Greenbushes Targeted Vertebrate and SRE Invertebrate Fauna Survey

Talison Lithium Limited

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EXECUTIVE SUMMARY

Talison Lithium Limited (Talison) mines and processes lithium bearing mineral spodumene at the Greenbushes Mine, located directly south of the Greenbushes town, approximately 250 kilometres (km) south of Perth, Western Australia. Biologic Environmental Survey Pty Ltd (Biologic) was commissioned by Talison to undertake a targeted survey for vertebrate fauna of conservation significance and short-range endemic invertebrates (SRE) within and surrounding the Greenbushes Mine. The area considered for this assessment (hereafter referred to as the Study Area) comprised 1,989 hectares (ha) and included the current mining area and an indicative future disturbance area.

The overarching objective of the survey was to determine the occurrence for a selection of vertebrate fauna considered to be of conservation significance and SRE fauna within the Study Area. Vertebrate fauna species of interest for this survey were species listed as 'Threatened' (Critically Endangered, Endangered, Vulnerable) or Conservation Dependent (Schedule 6) under the *Environment Protection and Biodiversity Conservation Act* (EPBC Act) and/or *Wildlife Conservation Act 1950* (WC Act), and considered possible, likely, highly likely or confirmed within the Study Area: the Western Ringtail Possum, Ngwayir (*Pseudocheirus occidentalis*), Western Quoll, Chuditch (*Dasyurus geoffroii*), Quokka (*Setonix brachyurus*) and Wambenger Brush-tailed Phascogale (*Phascogale tapoatafa wambenger*). The SRE component of the survey focussed on those taxonomic groups which are prone to endemism and commonly surveyed during SRE surveys for Environmental Impact Assessment (EIA): mygalomorph spiders, selenopid spiders, pseudoscorpions, scorpions, isopods, millipedes and terrestrial snails.

The survey was undertaken between the 12th and 21st of February 2018. Twelve motion camera sites were established in the Study Area, each consisting of five baited cameras. Twelve additional motion cameras were deployed opportunistically throughout the Study Area. Motion cameras were deployed at 24 individual locations for a total of 410 motion camera nights. Targeted searches for vertebrate fauna were conducted at 27 locations within the Study Area. Spotlighting searches were undertaken at ten locations over four nights. SRE sampling comprised sampling at 12 sites for a total of 18 personnel hours. Each site was subject to active foraging, leaf and soil sieving and burrow excavations (if found).

A total of 43 species were recorded during the survey directly and/or via secondary evidence, comprising 14 mammals (including six introduced species), 30 birds, seven reptiles and two amphibians. This total included five species considered of conservation significance:

- Western Quoll – Vulnerable (EPBC Act and WC Act);
- Forest Red-tailed Black Cockatoo – Vulnerable (EPBC Act, WC Act);
- Wambenger Brush-tailed Phascogale – Vulnerable (WC Act);
- Southern Brown Bandicoot – Priority 4 (DBCA Priority List); and
- Western Brush Wallaby – Priority 4 (DBCA Priority List).

Scats possibly belonging to the Western Ringtail Possum (Vulnerable, EPBC Act; Critically Endangered, WC Act) were also recorded but could not be confirmed as belonging to the species.

Based on the results of the survey, it is likely that all vertebrate fauna species of conservation significance occurring within the Study Area would be somewhat impacted by the proposed development, particularly if the Jarrah/Marri Forest (404 ha, 20%) and/or Jarrah/Marri Forest over Banksia (267 ha, 13%) habitat types are impacted. Both habitats appear to be habitat critical to the survival of each of these species.

Three invertebrate taxa recorded during the survey were identified as 'Potential SRE'. In all three cases, a precautionary level of Potential SRE was allocated as a precise taxonomic identification could not be made. This comprised two specimens identified as Nemesiidae sp. indet, two specimens of Paradoxosomatidae sp. indet., and one specimen belonging to the family Siphonotidae. Although limited, the current information for these taxa indicates that there is a reasonable likelihood that they may be range restricted. In each instance, genetic analysis would be required to determine the species and/or if the specimens are unique to what has previously been recorded within the region. A review of the habitats present in surrounding area and their connectivity indicates that all taxa identified as 'Potential SRE' may potentially occur in synonymous habitats outside the Study Area. As such, development and clearing of habitats within the Study Area is unlikely to severely impact these species – although further survey work and genetic analysis would need to be conducted to confirm this.

1 INTRODUCTION

1.1 Background

Talison Lithium Limited (Talison) mines and processes lithium bearing mineral spodumene at the Greenbushes Mine, located directly south of the Greenbushes town, approximately 250 kilometres (km) south of Perth, Western Australia (Figure 1.1). Biologic Environmental Survey Pty Ltd (Biologic) was commissioned by Talison to undertake a targeted survey for vertebrate fauna of conservation significance and short-range endemic invertebrates (SRE) within and surrounding the Greenbushes Mine. The area considered for this assessment (hereafter referred to as the Study Area) comprised 1,989 hectares (ha) and included the current mining area and an indicative future disturbance area (Figure 1.1). Biologic are of the understanding that the assessment is required to assist Talison with approval for further expansions to the current mine.

A Level 1 vertebrate fauna survey was previously conducted over the Study Area (Biologic, 2011), which confirmed the occurrence of one species considered to be of conservation significance and identified the possible occurrence of several others. A desktop assessment was also conducted recently for the Study Area (Biologic, 2018) to update information provided within the previous assessment (i.e. in light of recent taxonomic and listing changes) and to assess the likelihood of occurrence for SRE fauna. The desktop assessment suggested that a survey targeting SRE and a selection of species of conservation significance be conducted to inform an impact assessment of future development.

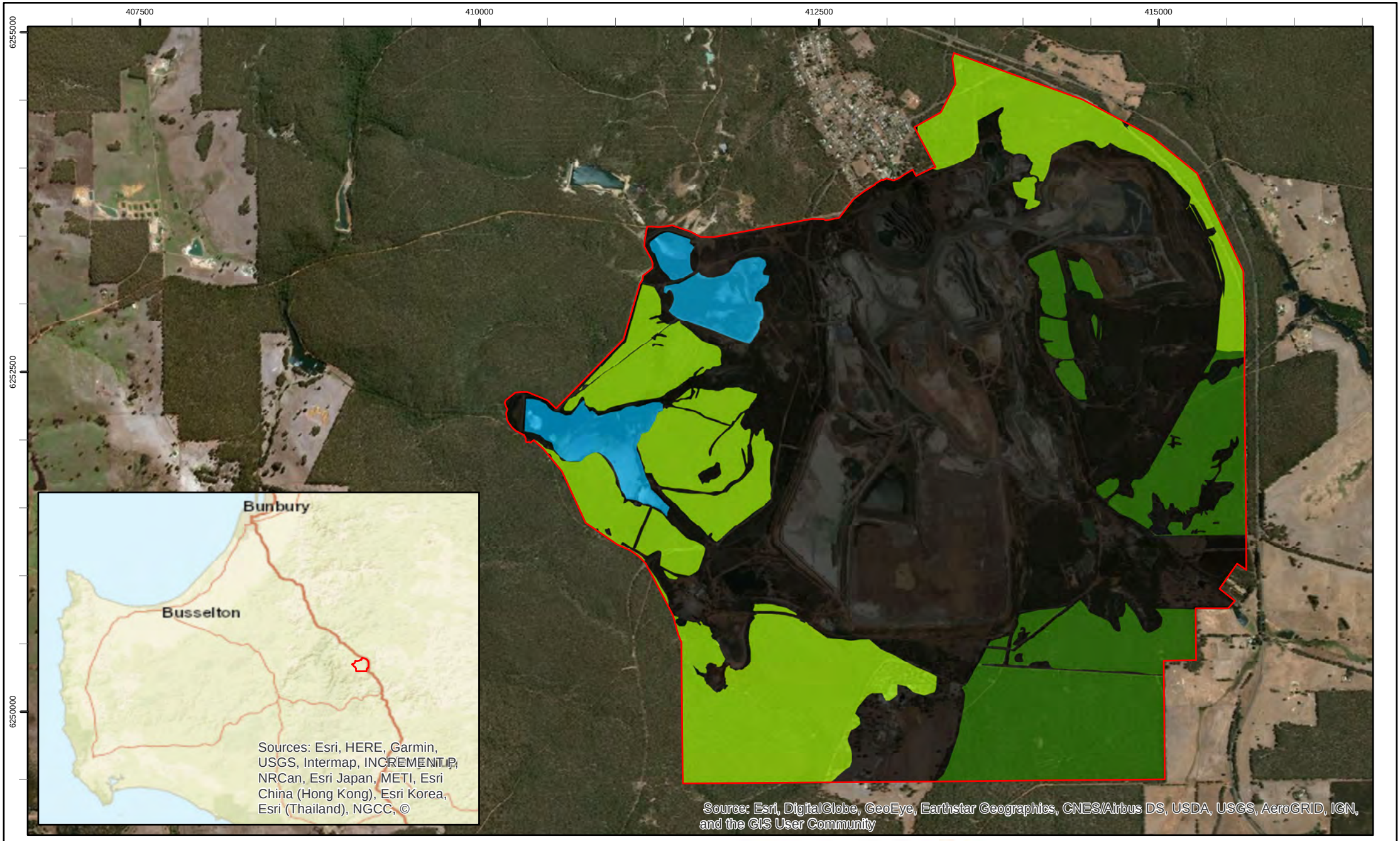
1.2 Objectives

The overarching objective of this survey was to determine the occurrence for a selection of vertebrate fauna considered to be of conservation significance and SRE fauna within the Study Area. Vertebrate fauna species of interest for this survey were species listed as Threatened (Critically Endangered, Endangered, Vulnerable) or Conservation Dependent (Schedule 6) under the EPBC Act and/or WC Act, and considered possible, likely, highly likely or confirmed within the Study Area: Western Ringtail Possum, Ngwayir (*Pseudocheirus occidentalis*), Western Quoll, Chuditch (*Dasyurus geoffroii*), Quokka (*Setonix brachyurus*) and Wambenger Brush-tailed Phascogale (*Phascogale tapoatafa wambenger*). The SRE component of the survey focussed on those taxonomic groups which are prone to endemism and commonly surveyed during SRE surveys for Environmental Impact Assessment (EIA): mygalomorph spiders, selenopid spiders, pseudoscorpions, scorpions, isopods, millipedes and terrestrial snails.

1.3 Compliance

This assessment was carried out in a manner consistent with the following documents developed by the Western Australian Environmental Protection Authority (EPA) and the Department of Environment and Energy (DoEE), formally the Department of Sustainability, Water, Population, and Communities (DSEWPaC):

- (EPA, 2016a) Technical Guidance: Sampling Methods for Terrestrial Vertebrate Fauna;
- EPA (2016c) Technical Guidance: Terrestrial Fauna Surveys;
- EPA (2016b) Technical Guidance: Sampling of Short-range Endemic Invertebrate Fauna; and
- DSEWPaC (2011) Survey Guidelines for Australia's Threatened Mammals



Legend

- Study Area

Broad Fauna Habitats

- Jarrah/Marri Forest over Banksia
- Jarrah/Marri Forest
- Marri/Blackbutt/Flooded Gum Woodland
- Water Bodies
- Disturbed

biologic Environmental Survey

N

1:35,000

0 0.375 0.75 1.5 km

Talison Lithium Australia

Greenbushes Targeted Fauna Survey

Figure 1.1: Study Area and regional location

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

Size A4. Created 10/07/2018

2 SPECIES OF CONSERVATION SIGNIFICANCE

2.1.1 Conservation Significance

Within Western Australia, native fauna are protected under the *Wildlife Conservation Act 1950* (WC Act) and at a national level under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). Any action that has the potential to impact on native fauna needs to be approved by relevant state and/or federal departments as dictated by the state *Environmental Protection Act 1986* (EP Act).

Some species of fauna that are determined to be at risk of extinction or decline are afforded extra protection under these Acts. For the purposes of this report, these species are deemed to be of conservation significance. A summary of applicable legislation and status codes is provided in Appendix A. For some species, there is insufficient information to determine their status. These species are also considered by the EPA and the Department of Biodiversity, Conservation and Attraction's (DBCA) as being of conservation significance for all development related approvals and are listed on a 'Priority List' that is regularly reviewed and maintained by the DBCA (Appendix A).

2.1.2 Species of Conservation Significance within the Study Area

The desktop assessment identified a total of 291 species of vertebrate fauna which have previously been recorded and/or have the potential to occur within the Study Area (Biologic, 2018). Of the 291 species of vertebrate fauna identified, 44 species are considered to be of conservation significance, comprising 13 mammals, 23 birds, two reptiles, one amphibian and five fish species (Biologic, 2018). The four species which were targeted during this survey are detailed below.

2.2 Western Ringtail Possum, Ngwayir (*Pseudocheirus occidentalis*)

The Western Ringtail Possum is currently listed as Vulnerable under the EPBC Act, Schedule 1 (Critically Endangered) under the WC Act and Critically Endangered by the International Union for Conservation of Nature and Natural Resources (IUCN).

Biology and Ecology

The Western Ringtail Possum is a nocturnal species distinguishable by its slender prehensile white-tipped tail. It feeds on the leaves of Peppermint (*Agonis flexuosa*) Trees (near the coast) and Jarrah (*Eucalyptus marginata*) and Marri (*Corymbia calophylla*) trees (further inland where such vegetation predominates) (Jones, 1995). While this species breeds throughout the year, pouch young are born predominantly during late autumn to winter (de Tores, 2008). Females usually only give birth to one individual, although there are rare occasions when a female has produced a litter of 2-3 young (Jones *et al.*, 1994). Young emerge from their mother pouch after three months and continue to suckle for a further 3-4 months (Jones *et al.*, 1994).

Throughout its range, this species shelters in dreys constructed from leaves (in coastal areas) and tree hollows (4 km inland from the coast) (Jones, 1995). None-the-less, tree hollows are important across this species' range, whereby hollow abundance is positively correlated with possum abundance in peppermint/tuart associations and makes up 70% of the refugia available to the Western Ringtail Possum in the jarrah forests (Williams *et al.*, 2017). Their home ranges vary between 0.5 and 2.5 hectares and

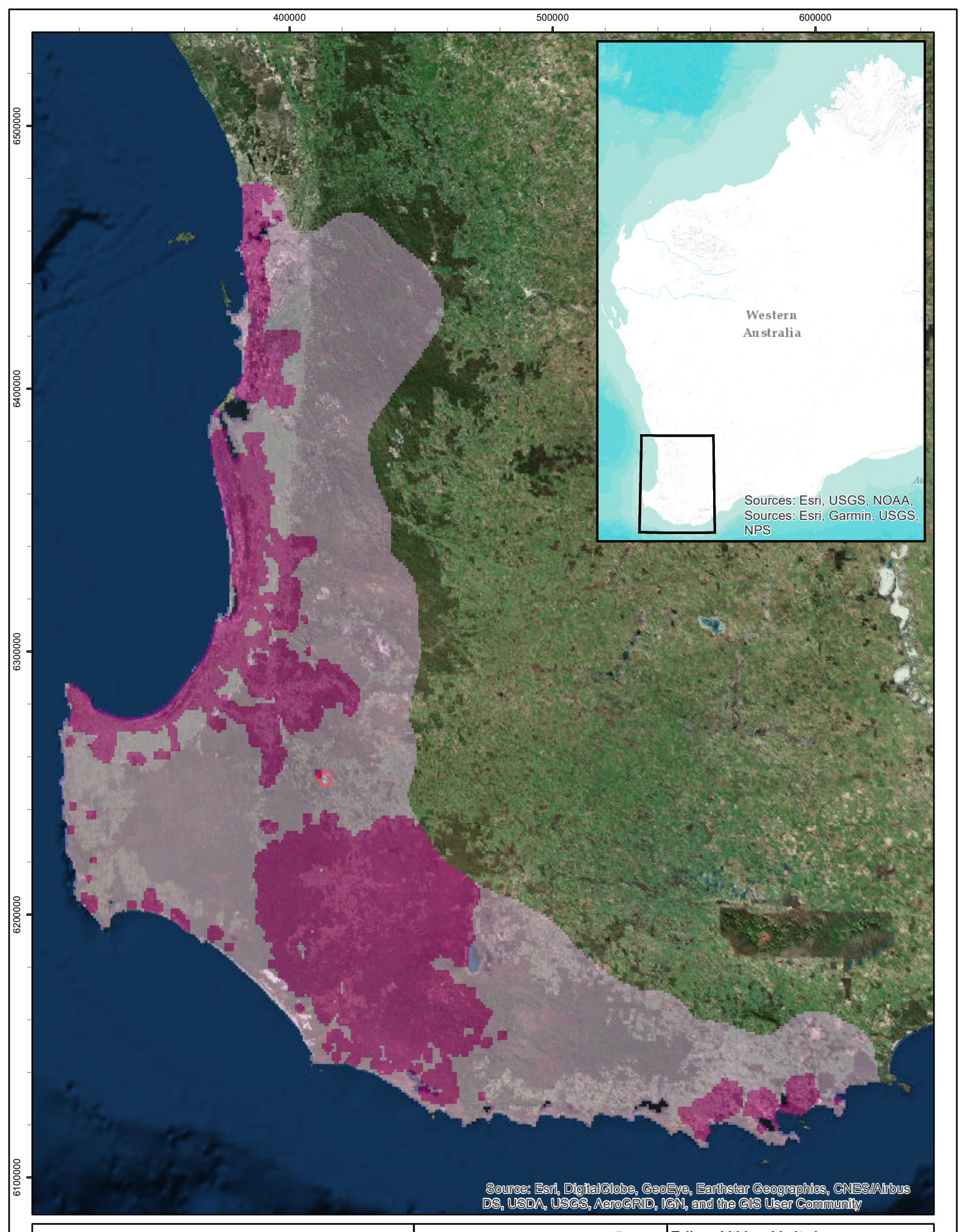
consists of 3-8 nesting sites (Jones, 1995) but may consist of a total of 20 throughout the year (Wayne *et al.*, 2005). While the species is solitary, the home ranges of adjacent individuals tend to overlap (Jones *et al.*, 1994).

Distribution

This species was formerly distributed throughout much of the southwestern Australia (de Tores, 2008) but is now confined to five regional locations the near-coastal area between Bunbury and Augusta, the south coast between Walpole and Albany, the lower Collie River Valley, Harvey River, and at the Perup Nature Reserve and the surrounding forest blocks near Manjimup (de Tores, 2008; de Tores *et al.*, 2004) (Figure 2.1). The Western Ringtail Possum is threatened by habitat loss and fragmentation, predation by introduced predators, changing fire regimes, climate change, competition for nest hollows and timber harvesting (Woinarski *et al.*, 2014).

Habitat

Habitat preference differs across its known range. The Western Ringtail Possum is associated with peppermint dominated forest and woodland with a tuart *Eucalyptus gomphocephala* canopy in some areas along the coast south of Bunbury, in peppermint forest in the Busselton area and in Jarrah, Wandoo (*Eucalyptus wandoo*) and Marri forest in inland localities (de Tores, 2008). Three management zones have been identified as areas know to currently or previously support large numbers of this species. Populations within these management zones are considered the most important extant populations at present. These zones include the (1) Swan Coastal Plain zone (2) Southern Forest zone and (3) South Coast zone (Williams *et al.*, 2017).



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Study Area

DoEE Species Distribution

Species or species habitat likely to occur

Species or species habitat may occur

biologic Environmental Survey

N

1:1,750,000

0 15 30 60 km

Talison Lithium Limited

Greenbushes Targeted Fauna Survey

Figure 2.1: Western Ringtail Possum, Ngwayir, regional distribution

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

Size A4. Created 10/07/2018

2.3 Western Quoll, Chuditch (*Dasyurus geoffroii*)

The Western Quoll is currently listed as Vulnerable under the EPBC Act, Schedule 3 (Vulnerable) under the WC Act and Near Threatened by the IUCN.

Biology

The Western Quoll is the largest carnivorous marsupial in Western Australia. It is white spotted with brown pelage, large, rounded ears and a pointed muzzle (Smith *et al.*, 2004). This species is solitary, nocturnal and arboreal, although it will feed on the ground (Glen *et al.*, 2010). The Western Quoll dens in hollow logs, burrows and tree hollows with a diameter of 30 cm (Dunlop & Morris, 2012). Females may utilise up to 66 logs and 110 burrows within her home range (DEC, 2012a). Within Jarrah forests where foxes are present, male home ranges are 15 km^2 with a 'core area' (defined by den locations) of 4 km^2 (Rayner *et al.*, 2012). Female home ranges tend to be 3-4 km^2 with a 'core area of 0.9 km^2 (Rayner *et al.*, 2012). Males home ranges can overlap with other males and females; however, females defend their home ranges and seldom overlap with other females (Serena & Soderquist, 1989). Mating occurs in late April-early July and females give birth to 2-6 pouch young after a gestation period of 17-18 days. Young are fully weaned by 4-5 months and will begin to disperse in December (de Tores *et al.*, 2007).

The Western Quoll opportunistically feeds on native mammals as well as birds, small lizards, bird and reptile eggs and invertebrates (Glen *et al.*, 2010).

Distribution

The Chuditch formerly occurred over nearly 70% of Australia and occurred throughout arid and semi-arid regions; but it is now patchily distributed throughout the Jarrah forests and mixed Karri (*Eucalyptus diversicolor*), Marri, Jarrah forests of southwestern Australia (Dunlop & Morris, 2012) (Figure 2.2). The species also occurs in very low numbers in the Midwest, Wheatbelt and South Coast regions, with records from Moora to the north, Yellowdine to the east and south to Hopetoun (DEC, 2012a).

Habitat

The species is known to occupy in a wide range of habitats from woodlands, dry sclerophyll (leafy) forests, riparian vegetation, beaches and deserts (DEC, 2012a). Riparian vegetation appears to support higher densities of Chuditch, possibly attributable to better, more reliable food sources and superior cover offered by dense vegetation (Serena & Soderquist, 2008).

Legend

Study Area

DoEE Species Distribution

Species or species habitat likely to occur

Species or species habitat may occur

biologic Environmental Survey

N

1:7,000,000

0 65 130 260 km

Talison Lithium Limited

Greenbushes Targeted Fauna Survey

Figure 2.2: Western Quoll, Chuditch, regional distribution

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

Size A4. Created 10/07/2018

2.4 Quokka (*Setonix brachyurus*)

The Quokka is currently listed as Vulnerable under the EPBC Act, Schedule 3 under the WC Act and Vulnerable by the IUCN.

Biology

This nocturnal species resides in small colonies no larger than two dozen individuals (Hayward *et al.*, 2003). Their home ranges vary with locality and in the southern forests can be up to 71 ha (Hayward *et al.*, 2004). Males are very territorial and their core ranges barely overlap while females exhibit high shelter and group fidelity (Hayward *et al.*, 2003; Hayward *et al.*, 2004). Home ranges tend to be larger in summer and autumn compared to winter (most likely attributable to the relative availability of palatable and nutritional food) (Bain *et al.*, 2015). Moreover, males core ranges tend to be larger than that of females. Although mainland Quokkas breed throughout the year, the number of births significantly reduce during the summer months as female body weights declines (Hayward *et al.*, 2005a). None-the-less, females are capable of embryonic diapause and consistently wean two offspring a year and 17 offspring over a lifetime; however, recruitment to independence appears low (Hayward *et al.*, 2005a).

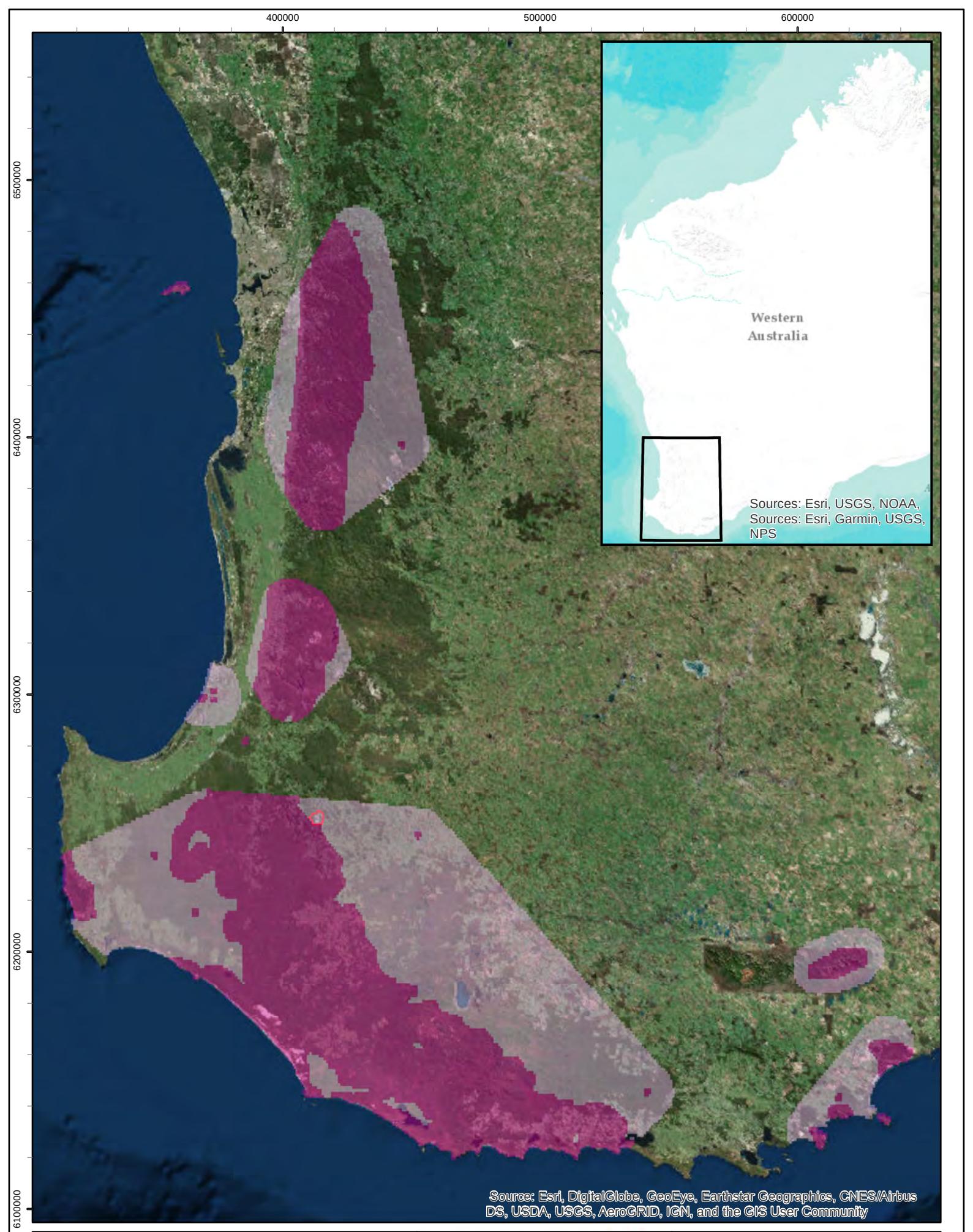
The Quokka is a browsing herbivore that consumes leaves and stems and they typically feed on early stages of vegetation (Hayward, 2005).

Distribution

Historically, the Quokka was widespread and abundant throughout southwestern Australia, although is now confined to 10 locations and seven distinct subpopulations (Figure 2.3) (de Tores *et al.*, 2007). The seven subpopulations are severely fragmented with little to no migration. The seven populations include Rottnest Island, Northern Jarrah Forests (state forests between Serpentine to Jarrahdale), Central Jarrah Forests (state forests in the Harris River area), Southern Jarrah-Karri Forests, South Coast (Two Peoples Bay Nature Reserve, Mount Manypeaks Nature Reserve, Tinkelelup Nature Reserve and Albany area), Stirling Range National Park and Bald Island Nature Reserve (de Tores *et al.*, 2007). Since the 1930's, the area of occupancy on the mainland is thought to have decreased by 50% (de Tores *et al.*, 2007).

Habitat

The Quokka is a habitat specialist, preferring complex vegetation structure with a minimum of three layers, low densities of woody debris and habitat patchiness (between 0 and 450 m to an alternative vegetation age) (Bain *et al.*, 2015). This species inhabits areas of dense, low understorey vegetation that provide refuge from predators and heat. The Quokka also requires water throughout the year and thus are often present in riparian and swamp habitat (Hayward *et al.*, 2005b). While the main habitat for mainland populations constitutes dense riparian vegetation, Quokka also use heath and shrubland, Swamp Peppermint (*Taxandria linearifolia*) dominated swamps in Jarrah forest, swampy shrublands, swordgrass-dominated understorey, regrowth areas of the Karri forest, Bullich (*Eucalyptus megacarpa*) swamp forest and Paperbark (*Melaleuca spp.*) swamp (Hayward *et al.*, 2005b). The draft Recovery Plan for the Quokka (DEC, 2013) identifies habitat critical to the survival of the species. In the southern forest, critical habitat comprises low-density of near-surface fuel, a complex vegetation structure and a varied fire-age mosaic.



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Study Area

DoEE Species Distribution

Species or species habitat likely to occur

Species or species habitat may occur

biologic Environmental Survey

N

1:1,800,000

0 15 30 60 km

Talison Lithium Limited

Greenbushes Targeted Fauna Survey

Figure 2.3: Quokka regional distribution

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

Size A4. Created 10/07/2018

2.5 Wambenger Brush-tailed Phascogale (*Phascogale tapoatafa wambenger*)

The Wambenger Brush-tailed Phascogale is currently listed as Schedule 6 under the WC Act and Near Threatened by the IUCN.

Biology

The Wambenger Brush-tailed Phascogale is characterised by its large naked ears and black, 'bottle-brush' like tail. This nocturnal, opportunistic feeder forages among the tree canopy, removing bark from tress in pursuit of prey (DEC, 2010). It predominantly feeds on invertebrates, but also on nectar and rarely on small vertebrates (Scarff *et al.*, 1998). Male home ranges overlap with other individuals and increase in size during the breeding season. Conversely, female home ranges do not overlap with unrelated females and can span 20-70 hectares (DEC, 2010). In addition, they tend to utilise many different nest sites (approximately 20) throughout their range (van der Ree *et al.*, 2006), with a preference for more matures trees (DEC, 2008) approximately 225 years of age (Rhind, 1996).

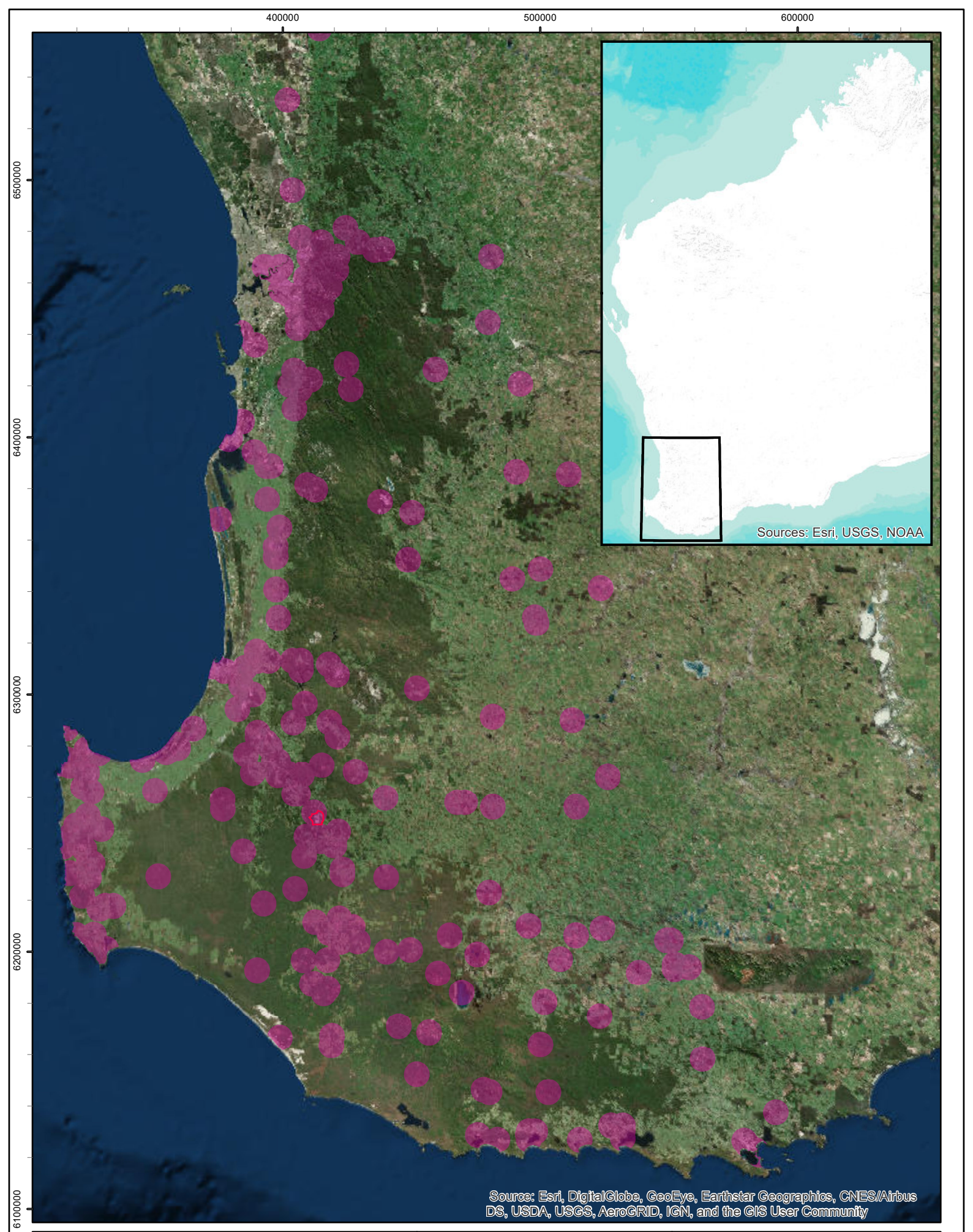
Although the breeding season for this species varies with locality, it generally occurs over a three-week period from mid-May to early July. Mating often occurs within tree hollows (DEC, 2010), and is followed by a 30 day gestation period (DEC, 2010). Stress-induced male die-off typically occurs at the end of the breeding season. Females give birth to a litter of 7-8 young (Millis *et al.*, 1999) and, after seven weeks, the young leave the pouch and reside in a maternal nest. By mid-summer, young disperse and males move larger distance than females (DEC, 2010).

Distribution

This subspecies was formerly distributed over a wide region of southwestern Australia, from Lake Hinds in the north to Kalgan in the southeast (Aplin *et al.*, 2015) (Figure 2.4). Its present distribution is believed to have reduced to approximately 50% of its former range and it is now known from Perth and south to Albany, west of Albany Highway. It occurs at low densities in the northern Jarrah forest and in highest densities in the Perup/Kingston area, Collie River valley, and near Margaret River and Busselton (Figure 2.4). The Wambenger Brushtail Phascogale is most likely impacted by habitat clearing and fragmentation, loss of tree hollows due to timber harvesting, mining, dieback disease and competition with feral bees, large and high intensity fires and environmental stress and disease (DEC, 2008).

Habitat

This subspecies has been observed in dry sclerophyll forests and open woodlands that contain hollow-bearing trees and sparse ground cover (DEC, 2010). The species has been observed nesting in Jarrah, Marri, Flooded Gum (*Eucalyptus rudis*) and Wandoo; however, their preference for nesting habitat appears less dependent on the species of tree and more dependent on the availability of suitable hollows (Rhind, 1996). Records are less common from wetter forests (DEC, 2010).



Legend

- Study Area
- ALA Species Records

biologic Environmental Survey

N

1:1,800,000

0 15 30 60 km

Talison Lithium Limited

Greenbushes Targeted Fauna Survey

Figure 2.3: Wambenger Brush-tailed Phascogale regional distribution

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

Size A4. Created 10/07/2018

3 SHORT-RANGE ENDEMIC INVERTEBRATES

Endemism refers to the restriction of a species to a particular area, whether it is at the continental, national or local scale, the latter being commonly referred to as short-range endemism (Allen *et al.*, 2006; Harvey, 2002). Short-range endemism is influenced by several factors including life history, physiology, habitat requirements, dispersal capabilities, biotic and abiotic interactions and historical conditions which not only influence the distribution of a species, but also the tendency for differentiation and speciation (Ponder & Colgan, 2002).

In recent years, several taxonomic groups of invertebrates have been highlighted as comprising a high proportion of species likely to be regarded as SREs (Table 3-1). This identification of restricted taxonomic groups has led to SRE invertebrate fauna being recognised as a potentially significant biodiversity issue, and that SRE fauna "may be at a greater risk of changes in conservation status as a result of habitat loss or other threatening processes" (EPA, 2016b).

Table 3-1: Taxonomic groups with known or likely SRE taxa in Western Australia (EPA, 2016b)

Phylum	Class	Order	Relevant Generic Group
Mollusca	Bivalvia	Unionoida	Freshwater mussels
	Gastropoda	Sorbeoconcha	Freshwater snails
		Eupulmonata	Land snails
Annelida	Oligochaeta	Haplotaxida	Earthworms
Onychophora	Onychophora	Onychophora	Velvet worms
Arthropoda	Arachnida	Araneae	Trapdoor spiders
		Pseudoscorpiones	Pseudoscorpions
		Schizomida	Schizomids
		Acari	Mites
	Malacostraca	Isopoda	Slaters
		Decapoda	Freshwater crayfish
	Diplopoda	Polydesmida	Millipedes
		Sphaerotheriida	Pill Millipedes
		Polyzoniida	Sucking Millipedes
		Spirostreptida	Spirostreptid Millipedes

Harvey (2002) proposed a range criterion for terrestrial short-range endemic (SRE) species at less than 10,000 km^2 (or 100 km x 100 km), which has been adopted by regulatory authorities in Western Australia (EPA, 2016b). SRE invertebrate species often share similar biological, behavioural and life history characteristics that influence their restricted distributions and limit their wider dispersal (Harvey, 2002). For example, burrowing taxa such as mygalomorph spiders and *Urodacus* scorpions may only leave their burrows (or a narrow home territory around the burrow) as juveniles dispersing from the maternal burrow, or when males search for a mate. In other cases, SRE taxa are dispersal-limited because of their slow pace of movement and cryptic habitats (such as isopods, millipedes and snails), while some specialised taxa can be limited by very specific habitat requirements, such as selenopid spiders within fractured rocky outcrops.

An increasingly large number of terrestrial invertebrates are discovered to exhibit short-range endemism in Western Australia. While protection for listed species (species of conservation significance) and/ or Threatened or Priority Ecological Communities is provided under state and federal legislation (see Section 2.1.1), the majority of SRE species and communities are not currently listed. This is due largely to incomplete taxonomic or ecological knowledge. As such, the assessment of conservation significance for SRE is guided primarily by expert advice provided by the Western Australian Museum (WAM) and other taxonomic experts.

4 FIELD SURVEY METHODOLOGY

The purpose of the field survey was to verify the data collated during the desktop assessment specifically the occurrence of target species and SRE species. Habitat assessments and habitat mapping has already been conducted over the Study Area (Biologic, 2011). Motion cameras, targeted searching and SRE sampling sites were the primary survey techniques utilised.

The survey was undertaken between the 12th and 21st of February 2018. by two experience zoologists, Michael Brown and Ray Lloyd. The survey was conducted under DBCA Regulation 17 license 08-001820-1 issued to C. Knuckey.

4.1 Timing and Weather

Greenbushes has a warm temperate climate, characterised by warm and dry summers with cool, wet winters. Rainfall ranges from 1200 millimetres (mm) in the south-west of the subregion to 500 mm in the east (Hearn *et al.*, 2002). Long-term rainfall data was available for Greenbushes (Station 9552; BoM, 2018); however, the nearest weather station documenting a long-term dataset of temperatures was Bridgetown (Station 9617; BoM, 2018) located 14 km south-east of the Study Area. Conditions experienced 6 months prior to (August 2017 to January 2018) were typical for the time of year. Greenbushes recorded 68.6 mm of rainfall, slightly higher than the long-term average for the same period (63.03 mm) (Figure 4.1).

Minimum temperatures during the survey ranged from 9.1ºC to 17.3ºC, with an average minimum of 12.9ºC, and maximum temperatures ranged from 22.6ºC to 33.7ºC with an average maximum of 28.8ºC (BoM, 2017) (Table 4-1). Only 0.8mm of rainfall was received during the survey, on the 20th of February 2018 (Table 4-1).

Table 4-1: Daily weather and recorded near the Study Area during the Survey

Date	Temperature (°C)		Rainfall (mm)
	Min	Max	
12/02/2018	9.1	29.9	0
13/02/2018	9.9	24.7	0
14/02/2018	11	29.6	0
15/02/2018	12.8	33.7	0
16/02/2018	15.3	33.5	0
17/02/2018	14.8	31.7	0
18/02/2018	17.3	31.4	0
19/02/2018	16.5	22.6	0
20/02/2018	10.8	23.9	0.8
21/02/2018	11.5	27.4	0
Average	**12.9**	**28.84**	**0.08**

Source: (BoM, 2018)

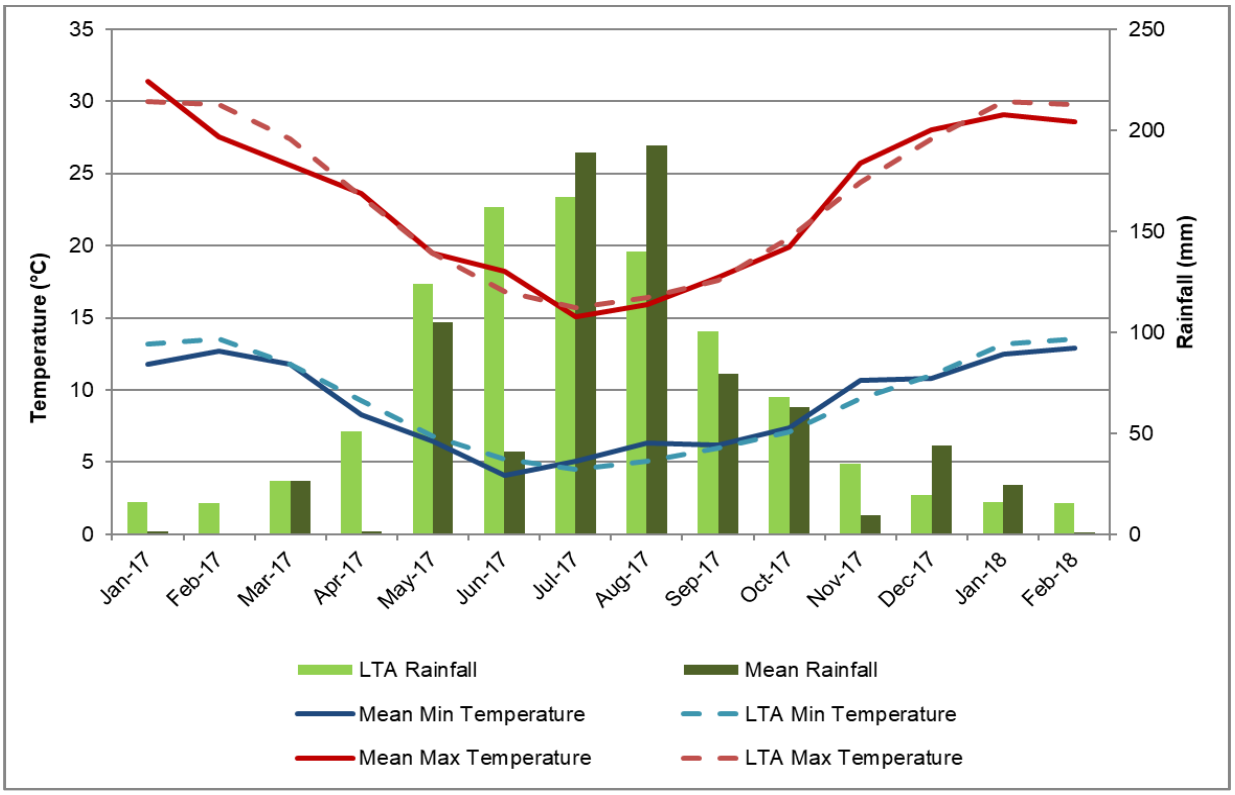


Figure 4.1: Long-term average and recent climatic data for the Study Area

4.2 Vertebrate Fauna

4.2.1 Motion Cameras

Twelve motion cameras transects were established across the Study Area (sites 1-12; Figure 4.2). Six of the transects were installed to target ground-dwelling species (sites 1-6), positioned on the ground, at log piles and fallen tree trunks (Appendix B). The remaining six transects (sites 7-12) targeted arboreal species, such as the Wambenger Brush-tailed Phascogale and Western Ringtail Possum (Appendix B). These cameras were deployed within trees and facing vertical tree trunks. Each transect consisted of five Bushnell Trophy Cams or Acorn motion cameras spaced ~50-100 m apart. Each camera was baited with universal bait, a mixture of oats, sardines and peanut butter. Cameras targeting ground dwelling species were deployed for seven nights while sites targeted arboreal species were deployed for six nights, equating to a total of 390 motion camera nights.

Additional cameras were also scattered elsewhere in the Study Area outside of the motion camera transects sites. Cameras were deployed at an additional twelve locations for 3-5 nights (Figure 4.2; Appendix B). Single motion cameras were deployed for a total of 50 nights. Cameras were targeted at ground-dwelling species and baited with universal bait.

Motion cameras were deployed at 24 distinct locations for a total of 410 motion camera nights (Figure 4.2; Appendix B).

4.2.2 Targeted Searches

Targeted searches were undertaken to identify the occurrence of fauna of conservation significance. Targeted searches were conducted within the most prospective areas in terms of microhabitat features and habitats suitable for species of conservation significance, although were spatially spread to ensure adequate coverage over all natural habitats within the Study Area.

Targeted searches were conducted at each of the twelve motion camera transects (12) as well as at 15 additional locations within the Study Area (Figure 4.3).

4.2.3 Spotlighting

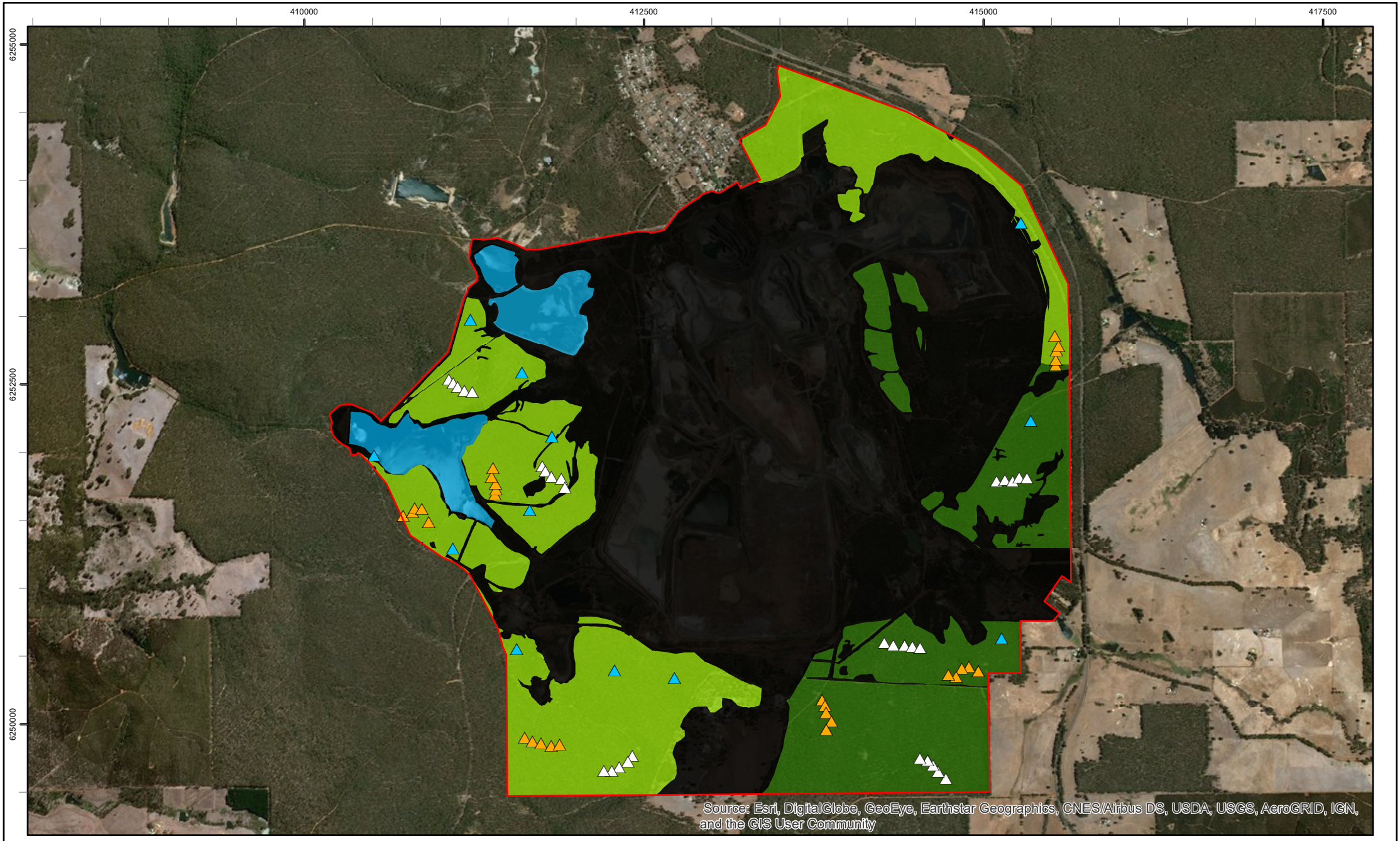
Spotlighting was undertaken on four nights of the survey 15-18th February. Spotlighting consisted of both walked searches and driving along tracks. Spotlighting searches were undertaken at ten locations (Figure 4.3).

4.2.4 Opportunistic Records

During the targeted searches and while traversing the Study Area, the team recorded all vertebrate fauna species encountered, either from primary (i.e. direct observation) or secondary (e.g. burrows, scratching's, diggings and scats) evidence. The locations of all fauna of conservation significance were recorded.

4.2.5 Taxonomy and Nomenclature

The latest checklist of mammal, reptile and amphibian names published by the Western Australian Museum (WAM, 2018b) was used as a guide to the current taxonomy and nomenclature of these groups. For birds, the current checklist of Australian birds maintained by Birds Australia (based on Christidis & Boles, 2008) used in conjunction with the WAM species list (WAM, 2018b).



Legend

- Study Area

Broad Fauna Habitats

- Jarrah/Marri Forest over Banksia
- Jarrah/Marri Forest
- Marri/Blackbutt/Flooded Gum Woodland
- Water Bodies
- Disturbed

Motion Camera Locations

- Ground-dwelling Fauna Camera
- Arboral Fauna Camera
- Opportunistic Camera

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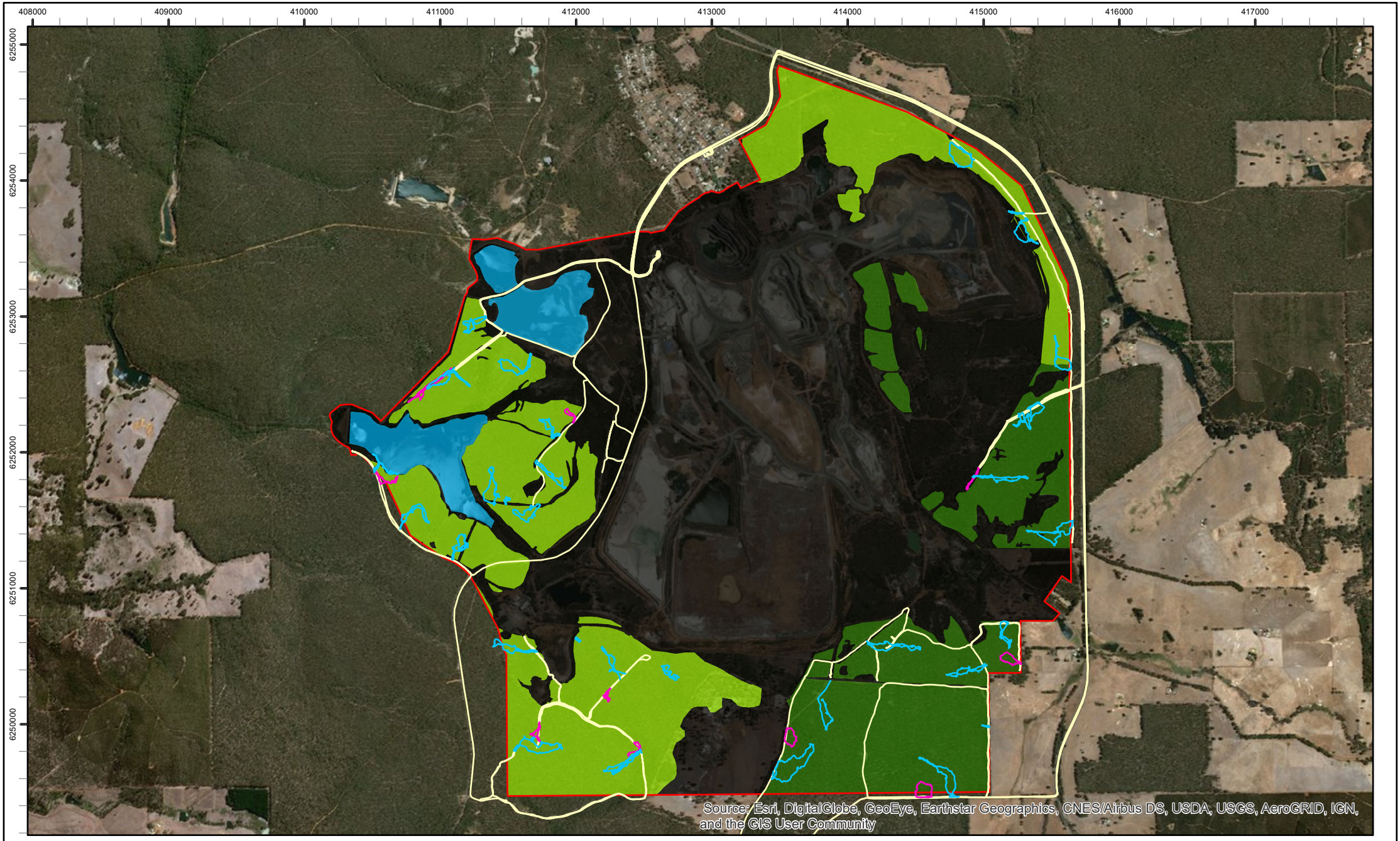
Talison Lithium Australia

Greenbushes Targeted Fauna Survey

Figure 4.2: Vertebrate fauna motion camera sampling locations

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

Size A4. Created 10/07/2018



Legend

- Study Area

Broad Fauna Habitats

- Jarrah/Marri Forest over Banksia
- Jarrah/Marri Forest
- Marri/Blackbutt/Flooded Gum Woodland
- Water Bodies
- Disturbed
- Diurnal_Searches
- Nocturnal_Searches
- Nocturnal_Drive

biologic Environmental Survey

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Talison Lithium Australia

Greenbushes Targeted Fauna Survey

Figure 4.3: Vertebrate fauna targeted searching locations

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

Size A4. Created 10/07/2018

4.3 Short-range Endemics

A total of 12 SRE sites over three habitat types were sampled during the survey (Figure 4.4; Appendix B). At each site, an area up-to approximately 25 metres in diameter (491 m^2 per site) was search around point locations displayed in Figure 4.4 (1962.5 m^2 in Jarrah/Marri Forest over Banksia dominated midstorey, 491 m^2 in Mine rehabilitation, and 3434.5 m^2 in Jarrah/Marri Forest). Each site was sampled for approximately 1.5 hours equating to a total of 18 person hours (Figure 4.4; Appendix B) using the following techniques: active foraging, leaf litter sifting and soil sifting, and targeted searches for spider and scorpion burrows.

4.3.1 Active Foraging

Active foraging was the primary technique undertaken at sites and involved searching within various microhabitat features including:

- woody debris: larger logs and woody debris were investigated and overturned searching for detritivores;
- vegetation and tree bark: significant vegetation were actively searched, including underneath sheets of bark; and
- burrow searching: active searches were undertaken for mygalomorph spider and scorpion burrows within suitable habitats. Note: searches for burrows are undertaken during foraging time and whilst walking through the Study Area, but time taken to excavate burrows is additional to foraging time.

4.3.2 Leaf litter and Soil Sifting

Leaf litter, humus and topsoil (to approximately 5 cm below surface) was placed in a sieve at the site and agitated to divide the sample into three grades (>7 mm, >3 mm, >1.4 mm, <1.4 mm). Each grade was thoroughly searched for target SRE species such as pseudoscorpions, millipedes, snails, and small scorpions. The maximum volume of litter in the sieve was approximately 4808 cm^3, and up to two sifts were conducted at each site, providing sufficient leaf litter and humus was available.

4.3.3 Specimen Preservation and Taxonomic Identification

All specimens were euthanised in 100% ethanol to preserve DNA for sequencing.

Mygalomorph spiders, scorpions and myriapods were sent to Dr Erich Volschenk and isopods were sent directly to Dr Simon Judd for taxonomic identification prior to vouchering at the WAM.

4.4 SRE Status Categorisation

The SRE status categories used in this report broadly follow the WAM's revised categorisation for SRE invertebrates. This system is based upon the 10,000km^2 range criterion proposed by Harvey (2002), and uses three broad categories to deal with varying levels of taxonomic certainty that may apply to any given taxon (Table 4-2).

Table 4-2: SRE categorisation used by WAM taxonomists

Distribution	Taxonomic Certainty	Taxonomic Uncertainty
<10,000km^2	Confirmed SRE • A known distribution of < 10,000km^2. • The taxonomy is well known. • The group is well represented in collections and/ or via comprehensive sampling.	Potential SRE • Patchy sampling has resulted in incomplete knowledge of geographic distribution. • Incomplete taxonomic knowledge. • The group is not well represented in collections. • Category applies where there are significant knowledge gaps. **SRE Sub-categories may apply:** A) Data Deficient B) Habitat Indicators C) Morphology Indicators D) Molecular Evidence E) Research & Expertise
>10,000km^2	Widespread (not an SRE) • A known distribution of > 10,000km^2. • The taxonomy is well known. • The group is well represented in collections and/ or via comprehensive sampling.	

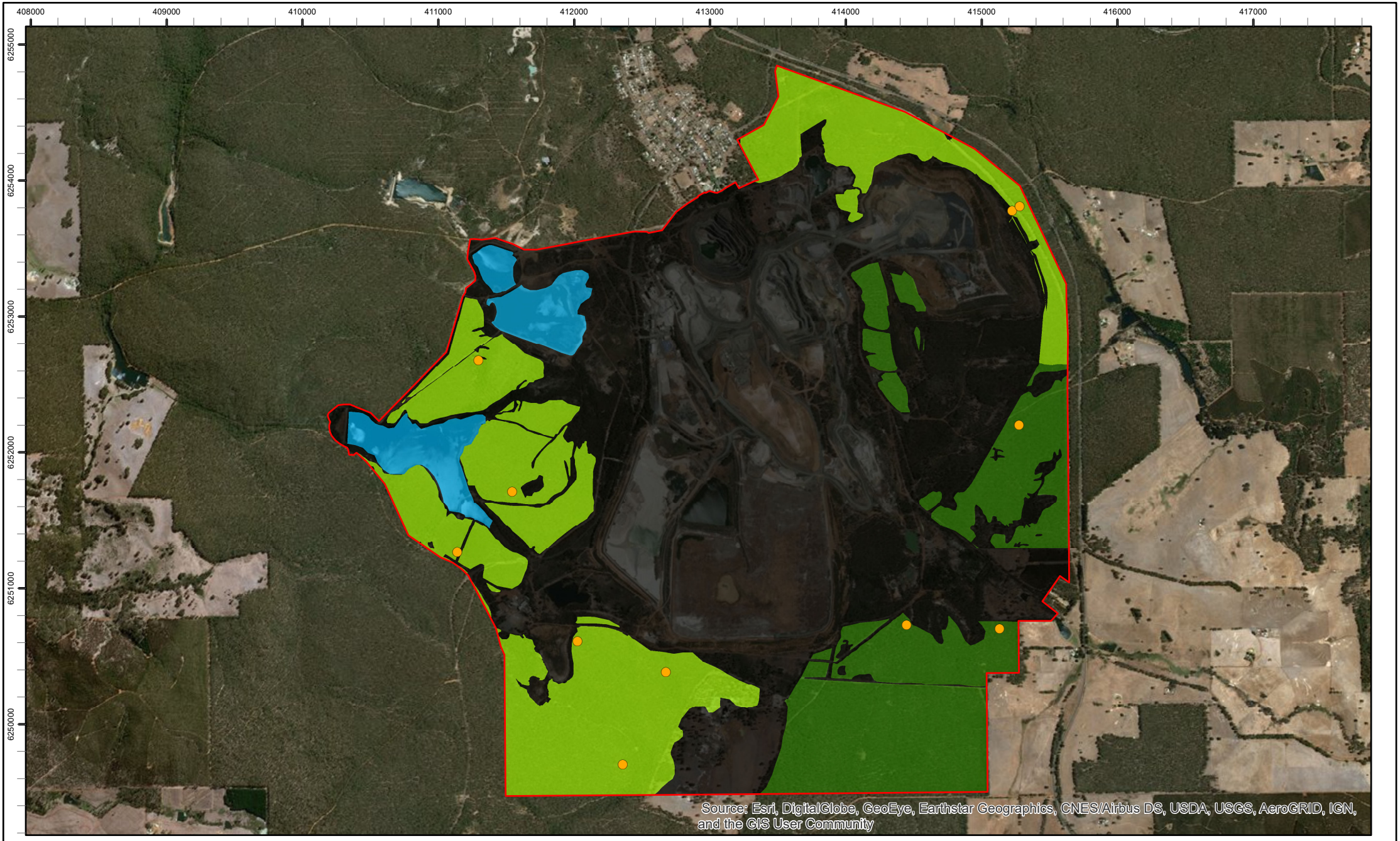
Under this system, “Potential SRE” status is the default categorisation for species within the typical SRE taxonomic groups including mygalomorph spiders, selenopid spiders, land snails, pseudoscorpions, scorpions, and isopods, unless sufficient evidence exists to confirm widespread or confirmed SRE status.

Potential SRE status is sub-categorised by what is currently known about the species in question; *i.e.* whether there are B) habitat indicators, C) morphology indicators, D) molecular evidence, or E) a weight of general knowledge and experience with the group that suggests a reasonable likelihood that the species could be SRE. In terms of SRE likelihood, the more evidence that exists under sub categories 'B', 'C', 'D', and 'E', the greater the likelihood that further investigation would confirm that the species is a SRE.

However, the Potential SRE category 'A' - data deficient is unique; this category indicates that the current information is insufficient to adequately assess the SRE status of the species in question. In such cases, where the SRE status cannot be confirmed, a conservative approach would be unable to consider the SRE risk to be higher than average where:

A. the taxonomy of the genus (or family) requires significant review to make any statement on SRE status, and/or
B. the genus is not known to include any confirmed SRE species within the region (subject to the extent of prior sampling / taxonomic effort).

To avoid confusion with other Potential SRE species for which there is some certainty and/or some precedent for their SRE status, this report represents the WAM’s "Potential SRE - category 'A' - data deficient” only as "data deficient". The results from taxonomists are also presented within the broader context of the results from habitat assessment, desktop review, habitat connectivity, and other ecological information collected during the survey. This approach aims to provide a more holistic assessment of SRE likelihood at scales relevant to the project, as well as the standard SRE range criterion of <10,000km^2 (Harvey, 2002).



Legend

- Study Area

Broad Fauna Habitats

- Jarrah/Marri Forest over Banksia
- Jarrah/Marri Forest
- Marri/Blackbutt/Flooded Gum Woodland
- Water Bodies
- Disturbed
- SRE Sample and Habitat Assessment

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Talison Lithium Australia

Greenbushes Targeted Fauna Survey

Figure 4.4: SRE sampling sites

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

Size A4. Created 10/07/2018

4.5 Potential Limitation and Constraints

4.5.1 Potential Limitation and Constraints

The EPA (2016b, 2016c) outlines several potential limitations to fauna surveys. These aspects are assessed and discussed in Table 4-3 below.

Table 4-3: Survey limitations and constraints

Potential limitation or constraint	Applicability to this survey
Experience of personnel.	The field personnel involved in the survey are highly experienced in surveying vertebrate and SRE throughout Western Australia. Both field personnel have over 10 years' experience undertaking surveys of this nature.
Scope (faunal groups sampled and whether any constraints affect this)	The primary objective of the survey was to determine the occurrence of vertebrate fauna species listed as Threatened or Conservation Dependent, which were assessed to possibly occur within the Study Area. Additionally, SRE invertebrates were all surveyed due to the potential occurrence of such species. No factors impacted the ability to undertake this work.
Proportion of fauna identified	Most vertebrate fauna species encountered during the survey and on motion camera were identified readily and with confidence. Two piles of scats were recorded during the survey which were identified as possibly belonging to the Western Ringtail Possum; however, it is difficult to distinguish these from the Common Brushtail Possum (*Trichosurus vulpecula vulpecula*), within the Southern Jarrah Forest without fresh material, and thus these scats were only deemed to 'possibly' belong to the species. Invertebrate specimens were sent to renowned taxonomic experts. Four specimens could not be identified to species level, due to absence of key diagnostic features (only present on adult males). Without a positive identification, these species were, as a precaution, assessed as 'Potential SRE'.
Sources of information (recent or historic) and availability of contextual information	A significant amount of survey work has been undertaken within the region, including baseline and targeted surveys, and monitoring programs for the species of interest. Most of the information is publicly available through reports, recovery plans and/or online databases – this information was obtained and reviewed by Biologic (2018).
Proportion of the task achieved	A targeted survey for the species and groups of interest was completed successfully and all objectives were answered effectively.
Disturbances (e.g. fire or flood)	A large portion of the Study Area has been previously disturbed by mining activity; however, these areas were not the focus of the assessment and thus did not impede the survey. No other disturbances affected the outcomes of the survey.
Intensity of survey	The level of survey was adequate to address the aims of the assessment and to provide a solid baseline for future work within the area.
Completeness of survey	The targeted survey was completed successfully and all objectives were answered effectively.
Resources (e.g. degree of expertise available)	All resources employed for the survey, including site access using 4WD vehicle, team make-up and experience levels, equipment used (i.e. motion cameras), logistics and safety support were suitable for the task.
Remoteness or access issues	The majority of the Study Area was accessible either by vehicle or on foot, thus the sampling techniques used during this survey were unconstrained by accessibility or remoteness.

5 RESULTS AND DISCUSSION

5.1 Vertebrate Fauna Recorded

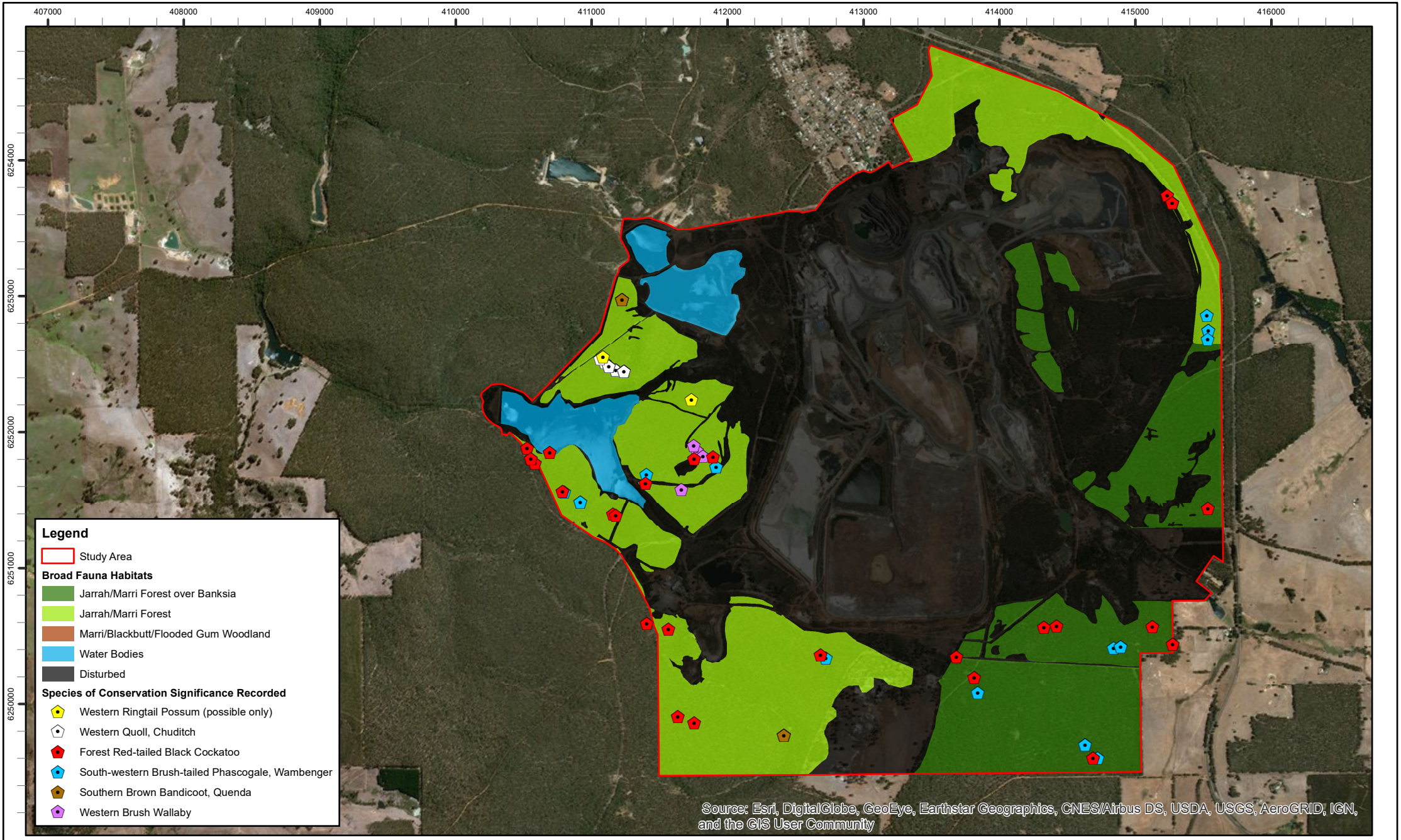
A total of 43 species were recorded during the survey directly and/or via secondary evidence, comprising 14 mammals (including six introduced species), 30 birds, seven reptiles and two amphibians (Table 5-1). Two species targeted during this survey were confirmed as occurring within the Study Area, the Western Quoll and the Wambenger Brush-tailed Phascogale (Figure 5.1; Appendix C). Scats possibly belonging to the Western Ringtail Possum were also recorded (Figure 5.1; Appendix C). Three additional species of conservation significance were also recorded within the Study Area, the Southern Brown Bandicoot (*Isoodon obesulus fusciventer*), Western Brush Wallaby (*Notamacropus Irma* - both species are listed as Priority 4 by DBCA) and the Forest Red-tailed Black Cockatoo (*Calyptorhynchus banksii naso* - listed as Vulnerable under the EPBC Act and WC Act) (Figure 5.1; Appendix C). Details on the occurrence of fauna of conservation significance can be located below (Section 5.2), except for the Forest Red-tailed Black Cockatoo which was assessed separately outside of this assessment.

Table 5-1: Vertebrate fauna recorded during the survey

Common Name	Scientific name	Record Type	Conservation Status	
			EPBC Act	In WA
Mammals				
Western Ringtail Possum, Ngwayir	*Pseudocheirus occidentalis*	Sc*	VU	S1
Western Quoll, Chuditch	*Dasyurus geoffroii*	MC	VU	S3
Wambenger Brush-tailed Phascogale	*Phascogale tapoatafa wambenger*	MC		S6
Southern Brown Bandicoot, Quenda	*Isoodon obesulus fusciventer*	MC		P4
Western Brush Wallaby	*Notamacropus irma*	MC		P4
Western Grey Kangaroo	*Macropus fuliginosus*	Op		
Common Brushtail Possum	*Trichosurus vulpecula*	MC, Sc		
Western Pygmy-possum	*Cercartetus concinnus*	Ob		
Pig	**Sus scrofa*	Di		
Fox	**Vulpes vulpes*	MC, Sc		
Cat	**Felis catus*	Tr		
Rabbit	**Oryctolagus cuniculus*	Ob		
House Mouse	**Mus musculus*	MC		
Black Rat	**Rattus rattus*	MC		
Birds				
Forest Red-tailed Black Cockatoo	*Calyptorhynchus banksii naso*	Ob, Sc	VU	S3
Emu	*Dromaius novaehollandiae*	Ob		
Musk Duck	*Biziura lobata*	Ob		
Black Swan	*Cygnus atratus*	Ob		
White-faced Heron	*Ardea novaehollandiae*	Ob		
Wedge-tailed Eagle	*Aquila audax*	Ob		
Square-tailed Kite	*Hamirostra isura*	Ob		

Common Name	Scientific name	Record Type	Conservation Status	
			EPBC Act	In WA
Common Bronzewing	*Phaps chalcoptera*	MC, Ob		
Purple-crowned Lorikeet	*Parvipsitta porphyrocephala*	Ob		
Australian Ringneck	*Platycercus zonarius*	Ob		
Boobook Owl	*Ninox boobook*	Ob		
Tawny Frogmouth	*Podargus strigoides*	Ob		
Australian Owlet-nightjar	*Aegotheles cristatus*	Ob		
Laughing Kookaburra	*Dacelo novaeguineae*	Ob		
Red-winged Fairy-wren	*Malurus elegans*	MC, Ob		
Yellow-rumped Thornbill	*Acanthiza chrysorrhoa*	Ob		
Western Gerygone	*Gerygone fusca*	Ob		
White-browed Scrubwren	*Sericornis frontalis*	Ob		
Striated Pardalote	*Pardalotus striatus*	Ob		
Australian Pelican	*Pelecanus conspicillatus*	Ob		
Red Wattlebird	*Anthochaera carunculata*	Ob		
New Holland Honeyeater	*Phylidonyris novaehollandiae*	Ob		
Western Yellow Robin	*Eopsaltria australis*	MC		
Scarlet Robin	*Petroica boondang*	MC		
Grey Fantail	*Rhipidura albiscapa*	Ob		
Willie Wagtail	*Rhipidura leucophrys*	Ob		
Dusky Woodswallow	*Artamus cyanopterus*	Ob		
Australian Magpie	*Cracticus tibicen*	MC, Ob		
Australian Raven	*Corvus coronoides*	MC, Ob		
Welcome Swallow	*Hirundo neoxena*	Ob		
Reptiles				
Southwestern Crevice Skink	*Egernia napoleonis*	Ob, Sc		
Four-toed Mulch Skink	*Hemiergis peronii*	Ob		
Southwestern Four-toed Lerista	*Lerista distinguenda*	Ob		
Shrubland Pale-flecked Morethia	*Morethia obscura*	Ob		
Western Bobtail	*Tiliqua rugosa*	MC, Ob		
Heath Monitor	*Varanus rosenbergi*	MC, Ob		
Tiger Snake	*Notechis scutatus*	Ob		
Amphibians				
Slender Tree Frog	*Litoria adelaidensis*	Ob		
Motorbike Frog	*Litoria moorei*	Ob		

MC = Motion Camera; Ob = Observation, Sc = Scat; Di = Digging; Tr = Tracks; * = possible only



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Talison Lithium Australia

Greenbushes Targeted Fauna Survey

Figure 5.1: Species of conservation significance recorded during the survey

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

Size A4. Created 10/07/2018

5.2 Occurrence of Targeted Vertebrate Fauna

5.2.1 Western Ringtail Possum, Ngwayir

Previous Records

Six records of Western Ringtail Possum have been recorded within the vicinity of the Study Area (DBCA, 2018). There are two records of the species approximately 320 m north of the Study Area from August and December 2014 (DBCA, 2018). The remaining four records are located within 20 km of the Study Area (DBCA, 2018). There is a notable density of NatureMap records between Balbarrup and Mayanup (~30km south east of the Study Area) as well as around Manjimup (~40 km south of the Study Area). Christensen *et al.* (1985) recorded Western Ringtail Possum in a pine plantation near Nannup (~30 km south west of the Study Area).

Records During Survey

Scats possibly belonging to Western Ringtail Possum (owing to their size and shape) were found in two locations in the north-western portion of the Study Area. The scats could not be confirmed due to similarity with scats of the Common Brushtail Possum within this region of the state (Jarrah Forest vs. Peppermint Forest). Note the Common Brushtail Possum was abundant throughout the Study Area.

Habitats within Study Area

The Study Area falls within the distribution of Western Ringtail Possum (Figure 2.1). Large expanses of undisturbed habitat located in the north west and south east of the Study Area are likely to support the species. The large portions of natural bush bisect the Study Area in the north-western portion of the Study Area. All potential Western Ringtail Possum scats were collected from Jarrah/Marri Forest habitat in the north-western portion of the Study. This is consistent with this species preference for Jarrah, Wandoo and Marri forest in inland localities (de Tores, 2008). The Jarrah/Marri Forest habitat constitutes 404 ha (20%) of the Study Area (Biologic, 2018).

5.2.2 Western Quoll, Chuditch

Previous Records

The Study Area occurs well within the species' distribution (Figure 2.2). Thirty-five records of Western Quoll have been recorded within the vicinity of the Study Area (DBCA, 2018). The nearest record was captured approximately 577 m north of the Study Area from June 1987 (DBCA, 2018). The remain 34 records are within approximately 21 km of the Study Area, a majority of which are to the north of the Study Area (DBCA, 2018).

Records During Survey

During the current survey, the species was recorded on five motion cameras set in a single targeted transect in the north-western portion of the Study Area (example Figure 5.2). Visually comparing spot patterning, it appears the captures may represent a single individual; however, a mark-capture-recapture survey would need to be conducted to confirm this and determine the population inhabiting the local area. This individual returned to three of the five motion cameras four consecutive nights in a row and to the fourth motion camera two consecutive nights in a row. It visited the fifth camera on only one night during

the survey. This suggest the individual is most likely a resident of the Study Area and that the Study Area (which falls well within the species distribution – refer to Figure 2.2) provides suitable habitat for the species.

Figure 5.2: Western Quoll recorded within the Study Area (Site 01)

Habitats within Study Area

The Chuditch was captured within the Jarrah/Marri Forest habitat within the north-western portion of the Study Area. The species is known to occupy a wide range of habitats from woodlands, dry sclerophyll (leafy) forests, riparian vegetation, beaches and deserts (DEC, 2012a). Riparian vegetation appears to support higher densities of Chuditch, possibly attributable to better, more reliable food sources and superior cover offered by dense vegetation (Serena & Soderquist, 2008). Given that the Jarrah/Marri Forest habitat in the north-western portion of the Study Area is adjacent to two waterbodies further suggests that the Study Area contains core habitat for this species. The Jarrah/Marri Forest habitat constitutes 404 ha (20%) of the Study Area.

5.2.3 Quokka

Previous Records

Forty-three records of Quokka have been recorded within the vicinity of the Study Area (DBCA, 2018). The nearest records were captured approximately 10.5 km, 11.1 km, 11.8 km and 12.3 km south west of the Study Area from December 2004, April 2005, February 2005 and April 2005 respectively (DBCA, 2018). The remaining 34 records are within 20 km of the Study Area to the south west (DBCA, 2018). There is a notable density of NatureMap records between Pemberton and Nannup (~30km south west of the Study Area). The Quokka was not recorded during the current survey although the Study Area occurs within the species' distribution (Figure 2.3).

Habitats within Study Area

Quokkas occur in a variety of habitats, and there is a variable understanding of habitat critical to survival across its range. The quokka's habitat requirements in the northern jarrah forest have been well defined,

where they require a complex mosaic of recently burnt areas and long unburnt areas (de Tores *et al.*, 2004; Hayward *et al.*, 2007). In the southern forest, quokkas occupy a range of forest, woodlands and wetland ecotypes and their potential habitat is more continuous. A low density of near-surface fuel, a complex vegetation structure and a varied fire-age mosaic best predict the probability of occupancy of quokka in the southern forest (Bain *et al.*, 2014). All-natural habitats with the Study Area provide potential habitat for the species, although favoured habitats with a dense understorey, like that which occurs in natural wetlands, does not occur within the Study Area. Therefore, it is unlikely that the species will reside permanently within the Study Area, although may occasionally occur while dispersing through the landscape.

5.2.4 Wambenger Brush-tailed Phascogale

Previous Records

Biologic (2011) recorded one individual within the Study Area in remnant regrowth Marri-Jarrah forest during a nocturnal survey. A further sixty-seven records of Wambenger Brush-tailed Phascogale have been recorded within the vicinity of the Study Area (DBCA, 2018). Five records were captured north of the Study Area; one approximately 320 m (in March 2005), one approximately 323 m (in March 2015) and three approximately 516 m (no date provided) north (DBCA, 2018). The remain 62 records are within 20 km of the Study Area to the south west (DBCA, 2018). Christensen *et al.* (1985) recorded Wambenger Brush-tailed Phascogale in Karri forests on the Donnelly River.

Records During Survey

The Wambenger Brush-tailed Phascogale was recorded on 21 occasions and from 15 locations during the survey. The Study Area falls within the species' distribution (Figure 2.4), explaining its prevalence during the current survey.

Habitats within Study Area

The Wambenger Brush-tailed Phascogale was captured within the Jarrah/Marri Forest habitat (9 motion cameras), Jarrah/Marri Forest over Banksia Dominated Midstorey habitat (5 motion cameras) and, to a lesser extent, Mine Rehabilitation habitat (1 motion camera) within the Study Area. The Jarrah/Marri Forest habitat constitutes 404 ha (20%) of the Study Area while the Jarrah/Marri Forest over Banksia Dominated Midstorey habitat constitutes 267 ha (13%) and Mine Rehabilitation habitat constitutes 126.6 ha (6.4%). Phascogales require hollow-bearing trees for nesting (DEC, 2010) and have been observed nesting in Jarrah, Marri, Flooded Gum and Wandoo (Rhind, 1996). The Jarrah/Marri Forest habitat and Jarrah/Marri Forest over Banksia Dominated Midstorey habitat therefore provide essential habitat for this species. The Mine Rehabilitation site contained some moderate sized trees with potential hollows therefore, while it may provide some suitable habitat for this species, it is not considered core habitat.

5.2.5 Southern Brown Bandicoot, Quenda

Previous Records

Fifty-five records of the Southern Brown Bandicoot have been recorded within the vicinity of the Study Area (DBCA, 2018). Thirty records were documented approximately 324m north of the Study Area from 2014 and 2015 (DBCA, 2018). The remaining 25 records are within 20 km of the Study Area to the south

west (DBCA, 2018). Astron (2013) recorded a Quenda digging during a Level 1 Survey of Greenbushes to Kirup.

Records During Survey

During the current survey, the Southern Brown Bandicoot was recorded on two different motion cameras within the Study Area (one in the north-western portion of the Study Area near the northern most waterbody and the along the southern border of the Study Area). Considering the two cameras were located 3.65 km apart, it is likely that at least two unique individuals were observed between the cameras. Moreover, Quenda were photographed on multiple nights by both motion cameras suggesting the individuals are likely to be residents within the Study Area.

Habitats within Study Area

This species inhabits a variety of habitats from coastal scrubs with sandy soils and scrubby ground-cover vegetation (particularly in area subjected to intermitted fire) (DSEWPaC, 2011) to dense scrubby, often swampy, vegetation with dense cover up to one metre high, often feeding in adjacent forest and woodland that is burnt on a regular basis, and in areas of pasture and cropland lying close to dense cover (DEC, 2012b). Fire helps to increase the diversity of food resources necessary for population growth and fecundity (Braithwaite, 1995). Populations inhabiting Jarrah and Wandoo forests are usually associated with watercourses (DEC, 2012b). During the current survey, Quenda were captured within Jarrah/Marri Forest habitat within the Study Area, which constitutes 404 ha (20%) of the Study Area. Therefore, this Jarrah/Marri Forest habitat could provide important foraging habitat for this species.

5.2.6 Western Brush Wallaby

Previous Records

Sixteen records of Western Brush Wallaby have been recorded within the vicinity of the Study Area (DBCA, 2018). Three records were documented approximately 509 m (September 2001), 771 m (March 1987) 1.1km (September 1965) north of the Study Area (DBCA, 2018). Twelve records are located within 20 km of the Study Area and one record is located approximately 23 km north of the Study Area (DBCA, 2018).

Records During Survey

Western Brush Wallaby were captured via six motion cameras within the north-western portion of the Study Area.

Habitats within Study Area

The Western Brush Wallaby favours open grassy areas and inhabits open forest and woodland. It is also found in some areas of mallee, heathland, low open grasses, and scrubby thickets. The species is uncommon in Karri forests where there is a dense understorey (DEC, 2012c; Woinarski & Burbidge,

2016). During the current survey, Western Brush Wallaby were captured within Jarrah/Marri Forest habitat within the Study Area, which constitutes 404 ha (20%) of the Study Area.

5.3 Specimens of SRE Groups Recorded

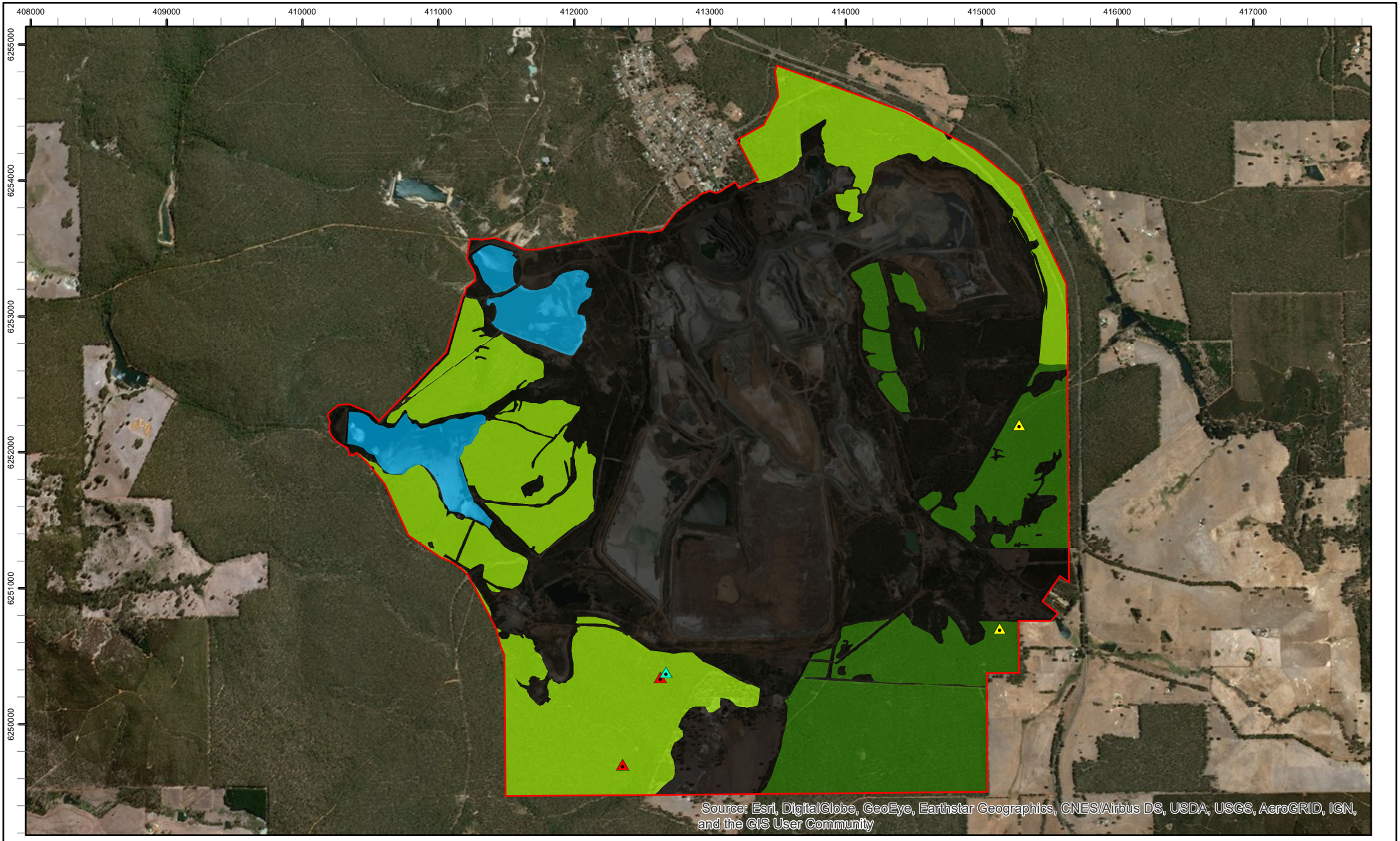
Twenty specimens belonging to SRE groups were collected during the survey (Table 5-2). This comprised specimens from four broad taxonomic groups: Two Mygalomorph spiders, two isopods, four scorpions, and twelve millipedes (Table 5-2). At least one specimen was recorded from every SRE site, except sites SRE07 and SRE08 and from two of the naturally occurring habitats, Jarrah/Marri Forest and Jarrah/Marri over Banksia.

Table 5-2: Invertebrates of SRE groups collected during the survey

Group	Taxa identification	Site Collected	Habitat Type	SRE Status
Isopods	*Buddelundia nitidissima*	SRE07	Jarrah/Marri Forest	Widespread
Isopods	*Laevophiloscia* sp. indet.	SRE08	Jarrah/Marri Forest	Widespread
Millipede	*Ommatoiulus moreletii*	SRE10	Jarrah/Marri Forest	Exotic (introduced)
Millipede	*Ommatoiulus moreletii*	SRE6	Jarrah/Marri Forest	Exotic (introduced)
Millipede	*Ommatoiulus moreletii*	SRE02	Jarrah/Marri Forest over Banksia dominated midstorey	Exotic (introduced)
Millipede	*Ommatoiulus moreletii*	SRE04	Mine Rehabilitation	Exotic (introduced)
Millipede	*Ommatoiulus moreletii*	SRE05	Jarrah/Marri Forest	Exotic (introduced)
Millipede	*Ommatoiulus moreletii*	SRE06	Jarrah/Marri Forest	Exotic (introduced)
Millipede	*Ommatoiulus moreletii*	SRE09	Jarrah/Marri Forest	Exotic (introduced)
Millipede	*Akamptogonus novarae*	SRE04	Mine Rehabilitation	Exotic (introduced)
Millipede	*Akamptogonus novarae*	SRE04	Mine Rehabilitation	Exotic (introduced)
Millipede	Paradoxosomatidae sp. indet.	SRE01	Jarrah/Marri Forest over Banksia dominated midstorey	Potential SRE
Millipede	Paradoxosomatidae sp. indet.	SRE03	Jarrah/Marri Forest over Banksia dominated midstorey	Potential SRE
Millipede	Siphonotidae sp. indet.	SRE05	Jarrah/Marri Forest	Potential SRE
Mygalomorph Spider	Nemesiidae sp. indet.	SRE11	Jarrah/Marri Forest	Potential SRE
Mygalomorph Spider	Nemesiidae sp. Indet.	SRE05	Jarrah/Marri Forest	Potential SRE
Scorpion	*Cercophonius sulcatus*	SRE04	Mine Rehabilitation	Widespread
Scorpion	*Lychas* 'austroccidentalis'	SRE02	Jarrah/Marri Forest over Banksia dominated midstorey	Widespread
Scorpion	*Lychas* 'austroccidentalis'	SRE12	Jarrah/Marri Forest over Banksia dominated midstorey	Widespread
Scorpion	*Lychas* 'austroccidentalis'	SRE12	Jarrah/Marri Forest over Banksia dominated midstorey	Widespread

From the 20 specimens collected, a total of eight taxa were identified; however, please note that some taxa contain multiple specimens that could not be identified to a species level and therefore it's possible that such taxa (Nemesiidae sp. Indet., Paradoxosomatidae sp. indet.) represent multiple species. Of the taxa identified, two were regarded as exotic/introduced species; *Ommatoiulus moreletii* and *Akamptogonus novaraei.* Two taxa were considered widespread species; *Lychas* 'austroccidentalis' and *Cercophonius sulcatus*. The remaining three taxa were identified as 'Potential SRE' based on the fact that they could not be identified to species level due to the absence of diagnostic features which are only

present on mature male specimens (Figure 5.3). Further text on each of the taxa considered to represent ‘Potential SRE’ is detailed below (Section 5.3.1 - 5.3.3).



Legend

- Study Area

Broad Fauna Habitats

- Jarrah/Marri Forest over Banksia
- Jarrah/Marri Forest
- Marri/Blackbutt/Flooded Gum Woodland
- Water Bodies
- Disturbed

'Potential SRE' Specimens

- Nemesiidae sp. indet.
- Paradoxosomatidae sp. indet.
- Siphonotidae sp. indet.

biologic Environmental Survey

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1:35,000

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Talison Lithium Australia

Greenbushes Targeted Fauna Survey

Figure 5.3: Locations of 'Potential SRE' collected during the survey

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

Size A4. Created 10/07/2018

5.3.1 Nemesiidae sp. indet.

Two of the specimens collected during the survey were identified as Nemesiidae sp. Indet. Nemesiidae represents a wide-ranging family of Mygalomorph spider with a worldwide distribution which spans across four continents (WSC, 2018). In Australia, nemesiids are known as wishbone spiders because they often build forked burrows with two openings at the soil surface that would resemble a wishbone if viewed in cross section (Main, 1976). There are over 364 species described although many more undescribed (WSC, 2018). Approximately twelve genera are known to occur within Australia (WSC, 2018). Both specimens of Nemesiidae collected during the survey represented juveniles, thus not containing the diagnostic features for identification which are only apparent on adult males; however, the specimens are considered 'Potential SRE' as a precaution given that short-range endemics of this family have been recorded in the region previously. Two species of the family have been recorded previously within the 25 km of the Study Area, as identified by WAM (Biologic, 2018; WAM, 2018a): *Chenistonia* `tepperi` and *Kwonkan* `MYG096`.

Specimens were collected from sites SRE05 and SRE11, which were both located within the Jarrah/Marri Forest habitat type.

5.3.2 Paradoxosomatidae sp. indet.

Two specimens of Paradoxosomatidae sp. indet. were recorded in the Study Area. Paradoxosomatidae represents a family of millipedes which contains over 139 described species from 40 genera in Australia (Car *et al.*, 2013). Eight of these genera are known to occur in Western Australia, although four are represented by paradoxosomatid species that have been introduced to the region (Car *et al.*, 2013). It is very likely that both specimens belong to the genus *Antichiropus*, the most abundant and diverse millipede group in Western Australia (Car *et al.*, 2013). This genus was first named in 1911 and is now known to consist of over 160 species, ranging from the Pilbara region in the north, to the Nullarbor Plain and the Eyre Peninsula in South Australia (Car *et al.*, 2013). With the exception of *Antichiropus variabilis*, and *Antichiropus* 'PM1' from the northern Wheatbelt and the Geraldton sandplain, most species of the genus are known to be SRE's, and many are known from only a few hundred square kilometres (Harvey, 2002).

Both Paradoxosomatidae specimens collected during the survey represented juveniles that did not possess the diagnostic features for accurate identification - which are only found on adult males. Specimens may potentially represent the same or distinct species. One unidentified specimen of *Antichiropus* has previously been collected within 25 km of the Study Area and a further 19 taxa have been recorded in the surrounding 40,000 km^2, as documented by WAM (Biologic, 2018; WAM, 2018a).

Specimens were collected from sites SRE01 and SRE03, which both occur within the Jarrah/Marri Forest over Banksia habitat type.

5.3.3 Siphonotidae sp. indet.

Siphonotidae is a family of millipede belonging to the order Polyzoniida. They are distinguished from other millipedes by their small, pointed head and flattened wide body segments (Harvey & Yen, 1989). The order Polyzoniida is widely distributed worldwide, although only represented within Australia by the one family, Siphonotidae. Siphonotidae was revised in a recent PhD thesis (Black, 1994) although papers

arising from this work are yet to be published and only five species from two genera have been formally described. It is likely that the family contains several SRE species (E. S. Volschenk *pers. comm*.).

Due to the taxonomic uncertainty of the family, the single specimen collected from this survey could not be identified beyond family, although it is likely that the specimen belongs to Black's (1994) unpublished genus 'Megalosiphon'. No taxa belonging to the family Siphonotidae have previously been recorded within 25 km of the Study Area according to WAM (2018a), although eight taxa have been recorded within 40,000 km^2 of the Study Area - the majority of records from the Margaret River and Pemberton regions.

The single specimen collected during this survey was from the Jarrah/Marri Forest habitat, site SRE05, where it was collected from soil under woody debris.

5.4 Occurrence of Short-range Endemic Fauna

Owing to the poor state of taxonomy for many of the species collected, the current assessment is somewhat limited in its ability to assess the local and regional significance of the fauna collected.

The taxa currently regarded as 'indet.' (Nemesiidae, Paradoxosomatidae, Siphonotidae) cannot be fully assessed for SRE status until significant knowledge gaps are resolved at various taxonomic levels. Five specimens from these three groups were recorded within the Study Area. Although limited, the current information for these taxa indicates that there is a reasonable likelihood that they may be range restricted, therefore they are considered Potential SREs as a precaution. In each instance, genetic analysis would be required to determine the species and/or if the specimens are unique to what has previously been recorded within the region.

In the absence of firm taxonomic identifications, it is reasonable to use habitats as a surrogate to assess the potential impact of development posed to Potential SRE species. All three naturally occurring habitat types within the Study Area (Jarrah/ Marri Forest, Jarrah/Marri Forest over Banksia and Marri/Blackbutt/Flooded Gum Woodland) would be considered to have a moderate potential to host SRE fauna. Each contains high habitat complexity with abundant leaf litter, woody debris, scattered rock formations, and a high prevalence of shade offered by the dense vegetation. The potential to cater for SRE fauna is further supported by the degree of habitat loss and fragmentation within the subregion, which may have reduced the distribution and opportunities for dispersal of most dispersal-limited invertebrate taxa. Aerial photography indicates that each of the moderately suitable SRE habitat zones (comprising the Jarrah/ Marri Forest, Jarrah/Marri Forest over Banksia and Marri/Blackbutt/Flooded Gum Woodland) is, however, well represented beyond the Study Area boundaries. Many of these areas immediately beyond the Study Area have not yet been sampled for SRE fauna, although based on the habitats likely to be present, it would be reasonable to assume that many of the Potential SRE fauna present within the Study Area may also occur there.

6 CONCLUSION

A targeted vertebrate and SRE invertebrate fauna survey was completed over the Study Area in February 2018. Four vertebrate fauna species of conservation significance were confirmed occurring within the Study Area and another was possibly recorded via secondary evidence, the Western Ringtail Possum. Two of the species possibly/confirmed in the Study Area are regarded as Matters of National Environmental Significance (MNES) under the EPBC Act (Western Quoll and Western Ringtail Possum); one is regarded as 'Conservation Dependent' under the WC Act (Wambenger Brush-tailed Phascogale); and two are considered Priority fauna as defined by the DBCA (Southern Brown Bandicoot and Western Brush Wallaby).

The Western Ringtail Possum was possibly recorded via scats at two locations within the Study Area. The species has also been recorded ~320 m north of the Study Area (2014) in native vegetation that continues into the Study Area. Despite an extensive amount of survey effort, using both motion cameras and spotlighting, no individuals of the species were recorded in the Study Area. The species will use 3-8 nesting sites at a time and up to 20 throughout the year as conditions (i.e. population densities, food resources etc.) within their home-range fluctuate. With this is mind, it is possible that the species occurs in the Study Area in low numbers, or on a transient basis, as populations and resources fluctuate in the surrounding areas. Both the Jarrah/Marri Forest (404 ha, 20%) and Jarrah/Marri Forest over Banksia (267 ha, 13%) habitat types provide potential suitable habitat for the species, particularly in the north-western section of the Study Area which adjoins a large block of undisturbed native forest. Any development within the Study Area resulting in the clearing of such habitats may potentially affect the local population of the species.

The Western Quoll was recorded on 21 occasions during the Survey, all via motion camera. The Study Area contains preferred habitats of the species and is located well within the species core-range. The survey was undertaken prior to the mating season (April to July), extinguishing the possibility that records represent transient or passing individuals. This is further supported by the number and frequency of the records obtained. All records were from the same site (Site 01) and potentially represented a single individual – although this is not confirmed. Both the Jarrah/Marri Forest (404 ha, 20%) and Jarrah/Marri Forest over Banksia (267 ha, 13%) habitat types provide suitable habitat for the species. Given the species typically large home-range (3 - 15 km^2), it is possibly that the species may occur throughout the Study Area, although it appears that the north-west portion of the Study Area which adjoins a large waterbody and portion of undisturbed forest provides preferred habitat for individuals within the Study Area. Land clearing is currently seen as the largest impact to the species and any development within the Study Area would potentially impact the local population.

The Wambenger Brush-tailed Phascogale was recorded on 21 occasions and from 15 locations during the survey and appears to be common within the Study Area. The species was recorded in both the Jarrah/Marri Forest and Jarrah/Marri Forest over Banksia habitat types. Home-ranges during the non-breeding season span 20-70 ha and do not typically overlap, suggesting that the Study Area contains a sizeable population. Any clearing of the Jarrah/Marri Forest (404 ha, 20%) and Jarrah/Marri Forest over Banksia (267 ha, 13%) habitat types is likely to impact the species.

The Quokka was not recorded in the Study Area during the survey despite the extensive amount of survey effort. If present, it is likely that the species occurs in very low densities or on a transient basis only. The species preferred habitat comprises woodlands and shrublands with a dense vegetated understorey, which for the most part is not overly abundant within the Study Area. Based on this, it is unlikely that development within the Study Area will severely impact the local population of the species if present.

The Southern Brown Bandicoot and the Western Brush Wallaby were recorded abundantly throughout the Study Area during the survey, recorded on 10 and five occasions respectively. Both species are likely to occur throughout the Study Area in all naturally occurring habitats present: Jarrah/Marri Forest (404 ha, 20%) and Jarrah/Marri Forest over Banksia (267 ha, 13%) Marri/Blackbutt/Flooded Gum Woodland (8 ha, 0.4%). Both species are listed as Priority 4 fauna by the DBCA. Any clearing within the Study Area is likely to impact upon the local population of this species.

Based on the results of the survey, it is likely that all vertebrate fauna species of conservation significance occurring within the Study Area would be somewhat impacted by the proposed development, particularly if the Jarrah/Marri Forest (404 ha, 20%) and/or Jarrah/Marri Forest over Banksia (267 ha, 13%) habitat types are impacted. Both of these habitats appear to be habitat critical to the survival of each of these species, as defined by DoE (2013) – habitats utalised for activities such as foraging, breeding, roosting, or dispersal. Further survey work to determine populations and distribution would be required to accurately assess the level of impact for each species, as would a thorough impact assessment considering all factors of the proposed development (i.e. clearing footprint, secondary impacts etc). Secondary management initiatives may also need to be considered to avoid further impacts, including translocation surveys prior and during clearing activities.

Three invertebrate taxa recorded during the survey were identified as ‘Potential SRE’. In all three cases, a precautionary level of Potential SRE was allocated as a precise taxonomic identification could not be made. This comprised two specimens identified as Nemesiidae sp. indet, two specimens of Paradoxosomatidae sp. indet., and one specimen belonging to the family Siphonotidae. Although limited, the current information for these taxa indicates that there is a reasonable likelihood that they may be range restricted. In each instance, genetic analysis would be required to determine the species and/or if the specimens are unique to what has previously been recorded within the region. A review of the habitats present in surrounding area and their connectivity indicates that all taxa identified as ‘Potential SRE’ may potentially occur in synonymous habitats outside the Study Area. As such, development and clearing of habitats within the Study Area is unlikely to severely impact these species – although further survey work and genetic analysis would need to be conducted to confirm this.

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8 APPENDICES

Appendix A Conservation Codes

International Union for Conservation of Nature

Category	Definition
Extinct (EX)	A taxon is Extinct when there is no reasonable doubt that the last individual has died. A taxon is presumed Extinct when exhaustive surveys in known and/or expected habitat, at appropriate times (diurnal, seasonal, annual), throughout its historic range have failed to record an individual. Surveys should be over a time frame appropriate to the taxon's life cycle and life form.
Extinct in the Wild (EW)	A taxon is Extinct in the Wild when it is known only to survive in cultivation, in captivity or as a naturalized population (or populations) well outside the past range. A taxon is presumed Extinct in the Wild when exhaustive surveys in known and/or expected habitat, at appropriate times (diurnal, seasonal, annual), throughout its historic range have failed to record an individual. Surveys should be over a time frame appropriate to the taxon's life cycle and life form.
Critically Endangered (CR)	A taxon is Critically Endangered when the best available evidence indicates that it meets any of the criteria A to E for Critically Endangered (see Section V), and it is therefore considered to be facing an extremely high risk of extinction in the wild.
Endangered (EN)	A taxon is Endangered when the best available evidence indicates that it meets any of the criteria A to E for Endangered (see Section V), and it is therefore considered to be facing a very high risk of extinction in the wild.
Vulnerable (VU)	A taxon is Vulnerable when the best available evidence indicates that it meets any of the criteria A to E for Vulnerable (see Section V), and it is therefore considered to be facing a high risk of extinction in the wild.
Near Threatened (NT)	A taxon is Near Threatened when it has been evaluated against the criteria but does not qualify for Critically Endangered, Endangered or Vulnerable now, but is close to qualifying for or is likely to qualify for a threatened category in the near future
Data Deficient (DD)	A taxon is Data Deficient when there is inadequate information to make a direct, or indirect, assessment of its risk of extinction based on its distribution and/or population status. A taxon in this category may be well studied, and its biology well known, but appropriate data on abundance and/or distribution are lacking. Data Deficient is therefore not a category of threat. Listing of taxa in this category indicates that more information is required and acknowledges the possibility that future research will show that threatened classification is appropriate. It is important to make positive use of whatever data are available. In many cases, great care should be exercised in choosing between DD and a threatened status. If the range of a taxon is suspected to be relatively circumscribed, and a considerable period of time has elapsed since the last record of the taxon, threatened status may well be justified.

Environment Protection and Biodiversity Conservation Act 1999

Category	Definition
Extinct (EX)	Taxa not definitely located in the wild during the past 50 years.
Extinct in the Wild (EW)	Taxa known to survive only in captivity.
Critically Endangered (CE)	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 future.
Migratory (MG)	Consists of species listed under the following International Conventions: Japan-Australia Migratory Bird Agreement (JAMBA) China-Australia Migratory Bird Agreement (CAMBA) Convention on the Conservation of Migratory Species of Wild animals (Bonn Convention)

Wildlife Conservation Act 1950

Category	Definition
Schedule 1 (S1)	Rare or likely to become extinct, as *critically endangered* fauna.
Schedule 2 (S2)	Rare or likely to become extinct, as *endangered* fauna.
Schedule 3 (S3)	Rare or likely to become extinct, as *vulnerable* fauna.
Schedule 4 (S4)	Being fauna that is presumed to be extinct.
Schedule 5 (S5)	Birds that are subject to international agreements relating to the protection of migratory birds.
Schedule 6 (S6)	Special conservation need being species dependent on ongoing conservation intervention.
Schedule 7 (S7)	In need of special protection, otherwise than for the reasons pertaining to Schedule 1 through to Schedule 6 Fauna.

Department of Biodiversity, Conservation and Attractions Priority codes

Category	Definition
Priority 1 (P1)	Taxa with few, poorly known populations on threatened lands.
Priority 2 (P2)	Taxa with few, poorly known populations on conservation lands; or taxa with several, poorly known populations not on conservation lands.
Priority 3 (P3)	Taxa with several, poorly known populations, some on conservation lands.
Priority 4 (P4)	Taxa in need of monitoring. Taxa which are considered to have been adequately surveyed, or for which sufficient knowledge is available, and which are considered not currently threatened or in need of special protection, but could be if present circumstances change.

Appendix B Locations of Sampling Sites

Site ID	Date Deployed	Date Retrieved	Sampling Nights	Latitude	Longitude	Habitat Type
Motion Camera Deployments						
Site 01.01	13/02/2018	20/02/2018	7	-33.863724	116.038495	Jarrah/Marri Forest
Site 01.02	13/02/2018	20/02/2018	7	-33.863962	116.038849	Jarrah/Marri Forest
Site 01.03	13/02/2018	20/02/2018	7	-33.864226	116.039182	Jarrah/Marri Forest
Site 01.04	13/02/2018	20/02/2018	7	-33.864473	116.039719	Jarrah/Marri Forest
Site 01.05	13/02/2018	20/02/2018	7	-33.864559	116.040356	Jarrah/Marri Forest
Site 02.01	13/02/2018	20/02/2018	7	-33.869526	116.045869	Jarrah/Marri Forest
Site 02.02	13/02/2018	20/02/2018	7	-33.869862	116.046114	Jarrah/Marri Forest
Site 02.03	13/02/2018	20/02/2018	7	-33.870235	116.046585	Jarrah/Marri Forest
Site 02.04	13/02/2018	20/02/2018	7	-33.870368	116.047373	Jarrah/Marri Forest
Site 02.05	13/02/2018	20/02/2018	7	-33.870956	116.047637	Jarrah/Marri Forest
Site 03.01	13/02/2018	20/02/2018	7	-33.888808	116.052813	Jarrah/Marri Forest
Site 03.02	13/02/2018	20/02/2018	7	-33.889193	116.052473	Jarrah/Marri Forest
Site 03.03	13/02/2018	20/02/2018	7	-33.889575	116.051766	Jarrah/Marri Forest
Site 03.04	13/02/2018	20/02/2018	7	-33.889805	116.051169	Jarrah/Marri Forest
Site 03.05	13/02/2018	20/02/2018	7	-33.889800	116.050553	Jarrah/Marri Forest
Site 04.01	13/02/2018	20/02/2018	7	-33.890503	116.077764	Jarrah/Marri Forest over Banksia dominated midstorey
Site 04.02	13/02/2018	20/02/2018	7	-33.890057	116.077153	Jarrah/Marri Forest over Banksia dominated midstorey
Site 04.03	13/02/2018	20/02/2018	7	-33.889621	116.076768	Jarrah/Marri Forest over Banksia dominated midstorey
Site 04.04	13/02/2018	20/02/2018	7	-33.889311	116.076317	Jarrah/Marri Forest over Banksia dominated midstorey
Site 04.05	13/02/2018	20/02/2018	7	-33.889153	116.075702	Jarrah/Marri Forest over Banksia dominated midstorey
Site 05.01	13/02/2018	20/02/2018	7	-33.881449	116.072974	Jarrah/Marri Forest over Banksia dominated midstorey

Site ID	Date Deployed	Date Retrieved	Sampling Nights	Latitude	Longitude	Habitat Type
Site 05.02	13/02/2018	20/02/2018	7	-33.881634	116.073686	Jarrah/Marri Forest over Banksia dominated midstorey
Site 05.03	13/02/2018	20/02/2018	7	-33.881668	116.074583	Jarrah/Marri Forest over Banksia dominated midstorey
Site 05.04	13/02/2018	20/02/2018	7	-33.881718	116.075199	Jarrah/Marri Forest over Banksia dominated midstorey
Site 05.05	13/02/2018	20/02/2018	7	-33.881813	116.075814	Jarrah/Marri Forest over Banksia dominated midstorey
Site 06.01	13/02/2018	20/02/2018	7	-33.870811	116.082020	Jarrah/Marri Forest over Banksia dominated midstorey
Site 06.02	13/02/2018	20/02/2018	7	-33.870726	116.082680	Jarrah/Marri Forest over Banksia dominated midstorey
Site 06.03	13/02/2018	20/02/2018	7	-33.870821	116.083295	Jarrah/Marri Forest over Banksia dominated midstorey
Site 06.04	13/02/2018	20/02/2018	7	-33.870581	116.083817	Jarrah/Marri Forest over Banksia dominated midstorey
Site 06.05	13/02/2018	20/02/2018	7	-33.870640	116.084422	Jarrah/Marri Forest over Banksia dominated midstorey
Site 07.01	14/02/2018	20/02/2018	6	-33.871409	116.042074	Jarrah/Marri Forest
Site 07.02	14/02/2018	20/02/2018	6	-33.871058	116.042165	Jarrah/Marri Forest
Site 07.03	14/02/2018	20/02/2018	6	-33.870661	116.042137	Jarrah/Marri Forest
Site 07.04	14/02/2018	20/02/2018	6	-33.870217	116.041817	Jarrah/Marri Forest
Site 07.05	14/02/2018	20/02/2018	6	-33.869622	116.041954	Jarrah/Marri Forest
Site 08.01	14/02/2018	20/02/2018	6	-33.872741	116.034761	Jarrah/Marri Forest
Site 08.02	14/02/2018	20/02/2018	6	-33.872521	116.035521	Jarrah/Marri Forest
Site 08.03	14/02/2018	20/02/2018	6	-33.872270	116.035675	Jarrah/Marri Forest
Site 08.04	14/02/2018	20/02/2018	6	-33.872302	116.036258	Jarrah/Marri Forest
Site 08.05	14/02/2018	20/02/2018	6	-33.873190	116.036800	Jarrah/Marri Forest
Site 09.01	14/02/2018	20/02/2018	6	-33.887542	116.044273	Jarrah/Marri Forest
Site 09.02	14/02/2018	20/02/2018	6	-33.887791	116.044876	Jarrah/Marri Forest
Site 09.03	14/02/2018	20/02/2018	6	-33.887958	116.045566	Jarrah/Marri Forest

Site ID	Date Deployed	Date Retrieved	Sampling Nights	Latitude	Longitude	Habitat Type
Site 09.04	14/02/2018	20/02/2018	6	-33.888091	116.046376	Jarrah/Marri Forest
Site 09.05	14/02/2018	20/02/2018	6	-33.888015	116.047047	Jarrah/Marri Forest
Site 10.01	14/02/2018	20/02/2018	6	-33.885235	116.067959	Jarrah/Marri Forest over Banksia dominated midstorey
Site 10.02	14/02/2018	20/02/2018	6	-33.885597	116.068204	Jarrah/Marri Forest over Banksia dominated midstorey
Site 10.03	14/02/2018	20/02/2018	6	-33.886076	116.068274	Jarrah/Marri Forest over Banksia dominated midstorey
Site 10.04	14/02/2018	20/02/2018	6	-33.886647	116.068711	Jarrah/Marri Forest over Banksia dominated midstorey
Site 10.05	14/02/2018	20/02/2018	6	-33.887203	116.068273	Jarrah/Marri Forest over Banksia dominated midstorey
Site 11.01	14/02/2018	20/02/2018	6	-33.883416	116.080414	Jarrah/Marri Forest over Banksia dominated midstorey
Site 11.02	14/02/2018	20/02/2018	6	-33.883113	116.079671	Jarrah/Marri Forest over Banksia dominated midstorey
Site 11.03	14/02/2018	20/02/2018	6	-33.883208	116.079108	Jarrah/Marri Forest over Banksia dominated midstorey
Site 11.04	14/02/2018	20/02/2018	6	-33.883764	116.078659	Jarrah/Marri Forest over Banksia dominated midstorey
Site 11.05	14/02/2018	20/02/2018	6	-33.883615	116.078044	Jarrah/Marri Forest over Banksia dominated midstorey
Site 12.01	14/02/2018	20/02/2018	6	-33.863145	116.086783	Jarrah/Marri Forest
Site 12.02	14/02/2018	20/02/2018	6	-33.862784	116.086808	Jarrah/Marri Forest
Site 12.03	14/02/2018	20/02/2018	6	-33.862189	116.086869	Jarrah/Marri Forest
Site 12.04	14/02/2018	20/02/2018	6	-33.861884	116.087034	Jarrah/Marri Forest
Site 12.05	14/02/2018	20/02/2018	6	-33.861196	116.086760	Jarrah/Marri Forest
GR 01	15/02/2018	20/02/2018	5	-33.859788	116.040258	Jarrah/Marri Forest
GR 02	15/02/2018	20/02/2018	5	-33.863301	116.044327	Jarrah/Marri Forest
GR 03	15/02/2018	20/02/2018	5	-33.867585	116.046658	Mine Disturbance
GR 04	15/02/2018	20/02/2018	5	-33.872440	116.044842	Jarrah/Marri Forest

Site ID	Date Deployed	Date Retrieved	Sampling Nights	Latitude	Longitude	Habitat Type
GR 05	15/02/2018	20/02/2018	5	-33.874936	116.038683	Jarrah/Marri Forest
GR 06	16/02/2018	20/02/2018	4	-33.883693	116.056222	Jarrah/Marri Forest
GR 07	16/02/2018	20/02/2018	4	-33.883125	116.051459	Jarrah/Marri Forest
GR 08	16/02/2018	20/02/2018	4	-33.881667	116.043701	Jarrah/Marri Forest
GR 09	16/02/2018	20/02/2018	4	-33.881248	116.082286	Jarrah/Marri Forest over Banksia dominated midstorey
GR 10	17/02/2018	20/02/2018	3	-33.868710	116.032482	Water Bodies
GR 11	17/02/2018	20/02/2018	3	-33.866827	116.084765	Jarrah/Marri Forest over Banksia dominated midstorey
GR 12	17/02/2018	20/02/2018	3	-33.853709	116.084116	Mine Rehabilitation
SRE Sampling Sites						
SRE01	18/02/2018	-	-	-33.8806	116.0823	Jarrah/Marri Forest over Banksia dominated midstorey
SRE02	18/02/2018	-	-	-33.8803	116.0749	Jarrah/Marri Forest over Banksia dominated midstorey
SRE03	18/02/2018	-	-	-33.8671	116.084	Jarrah/Marri Forest over Banksia dominated midstorey
SRE04	18/02/2018	-	-	-33.8529	116.0836	Mine Rehabilitation
SRE05	19/02/2018	-	-	-33.8833	116.0557	Jarrah/Marri Forest
SRE06	19/02/2018	-	-	-33.8812	116.0487	Jarrah/Marri Forest
SRE07	19/02/2018	-	-	-33.8752	116.0392	Jarrah/Marri Forest
SRE08	19/02/2018	-	-	-33.8712	116.0436	Jarrah/Marri Forest
SRE09	19/02/2018	-	-	-33.8526	116.0842	Jarrah/Marri Forest
SRE10	19/02/2018	-	-	-33.8625	116.041	Jarrah/Marri Forest
SRE11	20/02/2018	-	-	-33.8894	116.0522	Jarrah/Marri Forest
SRE12	20/02/2018	-	-	-33.8906	116.0773	Jarrah/Marri Forest over Banksia dominated midstorey

Appendix C Locations of Vertebrate Fauna of Conservation Significance

Site ID	Date	Common Name	Species Name	Record Types	No.	Latitude	Longitude
Site 01	14/02/2018	Western Quoll, Chuditch	*Dasyurus geoffroii*	MC	1	-33.864473	116.039719
Site 01	14/02/2018	Western Quoll, Chuditch	*Dasyurus geoffroii*	MC	1	-33.864473	116.039719
Site 01	15/02/2018	Western Quoll, Chuditch	*Dasyurus geoffroii*	MC	1	-33.864473	116.039719
Site 01	15/02/2018	Western Quoll, Chuditch	*Dasyurus geoffroii*	MC	1	-33.864473	116.039719
Site 01	16/02/2018	Western Quoll, Chuditch	*Dasyurus geoffroii*	MC	1	-33.864473	116.039719
Site 01	17/02/2018	Western Quoll, Chuditch	*Dasyurus geoffroii*	MC	1	-33.864473	116.039719
Site 01	14/02/2018	Western Quoll, Chuditch	*Dasyurus geoffroii*	MC	1	-33.864559	116.040356
Site 01	14/02/2018	Western Quoll, Chuditch	*Dasyurus geoffroii*	MC	1	-33.864559	116.040356
Site 01	14/02/2018	Western Quoll, Chuditch	*Dasyurus geoffroii*	MC	1	-33.864559	116.040356
Site 01	15/02/2018	Western Quoll, Chuditch	*Dasyurus geoffroii*	MC	1	-33.864559	116.040356
Site 01	15/02/2018	Western Quoll, Chuditch	*Dasyurus geoffroii*	MC	1	-33.864559	116.040356
Site 01	15/02/2018	Western Quoll, Chuditch	*Dasyurus geoffroii*	MC	1	-33.864559	116.040356
Site 01	16/02/2018	Western Quoll, Chuditch	*Dasyurus geoffroii*	MC	1	-33.864559	116.040356
Site 01	17/02/2018	Western Quoll, Chuditch	*Dasyurus geoffroii*	MC	1	-33.864559	116.040356
Site 01	14/02/2018	Western Quoll, Chuditch	*Dasyurus geoffroii*	MC	1	-33.863962	116.038849
Site 01	15/02/2018	Western Quoll, Chuditch	*Dasyurus geoffroii*	MC	1	-33.863962	116.038849
Site 01	14/02/2017	Western Quoll, Chuditch	*Dasyurus geoffroii*	MC	1	-33.864226	116.039182
Site 01	15/02/2017	Western Quoll, Chuditch	*Dasyurus geoffroii*	MC	1	-33.864226	116.039182
Site 01	16/02/2017	Western Quoll, Chuditch	*Dasyurus geoffroii*	MC	1	-33.864226	116.039182
Site 01	17/02/2017	Western Quoll, Chuditch	*Dasyurus geoffroii*	MC	1	-33.864226	116.039182
Site 01	14/02/2018	Western Quoll, Chuditch	*Dasyurus geoffroii*	MC	1	-33.863724	116.038495
GR10	17/02/2018	Forest Red-tailed Black Cockatoo	*Calyptorhynchus banksii naso*	Opp	1	-33.870600	116.033200
GR12	17/02/2018	Forest Red-tailed Black Cockatoo	*Calyptorhynchus banksii naso*	Scats	5	-33.853200	116.083700
GR14	17/02/2018	Forest Red-tailed Black Cockatoo	*Calyptorhynchus banksii naso*	Opp	1	-33.874000	116.086700
GR05	15/02/2018	Forest Red-tailed Black Cockatoo	*Calyptorhynchus banksii naso*	Opp	5	-33.874000	116.039400
GR08	16/02/2018	Forest Red-tailed Black Cockatoo	*Calyptorhynchus banksii naso*	Opp	5	-33.881700	116.043700
GR09	16/02/2018	Forest Red-tailed Black Cockatoo	*Calyptorhynchus banksii naso*	Opp	1	-33.881800	116.082200
Opp	16/02/2018	Forest Red-tailed Black Cockatoo	*Calyptorhynchus banksii naso*	R	2	-33.869600	116.032600
Opp	17/02/2018	Forest Red-tailed Black Cockatoo	*Calyptorhynchus banksii naso*	R	1	-33.883000	116.083800

Site ID	Date	Common Name	Species Name	Record Types	No.	Latitude	Longitude
Site 10	14/02/2018	Forest Red-tailed Black Cockatoo	*Calyptorhynchus banksii naso*	Opp	1	-33.885100	116.068000
Site 02	13/02/2018	Forest Red-tailed Black Cockatoo	*Calyptorhynchus banksii naso*	Opp	5	-33.870300	116.047400
Site 04	13/02/2018	Forest Red-tailed Black Cockatoo	*Calyptorhynchus banksii naso*	Opp	1	-33.890500	116.077400
Site 05	13/02/2018	Forest Red-tailed Black Cockatoo	*Calyptorhynchus banksii naso*	Opp	1	-33.881800	116.073600
Site 08	14/02/2018	Forest Red-tailed Black Cockatoo	*Calyptorhynchus banksii naso*	Opp	1	-33.872500	116.035400
Site 09	14/02/2018	Forest Red-tailed Black Cockatoo	*Calyptorhynchus banksii naso*	Opp	1	-33.887500	116.044400
Site 09	13/02/2018	Forest Red-tailed Black Cockatoo	*Calyptorhynchus banksii naso*	Opp	1	-33.881700	116.074600
Site 09	14/02/2018	Forest Red-tailed Black Cockatoo	*Calyptorhynchus banksii naso*	Opp	1	-33.887900	116.045700
Site 09	17/02/2018	Forest Red-tailed Black Cockatoo	*Calyptorhynchus banksii naso*	Opp	1	-33.853700	116.084100
Site 09	14/02/2018	Forest Red-tailed Black Cockatoo	*Calyptorhynchus banksii naso*	Opp	2	-33.872000	116.042000
Site 09	15/02/2018	Forest Red-tailed Black Cockatoo	*Calyptorhynchus banksii naso*	Opp	3	-33.874100	116.039600
Site 09	17/02/2018	Forest Red-tailed Black Cockatoo	*Calyptorhynchus banksii naso*	Opp	3	-33.869900	116.034400
Site 09	19/02/2018	Forest Red-tailed Black Cockatoo	*Calyptorhynchus banksii naso*	Opp	3	-33.883500	116.055800
Site 09	13/02/2018	Forest Red-tailed Black Cockatoo	*Calyptorhynchus banksii naso*	Opp	5	-33.883700	116.066600
Site 09	16/02/2018	Forest Red-tailed Black Cockatoo	*Calyptorhynchus banksii naso*	Opp	5	-33.881300	116.042000
Site 09	20/02/2018	Forest Red-tailed Black Cockatoo	*Calyptorhynchus banksii naso*	Opp	6	-33.870400	116.045900
Site 09	16/02/2018	Forest Red-tailed Black Cockatoo	*Calyptorhynchus banksii naso*	Opp	1	-33.870300	116.032900
GR01	16/02/2018	Southern Brown Bandicoot, Quenda	*Isoodon obesulus fusciventer*	MC	1	-33.859788	116.040258
GR01	16/02/2018	Southern Brown Bandicoot, Quenda	*Isoodon obesulus fusciventer*	MC	1	-33.859788	116.040258
GR01	16/02/2018	Southern Brown Bandicoot, Quenda	*Isoodon obesulus fusciventer*	MC	1	-33.859788	116.040258
GR01	17/02/2018	Southern Brown Bandicoot, Quenda	*Isoodon obesulus fusciventer*	MC	1	-33.859788	116.040258
GR01	17/02/2018	Southern Brown Bandicoot, Quenda	*Isoodon obesulus fusciventer*	MC	1	-33.859788	116.040258
GR01	17/02/2018	Southern Brown Bandicoot, Quenda	*Isoodon obesulus fusciventer*	MC	1	-33.859788	116.040258
GR01	18/02/2018	Southern Brown Bandicoot, Quenda	*Isoodon obesulus fusciventer*	MC	1	-33.859788	116.040258
GR01	19/02/2018	Southern Brown Bandicoot, Quenda	*Isoodon obesulus fusciventer*	MC	1	-33.859788	116.040258
GR01	20/02/2018	Southern Brown Bandicoot, Quenda	*Isoodon obesulus fusciventer*	MC	1	-33.859788	116.040258
Site 03	15/02/2018	Southern Brown Bandicoot, Quenda	*Isoodon obesulus fusciventer*	MC	1	-33.888808	116.052813
Site 03	16/02/2018	Southern Brown Bandicoot, Quenda	*Isoodon obesulus fusciventer*	MC	1	-33.888808	116.052813
Site 03	18/02/2018	Southern Brown Bandicoot, Quenda	*Isoodon obesulus fusciventer*	MC	1	-33.888808	116.052813

Site ID	Date	Common Name	Species Name	Record Types	No.	Latitude	Longitude
Site 03	18/02/2018	Southern Brown Bandicoot, Quenda	*Isoodon obesulus fusciventer*	MC	1	-33.888808	116.052813
Site 03	19/02/2018	Southern Brown Bandicoot, Quenda	*Isoodon obesulus fusciventer*	MC	1	-33.888808	116.052813
Site 03	20/02/2018	Southern Brown Bandicoot, Quenda	*Isoodon obesulus fusciventer*	MC	1	-33.888808	116.052813
Site 03	20/02/2018	Southern Brown Bandicoot, Quenda	*Isoodon obesulus fusciventer*	MC	1	-33.888808	116.052813
Site 03	20/02/2018	Southern Brown Bandicoot, Quenda	*Isoodon obesulus fusciventer*	MC	1	-33.888808	116.052813
Site 03	20/02/2018	Southern Brown Bandicoot, Quenda	*Isoodon obesulus fusciventer*	MC	1	-33.888808	116.052813
Site 03	20/02/2018	Southern Brown Bandicoot, Quenda	*Isoodon obesulus fusciventer*	MC	1	-33.888808	116.052813
GR12	20/02/2018	Wambenger Brush-tailed Phascogale	*Phascogale tapoatafa wambenger*	MC	1	-33.853709	116.084116
GR06	20/02/2018	Wambenger Brush-tailed Phascogale	*Phascogale tapoatafa wambenger*	MC	1	-33.883693	116.056222
Site 10	15/02/2018	Wambenger Brush-tailed Phascogale	*Phascogale tapoatafa wambenger*	MC	1	-33.886076	116.068274
Site 11	18/02/2018	Wambenger Brush-tailed Phascogale	*Phascogale tapoatafa wambenger*	MC	1	-33.883208	116.079108
Site 11	17/02/2018	Wambenger Brush-tailed Phascogale	*Phascogale tapoatafa wambenger*	MC	1	-33.883113	116.079671
Site 11	20/02/2018	Wambenger Brush-tailed Phascogale	*Phascogale tapoatafa wambenger*	MC	1	-33.883113	116.079671
Site 11	21/02/2018	Wambenger Brush-tailed Phascogale	*Phascogale tapoatafa wambenger*	MC	1	-33.883113	116.079671
Site 12	20/02/2018	Wambenger Brush-tailed Phascogale	*Phascogale tapoatafa wambenger*	MC	1	-33.861196	116.086760
Site 12	15/02/2018	Wambenger Brush-tailed Phascogale	*Phascogale tapoatafa wambenger*	MC	1	-33.862189	116.086869
Site 12	18/02/2018	Wambenger Brush-tailed Phascogale	*Phascogale tapoatafa wambenger*	MC	1	-33.862189	116.086869
Site 12	16/02/2018	Wambenger Brush-tailed Phascogale	*Phascogale tapoatafa wambenger*	MC	1	-33.862784	116.086808
Site 04	14/02/2018	Wambenger Brush-tailed Phascogale	*Phascogale tapoatafa wambenger*	MC	1	-33.889621	116.076768
Site 04	15/02/2018	Wambenger Brush-tailed Phascogale	*Phascogale tapoatafa wambenger*	MC	1	-33.889621	116.076768
Site 04	16/02/2018	Wambenger Brush-tailed Phascogale	*Phascogale tapoatafa wambenger*	MC	1	-33.889621	116.076768
Site 04	19/02/2018	Wambenger Brush-tailed Phascogale	*Phascogale tapoatafa wambenger*	MC	1	-33.890503	116.077764
Site 07	19/02/2018	Wambenger Brush-tailed Phascogale	*Phascogale tapoatafa wambenger*	MC	1	-33.871409	116.042074
Site 08	16/02/2018	Wambenger Brush-tailed Phascogale	*Phascogale tapoatafa wambenger*	MC	1	-33.872521	116.035521
Site 08	15/02/2018	Wambenger Brush-tailed Phascogale	*Phascogale tapoatafa wambenger*	MC	1	-33.873190	116.036800
Site 08	19/02/2018	Wambenger Brush-tailed Phascogale	*Phascogale tapoatafa wambenger*	MC	1	-33.873190	116.036800
Site 01	14/02/2018	Wambenger Brush-tailed Phascogale	*Phascogale tapoatafa wambenger*	MC	1	-33.864559	116.040356
Site 02	15/02/2018	Wambenger Brush-tailed Phascogale	*Phascogale tapoatafa wambenger*	MC	1	-33.870956	116.047637
GR04	20/02/2018	Western Brush Wallaby	*Macropus irma*	MC	1	-33.872440	116.044842

Site ID	Date	Common Name	Species Name	Record Types	No.	Latitude	Longitude
Site 01	16/02/2017	Western Brush Wallaby	*Macropus irma*	MC	1	-33.864226	116.039182
Site 02	14/02/2018	Western Brush Wallaby	*Macropus irma*	MC	1	-33.869862	116.046114
Site 02	17/02/2018	Western Brush Wallaby	*Macropus irma*	MC	1	-33.870235	116.046585
Site 02	15/02/2018	Western Brush Wallaby	*Macropus irma*	MC	1	-33.869526	116.045869
Site 02	16/02/2018	Western Brush Wallaby	*Macropus irma*	MC	1	-33.870956	116.047637
Site 09	13/02/2018	Western Ringtail Possum	*Pseudocheirus occidentalis*	SP	1	-33.863600	116.038700
Site 09	15/02/2018	Western Ringtail Possum	*Pseudocheirus occidentalis*	SP	1	-33.866500	116.045700

MC = Motion Camera; Opp = Opportunistic, R = Roost; SP = Scat (possible only)