Family	Species	Common name	BC Act	EPBC Act	TPFA	ALA	Nature Map	PMST	Birdlife Bird Data	This Survey
Oriolidae	Oriolus sagittatus	Olive-backed Oriole				•	•		•	•
Oriolidae	Sphecotheres vieilloti	Australasian Figbird							•	
Otididae	Ardeotis australis	Australian Bustard				•	•		•	•
Pachycephalidae	Colluricincla woodwardi	Sandstone Shrike-thrush				•	•		•	
Pachycephalidae	Colluricincla harmonica	Grey Shrike-thrush				•	•		•	•
Pachycephalidae	Colluricincla megarhyncha	Little Shrike-thrush				•			•	
Pachycephalidae	Pachycephala rufiventris	Rufous Whistler				•	•		•	•
Pandionidae	Pandion haliaetus	Osprey	MI	MI	•			•	•	
Pardalotidae	Pardalotus rubricatus	Red-browed Pardalote				•	•		•	
Pardalotidae	Pardalotus striatus	Striated Pardalote				•	•		•	•
Pelecanidae	Pelecanus conspicillatus	Australian Pelican				•	•		•	
Petroicidae	Microeca fascinans	Jacky Winter				•	•		•	
Petroicidae	Microeca flavigaster	Lemon-breasted Flycatcher					•		•	
Petroicidae	Poecilodryas superciliosa	White-browed Robin				•				
Petroicidae	Melanodryas cucullata	Hooded Robin							•	
Petroicidae	Poecilodryas cerviniventris	Buff-sided Robin					•		•	
Phalacrocoracidae	Phalacrocorax sulcirostris	Little Black Cormorant				•	•		•	
Phalacrocoracidae	Phalacrocorax carbo	Great Cormorant				•	•		•	
Phalacrocoracidae	Phalacrocorax melanoleucos	Little Pied Cormorant				•	•		•	•
Phalacrocoracidae	Phalacrocorax varius	Pied Cormorant				•	•		•	
Phasianidae	Coturnix ypsilophora	Brown Quail				•	•		•	•
Podargidae	Podargus strigoides	Tawny Frogmouth				•	•		•	
Podicipedidae	Poliocephalus poliocephalus	Hoary-headed Grebe				•	•		•	

Family	Species	Common name	BC Act	EPBC Act	TPFA	ALA	Nature Map	PMST	Birdlife Bird Data	This Survey
Podicipedidae	Tachybaptus novaehollandiae	Australasian Grebe				•	•		•	•
Pomatostomidae	Pomatostomus temporalis	Grey-crowned Babbler				•	•		•	•
Psittaculidae	Aprosmictus erythropterus	Red-winged Parrot				•	•		•	•
Psittaculidae	Melopsittacus undulatus	Budgerigar				•	•		•	
Psittaculidae	Neophema bourkii	Bourke's Parrot				•	•			
Psittaculidae	Pezoporus occidentalis	Night Parrot						•		
Psittaculidae	Platycercus venustus	Northern Rosella				•	•		•	
Psittaculidae	Polytelis alexandrae	Princess Parrot						•		
Psittaculidae	Trichoglossus rubritorquis	Red-collared Lorikeet				•	•		•	•
Psittaculidae	Trichoglossus versicolor	Varied Lorikeet				•	•		•	
Psittaculidae	Trichoglossus haematodus	Rainbow Lorikeet				•	•			
Ptilonorhynchidae	Ptilonorhynchus nuchalis	Great Bowerbird				•	•		•	•
Rallidae	Fulica atra	Eurasian Coot				•	•		•	
Rallidae	Gallirallus philippensis	Buff-banded Rail							•	
Rallidae	Amaurornis moluccana subsp. ruficrissa	Pale-vented Bush-hen							•	
Recurvirostridae	Himantopus himantopus	Black-winged Stilt				•	•		•	
Rhipiduridae	Rhipidura fuliginosa	Grey Fantail							•	
Rhipiduridae	Rhipidura leucophrys	Willie Wagtail				•	•		•	•
Rhipiduridae	Rhipidura rufiventris	Northern Fantail				•			•	
Rhipiduridae	Rhipidura albiscapa	Grey Fantail					•			
Rhipiduridae	Rostratula australis	Australian Painted Snipe						•		
Scolopacidae	Calidris acuminata	Sharp-tailed Sandpiper	MI	MI	•	•		•		
Scolopacidae	Calidris ferruginea	Curlew Sandpiper						•		

Family	Species	Common name	BC Act	EPBC Act	TPFA	ALA	Nature Map	PMST	Birdlife Bird Data	This Survey
Scolopacidae	Calidris melanotos	Pectoral Sandpiper				•		•		
Scolopacidae	Calidris ruficollis	Red-necked Stint				•				
Scolopacidae	Gallinago hardwickii	Latham's Snipe				•				
Scolopacidae	Numenius madagascariensis	Eastern Curlew						•		
Scolopacidae	Tringa glareola	Wood Sandpiper	MI	MI	•	•	•		•	
Scolopacidae	Tringa nebularia	Common Greenshank	MI	MI	•	•	•			
Scolopacidae	Tringa stagnatilis	Marsh Sandpiper	MI	MI	•	•	•		•	
Scolopacidae	Calidris canutus	Red Knot						•		
Scolopacidae	Limosa lapponica	Bar-tailed Godwit						•		
Scolopacidae	Actitis hypoleucos	Common Sandpiper			•	•		•	•	
Strigidae	Ninox rufa subsp. rufa	Rufous Owl					•			
Strigidae	Ninox connivens	Barking Owl				•	•		•	
Strigidae	Ninox novaeseelandiae	Boobook Owl				•				
Strigidae	Ninox boobook	Australian Boobook							•	
Threskiornithidae	Platalea flavipes	Yellow-billed Spoonbill				•	•			
Threskiornithidae	Platalea regia	Royal Spoonbill				•	•		•	
Threskiornithidae	Plegadis falcinellus	Glossy Ibis	MI	MI	•	•	•		•	
Threskiornithidae	Threskiornis spinicollis	Straw-necked Ibis				•	•		•	•
Threskiornithidae	Threskiornis moluccus	Australian White Ibis				•			•	
Turnicidae	Turnix pyrrhothorax	Red-chested Button-quail					•		•	
Turnicidae	Turnix velox	Little Button-quail					•		•	
Turnicidae	Turnix maculosa	Red-backed Button-quail							•	
Tytonidae	Tyto alba	Barn Owl							•	
Tytonidae	Tyto novaehollandiae	Masked Owl						•	•	
Mammals (46)										
Bovidae	Bos taurus	European Cattle					•			•

Family	Species	Common name	BC Act	EPBC Act	TPFA	ALA	Nature Map	PMST	Birdlife Bird Data	This Survey
Canidae	Canis familiaris	Dog								•
Dasyuridae	Dasyurus hallucatus	Northern Quoll	EN	EN	•		•	•		
Dasyuridae	Phascogale tapoatafa	Brush-tailed Phascogale						•		
Dasyuridae	Pseudantechinus ningbing	Ningbing Pseudantechinus					•			•
Emballonuridae	Saccolaimus flaviventris	Yellow-bellied Sheath-tailed Bat				•	•			
Emballonuridae	Saccolaimus saccolaimus	Bare-rumped Sheathtail-bat						•		
Emballonuridae	Taphozous georgianus	Common Sheath-tailed Bat				•	•			
Equidae	Equus caballus	Horse					•			
Felidae	Felis catus	Cat					•			•
Hipposideridae	Hipposideros ater	Dusky Leafnosed-bat					•			
Hipposideridae	Hipposideros stenotis	northern leaf-nosed bat	P2		•		•			
Macropodidae	Macropus agilis	Agile Wallaby					•			
Macropodidae	Macropus antilopinus	Antilopine Wallaroo					•			
Macropodidae	Macropus robustus	Euro					•			•
Macropodidae	Macropus rufus	Red Kangaroo					•			
Macropodidae	Notamacropus agilis	Agile Wallaby				•				
Macropodidae	Onychogalea unguifera	Northern Nailtail Wallaby				•	•			•
Macropodidae	Petrogale brachyotis	Short-eared Rock-wallaby				•	•			
Macropodidae	Petrogale concinna	Nabarlek						•		
Macropodidae	Petrogale lateralis	Black-footed Rock-wallaby						•		
Megadermatidae	Macroderma gigas	Ghost Bat	VU	VU	•		•	•		
Miniopteridae	Miniopterus orianae	Northern Bent-winged Bat or Large Bent-winged Bat					•			•
Molossidae	Chaerephon jobensis	Greater Northern Freetail-bat				•	•			•
Muridae	Leggadina lakedownensis	Northern Short-tailed Mouse, Lakeland Downs mouse, kerakenga	P4		•	•	•			

Family	Species	Common name	BC Act	EPBC Act	TPFA	ALA	Nature Map	PMST	Birdlife Bird Data	This Survey
Muridae	Pseudomys delicatulus	Delicate Mouse					•			•
Muridae	Pseudomys nanus	Western Chestnut Mouse				•	•			•
Muridae	Rattus tunneyi	Pale Field-rat				•	•			•
Muridae	Rattus villosissimus	Long-haired Rat								•
Muridae	Zyzomys argurus	Common Rock-rat				•	•			
Peramelidae	Isoodon auratus	Golden Bandicoot	VU	VU				•		•
Peramelidae	Isoodon macrourus	Northern Brown Bandicoot								•
Phalangeridae	Trichosurus vulpecula arnhemensis	Northern Brushtail Possum	VU	VU	•			•		
Pseudocheiridae	Petropseudes dahli	Rock Ringtail Possum	P3		•	•	•			
Pteropodidae	Pteropus alecto	Black Flying-fox				•	•			
Pteropodidae	Pteropus scapulatus	Little Red Flying-fox				•				
Rhinonycteridae	Rhinonicteris aurantia	Orange leaf-nosed bat	P4		•		•			
Tachyglossidae	Tachyglossus aculeatus	Short-beaked Echidna					•			
Thylacomyidae	Macrotis lagotis	Bilby	VU	VU	•			•		
Vespertilionidae	Chalinolobus gouldii	Gould's Wattled Bat				•	•			•
Vespertilionidae	Chalinolobus nigrogriseus	Hoary Wattled Bat				•	•			•
Vespertilionidae	Nyctophilus arnhemensis	Arnhem Land Long-eared Bat					•			
Vespertilionidae	Nyctophilus walkeri	Pygmy Long-eared Bat					•			
Vespertilionidae	Scotorepens greyii	Little Broad-nosed Bat					•			
Vespertilionidae	Vespadelus caurinus	Western Cave Bat				•	•			
Vespertilionidae	Vespadelus douglasorum	Yellow-lipped Cave Bat	P2		•	•	•			

Appendix D Fauna species by site matrix

Species	SITE01	SITE02	SITE03	SITE04	SITE05	SITE06	SITE07	SITE08	SITE09	SITE10	SITE11	SITE12	SITE13	SITE14	SITE15	SITE16	Opp-01	Opp-02	Opp-03	Opp-04	Opp-05	Opp-06	Opp-07	Opp-08	Opp-09	Opp-10	Opp-11	Opp-12	Opp-13	Opp-14	Opp-15	Opp-16	Opp-17	Opp-18	Opp-19	Opp-20	Opp-21	Opp-22	Grand Total
AMPHIBIANS																																							
Rhinella marina																1																								1
Litoria rothii									3																														3
Uperoleia borealis	1																																						1
REPTILES																																							
Liasis olivaceus																1																								1
Ctenotus piankai		1																																					1
Eremiascincus isolepis								1																															1
Lerista bipes	9			1				1																															11
Morethia ruficauda								2		1																													3
Diporiphora margaretae		1																																					1
Tiliqua scincoides			1																																				1
BIRDS																																							
Anas superciliosa											42																												42
Aythya australis											1																												1
Anseranas semipalmata										2																													2
Eurostopodus argus																																		3					3
Burhinus grallarius																							1	1															2
Elseyornis melanops											2					2																							4

Species	SITE01	SITE02	SITE03	SITE04	SITE05	SITE06	SITE07	SITE08	SITE09	SITE10	SITE11	SITE12	SITE13	SITE14	SITE15	SITE16	Opp-01	Opp-02	Opp-03	Opp-04	Opp-05	Opp-06	Opp-07	Opp-08	Opp-09	Opp-10	Opp-11	Opp-12	Opp-13	Opp-14	Opp-15	Opp-16	Opp-17	Opp-18	Opp-19	Opp-20	Opp-21	Opp-22	Grand Total
Vanellus miles																														5									5
Ardea ibis										1																													1
Ardea intermedia										2																													2
Ardea modesta																1																							1
Ardea novaehollandiae										1	1			1																									3
Ardea pacifica										1	3			1		2																							7
Nycticorax caledonicus														1																									1
Ephippiorhynchus asiaticus																											3												3
Threskiornis spinicollis										1	2																												3
Geopelia cuneata	6											1																											7
Geopelia humeralis	2							1		10		1	1		1	1																							17
Ocyphaps lophotes												1																											1
Ceyx azureus															1																									1
Dacelo leachii												1		1																										2
Todiramphus pyrrhopygius				1																																			1
Todiramphus sanctus														1	1																									2
Merops ornatus	2			1	2	1	2	1		5				1	1																									16
Cacomantis pallidus												1																												1
Chrysococcyx basalis	1			1		1		1	1	1																													6

Species	SITE01	SITE02	SITE03	SITE04	SITE05	SITE06	SITE07	SITE08	SITE09	SITE10	SITE11	SITE12	SITE13	SITE14	SITE15	SITE16	Opp-01	Opp-02	Opp-03	Opp-04	Opp-05	Opp-06	Opp-07	Opp-08	Opp-09	Opp-10	Opp-11	Opp-12	Opp-13	Opp-14	Opp-15	Opp-16	Opp-17	Opp-18	Opp-19	Opp-20	Opp-21	Opp-22	Grand Total
Accipiter cirrocephalus	1				1			2		1																													5
Accipiter fasciatus		1																																					1
Aquila audax	1																																						1
Circus approximans											1																												1
Haliastur sphenurus										1		1		2	1	2																							7
Hamirostra melanosternon													1				3																						4
Hieraaetus morphnoides															1																								1
Falco berigora												1								1																			2
Falco cenchroides																													1										1
Falco longipennis											1																												1
Coturnix ypsilophora	2	3										1																											6
Grus rubicunda										1												3																	4
Ardeotis australis										1					1	2										1													5
Smicrornis brevirostris															1																								1
Artamus cinereus							1							15							3																		19
Artamus leucorynchus																																			3				3
Artamus minor										1				6	1																					1				9
Artamus personatus								3																															3
Coracina novaehollandiae	1		1	1				1																															4

Species	SITE01	SITE02	SITE03	SITE04	SITE05	SITE06	SITE07	SITE08	SITE09	SITE10	SITE11	SITE12	SITE13	SITE14	SITE15	SITE16	Opp-01	Opp-02	Opp-03	Opp-04	Opp-05	Opp-06	Opp-07	Opp-08	Opp-09	Opp-10	Opp-11	Opp-12	Opp-13	Opp-14	Opp-15	Opp-16	Opp-17	Opp-18	Opp-19	Opp-20	Opp-21	Opp-22	Grand Total
Lalage tricolor				1																																			1
Corvus orru				1	1	1		12		1																													16
Cracticus nigrogularis			1					1																															2
Cracticus tibicen																														1									1
Grallina cyanoleuca	2	2				2				1	100	1		1	1	2															12								124
Myiagra inquieta				1							1	1		1								1																	5
Rhipidura leucophrys	1				1	1		1	1	1	3	1		1	1	1																							13
Erythrura gouldiae										3																													3
Neochmia phaeton																																	2						2
Neochmia ruficauda																																	3						3
Poephila acuticauda								3		30		1						40																					74
Poephila personata								1											3																				4
Taeniopygia bichenovii										10		1	1																				1						13
Taeniopygia guttata					30	2						1																											33
Petrochelidon ariel										6				5																									11
Petrochelidon nigricans															4																					2			6
Amytornis housei																																					1		1
Malurus lamberti	3																																						3
Malurus melanocephalus	3													3	1																								7

Species	SITE01	SITE02	SITE03	SITE04	SITE05	SITE06	SITE07	SITE08	SITE09	SITE10	SITE11	SITE12	SITE13	SITE14	SITE15	SITE16	Opp-01	Opp-02	Opp-03	Opp-04	Opp-05	Opp-06	Opp-07	Opp-08	Opp-09	Opp-10	Opp-11	Opp-12	Opp-13	Opp-14	Opp-15	Opp-16	Opp-17	Opp-18	Opp-19	Opp-20	Opp-21	Opp-22	Grand Total
Cissomela pectoralis							2														1																			3
Gavicalis virescens	1	3	1	1	1	2	1	1	1					1																										13
Lichmera indistincta	2	2	1	6	1	1	1	2																																16
Manorina flavigula																														5										5
Melithreptus albogularis			1																																					1
Melithreptus brevirostris											6																													6
Philemon argenticeps	1																																							1
Philemon citreogularis	1	2	1	1				1	1					1																										8
Ptilotula flavescens	1	2		3				2						5	1	2																								16
Stomiopera unicolor														1	2																									3
Oriolus sagittatus												2																												2
Colluricincla harmonica	1							1																																2
Pachycephala rufiventris	1			1				1					1		3																						1			8
Pardalotus striatus	5			1												2																								8
Pomatostomus temporalis	1		1	4	2		1	1						2																										12
Ptilonorhynchus nuchalis														1																4										5
Megalurus timoriensis								1	1																															2
Phalacrocorax melanoleucos											2																													2

Species	SITE01	SITE02	SITE03	SITE04	SITE05	SITE06	SITE07	SITE08	SITE09	SITE10	SITE11	SITE12	SITE13	SITE14	SITE15	SITE16	Opp-01	Opp-02	Opp-03	Opp-04	Opp-05	Opp-06	Opp-07	Opp-08	Opp-09	Opp-10	Opp-11	Opp-12	Opp-13	Opp-14	Opp-15	Opp-16	Opp-17	Opp-18	Opp-19	Opp-20	Opp-21	Opp-22	Grand Total
Tachybaptus novaehollandiae											47																												47
Aprosmictus erythropterus							4	2				1		5																										12
Cacatua galerita														1																										1
Cacatua roseicapilla	2		1			8		1	1	40						1																							54
Cacatua sanguinea	1									2				4																										7
Calyptorhynchus banksii			1						4							2																						6	13
Melopsittacus undulatus									20																														20
Trichoglossus rubritorquis		4	3	2																																	12	21
MAMMALS																																						
Bos taurus	1	3		1		1	1	1						1		1									5														15
Canis familiaris		1			1										1	1																							4
Felis catus								1								1											1												3
Pseudantechinus ningbing									1																														1
Onychogalea unguifera	1			1											1																	1							4
Osphranter robustus				1										1																									2
Isoodon auratus / macrourus			1	3																																			4
Isoodon auratus								1																															1
Isoodon macrourus								1																															1
Pseudomys delicatulus	2	1	1	1	1	1		2	1																														10

Species	SITE01	SITE02	SITE03	SITE04	SITE05	SITE06	SITE07	SITE08	SITE09	SITE10	SITE11	SITE12	SITE13	SITE14	SITE15	SITE16	Opp-01	Opp-02	Opp-03	Opp-04	Opp-05	Opp-06	Opp-07	Opp-08	Opp-09	Opp-10	Opp-11	Opp-12	Opp-13	Opp-14	Opp-15	Opp-16	Opp-17	Opp-18	Opp-19	Opp-20	Opp-21	Opp-22	Grand Total
Pseudomys nanus					1	1	1	1																															4
Rattus tunneyi						1	1																																2
Rattus villosissimus		1			1	1	1	1																															5