Appendix 36 Terrestrial Fauna Survey and Black Cockatoo Habitat Assessment for Huntly Mine – Holyoake

Terrestrial Fauna Survey and Black Cockatoo Habitat Assessment for Huntly Mine - Holyoake

Pinjarra Alumina Refinery Revised Proposal

Alcoa of Australia Limited

August 2021

→ The Power of Commitment

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Executive summary

Alcoa of Australia Limited (Alcoa) is proposing to increase production at the Pinjarra Alumina Refinery by 5 per cent from 5 million tonnes per annum (Mtpa) to 5.25 Mtpa and transition the Huntly Bauxite Mine to the proposed Myara North and Holyoake mine regions (the Proposal). The Proposal is located in the Peel Region of Western Australia (WA), approximately 100 km south-east of Perth

The Proposal will be subject to environmental impact assessment under Part IV of the WA *Environmental Protection Act 1986* (EP Act), and the *Environment Protection Biodiversity Conservation Act 1999* (EPBC Act). The environmental impact assessment will be via a Public Environmental Review (PER).

This Terrestrial Vertebrate Fauna Survey and Black Cockatoo Habitat Assessment (the Survey) has been prepared to support the EPA assessment of the Proposal and addresses the Holyoake mine region of the Proposal.

Survey Area

The Survey area comprises the Holyoake Development Envelope (DE) and adjacent conveyor and haul road corridors. The Survey Area is located approximately five kilometres east of the Dwellingup town site in the south-west of WA. The Survey Area covers approximately 10,541 hectares (ha).

The Survey included a desktop assessment, a consolidation of previous fauna studies, and a detailed and targeted vertebrate fauna survey undertaken in the Holyoake survey area in Winter (July/August) and Spring (November/December) of 2020. The Survey included a Black Cockatoo habitat assessment in accordance with Commonwealth guidance, and a targeted assessment of Carter's Freshwater Mussel.

Survey Results

Five broad fauna habitat types were delineated in the Survey Area during the field survey based on flora species, hydrology, soil, and topography. They include: Bullich forest, Blackbutt forest, Flooded Gum woodland and Jarrah -Marri forest being the most extensive habitat that accounts for approximately 88% of the Survey Area. Granite outcrop accounts for a relatively scarce proportion of fauna habitat (0.002%), in contrast to the Myara North survey area. In addition to the fauna habitats listed above, highly disturbed areas make up a small proportion of the Survey Area (1.85%) and include pine plantation, mine rehabilitation areas, and rural/clearing.

The conservation value of each fauna habitat type is specific to the locally occurring conservation significant fauna species and the type of habitat usage by those species. All three Black Cockatoo species were recorded, primarily throughout the Jarrah-Marri forest, however all habitat types will be utilised for foraging by either one or all the species. Flooded Gum woodland and riparian areas comprising Bullich Forest, Blackbutt Forest and Jarrah-Marri Forest support a Quokka population with records scattered throughout the Survey Area. Chuditch are wide ranging and expected to use all habitat types.

In total ten conservation significant species were recorded in the Survey Area including the Quokka, Chuditch, Brush-tailed Phascogale, Western Brush Wallaby, Forest Red-tailed Black Cockatoo, Baudin's Cockatoo, Carnaby's Cockatoo, Western False Pipistrelle, Quenda and Peregrine Falcon. All conservation significant species identified are likely to have resident populations and habitat present within the Survey Area. Although recorded nearby and outside of the Survey Area the presence of Carter's Freshwater Mussel is unlikely due to the lack of permanent surface waterbodies present.

The Survey Area has extensive foraging habitat for the three Black Cockatoo species, and potential breeding habitat (limited in extent) for Carnaby's and Forest Red-tailed Black Cockatoo. Regarding migratory shorebirds, the Survey Area lacks open water such as shallow shorelines or tidal zones for foraging habitat. The creek lines and vegetated dampland areas within the Survey Area are not suitable for migratory shorebirds.

Fauna database searches identified 190 vertebrate fauna taxa previously recorded within 20 km radius of the Survey Area. This total includes 24 mammals, 106 birds, 29 reptiles and 18 amphibians.

The detailed and targeted fauna survey program recorded 129 vertebrate fauna species utilising the Survey Area, including 22 mammals, 77 birds, 23 reptiles and 7 amphibians. Of these, eight introduced species (mammals and birds) were identified.

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Acronyms

DAWE	The Department of Agriculture Water and Energy
DBCA	Department of Biodiversity, Conservation and Attractions
DBH	Diameter Breast Height
DE	Development Envelope
DEE	Department of the Environment and Energy
DSEWPaC	Department of Sustainability, Environment, Water, Population and Communities
EMRC	Environmental Management and Research Consultants
EPA	Environmental Protection Authority
EPBC	Environment Protection Biodiversity Conservation
EP	Environmental Protection
ERD	Environmental Review Document
ESD	Environmental Scoping Document
FRTBC	Forest Red-tail Black Cockatoo
GoWA	Government of Western Australia
IBSA	Index of Biodiversity Surveys for Assessments
LOO	Likelihood of Occurrence
LTFMP	Long Term Fauna Monitoring Program
MNES	Matters of National Environmental Significance
PMST	Protected Matters Search Tool
SM	Song Meter
SOP	Standard Operating Procedure
SRE	Short-Range Endemic

1. Introduction

1.1 Project background

Alcoa of Australia Limited (Alcoa) is proposing to increase production at the Pinjarra Alumina Refinery by 5 per cent from 5 million tonnes per annum (Mtpa) to 5.25 Mtpa and transition the Huntly Bauxite Mine to the proposed Myara North and Holyoake mine regions (the Proposal). The Proposal is located in the Peel Region of Western Australia (WA), approximately 100 km south-east of Perth

The Proposal will be subject to environmental impact assessment under Part IV of the WA *Environmental Protection Act 1986* (EP Act), and the *Environment Protection Biodiversity Conservation Act 1999* (EPBC Act). The environmental impact assessment will be via a Public Environmental Review (PER).

This Terrestrial Vertebrate Fauna Survey and Black Cockatoo Habitat Assessment (the Survey) has been prepared to support the EPA assessment of the Proposal and addresses the Holyoake region of the Proposal. Separate reports address the Myara North region, Pinjarra Refinery, Short-Range Endemic (SRE) invertebrate fauna, aquatic fauna, and subterranean fauna.

1.2 Purpose and scope of this report

The purpose of the Survey is to support an Environmental Review Document (ERD) for assessment of the Proposal under Part IV of the EP Act and under the EPBC Act. Specifically, the Survey was to characterise terrestrial fauna habitats and communities to support assessment against the EPA's Terrestrial Fauna factor and EPBC Act Matters of National Environmental Significance (MNES); threatened and migratory fauna. The Survey will also inform mine planning to avoid and minimise impacts to conservation values, enable quantification of impacts, and inform mine management arrangements.

This Survey report has been prepared in accordance with the Environmental Scoping Document (ESD) prepared for the Proposal under Part IV of the EP Act. The Survey has been undertaken in accordance with EPA (2020) *Technical Guidance – Terrestrial vertebrate fauna surveys for environmental impact assessment* and relevant Commonwealth guidance on surveys for relevant threatened and migratory species.

This Survey report details the results of desktop assessment, a consolidation of previous fauna studies, and the findings of a detailed and targeted vertebrate fauna surveys undertaken in the Holyoake region in winter (July/August) and spring (November/December) of 2020. The Survey includes a black cockatoo habitat assessment in accordance with Commonwealth guidance.

1.3 Survey Area

The Survey Area comprises the Holyoake Development Envelope (DE) and adjacent infrastructure corridors and is located approximately five kilometres north-east of the Dwellingup town site in the south-west of Western Australia (WA). The Survey Area lies in State Forest and covers approximately 10,541 ha (refer Figure 1, Appendix A).

For this report, the term Study Area comprises the Survey Area with a 10 km buffer. The Study Area defines the limits of some of the desktop searches as described in section 2.2.

1.4 Scope of works

The scope of works was to:

- Complete a comprehensive desktop assessment comprising vertebrate fauna database search for the Study Area to determine the presence, or likely presence, of conservation significant vertebrate fauna species.
- Review relevant literature provided by Alcoa and relating to fauna within Alcoa's ML1SA mineral lease, with particular focus on conservation significant fauna.
- Undertake a two-season detailed and targeted (Forest Red-tailed Black Cockatoo, Carnaby's Cockatoo, Baudin's Cockatoo, Chuditch, Quokka, Carter's Freshwater Mussel, and other priority species) vertebrate fauna survey within the Holyoake Survey Area.

– Provide a technical report (this document) detailing the results and findings of the survey
– Submit fauna survey data to the Index of Biodiversity Surveys for Assessments (IBSA) in accordance with Statutory requirements.
– Though not a vertebrate species, a targeted survey was undertaken for the threatened aquatic invertebrate Carter's Freshwater Mussel as part of the field survey program. The targeted survey was undertaken further to the findings of a desktop aquatic fauna assessment (WRM 2021) which identified the potential presence of the species in the Survey Area.

1.5 Limitations and assumption

This report has been prepared by GHD for Alcoa of Australia Limited and may only be used and relied on by Alcoa of Australia Limited for the purpose agreed between GHD and the Alcoa of Australia Limited as set out in 1.4 of this report.

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1.6 Proposal terminology and definitions

Some common Proposal terminology are described below in Table 1.

Table 1 Proposal terminology and definitions

Term (Abbreviation)	Definition/Use
Alcoa of Australia Limited (Alcoa)	Proponent of the Proposal and client of GHD for this Survey.
GHD Pty Ltd (GHD)	Consultant engaged by Alcoa to prepare environmental approvals documentation and supporting technical studies.
Mining region	Sub-regions that comprise the Huntly Mine, including current (Myara), past (Del Park, Huntly 1 & 2, White, McCoy and O'Neil) and future (Myara North, Holyoake), etc.
Survey Area	Holyoake Development Envelope and associated infrastructure corridor.
Study Area	The Survey Area with a 10 km buffer used to define the limits of desktop database searches.
Haul Road	Truck and mine infrastructure access road linking into existing corridors.
Conveyor Corridor	New conveyor through the Myara region connecting to the Holyoake Development Envelope.
Detailed fauna survey	As per EPA 2020 describing the type of survey required, replaces wording from EPA 2016 for Level 2 assessment.
Targeted fauna survey	As per EPA 2020 describing the type of survey required, refers to undertaking targeted assessments for specific fauna species.

2. Methodology

2.1 Relevant legislation, conservation codes and background information

In WA some ecological communities, flora and fauna are protected under both Australian Government and State Government legislation. In addition, regulatory authorities also provide a range of guidance and information on expected standards and protocols for environmental surveys.

An overview of key legislation and guidelines, conservation codes and background information relevant to this biological survey is provided in Appendix B.

2.2 Desktop assessment

The desktop assessment comprises a review of various databases and literature sources (listed below) related to the environmental and ecological nature of the Survey Area.

The desktop assessment included a review of:

– The Department of Agriculture Water and Energy (DAWE), formerly Department of the Environment and Energy (DEE) Protected Matters Search Tool (PMST) to identify communities and species listed under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) potentially occurring within the Study Area (DAWE 2020) (Appendix C).
– The DBCA *NatureMap* database for fauna species previously recorded within the Study Area (DBCA 2007) (Appendix C).
– Existing datasets including previous broad-scale vegetation mapping of the Survey Area, aerial photography, geology/soils, and hydrology information to provide background information on the variability of the environment, likely vegetation units and fauna habitats and to identify areas with the potential to contain Threatened and Priority fauna species.
– Literature provided by Alcoa and relating to fauna recorded in Alcoa's ML1SA mining lease within the Northern Jarrah Forest (refer Table 19).

Due to the varying complexity of the reviewed data, various search extents were used to best display the targeted information. The extent used on each database as well as the literature review is displayed in Table 2.

Table 2 Extent of data searches

Component	Extent	Rationale
Regional biogeography	Region	This is a regional characterisation.
Climate	Dwellingup	Closest reliable weather station
Geology	Study Area	Broad classification with low number of outputs in Study Area
Land systems	Study Area	Broad classification with low number of outputs in Study Area
Surface water and hydrology	Study Area	Considered important to include surface water sources in proximity to the survey are which may be used by fauna as a drinking water supply and which may impact habitat type and availability.
Conservation reserves	Study Area	To consider protected land in and in proximity to the Survey Area.
DBCA Managed Lands		
Environmentally Sensitive Areas		
Regional Ecological Linkages		
Broad vegetation mapping	Survey Area	Fairly detailed and complex data
Fauna species databases	Study Area	Search area extended due to motile nature of some fauna
Literature review	Region	Much of the literature was from Alcoa's Myara, Huntly and McCoy sites and surrounding forest to the south of the current Survey Area. Available literature was reviewed if applicable to terrestrial fauna.

2.3 Field survey

2.3.1 Survey details and timing

Field surveys were performed between 25 July and 19 February 2021 and consisted of six site visits ranging from one to eleven days in duration. Survey timing and personnel are provided in Table 3. Most of the survey timing falls within the recommended survey timing for the southern climatic region for all species groups (EPA 2020). However, the first phase was undertaken in Winter 2020, outside of the recommended period. This was undertaken to fulfil the survey schedule and the ability to maximise reptile detection via hand searches during seasonally low activity periods. It is unlikely that this survey timing adversely influenced the potential detection of mammal, bird or amphibian via the captures and recording methods used as these fauna groups remain active throughout the year and are detectable during winter. Prescribed burns occurred between Phase 1 and Phase 2 surveys in the north-western portion of the Survey Area. Although not known, it is unlikely the prescribed burns adversely affected fauna results relative to trapline locations as fire was not within proximity.

Table 3 Holyoake survey details and timing

Field Trip	Dates	Task	Duration (days)	Zoologist/Ecologist	Field personnel experience (years) l
1	25 July 2020	Reconnaissance, camera and acoustic bat detector deployment	1	Principal Zoologist	20
				Senior Zoologist	20
2	27 July to 7 August 2020	Phase 1 Survey: Detailed fauna survey (including trapping) within the Survey Area, identification and mapping of potential Black Cockatoo breeding trees and selected large hollows	12	Principal Zoologist	20
				Senior Zoologist	20
				Zoologist	5
				Ecologist	3
				Graduate Ecologist	2
				Graduate Ecologist	2
				Graduate Hydrologist (field hand)	2
3	19 to 20 August 2020	Assessment of black cockatoo trees and habitat identified in Holyoake	2	Black cockatoo specialist	20
4	7 to 16 September 2020	Remote camera collection and survey of conveyor corridor	7	Zoologist	5
				Graduate Ecologist	2
5	24 November to 4 December 2020	Phase 2 Survey: Detailed fauna survey (including trapping) within the Survey Area, Carter's Freshwater Mussel and Rakali habitat assessment, Quokka habitat assessment	11	Principal Zoologist	20
				Senior Zoologist	20
				Senior Zoologist	20
				Ecologist	10
				Zoologist	5
				Graduate Ecologist	2
6	11 to 12 November 2020	Assessment of black cockatoo trees and habitat identified in proposed Holyoake facilities location	2	Black cockatoo specialist	20
7	22 December 2020	Collection of cameras deployed in Phase 2 survey.	2	Principal Zoologist	20
				Graduate Ecologist	2
8	18 February 2021	Collection of outstanding cameras deployed in Phase 2 survey	1	Senior Zoologist	20
				Graduate Ecologist	2

2.3.2 Guiding documents

The survey methodology and data collection GHD employed was scoped according to EPA *Technical Guidance – Sampling methods for terrestrial vertebrate fauna* (EPA 2016a) and *Technical Guidance –Terrestrial Fauna Surveys* (EPA 2016b). However, during mobilisation of the Survey the updated *Technical Guidance –Terrestrial vertebrate fauna surveys for environmental impact assessment* (EPA 2020) was released. Where practicable this document was followed.

The following Commonwealth survey guidance was adopted where relevant:

– EPBC Act referral guidelines for three threatened black cockatoo species: Carnaby's Cockatoo (Endangered) *Calyptorhynchus latirostris, Baudin's* Cockatoo (Vulnerable) *Calyptorhynchus baudinii*, and Forest Red-tailed Black Cockatoo (Vulnerable) *Calyptorhynchus banksii naso* (DSEWPaC 2012a).
– Survey guidelines for Australia's threatened bats (Commonwealth Department of the Environment, Water, Heritage and the Arts 2010).
– Survey guidelines for Australia's threatened reptiles (Commonwealth Department of the Sustainability, Environment, Water, Population and Communities 2011a).
– Survey guidelines for Australia's threatened mammals (Commonwealth Department of the Sustainability, Environment, Water, Population and Communities 2011b).

2.3.3 Permits and ethics

A Section 40 Authorisation to Take or disturb threatened Fauna (Licence Number: 2020-0075), and a Regulation 27 (Licence No. BA27000269) to take Fauna for biological assessment was obtained from DBCA prior to undertaking the fauna surveys. The fauna survey (specifically trapping and animal handling) was undertaken in accordance with Standard Operating Procedures (SOPs) which were required to be followed under the conditions of GHD's fauna trapping permit. At the time of survey, compliance with these SOPs was accepted by DBCA as evidence of ethical treatment of animals.

2.3.4 Habitat assessment

The Survey Area was assessed for habitat type based on floristic species, structural complexity, connectivity, hydrology, disturbance, type and extent of resource availability and value for fauna. Specifically, the assessment included:

– Habitat structure (e.g. vegetation type, presence/absence of overstorey, mid-storey, understorey, and ground cover).
– Description of geomorphology, topography and substrate where applicable.
– Presence/absence of refuge including: fallen timber (coarse woody debris), hollow-bearing trees and stags and rocks/breakaways, and the type and extent of each refuge.
– Location of the habitat within the Survey Area in comparison to the habitat within the surrounding landscape.
– Habitat connectivity of refugia i.e., low dense vegetation associated with drainage lines and damplands within the Jarrah Forest, and identification of wildlife corridors for habitat specialist fauna, namely Quokka and Quenda within and immediately adjacent to the Survey Area.
– Identification and evaluation of key habitat features and types identified during the desktop assessment relevant to fauna of conservation significance.
– Evaluation of the likelihood of occurrence of conservation significant fauna within the environments present (based on presence of suitable habitats and species recorded)
– A representative photograph of each habitat type to complement description of habitat characteristics.

Habitat types have been delineated to align with Mattiske (2021) vegetation community types. That is, each habitat type represents one or more vegetation types. Refer to section 4.1.

2.3.5 Fauna identification and nomenclature

Identification of fauna species was made in the field using available field guides and electronic guides (Table 4). Where identification was not possible, photographs of specimens were collected to be later identified.

Table 4 Fauna references

Fauna group	Field guide
Mammals	Menkhorst & Knight (2010), Van Dyck & Strahan (2008)
Bats	Churchill (2008), Menkhorst and Knight (2010)
Birds	Morcombe (2004)
Reptiles	Wilson & Swan (2017), Storr *et al*. (1999), Storr *et.al*. (2002)
Amphibians	Tyler & Doughty (2009)

Nomenclature

Nomenclature used in this report follows that used by the WA Museum as reported on *NatureMap.* This nomenclature is deemed the most up-to-date species information for WA fauna, with the exception of birds, which follows Christidis & Boles (2008).

2.3.6 Trapping program

The same sampling techniques and trap layouts were used during both phases of the survey and involved a series of standardised systematic trapping quadrat sites comprising pit-fall traps, Elliott box traps, cage traps and funnel traps. Details of each trap type used are provided below. During both phases, a total of nine quadrats were established across the Survey Area and each quadrat was systematically surveyed (trapped) for seven nights. The trap quadrats were selected to sample across the major habitat types occurring within the Survey Area. Trap quadrat details are presented in Table 15 and locations shown in Figure 3, Appendix A.

Traps sites were established during the first phase of trapping and closed upon survey completion, before being reopened during the second phase of trapping and removed upon survey completion. During Phase 2 of the survey, traps were closed for three nights over the weekend after four nights of being opened, and then reopened again for a further three nights (see section 2.3.11). This occurred so that GHD could be in accordance with Alcoa's fatigue management guidelines. Initial design focused on undertaking a detailed assessment (EPA 2020) however through refinement, it developed into a targeted focused survey for conservation significant species identified in the Likelihood of Occurrence assessment (Section 3.6.2) as discussed below.

Potential SRE fauna bycatch was collected throughout the Phase 2 survey and provided to Phoenix Environmental for identification and assessment of SRE fauna (Phoenix 2021). Specimens collected were only those from SRE candidate groups such as isopods, mygalomorphs, scorpions, millipedes, and planarians.

Pit-trap with drift fence

Seven (7) pit-traps were established at each quadrat within the Survey area. Pit-traps comprised of 20 L plastic buckets (30 cm diameter, 40 cm deep) at each quadrat. A 50 m long flywire drift fence (30 cm high) bisected the pits; directing fauna into them. Pits were spaced at seven metre intervals along the fence. Soil and an egg carton were placed within each pit to provide shade and protection for captured animals.

Species targeted through this method were the Dell's Skink (*Ctenotus delli*) and Southern Death Adder (*Acanthophis antarcticus*). There are no specific guidelines on the assessment of these reptiles specifically in WA, however detection methods were derived from DSEWPaC (2011a).

Funnel traps

Twelve (12) funnel traps were used along the drift fence at each quadrat. Traps were placed such that animals were directed into them from the drift fence in between the pit traps. Funnel traps were covered with insulating materials to minimise heat or cold exposure to animals.

Species targeted through this method were the Dell's Skink and Southern Death Adder. There are no specific guidelines on the assessment of these reptiles specifically in WA, however detection methods derived from DSEWPaC (2011a).

Elliot box traps

One line of ten (10) Elliot ® box traps was established at each quadrat and positioned approximately 50 m away (and parallel to) the drift fence. Traps were placed approximately 10 m apart and baited with universal bait (a mixture of peanut butter, rolled oats and sardines). Elliott traps were located within shady areas or covered with vegetation to minimise exposure to captured animals. Where practicable Elliot traps were placed (strapped) in trees and onto logs to increase the likelihood of arboreal mammal captures.

Species targeted through this method include Brush-tailed Phascogale (*Phascogale tapoatafa wambenger*). The techniques utilised for this species were derived from Orell (2004), Scida and Gration (2017) and DSEWPaC (2011b).

Cage traps

Two (2) cage traps (with approximate dimensions 26 by 23 by 66 cm) were located at each quadrat site. These traps were placed at each end of the line of Elliot traps approximately 100 m apart. Cage traps were baited with universal bait and chicken wings.

Species targeted through this method include Brush-tailed Phascogale, Chuditch (*Dasyurus geoffroii)* and Quenda (*Isoodon fusciventer*). Specific survey guidelines exist for the Chuditch and this technique derived from DSEWPaC (2011b). Brush-tailed Phascogale and Quenda are also trapped via cage traps (Orell 2004).

Targeted cage trap lines

Cage traps (with approximate dimensions 26 by 23 by 66 cm) were deployed for a minimum of seven nights along five transects during both survey phases to target Brush-tailed Phascogale, Chuditch and Quenda. Each transect consisted of ten cage traps except for transect number six during Phase 2 which consisted of seven cage traps (due to cage availability at time of survey). These cages were baited with chicken wings as per recommendations from Alcoa (McGregor *et al*. 2014). For each trap deployed, the time and date deployed and recovered, as well as the GPS coordinates were recorded (refer Table 5). Cage trap locations are presented in Figure 3, Appendix A.

Captured Chuditch were to be capture-marked-released to assess population size. Upon capture, gender, reproductive stage, and health index would be recorded. Health index was rated on a scale from 1 to 3 after feeling the base of the Chuditch tail where a scale of 1 meant that bones could be felt and the Chuditch may be in poor health, and a scale of 3 meant that tail vertebrates could not be felt due to a layer of fat and the Chuditch was considered in excellent health. Photographs would then be taken of the Chuditch's head and back, one spot on the back would then be coloured with permanent marker before a second dorsal photograph was recorded and the Chuditch was released in a suitable hollow or burrow. A summary of each Chuditch that was captured and assessed is provided in Appendix D.

Cages would be closed if females carrying pouch young were recaptured, or any Chuditch was re-captured three consecutive nights in a row.

Table 5 Targeted Chuditch cage trap lines summary

Transect Number	Site name I. D	Habitat type	Location		Nights deployed during each phase
			Easting	Northing	
Phase 1					
Transect 1	Cage 1	Very open forest of Jarrah and Marri over Sheoak	422114	6375016	4
	Cage 2		422069	6374910	4
	Cage 3		422026	6374833	4
	Cage 4		421959	6374756	4
	Cage 5		421889	6374679	4
	Cage 6		421849	6374582	4
	Cage 7		421797	6374521	4
	Cage 8		421686	6374455	4
	Cage 9		421582	6374387	4
	Cage 10		421478	6374271	4
Transect 2	Cage 11	Open forest of Jarrah with scattered marri over *Banksia grandis*	424568	6378781	10
	Cage 12		424758	6378680	10
	Cage 13		424879	6378543	10
	Cage 14		425098	6378461	10
	Cage 15		425256	6378405	10
	Cage 16		425431	6378250	10
	Cage 17		425543	6378127	10
	Cage 18		425716	6378010	10
	Cage 19		425904	6377966	10
	Cage 20		426099	6377946	10
Transect 3	Cage 21	Open forest of Jarrah, scattered Marri and Sheoak (dominant) over *Xanthorrhoea preissii*	427212	6387417	8
	Cage 22		427118	6387686	8
	Cage 23		427015	6387869	8
	Cage 24		426875	6388008	8
	Cage 25		426728	6388142	8
	Cage 26		426549	6388167	8
	Cage 27		426341	6388247	8
	Cage 28		426157	6388276	8
	Cage 29		425969	6388325	8
	Cage 30		425810	6388439	8
Transect 4	Cage 31	Open forest of Jarrah (dominant), scattered Marri over Sheoak	426046	6383857	8
	Cage 32		426013	6383653	8
	Cage 33		425984	6383456	8
	Cage 34		425959	6383249	8
	Cage 35		425931	6383055	8
	Cage 36		425884	6382856	8
	Cage 37		425812	6382661	8
	Cage 38		425666	6382542	8

Transect Number	Site name I. D	Habitat type	Location		Nights deployed during each phase
			Easting	Northing	
	Cage 39		425467	6382464	8
	Cage 40		425287	6382392	8
Transect 5	Cage 41	Open forest of Eucalyptus patens (black butt), scattered Corymbia calophylla and Eucalyptus marginata over Xanthorrhoea preissii	421079	6381754	9
	Cage 42		421171	6381558	9
	Cage 43		421193	6381361	9
	Cage 44		421200	6381156	9
	Cage 45		421251	6380964	9
	Cage 46		421323	6380778	9
	Cage 47		421475	6380632	9
	Cage 48		421646	6380543	9
	Cage 49		421835	6380462	9
	Cage 50		421951	6380303	9
Transect 6	Cage 51	Open forest Jarrah and Marri with *Eucalyptus rudis* over *Banksia littoralis* and Hakea sp.	423829	6377211	8
	Cage 52		423586	6377187	8
	Cage 53		423365	6377125	8
	Cage 54		423122	6377023	8
	Cage 55		422937	6376907	8
	Cage 56		422788	6376726	8
	Cage 57		422720	6376566	8
	Cage 58		422543	6376435	8
	Cage 59		422368	6376378	8
	Cage 60		422199	6376284	8
Transect 7	Cage 61	Open forest of Eucalyptus patens and scattered Eucalyptus rudis, over Xanthorrhoea preissii	423296	6373143	6
	Cage 62		423059	6373160	6
	Cage 63		422823	6373201	6
	Cage 64		422610	6373242	6
	Cage 65		422401	6373287	6
	Cage 66		422180	6373350	6
	Cage 67		421964	6373397	6
	Cage 68		421827	6373481	6
	Cage 69		421723	6373569	6
Phase 1 Total					**524**
Phase 2					
Transect 1	Cage 1	Very open forest of Jarrah and Marri over Sheoak	422114	6375016	7
	Cage 2		422069	6374910	7
	Cage 4		421959	6374756	7
	Cage 5		421889	6374679	7
	Cage 6		421849	6374582	7
	Cage 7		421797	6374521	7
	Cage 8		421686	6374455	7

Transect Number	Site name I. D	Habitat type	Location		Nights deployed during each phase
			Easting	Northing	
	Cage 9		421582	6374387	7
	Cage 10		421478	6374271	7
Transect 2	Cage 11	Open forest of Jarrah with scattered Marri over *Banksia grandis*	424593	6385557	7
	Cage 12		424773	6385443	7
	Cage 13		424900	6385299	7
	Cage 14		424955	6385103	7
	Cage 15		425025	6384922	7
	Cage 16		425202	6384815	7
	Cage 17		425399	6384780	7
	Cage 18		425581	6384817	7
	Cage 19		425739	6384949	7
	Cage 20		422114	6375016	7
Transect 3	Cage 21	Open forest of Jarrah, scattered Marri and Sheoak (dominant) over *Xanthorrhoea preissii*	425459	6389971	7
	Cage 22		425253	6389872	7
	Cage 23		425049	6389832	7
	Cage 24		424906	6389693	7
	Cage 25		424753	6389545	7
	Cage 26		424632	6389390	7
	Cage 27		424541	6389206	7
	Cage 28		424496	6389024	7
	Cage 29		424391	6388862	7
	Cage 30		424258	6388716	7
Transect 4	Cage 31	Open forest of Jarrah (dominant), scattered Marri over Sheoak	419759	6379841	7
	Cage 32		419826	6379632	7
	Cage 33		419877	6379452	7
	Cage 34		419871	6379218	7
	Cage 35		420054	6379021	7
	Cage 36		420154	6378865	7
	Cage 37		420305	6378710	7
	Cage 38		420491	6378675	7
	Cage 39		420680	6378506	7
	Cage 40		420720	6378269	7
Transect 5	Cage 41	Open forest of Eucalyptus patens (black butt), scattered Corymbia calophylla and Eucalyptus marginata over Xanthorrhoea preissii	424509	6378809	7
	Cage 42		424722	6378721	7
	Cage 43		424862	6378570	7
	Cage 44		425137	6378459	7
	Cage 45		425331	6378357	7
	Cage 46		425522	6378185	7
	Cage 47		425658	6378035	7
	Cage 48		425821	6377990	7

Transect Number	Site name I. D	Habitat type	Location		Nights deployed during each phase
			Easting	Northing	
	Cage 49		426085	6377954	7
	Cage 50		426271	6377934	7
Transect 6	Cage 51	Open forest Jarrah and Marri with *Eucalyptus rudis* over *Banksia littoralis* and Hakea sp.	424536	6382208	7
	Cage 52		424755	6382177	7
	Cage 53		424958	6382155	7
	Cage 54		425156	6382118	7
	Cage 55		425336	6382036	7
	Cage 56		425498	6381938	7
	Cage 57		425652	6381799	7
Phase 2 Total					**392**
Phase 1 and Phase 2 Combined Total					**916**

Avifauna

Avifauna surveys were undertaken at each of the quadrat sites and opportunistically for a combined total of 1150 minutes. Each survey comprised of at least a 20 minute census of birds within an unbounded two hectare area, which is the standard method used by Birds Australia for the Bird Atlas project. Birds detected visually (using binoculars) and/or aurally over at least a 20 minute period were recorded. Numbers of each species observed were also recorded.

All systematic bird surveys were undertaken either within four hours of dawn or two hours of dusk, as these are the times of day when birds are most active. In addition to systematic surveys, observations of birds were also made opportunistically throughout the survey activities. These are not part of the systematic quadrat surveys contribute a significant proportion of the bird species observed.

Avifauna survey effort is displayed in Table 6.

Table 6 Avifauna survey effort

Site Type	Location		Habitat Type	Survey Effort (minutes)
	Easting	Northing		
Phase 1				
TL1	422196	6374150	Very open Jarrah and Marri forest over Sheoak and *Banksia grandis*	40
TL2	422128	6376133	Open forest of Jarrah with scattered Marri over *Banksia grandis*	40
TL3	424323	6378919	Open Jarrah forest, scattered Marri and Sheoak (dom) over *Xanthorrhoea preissii*, scattered *Banksia grandis*	40
TL4	420760	6378215	Open Jarrah forest (dom), scattered Marri over Sheoak, *Banksia grandis*, over *Macrozamia ridei, Xanthorrhoea preissii*	40
TL5	424452	6385508	Open Blackbutt forest scattered Marri and Jarrah over *Xanthorrhoea preissii* and mixed herbs	40
TL6	427454	6386849	Open Blackbutt forest and scattered Marri over Melaleuca sp.(paperbark), *Banksia littoralis, Xanthorrhoea preissi.*	40

Site Type	Location		Habitat Type	Survey Effort (minutes)
	Easting	Northing		
TL7	423884	6388643	Open Blackbutt forest and scattered Eucalyptus rudis, over *Xanthorrhoea preissii*	40
TL8	425643	6384023	Open forest Jarrah and Marri with Eucalyptus rudis over Banksia and Hakea sp.	40
TL9	425713	6381118	Open forest of Jarrah, Marri, scattered Blackbutt over Banksia grandis, *Xanthorrhoea preissi*.	40
Opportunistic	424176	6375415	Not recorded	20
Opportunistic	418218	6387450	Not recorded	20
Opportunistic	426892	6378149	Not recorded	20
Opportunistic	415266	6391974	Not recorded	20
Opportunistic	421288	6377102	Not recorded	20
Opportunistic	423777	6388695	Not recorded	20
Opportunistic	421365	6388262	Not recorded	20
Total Phase 1				**500**
Phase 2				
TL1	422196	6374150	Very open Jarrah and Marri forest over Sheoak and *Banksia grandis*	40
TL2	422128	6376133	Open forest of Jarrah with scattered Marri over *Banksia grandis*	40
TL3	424323	6378919	Open Jarrah forest, scattered Marri and Sheoak (dom) over Xanthorrhoea preissii, scattered *Banksia grandis*	40
TL4	420760	6378215	Open Jarrah forest (dom), scattered Marri over Sheoak, *Banksia grandis*, over *Macrozamia riedlei, Xanthorrhoea preissii*	40
TL5	424452	6385508	Open Blackbutt forest scattered Marri and Jarrah over *Xanthorrhoea preissii* and mixed herbs	40
TL6	427454	6386849	Open Blackbutt forest and scattered Marri over Melaleuca sp.(paperbark), *Banksia littoralis, Xanthorrhoea preissi.*	40
TL7	423884	6388643	Open Blackbutt forest and scattered *Eucalyptus rudis,* over *Xanthorrhoea preissi*	40
TL8	425643	6384023	Open forest Jarrah and Marri with *Eucalyptus rudis* over *Banksia littoralis* and Hakea sp.	40
TL9	425713	6381118	Open forest of Jarrah, Marri, scattered Blackbutt over *Banksia grandis, Xanthorrhoea preissi*.	40
Opportunistic	425801	6384120	Not recorded	30
Opportunistic	422497	6374395	Not recorded	20
Opportunistic	423191	6375504	Not recorded	20
Opportunistic	425036	6383855	Not recorded	20

Site Type	Location		Habitat Type	Survey Effort (minutes)
	Easting	Northing		
Opportunistic	422875	6378236	Not recorded	20
Opportunistic	422062	6377339	Not recorded	20
Opportunistic	420731	6379824	Not recorded	20
Opportunistic	419508	6380870	Not recorded	20
Opportunistic	419478	6380535	Not recorded	20
Opportunistic	420265	6380199	Not recorded	20
Opportunistic	427755	6386035	Not recorded	20
Opportunistic	426633	6385980	Not recorded	20
Opportunistic	426434.	6385142	Not recorded	20
Opportunistic	424162	6390119	Not recorded	20
Total Phase 2				**650**
Combined Phase 1 and 2 Total				**1150**

Camera traps

26 remote cameras (Reconyx-Hyperfire ®) were deployed during Phase 1 and 21 cameras in Phase 2 for a combined total of 1630 trap nights. The duration of trap nights for each camera ranged from 10 to 86 trap nights.

Remote cameras were deployed to target the conservation significant Chuditch (VU), Quokka (*Setonix brachyurus*, VU), Quenda (P4), Rakali (*Hydromys chrysogaster*, P4), Western Brush Wallaby (*Macropus irma,* P4), Brush-tailed Phascogale (CD) and general fauna (birds, reptiles and mammals). This was done by positioning cameras within the core habitat of targeted species, i.e. for Quokka, creek lines and damplands were investigated and cameras placed low in dense vegetation (within runnels if present). Conversely in upland habitat, Chuditch were targeted by utilising logs and hollows to position cameras. To target Brush-tailed Phascogale, cameras were set up like that described in Scida and Gration (2017). Cameras were baited with universal animal bait (peanut butter, oats and sardines) to attract fauna species within the Survey Area. For each camera location the number of nights deployed, and the GPS coordinates were recorded (Table 8). Cameras were used in this instant to supplement other trapping techniques and sample for more cryptic species such as the Quokka. The use of cameras also reduces the invasive impacts of trapping on species (DEC 2011).

Camera setup included fast trigger speed (faster than 0.5 seconds) and colour photographs during the day and monochrome at night. The highest mega pixel possible, frames per second (>1) with capture set to three pictures per trigger with a one second delay.

Data from the cameras were downloaded to a computer and manually analysed for the presence of fauna following the field survey.

Species targeted through this method include Chuditch, Quokka, Quenda, Rakali, Western Brush Wallaby and Brush-tailed Phascogale. Information on the remote cameras deployed during the survey are displayed in Table 7.

Table 7 Camera trap locations

Camera number	Habitat Type	Location		Deployed		Trap Nights Deployed
		Easting	Northing	Set	Collected	
Phase 1						
CAM 14	Blackbutt Forest	424581	6382222	28/08/2020	7/09/2020	10
CAM 166	Flooded Gum Woodland	420184	6379667	28/08/2020	8/09/2020	11
CAM B	Blackbutt Forest	421061	6376383	28/08/2020	8/09/2020	11
CAM C42	Jarrah Marri Forest	422604	6375690	28/08/2020	8/09/2020	11
CAM C45	Jarrah Marri Forest	424955	6377374	28/08/2020	7/09/2020	10

Camera number	Habitat Type	Location		Deployed		Trap Nights Deployed
		Easting	Northing	Set	Collected	
CAM GLEN	Jarrah Marri Forest	425606	6389753	28/08/2020	7/09/2020	10
CAM SG3	Flooded Gum Woodland	423354	6386893	28/08/2020	7/09/2020	10
CAM SG5	Blackbutt Forest	421405	6376249	28/08/2020	8/09/2020	11
CAM SG6	Jarrah Marri Forest	425768	6386803	28/08/2020	7/09/2020	10
CAM SG7	Jarrah Marri Forest	420648	6378661	28/08/2020	8/09/2020	11
CAM 2	Flooded Gum Woodland	425449	6384036	28/08/2020	7/09/2020	10
CAM 26	Flooded Gum Woodland	424499	6387077	28/08/2020	7/09/2020	10
CAM SG1	Jarrah Marri Forest	420714	6376178	31/07/2020	8/09/2020	39
CAM PRO 1	Blackbutt Forest	422898	6381493	31/07/2020	7/09/2020	38
CAM PRO 4	Flooded Gum Woodland	422588	6382300	31/07/2020	8/09/2020	39
CAM PRO 2	Flooded Gum Woodland	424960	6383776	31/07/2020	15/09/2020	46
CAM PRO 9	Bullich Forest	420748	6380629	31/07/2020	8/09/2020	39
CAM 10 SG4	Flooded Gum Woodland	422684	6382219	31/07/2020	8/09/2020	39
Cam SG2	Flooded Gum Woodland	419865	6379507	31/07/2020	8/09/2020	39
CAM GG 1	Jarrah Marri Forest	426115	6379624	2/08/2020	7/09/2020	36
GG3	Blackbutt Forest	415254	6392080	3/08/2020	7/09/2020	35
GG2	Jarrah Marri Forest	420391	6384273	3/08/2020	7/09/2020	35
CAM PRO 1	Flooded Gum Woodland	417330	6388746	3/08/2020	7/09/2020	35
CAM 4SG	Jarrah Marri Forest	416487	6391683	09/09/2020	1/12/2020	83
CAM B1	Rehabilitation Areas	420476	6388879	08/09/2020	1/12/2020	84
Total Phase 1						**769**
Phase 2						
CAM 20	Flooded Gum Woodland	427785	6385046	25/11/2020	22/12/2020	27
CAM 23	Flooded Gum Woodland	427628	6384679	25/11/2020	22/12/2020	27
CAM 21	Flooded Gum Woodland	427333	6384509	25/11/2020	22/12/2020	27
CAM7	Flooded Gum Woodland	424964	6383773	24/11/2020	22/12/2020	28
CAM 24	Jarrah Marri Forest	425050	6383835	24/11/2020	22/12/2020	28
CAM 8	Flooded Gum Woodland	423156	6386761	26/11/2020	29/11/2020	26
CAM 77	Jarrah Marri Forest	425153	6383834	24/11/2020	22/12/2020	28
CAM 43	Flooded Gum Woodland	423238	6386859	26/11/2020	22/12/2020	26
SG5	Flooded Gum Woodland	428144	6386526	26/11/2020	22/12/2020	26
1SG	Flooded Gum Woodland	426983	6387026	26/11/2020	22/12/2020	26
CAM4	Not recorded	422363	6382815	24/11/2020	22/12/2020	28
6SG	Jarrah Marri Forest	423576	6383704	27/11/2020	22/12/2020	25
CAM 45	Not recorded	422337	6382914	24/11/2020	22/12/2020	28
CAM 29	Jarrah Marri Forest	426935	6381616	26/11/2020	22/12/2020	26
CAM 31	Blackbutt Forest	419759	6379841	25/11/2020	19/02/2021	86
SG3	Flooded Gum Woodland	424118	6379707	26/11/2020	22/12/2020	26
SG7	Jarrah Marri Forest	426806	6380313	26/11/2020	22/12/2020	26
4SG	Jarrah Marri Forest	426098	6376800	1/12/2020	18/02/2021	79

Camera number	Habitat Type	Location		Deployed		Trap Nights Deployed
		Easting	Northing	Set	Collected	
CAM B1	Jarrah Marri Forest	425869	6375493	1/12/2020	18/02/2021	79
CAM PRO 1	Jarrah Marri Forest	423751	6376327	1/12/2020	18/02/2021	79
CAM R41	Not recorded	423894	6384402	1/12/2020	18/02/2021	79
Total Phase 2						**830**
Combined Phase 1 and 2 Total						**1626**

Bat Surveys

Bat Detectors (SM2 and SM4 SongMeters ®) were deployed for a period of between two and four nights at each survey location during both survey phases for a combined total of 60 nights. Bat detectors were positioned in areas where bat species might be recorded i.e., utilising water bodies or fly ways. Bat detectors were set to record from 30 minutes pre-dusk to 30 minutes post-dawn. For each detector the time and date deployed and recovered, and the GPS coordinates were recorded (Table 8). Bat detector locations are depicted in Figure 3, Appendix A.

Data from the bat detectors were downloaded to a computer and analysed by GHD Principal Ecologist, Craig Grabham for the presence of bats following the field survey. The results of this assessment are provided in Appendix D.

Table 8 Bat detectors locations

Bat detector	Habitat type	Location		Deployed		Nights deployed
		Easting	Northing	Set	Collected	
Phase 1						
SM4-5	Jarrah Marri Forest	422243	6374172	27/07/20	30/07/20	3
SM4 2	Jarrah Marri Forest	421809	6380112	29/07/20	2/08/20	4
SM4-1	Flooded Gum Woodland	425823	6380994	29/07/20	2/08/20	4
SM4-4	Flooded Gum Woodland	427638	6384707	29/07/20	2/08/20	4
SM4-6	Jarrah Marri Forest	424201	6378933	30/07/20	3/08/20	4
SM4 5	Jarrah Marri Forest	426504	6377505	30/07/20	2/08/20	3
SM4 2	Jarrah Marri Forest	420832	6377827	2/08/20	6/08/20	4
SM4-6	Jarrah Marri Forest	420281	6382210	3/08/20	5/08/20	2
SM4-5	Jarrah Marri Forest	418464	6387128	3/08/20	7/08/20	4
SM4-1	Flooded Gum Woodland	425632	6388557	3/08/20	6/08/20	3
SM4-4	Bullich Forest	423907	6388713	2/08/20	4/08/20	2
SM4-4	Jarrah Marri Forest	424214	6390035	4/08/20	7/08/20	3
SM4-6	Jarrah Marri Forest	427713	6386760	5/08/20	7/08/20	2
Total Phase 1						**42**
Phase 2						
SM4-1	Jarrah Marri Forest	427141	6384977	24/11/2020	27/11/2020	3
SM4 -2	Jarrah Marri Forest	424275	6388710	24/11/2020	27/11/2020	3
SM4-1	Bullich Forest	421400	6379082	27/11/2020	30/11/2020	3
SM4-2	Flooded Gum Woodland	425876	6382538	27/11/2020	30/11/2020	3
SM4-1	Jarrah Marri Forest	422367	6373299	30/11/2020	3/12/2020	3

Bat detector	Habitat type	Location		Deployed		Nights deployed
		Easting	Northing	Set	Collected	
SM4-2	Jarrah Marri Forest	428187	6377721	30/11/2020	3/12/2020	3
Total Phase 2						**18**
Combined Phase 1 and 2 Total						**60**

Nocturnal Bird Acoustics and Bird Census

Bird Acoustics recorders (SM4 acoustics) were deployed for a period of between two to nine nights at each survey location during both survey phases for a combined total of 54 nights. Acoustics were positioned in areas where bird species might be recorded i.e. utilising water bodies, fly ways. For each acoustic the time and date deployed and recovered, and the GPS coordinates were recorded (Table 9). Bird Acoustic recorder's locations are depicted in Figure 3, Appendix A.

Data from the acoustic recorders were downloaded to a computer and analysed for the presence of birds following the field survey. Data from the acoustic recorders was assessed by Nigel Jackett for the presence of bird species. The results of this assessment are provided in detail in Appendix D.

It should be noted that Song Meters were placed at targeted Masked Owl habitat during the Phase 1 survey and deployed to fill in 'gaps' in the Phase 2 survey to increase coverage over the Survey Area and indicate distribution of Masked Owl.

Table 9 Bird Acoustics recorder locations

Bird Acoustics	Habitat type	Location		Deployed		Nights deployed
		Easting	Northing	Set	Collected	
Phase 1						
SM4 AC2	Not recorded	427659	6384775	29/07/20	2/08/20	4
SM4 AC1	Jarrah forest amongst grass trees	422989	6374878	30/07/20	2/08/20	3
SM4 AC3	Jarrah Marri forest	425118	6375292	30/07/20	3/08/20	4
SM4 4	Jarrah Marri forest	419843	6379645	31/07/20	5/08/20	5
SM4 AC1	Jarrah Marri open forest over Sheoak	421415	6374163	2/08/20	6/08/20	4
SM4 AC3	Blackbutt, Rudis drainage line	423028	6381197	3/08/20	5/08/20	2
SM4-AC2	Not recorded	423890	6388670	2/08/20	4/08/20	2
SM4-2	Not recorded	424201	6390032	4/08/20	7/08/20	3
SM4-2	Not recorded	423882	6388723	2/08/20	4/08/20	2
SM4-AC3	Upland Jarrah near drainage line,	427717	6386775	5/08/20	7/08/20	2
Total Phase 1						**29**
Phase 2						
SM4-AC1	Not recorded	427137	6384987	24/11/2020	27/11/2020	3
SM4-AC2	Not recorded	424253	6388731	24/11/2020	27/11/2020	3
SM4-AC2	Not recorded	421402	6379081	27/11/2020	30/11/2020	3
SM4-AC1	Not recorded	425878	6382538	27/11/2020	30/11/2020	3
SM4 AC3	Not recorded	426752	6380334	26/11/2020	30/11/2020	4
SM4 AC3	Not recorded	419437	6380444	30/11/2020	3/12/2020	3
SM4-AC2	Not recorded	422373	6373299	30/11/2020	3/12/2020	3

Bird Acoustics	Habitat type	Location		Deployed		Nights deployed
		Easting	Northing	Set	Collected	
SM4-AC1	Not recorded	428188	6377722	30/11/2020	3/12/2020	3
Total Phase 2						**25**
Combined Phase 1 and 2 Total						**54**

Carter's Freshwater Mussel assessment

Carter's Freshwater Mussel (*Westralunio carteri*) assessments were conducted during the Phase 2 survey. The survey approach was based on a method used by Klunzinger *et al*. (2012) to study Carter's Freshwater Mussel populations in the lower Vasse River. This method is aimed at detecting individual presence. Due to the ephemeral nature of the water bodies assessed this method was based on the assumption of low density of individuals.

Seven locations were selected for assessment prior to the field survey based potential direct impacts from haul road crossings over stream zone areas. Potential survey locations focussed on streams likely to have water present in order to maximise detection to confirm presents/absence. For each survey location zoologists walked 100 m upstream and 200 m downstream assessing 10 (one by one metre) quadrats at regular 30 m intervals. While traversing the stream zone opportunistic searching for mussels was also done between each quadrat. In situations where stream zones may have become inaccessible due to dense riparian vegetation, the maximum number of quadrats was surveyed along the accessible stream zone. The following was recorded:

– Any evidence of Carter's Freshwater Mussel including live mussels and dead shell remains within the water, as well as any shell evidence on banks
– Presence of water and if so, still or flowing, size of water body and depth if determinable
– Riparian vegetation, bank/bed condition including evidence of bank erosion, bed sediment deposition and disturbance (i.e. tramping by pigs, dumped material etc.)
– Riparian vegetation condition
– Evidence of riparian terrestrial fauna including Rakali middens, quokka tracks/runnels/scat etc.
– For standing water the following was recorded:
    - Approximate depth, width and (for pools) length
    - Substrate (rocky, sandy etc)
    - Water quality (clear, turbid, sheen etc)
    - Opportunistic observations for aquatic fauna (fish, crayfish, frogs etc).

In total seven (7) Carter's Freshwater Mussel transects were surveyed over the Survey Area. Locations of these transects are presented in Table 10. Greater details on the assessment can be found in Appendix D.

Table 10 Carter's Freshwater Mussel transect summary

Site Type	Location		Date completed	Number of quadrats
	Easting	Northing		
CFM1	421107.87	6383127.61	03/08/2020	3
CFM2	425865.99	6383989.98	25/11/2020	10
CFM3	423282.13	6386913.12	25/11/2020	1
CFM4	423797.22	6380448.43	25/11/2020	11
CFM5	418227.84	6377815.62	25/11/2020	8
CFM6	423030.941	6386487.24	25/11/2020	5
CFM7	427625.8994	6384677.106	25/11/2020	15

Rakali assessment

Due to similarity of habitat preference, Rakali habitat assessments were performed in conjunction with the Carter's Freshwater Mussel assessments. Each Carter's Freshwater Mussel transect (ten one by one metre quadrats over a 300 m distance) was also searched for the presence of middens, tracks and scat as well as an overall assessment of habitat quality (permanent water, presence of food species, refuge habitat, fire history etc.). In addition to those mentioned above, an additional three locations were actively searched for the presence of Rakali. The locations of these active searches are presented in Table 11.

Remote cameras were also set to target Rakali in areas considered potentially suitable to support their presence such as alongside streams and creeks. Remote cameras are considered unreliable to capture Rakali (due to cool temperatures a wet Rakali maintains). However, cameras placed slightly away from water with sufficient bait to keep the species present longer also yield results (GHD pers comm. Cockatoo Island Fauna Surveys). Remote camera locations are presented in Table 7 and Figure 3, Appendix A. Greater details on the assessment can be found in Appendix D.

Table 11 Additional Rakali active search summary

Site name	Location		Date completed	Survey effort (minutes)
	Easting	Northing		
Rakali Active Search 1	421107.87	6383127.61	03/08/2020	30
Rakali Active Search 2	425865.99	6383989.98	25/11/2020	30
Rakali Active Search 3	423282.13	6386913.12	25/11/2020	30
Rakali Active Search 4	423797.22	6380448.43	25/11/2020	30
Rakali Active Search 5	418227.84	6377815.62	25/11/2020	30
Rakali Active Search 6	423030.941	6386487.24	25/11/2020	30
Rakali Active Search 7	427625.8994	6384677.106	25/11/2020	30
Rakali Active Search 8	424220	6416019	4/11/2020	30
Rakali Active Search 9	425346	6413895	4/11/2020	30
Rakali Active Search 10	424902	6413431	5/11/2020	30
Total				**300**

Quokka Assessments

Quokka assessments were performed during the Phase 1 and 2 surveys (Table 12). Assessments were conducted by targeting potential Quokka habitat (primarily medium-long unburnt riparian vegetation with dense undergrowth and Flooded Gum woodland). Areas of potential Quokka habitat were searched for presence of runnels, tracks and scat as well as the extent of habitat and connectivity to surrounding potentially suitable habitat. Each identified habitat was searched (meandered) by two ecologists for approximately 60 minutes. This methodology (Quokka habitat assessment) was extracted from Bain (DEC 2013) and where habitat is considered suitable, or quokka detected (due to evidence found) remote cameras were placed. In total approximately 13 hours (780 minutes) of Quokka assessments were undertaken spread over 29 sites.

Targeted remote cameras were set during both survey phases at locations deemed to be suitable to support Quokkas to confirm their presence. Suitability of camera location was based on habitat characteristics. Habitat with relatively high density of shrubs associated with creeklines and/or Flooded gum woodland (associated with Melaleuca dampland). As these habitats provide shelter and movement corridors under cover for Quokkas. Camera location were also selected in proximity to secondary Quokka evidence detected during Quokka assessments such as scats, runnels, and footprints. Remote camera locations are presented in Table 7 and Figure 3, Appendix A.

Table 12 Quokka assessment summary

Site Type	Location		Date completed	Habitat type	Survey effort (minutes)
	Easting	Northing			
Quokka assessment	419963	6379560	30/07/2020	Flooded gum woodland	30
	422800	6382154	31/07/2020	Creekline	30
	422581	6382319	31/07/2020	Creekline	30
	420723	6380919	31/07/2020	Creekline	30
	422938	6381446	31/07/2020	Creekline	30
	420726	6380644	31/07/2020	Creekline	30
	424954	6383759	31/07/2020	Creekline	30
	420176	6379661	1/08/2020	Minimal drainage line	20
	426767	6378130	2/08/2020	Minimal drainage line	20
	422957	6375593	2/08/2020	Historical drainage line	20
	417336	6388796	3/08/2020	Creekline of bullich and blackbutt	30
	421073	6383130	3/08/2020	Creekline of bullich and blackbutt	30
	415280	6392001	3/08/2020	Creekline of bullich and blackbutt	30
	423367	6388225	4/08/2020	Creekline	30
	422679	6389373	4/08/2020	Rudis and blackbutt	20
	424483	6381953	5/08/2020	Flooded gum woodland	30
	424675	6387320	5/08/2020	Creekline	20
	427372	6386824	6/08/2020	Creekline	20
	426848	6387253	6/08/2020	Flooded gum woodland	20
	425677	6388802	7/08/2020	Flooded gum woodland	20
	423052	6388539	7/08/2020	Creekline	20
	418237	6377815	25/11/2020	Flooded gum woodland	30
	423282	6386932	25/11/2020	Flooded gum woodland	30
	428164	6386522	26/11/2020	Flooded gum woodland	30
	421281	6377506	1/12/2020	Creekline	30
	423903	6384392	1/12/2020	Creekline	30
	424056	6379745	26/11/2020	Flooded gum woodland	30
	427297	6384493	25/11/2020	Creekline	30
	426940	6387122	26/11/2020	Flooded gum woodland	30
Total	**780**				

Brush-tailed Phascogale assessment

Brush-tailed Phascogales were targeted using remote cameras, cages and Elliot box traps. Remote cameras were deployed in habitats deemed potentially suitable to support phascogales and were deployed within key habitat features important to the Brush-tailed Phascogale such as in trees and facing onto logs. Cameras were deployed during both phases of the survey to increase the capture potential.

Elliot box traps deployed at the traplines were adapted to target Brush-tailed Phascogale during the Phase 2 survey. Elliot traps were strapped into trees and on logs to target phascogale which are largely arboreal (tree dwelling). The Elliot traps were baited with universal bait (a combination of peanut butter, oats and sardines) and covered with bark, leaves or Sheoak needles.

2.3.7 Black Cockatoo habitat assessment

A Black Cockatoo habitat assessment (for Carnaby's Cockatoo, Forest Red-tailed Black Cockatoo and Baudin's Black Cockatoo) was undertaken for the Survey Area to assess the presence, quality, and extent of habitat. The assessment involved visual and aural assessment of the Survey Area, identifying breeding habitat (presence/absence of actual and potential breeding trees), foraging habitat, roosting areas, current activity, and any other signs of use by Black Cockatoos. For this assessment, the DSEWPaC (2012a) Black Cockatoo referral guidelines were used to define breeding, foraging and night roosting habitat.

The number of potential breeding trees within the Survey Area was quantified by surveying twenty-eight (28) plots (60 m by 500 m) over the entire Survey Area, recording all potential Black Cockatoo trees (based on Diameter Breast Height (DBH) suitability) within the bound area. Each plot was traversed on foot and all potential Black Cockatoo breeding trees (based on Diameter Breast Height (DBH) recorded. Plots were selected to sample across all the vegetation complexes occurring locally based on vegetation mapping by Mattiske and Havel (1998). The number of plots within each vegetation complex was roughly proportional to the relative amount of each complex within the Survey Area. For example, the extensive Jarrah Marri forest habitat type had proportionately more plots than Bullich forest habitat type which comprised a small proportion of the Survey Area.

Breeding habitat was extrapolated using averaged results from these plot surveys per fauna habitat type throughout the Survey Area. This method was undertaken due to the large extent of the Survey Area and the commitment by Alcoa to undertaking detailed pre-clearing surveys of potential breeding trees in mining and haul road footprints once these are confirmed. For each potential breeding tree, details of the tree location, species, DBH, size and number of hollows observed, evidence of use and any other significant observations were recorded. Where trees were recorded to have a suitable large hollow that could be used or had signs of being used (potential or likely), trees were revisited by Tony Kirkby (Black Cockatoo Specialist) where the hollows were checked for Black Cockatoo use by using a drone, pole camera and telephoto lens.

Information collected during the field survey included:

– Foraging habitat - the location and extent of suitable Black Cockatoo species foraging habitat was identified and mapped for the Survey Area and extended Survey Area, based on the vegetation associations and presence/absence of known foraging species. During the field surveys any direct or indirect evidence of foraging by Black Cockatoos was recorded via GPS.
– Breeding habitat - suitable breeding habitat for Black Cockatoos is defined by DSEWPaC (2012) as trees of species known to support breeding within the range of the species which either have a suitable nest hollow or are of a suitable Diameter at Breast Height (DBH) to develop a nest hollow. For most tree species, suitable DBH is 500 mm. For Salmon Gum (*Eucalyptus salmonophloia*) and Wandoo (*Eucalyptus wandoo*), suitable DBH is 300 mm (DSEWPaC 2012a). On average, Carnaby's Black Cockatoos are known to nest in hollows with an entrance diameter greater than 20 to 30 cm (Johnstone & Storr 1998; Groom 2011). While the Forrest Red-tailed Black Cockatoo is known to nest in hollows with an entrance of greater than 12 cm (Johnstone & Storr 1998). Therefore, during the field survey hollows were graded into small (up to 6 cm) Medium (6 to 10 cm) and Large (10+ cm).
– Night roosting habitat - suitable roosting habitat is defined by DSEWPaC (2012a). Suitable roosting habitat was identified based on the presence of suitable tall trees, evidence of roosting (feathers, twig clips etc.) and proximity of known roosting sites in the Survey Area and extended Survey Area.

– Opportunistic observations - both visual and aural observations of Black Cockatoos within the Survey Area and surrounding region were noted during the survey. This information was used to calculate the amount of foraging habitat, potential breeding habitat and night roosting habitat within the Survey Area. Any area containing known foraging species or potential nesting trees was considered as habitat for Black Cockatoos.

This information was used to calculate the amount of foraging habitat, potential breeding habitat and night roosting habitat within the Survey Area and a guide to the habitats available within the extended Survey Area. This information is presented in Figure 4b and 4d.

2.3.8 Other Searches

Rare and threatened species may have a patchy, disparate distribution through landscapes. To provide the best opportunity to determine the presence and relative prevalence of these species, this study employed a variety of sampling methods. Systematic sampling sites were also assessed using non-systematic methods to ensure thorough coverage of the sites, and non-systematic techniques were used to sample the broader Survey Area and increase survey effort.

Diurnal searching

Each trapping site was surveyed for amphibians, reptiles, and mammals. Surveys comprised of active searching of potential shelter sites (overturning logs, rocks and leaf litter), low vegetation (under bark and in tree stumps) and recording all individuals observed. Species presence was also detected and identified via secondary evidence, in the form of scats, tracks, feathers, burrows and skeletal remains. A summary of the diurnal search effort completed is provided below in Table 13 with survey locations displayed in Figure 3, Appendix A.

Table 13 Active diurnal search summary

Site name	Location		Habitat type	Survey effort (minutes)
	Easting	Northing		
	Phase 1			
Active search	420109	6380386	Upland Jarrah forest	30
	422567	6373218	Upland Jarrah forest	40
	422916	6372351	Jarrah, Sheoak open forest	120
	422240	6374248	Granite outcrop/Domes	30
	426941	6378079	Not recorded	30
	424213	6379026	Not recorded	30
	421946	6376080	Not recorded	20
	423299	6387275	Drainage line, Rudis/Patens	40
	422111	6374217	Not recorded	30
	425297	6383950	Not recorded	30
	420560	6378435	Not recorded	20
	420666	6376761	Granite outcrop/Domes	50
	421060	6383137	Drainage line, Rudis/Patens	60
	423106	6376582	Not recorded	30
	425825	6380996	Not recorded	10
	423919	6388680	Not recorded	30
	424915	6383692	Drainage line, Rudis/Patens	20
	427005	6385684	Not recorded	30
	423176	6372293	Granite outcrop/Domes	30
	422924	6372326	Granite outcrop/Domes	60
	418437	6377595	Not recorded	40
	Total Phase 1			**780**
	Phase 2			
Active search	424881	6379897	Not recorded	30
	424881	6379897	Not recorded	60
	420939	6375009	Not recorded	30
	426403	6388866	Not recorded	30
	423892	6384409	Waterbody- 200m x 12 m, 1.5 m deep, woody debris in water	30
	423893	6384404	Waterbody- 200m x 12 m, 1.5 m deep, woody debris in water	30
	423919	6384306	Waterbody- 200 m by 12 m, 1.5 m deep, woody debris in water	30
	Total Phase 2			**240**
	Combined Phase 1 and 2 Total			**1020**

Nocturnal searching

Spot lighting was undertaken to locate nocturnal species that may otherwise remain undetected using other survey techniques. Handheld or head mounted spotlights were used for a minimum of 20 minutes at each trapping line for each survey phase and within the general area. A summary of the nocturnal searches including survey effort completed is provided below in Table 14. The survey locations shown in Figure 3, Appendix A.

Table 14 Nocturnal search summary

Site Type	Location		Habitat type	Survey effort (minutes)
	Easting	Northing		
Phase 1				
Frog census	424347	6387011	Drainage Line	20
Frog census	425688	6381105	Drainage Line	20
Frog census	427624	6384697	Drainage Line, permanent waterbody	30
Nocturnal search	422918	6372272	Granite outcrop amongst Jarrah- Marri open forest – south eastern portion	20
Nocturnal search	422349	6373352	Upland Jarrah open forest	20
Nocturnal search	421662	6374758	Upland Jarrah open forest	20
Nocturnal search	421225	6374371	Lowland Bullich forest, small parch in seasonal damp area, south western corner	20
Nocturnal search	425716	6384026	Drainage Line	30
Nocturnal search	425669	6381077	Not recorded	60
Nocturnal search	424449	6385646	Not recorded	20
Nocturnal search	422580	6377208	Not recorded	60
Nocturnal search	421990	6376125	Not recorded	120
Nocturnal search	419879	6379463	Not recorded	70
Nocturnal search	418775	6381197	Not recorded	70
Nocturnal search	425670	6381043	Drainage Line	60
Total Phase 1				**640**
Phase 2				
Nocturnal search	420727	6376750	Not recorded	120
Nocturnal search	425900	6384372	Not recorded	60
Nocturnal search	422839	6372308	Not recorded	30
Nocturnal search	421169	6375638	Not recorded	30
Nocturnal search	427888	6387857	Not recorded	60
Nocturnal search	424557	6389193	Not recorded	60
Nocturnal search	425607	6384782	Not recorded	60
Nocturnal search	423748	6386902	Not recorded	60
Nocturnal search	427642	6384749	Riparian, pool	30
Nocturnal search	427758	6385061	Riparian, pool	30
Total Phase 2				**540**
Combined Phase 1 & 2 Total				**1180**

Opportunistic observations

Opportunistic observations involve the recording of fauna taxa (physical presence and/or signs of presence) spatially throughout the Survey area. These observations are gathered throughout the survey duration during all in-situ activities including travel, and generally account for a significant proportion of the species assemblage recorded. Opportunistic observations include physical observations (sighting or hearing fauna), and indirect evidence (scats, tracks, diggings, nests, feathers, remains, pellets) which indicate the current or recent activity of a species present. Wherever possible, numbers of individuals, microhabitat use, and other relevant information was recorded. Opportunistic observations were recorded outside of the diurnal, nocturnal or general trap site surveys (for example when driving, walking to a site, checking camera traps and bat detectors). Opportunistic observation locations can be seen in Figure 3, Appendix A.

2.3.9 Summary of survey effort

Survey effort is described as the amount and type of survey that is undertaken during an assessment. Table 15 provides detail on the type and amount of survey time undertaken during both survey phases: the winter 2020; and the spring 2020 survey. Each of the trapping sites was sampled for a minimum of seven (7) consecutive trap-nights including bucket, cage, funnel and elliott traps. Additionally, 1150 minutes of bird assessments (Table 6) were undertaken at each site, 1626 camera nights (Table 7), 60 nights of bat detector acoustic deployment (Table 8), 54 nights of bird acoustic deployment (Table 9), 1020 minutes of diurnal active search (Table 13) and 1180 minutes of nocturnal search (Table 14). The total trapping effort across both survey phases consisted of 1,420 trap-nights (total trap effort) (Table 15).

Table 15 Summary of fauna survey effort

Fauna Trapping sites Winter 2020				**Elliot traps**		**Pit traps**		**Cage traps**		**Funnel traps**	
Phase 1 Sites	Easting	Northing	nights open	# of traps	trap nights	# of traps	trap nights	# of traps	trap nights	# of traps	trap nights
TL 1	422196	6374150	7	10	70	7	70	2	14	12	63
TL 2	422128	6376134	7	10	70	7	70	2	14	12	63
TL 3	424323	6378919	7	10	70	7	70	2	14	12	63
TL 4	420761	6378215	7	10	70	7	70	2	14	12	63
TL 5	424452	6385508	7	10	70	7	70	2	14	12	63
TL 6	427454	6386849	7	10	70	7	70	2	14	12	63
TL 7	423884	6388644	7	10	70	7	70	2	14	12	63
TL 8	425643	6384023	7	10	70	7	70	2	14	12	63
TL 9	425713	6381118	7	10	70	7	70	2	14	12	63
Total Phase 1				**90**	**630**	**63**	**630**	**18**	**126**	**108**	**567**
Fauna Trapping sites Spring 2020				**Elliot traps**		**Pit traps**		**Cage traps**			
Phase 2 Sites	Easting	Northing	nights open	traps	trap nights		traps	# of traps		# of traps	trap nights
TL 1	422196	6374150	7	10	70	7	70	2	14	12	63
TL 2	422128	6376134	7	10	70	7	70	2	14	12	63
TL 3	424323	6378919	7	10	70	7	70	2	14	12	63
TL 4	420761	6378215	7	10	70	7	70	2	14	12	63
TL 5	424452	6385508	7	10	70	7	70	2	14	12	63
TL 6	427454	6386849	7	10	70	7	70	2	14	12	63
TL 7	423884	6388644	7	10	70	7	70	2	14	12	63
TL 8	425643	6384023	7	10	70	7	70	2	14	12	63
TL 9	425713	6381118	7	10	70	7	70	2	14	12	63
Total Phase 2				**90**	**630**	**63**	**630**	**18**	**126**	**108**	**567**
Total Phase 1 and 2 combined				**126**	**1260**	**126**	**1260**	**36**	**252**	**216**	**1,134**

2.3.10 Species accumulation

The number and type of species trapped each day was recorded and a species accumulation curve was created for the Survey Area using PRIMER v6 (Clarke & Gorley 2006). The species accumulation curve represents the successfulness of the trapping program for its duration. Typically, the longer the trapping program the more complete the representation of species sampled per trapping location or habitat type. Accumulation curves should show “levelling” of the groups species counts prior to the completion of the survey. Many limitations can influence the results of a curve and should be observed as a guide to the Survey’s success. This curve is presented in Plate 9 in Section 4.3.1

The data was run through Primer v6 against eight existing models, these models are:

– Sobs - Curve of observed species counts
– Chao 1 - Chao's estimator based on number of rare species
– Chao 2 - Chao's estimator using just presence-absence data
– Jacknife 1 - Jacknife estimator based on species that only occur in one sample
– Jacknife 2 - Second order jacknife estimator
– Bootstrap - Bootstrap estimator based on proportion of quadrats containing each species
– MM (Michaelis-Menton) - Curve fitted to observed Sobs curve
– UGE - Calculated species accumulation curve based on (Ugland, Gray & Ellingsen 2003)

2.3.11 Fauna survey limitations

Guidance Statement No. 56 (EPA 2020) states that fauna and faunal assemblage survey reports for environmental impact assessment in WA should contain a section describing the limitations of the survey methods used. The limitations and constraints associated with the fauna component of this field survey are discussed in Table 16.

Table 16 Fauna survey limitations

Limitations	Constraints	Impact on Survey outcomes
Scope (what fauna groups were sampled and were some sampling methods not able to be employed because of environmental constraints)	Nil	All fauna groups were able to be sampled. During the Phase 2 survey the traps had to be closed for three nights due to fatigue management. The traps were re-opened following the two day break and were open for a minimum of 7 nights (combined) each.
Seasonal environmental conditions	Nil	The surveys were scoped and designed around EPA (2016) guidelines; however, they were modified and completed when EPA (2020) guidelines was released. This document provides recommended survey timing for the Southern Climatic Region for amphibians, birds, and mammals. The recommended survey timing for reptiles in accordance with these guidelines include a primary survey being undertaken between October-December (completed) and a secondary survey to be completed between February-March (not completed). The first survey undertaken for the Holyoake Survey Area was completed in August 2020 which is outside of the recommended survey timing for reptiles (EPA 2020). The survey was arranged prior to the release of the EPA (2020) guidelines; however, the survey incorporated extensive active searching in habitats deemed suitable for the Dell Skink and Southern Death Adder - conservation significant reptiles identified in the desktop assessment as potentially occurring within the Survey Area. Raking of leaf litter and active searching in granite is considered particularly useful during the winter months to detect reptiles lying dormant in the cooler weather. A high proportion of the reptile species recorded were detected via active searching. The survey timing discrepancy is not considered a major limitation to this survey due to the effort applied to active searching with particular focus on the conservation significant reptiles. The survey timing had no impact of recording mammals and birds.
Proportion of fauna identified, recorded and/or collected	Nil	All fauna were identified and released on site.
Proportion of the task achieved and further work which might be needed.	Nil	All scoped work was completed successfully.
Remoteness and/or access problems	Nil	No issues were encountered.
Accordance to EPA guidelines	Nil	Change of EPA guidelines from 2016 vertebrate guidance to 2020 during Phase 1 survey. Original scoping was to perform a detailed terrestrial fauna survey over the Survey Area in accordance with EPA (2016). Following the release of the EPA (2020) guidelines the survey was adapted to take on more of a targeted approach. Chuditch and Black Cockatoo were targeted during both phases of the survey, while targeted Carters Freshwater Mussel and Quokka assessments were included into the Phase 2 survey.

2.4 Climate data for survey period

The site weather conditions were generally cool and wet during Phase 1 and mild with minimal rainfall during Phase 2. The weather data over the survey period is presented below in Table 17. Temperature data was obtained from the Bureau of Meteorology website closest weather station to the site, Dwellingup Station (No. 009538) which is approximately 5 km north of the Holyoake Survey Area.

Table 17 Weather data for survey period (Phase 1 and 2)

Date	Minimum temp (°C)	Maximum temp (°C)	Rainfall (mm)
Phase 1			
27 July 2020	13	21.1	0
28 July 2020	6.8	17	25
29 July 2020	6.8	18.2	0
30 July 2020	3.1	18.2	0
31 July 2020	6.7	17.3	0.2
1 August 2020	3.5	16.9	0.4
2 August 2020	4.8	16.1	0
3 August 2020	2.9	13.8	5.0
4 August 2020	5	14.3	3.4
5 August 2020	8.1	17.5	0
6 August 2020	3.7	14.7	0
7 August 2020	4.4	14.2	0
Phase 2			
23 November 2020	10.6	33.0	0
24 November 2020	13.6	31.3	0
25 November 2020	13.6	26.2	0
26 November 2020	12	24.9	0
27 November 2020	9.4	21.3	0
28 November 2020	6.5	22.3	0
29 November 2020	11.4	20.7	0
30 November 2020	10.3	16.2	7.4
1 December 2020	4.4	22.2	1.4
2 December 2020	8.5	26.4	0
3 December 2020	11.0	30.2	0
4 December 2020	11.9	21.2	0

3. Desktop Assessment

3.1 Climate

The Study Area is located within the Dwellingup State Forest subregion of WA. The climate of this region is classified as Warm Mediterranean, with two distinct seasons: a warm and dry summer (December to February) and a cool wet winter (June to August) (Williams & Mitchell 2001).

The region is characterised spatially by rainfall, with rainfall being greatest on the scarp and decreasing to the east and north (Williams & Mitchell 2001). The majority of all rainfall received occurs during winter months and is a result of low-pressure system associated with the westerly wind system. The closest operating weather station is Dwellingup (Station ID: 009538) located approximately 5 km from the Survey Area. Climate data from this station indicate:

Climate data (Bureau of Meteorology 2020) at this station indicates:

– Mean maximum temperature ranges from 15.1 °C in July to 29.7 °C in January
– Mean minimum temperature ranges from 5.5 °C in July and August to 14.6 °C in February.
– Mean annual rainfall is 1228.7 mm with average of 236.1 mm in June with an average of 102.6 rain days/year.

3.2 Geology and land systems

3.2.1 Geology

The Australian continent is made up of four continental blocks: the Yilgarn, Pilbara and Gawler Cratons and the Wilyama Block. The Survey Area is located within the South West Terane of the Yilgarn Craton. The Yilgarn Craton is comprised of geological formation from the Archaean (2.5 billion years ago) to Cainozoic ages (66 million years ago to present) and bounded by the Murgoo Gneiss Complex of the Western Gneiss Terrane in the west and the Southern Cross Province in the east. The South West Terrane is composed of granitic rocks classified based on characteristics. The Study Area overlays two geological units:

– South West Terrane greenstones – granulite and migmatite
– Yilgarn Craton Granites - granitic rock, undivided; metamorphosed

3.2.2 Land Systems

The Study Area is located within two land systems:

– Darling Plateau System - Lateritic plateau. Duplex sandy gravels, loamy gravels, and wet soils. Jarrah-Marri-wandoo forest and woodland.
– Murray Valleys System - Western Darling Range from the Avon Valley to Harvey. Deeply incised valleys with Red loamy earths, shallow duplexes and rock outcrop and Jarrah-Marri-wandoo forest and woodland with mixed shrubland

3.3 Surface Water and Hydrology

The proposed mining areas lie over the catchment areas of developed reservoirs, including the Serpentine, North Dandalup and South Dandalup Dams that are used for drinking water. The following watercourses occur within the survey boundary area:

– South Dandalup River is the major river that is situated approximately 1.5 km west of the survey boundary. This river intersects the Survey Area in the northern portion and continues for approximately 11 km outside of the Survey Area prior to terminating.

– A minor perennial tribulation that runs off South Dandalup River intersects the middle of the Survey Area approximately four kilometres south of the South Dandalup River. This continues for approximately 1.75 km east of the Survey Area prior to terminating.
– Davis Brook, a minor river located within the western portion of the Survey Area runs off Holyoake Brook to the west inside the Survey Area for approximately two kilometres north-east from the Survey Area prior to terminating.

The following watercourses occur outside of the Survey Area, but within the Study Area;

– North Dandalup River occurs in the north-western portion.
– South Dandalup Reservoir (South Dandalup River) occurs in the western portion.
– Big Brook, a major river that's occurs in the north-eastern portion. Cameron East, a minor perennial tribulation runs off this river to the south-east and Cameron West to the south-west.
– O'Neil Brook occurs beyond Big Brook in the far north-western portion of the Study Area.
– An unnamed significant stream occurs in between North Dandalup and South Dandalup River in the north-western portion of the Study Area.
– Holyoake Brooke, a non-perennial minor watercourse is situated south of the South Dandalup River. Marrinup Brook, a minor river occurs to the west of this watercourse. Davis Brook, a minor river runs off Holyoake Brook to the south.
– The Murray River is the main stream that runs off Davis Brook to the south and south west which extends past the Study Area. Dwellingup Brook, a minor tribulation runs off Murray River to the north. Archies Brook, a minor tribulation runs off Dwellingup Brook to the north east. Yarragil Brook, a significant stream runs off Murray River to the south-east. A minor unnamed tribulation runs off to the south east of this for approximately 3.5 km before terminating. Two minor perennial watercourses also run off the Yarragil Brook to the south before terminating within the Study Area.
– Swamp Oak Brook, a minor perennial watercourse runs off the Murray River and continues for approximately five kilometres east of the Study Area before terminating.
– 34 Mile Brook, a significant stream is located on the far western boundary of the buffer zone and runs off the two main water supply reservoir dams.

The closest Water Management Area nearby is the Peel Inlet Management Area (approximately 22 km west of the Survey Area).

3.4 Land Use

3.4.1 Conservation reserves and estates

There is a single reserve located within the Survey Area (Table 18, Figure 2, Appendix A). The Survey Area lies within the (legal identification F 14). This is a Classification A Crown Land State Forest and underlies the entire Survey Area. This classification of land also exists immediately adjacent to the north east and west of the Survey Area within the Study Area.

Table 18 Reserve within the Survey Area

Reserve number	Name	Class	Use	Approximate location relative to Survey Area
State Forest 14	Dwellingup State Forest	Class C	State Forest	Covers the entirety of the Survey Area

The following DBCA managed lands adjacent or in the vicinity of the Survey Area:

– Lane Poole Reserve (Class C) – adjacent and to the south-west
– Unnamed Reserve (Class C) – Railway Water Supply – 100 m to the south-west
– Un-named Reserve (Class C) – Waterway – 500 m to the south-west.

3.4.2 Environmentally Sensitive Areas

Nine Environmentally Sensitive Areas (ESAs) lie within the north western portion of the Study Area. (Figure 2, Appendix A), none of which occur within the Survey Area.

3.4.3 Regional Ecological Linkages

Regional Ecological Linkages data does not exist for the Holyoake Study Area.

3.5 Vegetation

3.5.1 Broad vegetation mapping and extents

Vegetation associations

Broad scale (1:250,000) pre-European vegetation mapping of the Study Area has been completed by Beard (1976) at an association level. The mapping indicates the Survey Area intersects two vegetation associations:

– Mainly Jarrah (*Corymbia calophylla*)
– Marri *Eucalyptus marginata*.

This vegetation association exists in all directions within and extending beyond the 10 km buffer zone. The pre-European mapping has been adapted and digitised by Shepherd *et al*. (2002). The extent of the vegetation associations has been determined by the state-wide vegetation remaining extent calculations maintained by the DBCA (current as of March 2019 –Government of Western Australia (GoWA) 2018).

Vegetation complexes

Regional vegetation complex mapping has been completed by Mattiske & Havel (1998) with updates from Webb *et al*. (2016) based on major landform boundaries within the South West Forest and forested region of south-west WA. The mapping indicates six vegetation complexes are present within the Survey Area:

– Dwellingup (D1): Open forest of *Eucalyptus marginata* subsp. *marginata-Corymbia calophylla* on lateritic uplands in mainly humid and subhumid zones. This occurs throughout all portions of the Survey Area.
– Yarragil 1 (Yg1): Open forest of *Eucalyptus marginata subsp. marginata-Corymbia calophylla* on slopes with mixtures of *Eucalyptus patens* and *Eucalyptus megacarpa* on the valley floors in humid and subhumid zones.
– Yarragil 2 (Yg2): Open forest of *Eucalyptus marginata subsp. thalassica-Corymbia calophylla* on slopes, woodland of *Eucalyptus patens-Eucalyptus* rudis with *Hakea prostrata* and *Melaleuca viminea* on valley floors in subhumid and semiarid zones. This occurs predominantly in the northern portion of the Survey Area. This occurs throughout the Survey Area except for the most northern portion.
– Cooke (Ce): Mosaic of open forest of *Eucalyptus marginata subsp. marginata-Corymbia calophylla* (subhumid zone) and open forest of *Eucalyptus marginata subsp. thalassica-Corymbia calophylla* (semiarid and arid zones) and on deeper soils adjacent to outcrops, closed heath of Myrtaceae-Proteaceae species and lithic complex on granite rocks and associated soils in all climate zones, with some *Eucalyptus laeliae* (semiarid), and *Allocasuarina huegeliana* and *Eucalyptus wandoo* (mainly semiarid to perarid zones). This occurs for a small portion of the southern area of the Survey Area.
– Swamp (S): Mosaic of low open woodland of *Melaleuca preissiana-Banksia littoralis*, closed scrub of *Myrtaceae* spp., closed heath of *Myrtaceae* spp. and sedgelands of *Baumea* and *Leptocarpus* spp. on seasonally wet or moist sand, peat and clay soils on valley floors in all climatic zones. This occurs occasionally on the Survey Area boundary to the north east and north west.
– Murray 1 (My1): Open forest of *Eucalyptus marginata subsp. marginata-Corymbia calophylla-Eucalyptus patens* on valley slopes to woodland of *Eucalyptus rudis-Melaleuca rhaphiophylla* on the valley floors in humid and subhumid zones. This occurs occasionally in the far south portion of the Survey Area and a small section on the far western side of the Survey Area.

Similar vegetation association occurs outside of the Survey Area, within the Study Area. In addition to the above mentioned vegetation association the following occurs to the east and south east of the Survey Area, within the Study Area:

– Pindalup (Pn) Open Eucalyptus wandoo woodland with some Eucalyptus patens, Eucalyptus. marginata and Corymbia calophylla. Also with areas of open forest of Eucalyptus marginata subspecies thalassica – Corymbia calophylla on slopes. This vegetation complex exists in the eastern and northern areas of the Darling Plateau in semiarid and arid zones.

3.6 Fauna

3.6.1 Fauna diversity

The NatureMap database identified 174 terrestrial vertebrate fauna species previously recorded within the Study Area. This total included 13 amphibians, 101 birds, 26 mammals and 34 reptiles. Of the 174 fauna species previously recorded, 166 are native species and 8 are naturalised (introduced) species. The PMST search detected an additional four bird species as potentially occurring within the Study Area.

The NatureMap and PMST database search is provided in Appendix C. DBCA Threatened and Priority Fauna results are displayed in Figure 2, Appendix A.

3.6.2 Conservation significant fauna

Based on the above database searches, 13 conservation significant terrestrial vertebrate taxa were identified as likely to occur or known to be present within the Survey Area.

These species included:

– One species, Woylie (*Bettongia penicillata ogilbyi*), listed as Critically Endangered under the BC Act, and Endangered under the EPBC Act.
– Two species listed as Endangered under the EPBC Act and BC Act including Baudin's Cockatoo (*Calyptorhynchus baudini*) and Carnaby's Cockatoo (*C.latirostris*);
– Three species listed as Endangered under the EPBC Act or BC Act including Forest Red-tailed Black Cockatoo (C*. banksii naso*), Chuditch (*Dasyurus geoffroii*), and Quokka (*Setonix brachyurus*)
– One species, Peregrine Falcon (*Falco peregrinus*) listed as 'Other specially protected' under the BC Act.
– Five species listed as Priority 3 or 4 by DBCA.
– *Phascogale tapoatafa wambenger* listed as 'Conservation Dependent' by the DBCA.

All conservation significant species identified as potentially occurring are presented in the Likelihood of Occurrence (LOO) assessment in Appendix D and further discussed regarding survey results in section 4.3.

3.7 Previous studies

A literature review was performed on previous terrestrial fauna studies considered relevant to the current Survey Area, to inform the basis of the fauna surveys. The review focuses on conservation significant species recorded during surveys on Alcoa mining lease and surrounding areas. A review of 26 existing reports that are considered relevant to the current study is provided in Table 19.

Table 19 Previous studies considered relevant to Holyoake Survey Area

Study	Location and key findings	Location in relation to this Survey Area
Environmental Management and Research Consultants (EMRC) (1992) Long term fauna monitoring program 1992 (draft)	Location: 20 plots between Jarrahdale, Huntly and Karnet (control) Alcoa conducted numerous surveys as part of a monitoring program which included trapping (five successive trap nights in July, August and September), avifauna (quantitative and inventory surveys in summer and winter), reptile survey (trapping over five consecutive nights in Summer with toenail clippings to indicate recapture) opportunistic survey, nocturnal surveys and active searches. A total of 16 mammals, 61 birds, 21 reptiles, 6 frog and 80 ant species were recorded. Recorded threatened fauna comprise: • Quenda – trapped at Jarrahdale • Baudin's Cockatoo (recorded at all sites) • Red-eared Firetail (delisted) • Carpet Python (delisted)	8 survey plots established in Jarrahdale, 8 plots established in Huntly and four control plots at Karnet. Exact locations are not shown in report, but Jarrahdale plots are expected to be within 50 km north of the Survey Area. Huntly is within 20 km north and Karnet is within 50 km north of the Survey Area
EMRC (1995) Long term fauna monitoring program 1995	Location: 20 plots between Jarrahdale, Huntly and Karnet (control) Alcoa conducted numerous surveys as part of a monitoring program which included trapping (five successive trap nights in July, August and September), avifauna (quantitative and inventory surveys in summer and winter), reptile survey (trapping over five consecutive nights in Summer with toenail clippings to indicate recapture) opportunistic survey, nocturnal surveys and active searches. A total of 19 mammals (six introduced), 57 birds, 20 reptiles, 5 frog and 52 ant species were recorded. Recorded threatened fauna comprise: • Quenda – four individuals were trapped • Chuditch – all opportunistic sightings (one near Phillips Road/Nettleton Road and seven ay Huntly Mine in 1995).	8 survey plots established in Jarrahdale, 8 plots established in Huntly and four control plots at Karnet. Exact locations are not shown in report but Jarrahdale plots are expected to be within 50 km north of the Survey Area. Huntly is within 20 km north and Karnet is within 50 km north of the Survey Area
EMRC (2003). McCoy Long Term Fauna Monitoring Program 2003	Location: six plots established, two in the Cameron catchment, two in the Gordon control catchment and two between these and the current Huntly Mine McCoy region crusher site. The monitoring program surveyed all terrestrial vertebrate species and ants. Mammal trapping occurred over four successive trap nights in both summer and winter using 10 pit traps, 16 medium Elliot traps, four large Elliot traps and four cage traps. Reptiles were targeted using five PVC pot traps with drift fence during summer. Traps were open on 29th Jan (summer) and 13 Aug (winter). Birds were surveyed using quantitative methods (two permanent bird transects surveyed on three consecutive days in summer and winter) and inventory methods (opportunistic recordings at each plot during the trapping program). A total of six mammals (one introduced), 39 birds, 7 reptiles, 9 frog and 37 ant species were recorded. Recorded threatened fauna comprise: • Chuditch – two trapped plus sightings or signs • Baudin's Cockatoo - sightings	Huntly Mine approximately 20 km north of the Survey Area.
EMRC (2006) Long term fauna monitoring program 2006	Location: 20 plots between Jarrahdale, Huntly and Karnet (control) Alcoa conducted numerous surveys as part of a monitoring program which included trapping (five successive trap nights in July, August and September), avifauna (quantitative and inventory surveys in summer and winter), reptile survey (trapping over five consecutive nights in Summer with toenail clippings to indicate recapture) opportunistic survey, nocturnal surveys and active searches. A total of 18 mammals (six introduced), 49 birds, 21 reptiles, 5 frog and 70 ant species were recorded. Recorded threatened fauna comprise: • Chuditch – opportunistic sightings at Huntly • Quokka – opportunistic sighting at Huntly • Baudin's Cockatoo – sighted at Jarrahdale, Huntly and Karnet • Carpet Python (delisted) • Quenda - trapped at Jarrahdale and Karnet • Western Brush Wallaby - sighted at Jarrahdale and Huntly	8 survey plots established in Jarrahdale, 8 plots established in Huntly and four control plots at Karnet. Exact locations are not shown in report but Jarrahdale plots are expected to be within 50 km north of the Survey Area. Huntly is within 20 km north and Karnet is within 50 km north of the Survey Area
EMRC (2007). McCoy Long Term Fauna Monitoring Program – results of the 2007 survey	Location: six plots established, two in the Cameron catchment, two in the Gordon control catchment and two between these and the current Huntly McCoy crusher site. Methods used were identical to those used in the 2003 survey (above). A total of seven mammal (two introduced), 41 bird, seven reptile, five frog and 54 ant species were recorded. Recorded threatened fauna comprise: • Baudin's Cockatoo –sightings • Western Brush Wallaby – multiple sightings	Huntly Mine approximately 20 km north of the Survey Area..
ALCOA World Alumina Australia (2010) No 40. Threatened fauna species management plans for Alcoa's bauxite mining operations in the Jarrah forest	Location: Mining Lease ML1sa Management Plan for seven species of fauna known to occur within the mining lease: • Noisy Scrub-bird • Chuditch • Quokka • Baudin's Black Cockatoo • Forest Red-tailed Black Cockatoo • Peregrine Falcon • Carpet Python (delisted)	Huntly Mine approximately 20 km north of the Survey Area.

Study	Location and key findings	Location in relation to this Survey Area
Stokes (2011) Orion Long Term Fauna Monitoring Program	Location: six monitoring sites within Alcoa's Orion mine region comprising two typical upland forest areas, two associated with stream zones and two within rehabilitated forest (8 years old). Mammals, birds, reptiles and frogs were surveyed during both summer (March) and winter (July), and ground dwelling invertebrates were sampled in summer only. Survey methods were similar to those used in EMRC (2006) with the addition of a single large trapping transect designed to specifically target Chuditch and species of goanna. This transect covered approx. 880 ha and comprised 40 wire cage traps spaced 300 m apart and was trapped over four successive nights at the same time as the generic mammal survey. A total of 10 mammals (three introduced), 38 birds, 9 reptiles, two frogs, 22 ground invertebrates, 49 ant species was recorded. Recorded threatened fauna comprise: • Chuditch – five males trapped in summer • Quenda – one trapped • Western Brush Wallaby – multiple sightings • Baudin's Cockatoo – sightings • Forest Red-tailed Black Cockatoo - sightings	Within 10 km of the far western boundary of the Survey Area
Stokes (2012) Vertebrate Fauna Survey of Planted Mining Areas at Alcoa's Keats Mining Region 2011/2012	Location: Keats mining region. Fauna was surveyed using a range of techniques, including trapping, remote sensitive cameras, tracking tunnels, observational surveys and spotlighting. Pitfall traps were not used. Five areas were trapped for mammals comprising two dieback free Jarrah forest areas and three stream zones. One landscape trapping transect was deployed to target Chuditch and goanna and this encompasses upland Jarrah forest, stream zones, low lying open forest, dieback graveyards and Sheoak forest. Black Cockatoo habitat survey was also undertaken. Surveys were only undertaken in summer due to time constraints. Recorded threatened fauna comprise: • Forest Red-tailed Black Cockatoo – flock sighted (up to 11 individuals) • Baudin's Cockatoo – 2 individuals sighted • Western Brush Wallaby – sightings and recorded on remote camera • Chuditch – one male trapped • Carpet Python (delisted)	Huntly Mine approximately 20 km north of the Survey Area.
Way *et al*. (2013), McCoy Long Term Fauna Monitoring Program Report of the 2013 Field Survey	Location: six plots established, two in the Cameron catchment, two in the Gordon control catchment and two between these and the current Huntly McCoy crusher site and an additional three sites established in two-year-old rehabilitation within the McCoy Intermediate Rainfall Zone. In 2013 the McCoy Long Term Fauna Monitoring Program involved survey of terrestrial vertebrates (including mammals, birds and reptiles) and ground invertebrates, using the same methods used in previous LTFMP at McCoy (EMRC 2003, 2007). Mammals, birds, reptiles, and frogs were surveyed in both winter (July-August 2013) and summer December 2013-January 2014). Additional survey methods were also implemented including a single large trapping transect to sample highly mobile species, remote sensor cameras and all invertebrates collected in pitfall traps were identified to taxonomic order. A total of 13 mammal species (four introduced), 46 birds, five frog, 31 invertebrates, and 64 ant species was recorded. Recorded threatened fauna comprise: • Western Quoll – one adult male trapped • Quenda – recorded on remote cameras • Western Brush Wallaby – multiple sightings and on remote cameras • Baudin's Cockatoo – multiple sightings • Forest Red-tailed Black Cockatoo – multiple sightings	Huntly Mine approximately 20 km north of the Survey Area.
Chuditch survey raw data Myara 2013	This is an excel data file along with short summary document with the location description as 'Myara west' and 'Myara east'. Shows details of eight quoll captures at 'Myara west' and one quoll captured at 'Myara east' between 18-22 March 2013. Myara West excel data provides 8 GPS capture locations (in cage traps). Myara East excel data provides 40 locations with coordinates however according to the report only 1 capture location was recorded at Cage 26. The coordinates of this location was unable to be identified. Total number of captures comprised of five males and four females.	Location described as Myara west and east and general area surrounding Karnet Prison which is approximately 20 km north of the Survey Area. GPS coordinates provided: • 410458 E, 6409663 N • 410839 E, 6408964 N • 411357 E, 6408290 N • 411766 E, 6410671 N • 411138 E. 6407725 N • 412384 E, 6408752 N • 414231 E. 6408816 N • 414362 E, 6409006 N
McGregor *et al*. (2014). Does forest restoration in fragmented landscapes provide habitat for a wide-ranging carnivore?	Location: Huntly and Willowdale mines Fourteen Chuditch trapping sessions (13 at Huntly, one at Willowdale) across 9 trapping transects (8 at Huntly, one at Willowdale) were undertaken between June 2009 and Dec 2010. Radio collars with a two-stage transmitter and mortality mode were attached to 14 adult Chuditch (9 female, 5 males – all trapped at Huntly). Chuditch were tracked to their dens during the day. Spool and line tracking was also used. In total 29 individual Chuditch were captured on 60 occasions. Of the 14 individuals fitted with radio collars, three were found dead on the Huntly mine access road with evidence of road trauma. Another three Chuditch were also found dead from vehicle strikes along this road. The study identified 138 den sites from 11 tracked animals: 75 in unmined forest and 63 in restored forest ranging from 2-32 years old. In unmined forest, dens were mostly in hollow logs and ground burrows beneath tree stumps, but these substrates were never used in restored forest where dens were mostly ground burrows, usually associated with rock piles at the surface.	Huntly Mine approximately 20 km north of the Survey area. Willowdale (within 30 km south of the far southern boundary of the Survey Area)

Study	Location and key findings	Location in relation to this Survey Area
Burgar *et al*. (2015) The importance of mature forest as bat roosting habitat within the production landscape	Location: forest surrounding Huntly mine site, for both restored and unmined forest. *Nyctophilus gouldii* and *Vespadelus regulus* were trapped and tracked during maternity and mating seasons using harp traps and position-sensitive radio transmitters. Few bats were captured in restored forest so traps were relocated to water sources. Study aimed at identifying roost habitat within restored forest vs unmined forest. Findings indicate that habitat restoration in production forest landscapes is unlikely to play a significant role in conserving species that rely on slow developing microhabitats such as tree hollows for decades or centuries and that retaining and managing forest remnants would be a more effective strategy to conserve populations of these species.	Huntly mine, approximately 15 km north of the current Survey Area.
Burgar *et a*l. (2017) Habitat features act as unidirectional and dynamic filters to bat use of production landscapes	Location: five forest types around the Huntly mine (four restored forest with different stages of vegetation succession, and one unmined forest) Ultrasonic detectors (Anabat Titley Electronics) were set at 64 sites four times per year between Oct and March 2010/2011 and 2011/2012 for a total of 512 survey nights. 31,347 bat call files were recorded over both years of which 22,520 were identified to species/species group. *Vespadelus regulus* was detected most frequently (15,833 call files) and *Falsistrellus mackenziei* least frequently (167 call files). Six species/groups were detected. Recorded threatened fauna comprise: Western False Pipistrelle	Huntly Mine approximately 20 km north of the Survey Area.
Craig *et al*. (2017) Can postmining revegetation create habitat for a threatened mammal?	Location: Jarrah Forest (Huntly mine site approximately 10 km north of Dwellingup) Most revegetation conducted for biodiversity conservation aims to mimic reference ecosystems present predisturbance. However, revegetation can overshoot or undershoot targets, particularly in the early stages of a recovery process, resulting in conditions different from the reference model. Revegetation that has, yet, failed to fully meet revegetation targets may, nonetheless, provide habitat for threatened species not present in reference ecosystems. To investigate this possibility a survey of the Quokka (*Setonix brachyurus*), a threatened macropod, in a mining landscape in south-western Australia was conducted. Four sites in each of riparian forest (the preferred habitat of quokkas) but is not mined, mid-slope forest, which is the premining reference ecosystem but is not suitable habitat for quokkas, and revegetated forest on mine pits 16–21 years postmining. Quokkas were recorded in all riparian forest sites and two revegetated forest sites but not in any mid-slope forest sites. Occupied revegetated sites had greater cover between 0 and 2 m and were spatially closer to riparian forest than unoccupied revegetated sites, suggesting predation pressure was likely influencing which mine pits were occupied. The study demonstrated postmining revegetation can provide new habitat for a threatened species and suggested that revegetating a small proportion of sites to provide new habitat for threatened species could be considered as a management option in some scenarios. This could improve landscape connectivity and increase both the area of available habitat and between-site heterogeneity, which could all potentially increase the ability of revegetation to conserve biodiversity.	Huntly Mine approximately 20 km north of the Survey Area.
EMRC (2015) Long Term Fauna Monitoring Program Summary of Results at Orion Mining Region.	Location: Numerous plots over the Willowdale Mine area Results of the 3rd survey of the LTFMP. Same methodology and plot locations as 2010 survey of the area. Additionally a large trapping transect targeting Chuditch and remote sensing cameras also deployed. Trapping conducted over 4 nights in both winter and summer seasons. The study results: • Twelve mammal species were trapped • Thirty-five bird species recorded • Thirteen reptile species recorded • Three frog species recorded Results were indicative of some species being affected (not present afterwards or in lower numbers) by the January 2016 wildfire that burnt through the Willowdale Mine and surrounding areas including four of the six Orion sites.	Willowdale (within 30 km south of the far southern boundary of the Survey Area)
Doherty *et al*. (2016). Successional changes in feeding activity by threatened cockatoos in revegetated mine sites.	Location: Numerous plots over the Huntly Mine, Boddington Bauxite Mine and Newmont Boddington Gold Mine. 232 plots were surveyed in revegetated forest and 480 plots were surveyed in unmined forest to determine whether there were successional patterns in cockatoo feeding activity in revegetation aged between 4 to 23 years. The study concludes that black cockatoos feed in vegetation at all three mine sites, despite variations in vegetation age, structure and floristics. Black cockatoos begun feeding on proteaceous and myrtaceous food plants within 4 and 7 years following revegetation, indicating that some food sources are restored quickly after mining disturbance of the Jarrah forest. The results highlight the importance of monitoring fauna recolonization over appropriate time scales to understand how successional processes in revegetation influence fauna persistence in production landscapes.	Huntly Mine approximately 20 km north of the Survey Area. Boddington Bauxite Mine approximately 20 km south east of the current Survey Area, Newmont Boddington Gold Mine approximately 25 km south east of current Survey Area.
Mastrantonis *et al*. (2019) Climate change indirectly reduces breeding frequency of a mobile	Location: The Northern Jarrah Forest of South- Western Australia over both the Swan and Murray River Catchments. Using a dataset of annual breeding frequency spanning 19 years, in combination with hydrological, climatological, and remotely sensed data, the effects of environmental variation on the annual breeding frequency of Forest Red-tailed Black Cockatoo's (FRTBC) were modelled. In total, 143 unique trees were surveyed over the 19 year period. A total of 173 breeding events were observed during this time with 104 and 71 events observed in the Swan and Murray River catchments respectively. On average there were 5.83 breeding events recorded per year with events ranging from 0 to 21 annually. Results found several significant relationships between annual breeding frequency of FRTBCs and environmental variation. While the model, which included a proxy for the availability of the cockatoo's primary food source and the previous season's rain, explained 49% of annual breeding frequency, there were also direct and indirect effects of heatwaves and forest productivity. FRTBC breeding was found to appear be linked to the spatiotemporal availability of its primary food sources, the fruit from the tree species, Marri *Corymbia calophylla* and Jarrah *Eucalyptus marginata*. However, due to climate change experienced and predicted to be experienced in the future in WA it is expected that the food resources during the breeding season for cockatoos will become increasingly limited in time and space, thus threatening their persistence	Approximately 10 km north of the northern boundary of the Study Area

Study	Location and key findings	Location in relation to this Survey Area
Burn (2000) A survey of the impact of burning on mammals and birds in Alcoa's rehabilitated Bauxite mines at Jarrahdale	Location: Jarrahdale forest (two unmined and four rehabilitated bauxite mine pits) To ascertain the impact of burning on birds and mammals at the above location pre burning monitoring took place 1997, and post burn monitoring commenced in 1998 in both burnt and unburnt, rehabilitated and unmined forest sites. Low numbers of mammals were caught making it difficult to conclude with certainty whether burning influenced most species. New epicormic growth may have attracted possums into one rehabilitated area, while mice invaded the dense rehabilitated site after the burn. There was a large decline in the numbers of birds and bird species following the burn in the dense rehabilitation. Burning sparse rehabilitation only resulted in a small decline while fire had little effect on bird populations of unmined forest. It was concluded that more time was needed to define the longer-term effects of burning on mammals and birds. The present survey was therefore undertaken in 2000 to assess the situation three years after burning.	Approximately 10 km north of the northern boundary of the Study Area.
Huntly rehabilitation (2000)	As no long-term monitoring of fauna has been conducted at Huntly since 1998, it was decided a repeat of the 1994 survey using identical methods would occur to gain a better understanding of the extent to which vertebrate fauna colonise older rehabilitation. The sites ranged from 14 to 22 years. Sixteen mammal species are known to inhabit rehabilitation at Huntly including 10 native and 6 feral species. Thirty-four bird species were recorded in the rehabilitated areas surveyed (like the 36 recorded in the 1994 survey. Eight reptile species and one frog species were recorded in the rehabilitated areas surveyed. Fourteen recommendations came about which if implemented should encourage the return of fauna species in similar number to which they occur in surrounding unmined forest. Some recommendations are identical to the 1994 study; they have either not been implemented or they should continue. Key recommendations include: • Where it is not yet known about species recolonisation follow up monitoring in rehabilitated areas will reveal whether they have recolonised. • Surrounding forest if the source of all fauna recruitment. It is important that fauna habitat be protected so that species are available to recolonise.	Huntly mine, approximately 20 km north of the current Survey Area.
EMRC (2007) A Vertebrate Fauna Survey of Rehabilitated Areas at Alcoa's Huntly Mine site. (Final report)	Provides an overview of the 1994, 2000 and 2007 vertebrate fauna surveys of Alcoa's rehabilitated bauxite mines at Huntly. Mammals, birds and reptiles were surveyed in six rehabilitated pits ranging in age from 8 to 16 years. In total 16 mammal species (11 indigenous and 5 introduced), 34 birds and 8 reptiles were recorded. Rare or specially protected species either recorded in the present survey or recently sighted or trapped in rehabilitation at Huntly include the Brush-tailed Phascogale, Chuditch, Quokka, Baudin's Cockatoo, Forest Red-tailed Black Cockatoo and Carpet Python. Other species recorded in rehabilitation during the survey included the Echidna, Brush-tailed Phascogale and Common Brushtail Possum, while Western Brush Wallaby, Chuditch and Quenda have also recently been either trapped or sighted in rehabilitation at Huntly. Total bird species numbers recorded have remained like those in 2000 and in 1994, however in individual rehabilitated sites, the numbers of bird species and bird diversity have both decreased. Numbers of reptile species remained like those of previous years, with the Specially Protected Carpet Python seen in rehabilitation on a number of occasions. Thirteen recommendations were given as a result including protection of adjacent fauna habitat, construction of fauna habitats and corridors, control of feral species, construction of suitable habitat specific to mammals and reptiles.	Huntly mine, approximately 20 km north of the current Survey Area.
EMRC (2001) Alcoa World Alumina Australia Ltd. Long Term Fauna Monitoring Program. (V2)	The Alcoa Long Term Fauna Monitoring Program was designed in 1991. Monitoring events took place in 1992, 1995, 1998 and 2001 (Nichols 1992) using identical methods each time (except for the baseline). The program is designed to monitor fauna every three years at twenty plots located in rehabilitation and nearby forest at Jarrahdale, Huntly and Karnet (remote from mining). A total of 16 mammal (10 indigenous, six introduced), 50 bird, 17 reptile, 7 frog and 73 ant species was recorded. In 1998, the corresponding figures were 18 mammal, 53 bird, 21 reptile, 7 frog and 56 ant species. Mammals recorded included one officially gazetted rare species, the Chuditch. Two of the species recorded in 1998 were not detected in 2001. These were the Brush-tailed Phascogale and an unidentified bat species. Numbers of several species appear to have changed significantly with some mammal and bird species declining, possibly due to very dry summer followed by very low winter rainfall. . Common brushtail possum and frog species increased. Baudin's Cockatoo was recorded at both Jarrahdale and Huntly. The reptile fauna included one 'Specially Protected' species, viz. the Carpet Python. Quantitative data showed that the composition of all rehabilitated sites was becoming more like that of the unmined sites. However, they remain linked to each other, particularly JR1 and JR2, which have become even more like each other.	Exact locations are not shown in report but Jarrahdale plots are expected to be within 50 km north of the Survey Area. Huntly is within 20 km north and Karnet is within 50 km north of the Survey Area
EMRC (1998) Alcoa of Australis Ltd. Long Term Fauna Monitoring Program (1998)	Location: Plots located in rehabilitation and nearby forest at Jarrahdale, Huntly and Karnet. This report provides the results of the 1998 fauna monitoring program. Methods used were identical to the 1995 monitoring program. Results are then compared to previous monitoring programs (1992 and 1995) in detail and the influence of mining and successional processes on fauna can be assessed. A total of 18 mammal (12 indigenous, six introduced), 53 bird, 20 reptile, 5 frog and 56 ant species were recorded. Mammals recorded included two officially gazetted rare species, viz. the Chuditch and the Quokka. Two of the species recorded (Dunnart *Sminthopsis gilberti* and the Honey Possum) in 1995 were not detected in 1998. Several species have increased since the previous monitoring event (Mardo and Quenda). There wasn't any evidence of any mammal species declining due to proximity of mining. All bird species recorded in 1992 and 1995 were recorded in 1998. Only one rare bird species, Baudin's Cockatoo was recorded and this was present at all sites. One new skink species was collected - *Glaphyromorphus gracilipes* was trapped at stream site HS1 (Banya Road) during the summer trapping program. Insufficient reptile numbers were collected to determine trends over time.	Exact locations are not shown in report but Jarrahdale plots are expected to be within 50 km north of the Survey Area. Huntly is within 20 km north and Karnet is within 50 km north of the Survey Area
EMRC (2004) Orion LTFMP report 2004 Final	Location: Willowdale -north east portion of Orion region (two healthy forest and two dieback forest plots, two steam zone plots and two plots in rehabilitation) The LTMFP was reviewed in 2003 (Majer, 2003) which included a recommendation for a similar program to be established at Orion so that any differences in faunal successional processes taking place at Willowdale could be detected. Similar techniques to those used at Jarrahdale, Huntly and McCoy. Mammals recorded during the survey included the Chuditch, Quokka, Mardo, Dunnart, Common Brushtail Possum, Western Brush Wallaby. Only one mammal species was recorded in the young rehabilitation (Feral Mouse). Forty-one bird species was recorded including the Baudin's Cockatoo. Bird numbers were highest at steam sites and lowest at rehabilitated sites. Six reptile species were recorded compared with 15 species recorded in the 1999 pre-mining survey. Three frog species were recorded. Fifty ant species were recorded. Further monitoring was recommended to determine successional patterns.	Willowdale (within 30 km south of the far southern boundary of the Survey Area)

Study	Location and key findings	Location in relation to this Survey Area
EMRC (1999) A fauna survey of planned mining areas at Alcoa's Orion Mining region	Location: Orion mining region at Willowdale This report provides the results of the fauna survey conducted between February and November 1999. The habitats monitored were poorly surveyed in current mining areas, extensive dieback affected areas, small dieback free areas and on sites where mining operations are planned. A total of 46 bird species, nine mammals (6 native, 3 introduced), 13 reptiles and five frogs were recorded. These included three rare species (the Chuditch, Baudin's Cockatoo and possibly the Quokka) and one Specially Protected species (the Carpet Python). As well as these, the Noisy Scrub-bird has been reintroduced into the area and the uncommon Brush-tailed Phascogale is present albeit in low densities. The fauna of the Orion area was largely comparable to that of existing Willowdale mining areas. Results emphasise the need for ongoing fox control. Rehabilitation using Jarrah and other indigenous species offers the best prospects of successfully recreating suitable habitat for the species. Eleven recommendations were given for managing the area's faunal diversity including; protection of adjacent fauna habitat, construction of fauna habitats and corridors, control of feral species, construction of suitable habitat specific to mammals and reptiles.	Willowdale (within 30 km south of the far southern boundary of the Survey Area)
EMRC (2007) A Vertebrate Fauna Survey of Rehabilitated Areas at Alcoa's Willowdale Minesite	Location: Willowdale (rehabilitated bauxite mine sites) This report details the 2007 results of the long term fauna monitoring. Previous monitoring events occurred in 1994, 2000 (following fox control) and again in 2007. In the 2007 survey a total of 25 bird species, 10 mammals (seven indigenous, three introduced) and five reptiles was recorded in rehabilitation. They included three rare species, viz. the Chuditch, Brush-tailed Phascogale and Forest Red-tailed Black Cockatoo. Numbers of native mammals trapped in rehabilitation were higher than in previous years, with Yellow-footed Antechinus increasing from 0 in 1994 to 6 in 2007; Brush-tailed Phascogales increased from 0 to 1 and Chuditch increased from 0 to 3. Bird species had declined since the 2000 survey. Total numbers of both insectivores and honeyeaters both showed large declines between 1994 and 2000. There was a gradual decline in numbers of the skink *Acritoscincus trilineatus* as the rehabilitated sites become more like upland forest habitat and less suitable for this species. Fifteen recommendations were given for managing the area's faunal diversity including; protection of adjacent fauna habitat, construction of fauna habitats and corridors, control of feral species, construction of suitable habitat specific to mammals and reptiles	Willowdale (within 30 km south of the far southern boundary of the Survey Area)
EMRC (2001) A Vertebrate Fauna Survey of rehabilitated areas at Alcoa's Willowdale Mine site	Location: Willowdale (rehabilitated bauxite mine sites) This report details the 2000 fauna monitoring event results after the introduction of fox control following the 1994 monitoring event. A total of 31 bird species, nine mammals (five introduced, four indigenous) and five reptiles was recorded. Although not trapped or recorded in the present survey, both the rare Chuditch and the specially protected Carpet Python have been recently recorded in rehabilitation at Willowdale. Numbers of native mammals trapped in rehabilitation were low, as in 1994. Some evidence suggests that Fox predation may still be a problem near farmland. The 31 bird species recorded in the 2000 survey is less than the 45 recorded in 1994. The five reptile species recorded indicate that the rehabilitation has not yet become more suitable for this fauna group. Fifteen recommendations were given for managing the area's faunal diversity including; protection of adjacent fauna habitat, construction of fauna habitats and corridors, control of feral species, construction of suitable habitat specific to mammals and reptiles.	Willowdale (within 30 km south of the far southern boundary of the Survey Area)

4. Survey Results

4.1 Fauna Habitats

There were seven broad fauna habitat types delineated in the Survey Area during the field survey. These habitat types are categorised based on flora species, hydrology, soil and topography. They align with the vegetation types identified by Mattiske (2021) with groupings of vegetation types to form the broad fauna types. The habitat types recorded in the Survey Area are described below in Table 20 and mapped in Figure 5, Appendix A. The broad fauna habitat types are:

– Bullich forest
– Granite outcrop
– Blackbutt forest
– Flooded Gum woodland
– Jarrah-Marri forest
– Mine rehabilitation
– Pine plantation.

In addition to the fauna habitats listed above, highly disturbed areas make up a small proportion of the Survey Area and include rural/clearing. These areas are included in Figure 5, Appendix A. Cleared areas can have limited habitat values due to lack of paucity, or low quality of intact native vegetation, however pine plantation provides high quality seasonal foraging habitat for Carnaby's Black Cockatoo, see section 4.3. Mine rehabilitation areas can be up to 25 years of age and can comprise of ground layer vegetation with developing litter layers. The ground layer can be used by a wide range of species including mammals, birds and reptiles.

4.1.1 Fauna Habitat Linkages

The Survey Area represents a large continuous tract of forest with good connectivity to all habitats directly adjacent.

Impacts to all habitat types in the Survey Area include damage from fire, historical logging, mining, trampling of vegetation (public wood collection and camping), soil compaction along trails (recreational users), off road public use, small amounts of clearing for tracks and artificial water sources as well as grazing from feral animals (pigs) and native kangaroos. The structural complex of some habitat types show stress signs of dieback.

The habitats in the Survey Area have direct connectivity to surrounding habitats. From what could be observed, no additional obvious habitat types were detected in immediately surrounding lands that are not present on the Survey Area. In contrast to the Myara North mine region scattered and scarce granitic formations only appear in the south western portions of the Survey Area (see Figure 5).

4.1.2 Quality of habitat

Whilst the vegetation is mostly intact the impact by logging, frequent and extensive fire and dieback in some areas were evident. Despite this the habitat presents a large contiguous intact forest with multiple habitat types suitable for highly mobile species with relatively large home ranges such as the Chuditch, Brush-tailed Phascogale and Western Brush Wallaby.

Jarrah-Marri forest is by far the most extensive habitat type covering most the of the Survey Area. With the exception of dieback infestation and some areas of substantial logging this habitat type was found to be relatively intact. The forested habitats provided an array of micro-habitats such as logs, hollows, leaf litter, soft sand and dense foliage with a broad range of floristic species providing a range of foraging, roosting, denning and sheltering habitat.

Small drainage lines were recorded within the Survey Area. Habitats associated with these areas include Flooded Gum woodland (associated with Melaleuca shrubland) and Blackbutt forest. These habitats provide accessible

drinking water to fauna. Streams associated with these drainage lines feed into South Dandalup Reservoir and appear to flow seasonally. Low dense vegetation associated with the drainage lines was identified as suitable habitat for Quokka and where frogs were recorded calling during both survey phases.

The granite outcrop habitat which comprises a very small portion (0.002%) of the Survey Area provides habitat limited to one area (south western portion of the Survey Area) for granite-specialist species such as the Ornate Crevice Dragon. Signs of disturbance included; rock damage, frequent fire and trail bike damage to vegetation.

Table 20 Major habitat types within the Survey Area

Description	Corresponding Vegetation Type Code (Mattiske 2021)	Extent in the Mine Development Envelope Survey Area (ha)	Extent in the Conveyor/Haul Road Corridor Survey Area (ha)	Total Survey Area (ha)	Percentage of Total Survey Area (%)	Representative Images
Granite outcrop. Granite outcrop consisting of exfoliated slabs, boulders and exposed rock surfaces supporting scattered low myrtaceous shrubs, mosses, lichens, *Borya nitida* (Pyramid Plant) and other granite specialist flora. Outcrops are surrounded by Jarrah Marri forest. Granite also associated with seasonal watercourse in some areas. Provides shelter and foraging habitat for a range of terrestrial vertebrates such as Southern Carpet Python, Black-tailed monitor, South western cool-skink, Gould's hooded snake and Barking Gecko. Also provides habitat for granite-specialist species such as Ornate Crevice Dragon. Water courses associated with Granite outcrops provide breeding habitat for a range of common local frog species such as Quacking Frog, Lea's Frog, Moaning Frog, Signs of disturbance include rock damage, frequent fire and trail bike damage to vegetation. This habitat comprises a very small proportion of the Survey Area. **Species recorded:** **Habitat for conservation significant species:** Foraging habitat for Chuditch, Forest Red-tailed Black Cockatoo, Carnaby's Cockatoo) and Western Brush Wallaby.	R, RG, G, G1, G2	0.24	0.0	0.24	0.002	
Jarrah-Marri Forest. The most extensive fauna habitat within Survey Area. Habitat dominated by Jarrah (*Eucalyptus marginata)* and Marri (*Corymbia calophylla)* forest. With mixed understory of open to scattered to patchy Sheoak, *Banksia grandis* and *Woody Pear* over *Persoonia, Xanthorrhoea, Macrozamia* and diverse low shrublayer, Soils are orange-brown lateritic sandy clay with pea gravel. There are very few well defined surface flow drainage lines as the soils tend to be well-draining. Provides foraging, shelter and breeding habitat for a range of common locally occurring, mammals and reptiles such as Mardo, Grey kangaroo, and Rosenberg monitor, also habitat for a wide range of forest birds such as seasonal nectar feeding Purple-crowned Lorikeet, and Western Spine-bill. Disturbance signs include historical and current logging, areas of mine rehabilitation, frequent fire, and ground disturbance from pigs. **Significant Species recorded:** Forest Red-tailed Black Carnaby's, and Baudin's Cockatoo, Western False Pipistrelle, Chuditch, Western Brush Wallaby, Brush-tailed Phascogale. **Habitat for conservation significant species:** Provides foraging and breeding habitat for Forest Red-tailed Black, and Carnaby's Cockatoo, Chuditch, Brush-tailed Phascogale and Western False Pipistrelle and foraging habitat for Baudin's Cockatoo.	D, DA, DG, E, J, M, P, PG, PJ, PT, PS, PW, S, SP, ST, T, SW, TP, TS, Q	9159.10	150.70	9309.81	88.32	 

Description	Corresponding Vegetation Type Code (Mattiske 2021)	Extent in the Mine Development Envelope Survey Area (ha)	Extent in the Conveyor/Haul Road Corridor Survey Area (ha)	Total Survey Area (ha)	Percentage of Total Survey Area (%)	Representative Images
Open Blackbutt forest. Dominated by Blackbutt, and with scattered or occasional Jarrah- Marri and Flooded Gum over Xanthorrhoea preissii , Persoonia *longifolia, Macrozamia riedlei* over mixed shrubs (*Trymalium ledifolium*, *Grevillea wilsonii, Banksia dallanneyi*). and mixed, sedges and herbs.This habitat occupies a small proportion of the Survey Area and tends to be associated with seasonal creeks (drainage lines) and poor draining clay soils areas of low elevation. The vegetation of understory stratum varies from dense to sparse. Where sufficient density of shrub layer occurs, the habitat provides suitable movement corridor for Quokka and Quenda and a range of forest birds, mammals and reptiles. Disturbance includes frequent fire, pig disturbance and historical logging. **Significant Species recorded:** Forest Red-tailed Black Cockatoo, Carnaby's Cockatoo, Western False Pipistrelle**.** **Habitat for conservation significant species:** Limited Foraging habitat for Carnaby's and Baudin's Cockatoo due to low density of foraging plants. Moderate foraging (Blackbutt) for Forest Red-tailed Black Cockatoo. Provides movement corridors for Quokka, Quenda, and Chuditch	CW, AW, AW/AX, AW/CW, C	299.55	1.36	300.91	2.85	 

Description	Corresponding Vegetation Type Code (Mattiske 2021)	Extent in the Mine Development Envelope Survey Area (ha)	Extent in the Conveyor/Haul Road Corridor Survey Area (ha)	Total Survey Area (ha)	Percentage of Total Survey Area (%)	Representative Images
Flooded Gum Woodland. Open tall woodland dominated by Flooded Gum with occasional Blackbutt and Jarrah over open to sparse *Melaleuca persiana* and *Banksia littoralis* over low mixed shrubs, and sedges. Associated with and restricted to poor drainage areas of ephemeral swamp and dampland associated with grey sandy clay soils. Disturbances include pig activity and frequent fire. **Significant Species recorded:** Quokka, Western Brush Wallaby, Quenda. **Habitat for conservation significant species**: Limited foraging habitat for Black Cockatoos. Foraging and shelter for Quokka, Quenda, and western Brush wallaby.	AC, AD, AX	380.06	11.37	391.44	3.71	
Open Bullich Forest. Open Bullich forest amongst thick low/mid storey sedges and bracken, sword grass generally associated with drainage lines/watercourses. Comprises a relatively small proportion of the Survey Area. Disturbance signs include frequent fire and pig activity. **Significant Species recorded:** Quokka and Quenda **Habitat for conservation significant species:** Refuge and movement corridor for Quokka and Quenda. Potential breeding trees for Carnaby's and Forest Red-tailed Black Cockatoo. Limited foraging habitat for Black Cockatoo species.	W, WA, WD	282.14	16.10	298.24	2.82	
Mine rehabilitation. Includes areas of historical mining and other vegetation clearing where revegetation of Jarrah- Marri forest has commenced. These areas have immature eucalyptus trees as well as trees up to twenty five years of age and include a range of understorey and ground layer vegetation with developing litter layers. These areas provide foraging habitat for a range of common forest birds, reptiles and mammals. There is limited foraging value for Carnaby's, Baudin's and Forest Red-tailed Black Cockatoos.	Rehab	0.00	176.35	176.35	1.67	Photo unavailable
Pine plantation These are monocultures of Pine timber tree species (Pinus). They represent high quality foraging habit for Carnaby's and Baudin's Cockatoos. They tend to be devoid of understory and ground layer vegetation and lack habitat values for most other native vertebrates.	PL	18.72	0.00	18.72	0.18	Photo unavailable

4.2 Fauna Diversity

The combined fauna surveys (Phase 1 and Phase 2) recorded 129 vertebrate fauna species utilising the Survey Area, including 22 mammals, 77 birds, 23 reptiles and 7 amphibians. A breakdown of the fauna assemblage is provided below.

4.2.1 Mammals

The combined surveys recorded 22 mammal species from 13 families within the Survey Area including six species of introduced mammals and 15 native mammal species. The most speciose family was the Vespertilionine and Dasyuridae with four species and Macropodidae (three species). Six micro-chiropteran bats were positively identified from call analysis and further two species were unconfirmed. Six of the mammal species recorded are listed as conservation significant and are further discussed in section 4.3.

A breakdown of mammal families recorded during the surveys is provided in Table 21.

Table 21 Mammal families recorded during the field surveys

Mammal Family	Number of species	
	Phase 1	Phase 2
Burramyidae (Pygmy possum)	0	1
Canidae (Fox)	1	1
Dasyuridae (Quoll)	3	4
Felidae (Cat) (domestic)	1	1
Leporidae (Rabbit)	1	1
Macropodidae (Kangaroo)	3	3
Molossidae (Free-tail Bat)	2	2
Muridae (Black Rat)	1	0
Peramelidae (Quenda)	1	0
Phalangeridae (Possum)	1	0
Suidae (Wild pig)	1	1
Tachyglossidae (Echidna)	1	1
Vespertilionidae (Simple-nosed Bats)	4	4
Total	**20**	**19**

4.2.2 Birds

Bird surveys identified 77 bird species from 29 families over the combined Phase 1 and Phase 2 surveys. The most speciose families were the Meliphagidae (nine species), Acanthizidae (seven species) and Psittaculidae (six species). Three of the bird species recorded are listed as conservation significant and are further discussed in section 4.3.

No migratory shorebirds were recorded during the survey. The Survey Area lacks open water including shallow shorelines for foraging habitat. The creek lines and vegetated dampland areas within the Survey Area are not suitable. Therefore, they are unlikely to occur within the Survey Area, and any occurrence would be as vagrant visitation due to proximity of South Dandalup dam.

A breakdown of bird families recorded during the survey is provided in Table 22.

The Masked Owl (Tyto novaehollandiae) was specifically targeted for assessment utilising SM4 Acoustic Song Meters in suspected habitat areas as shown in Table 9 and Figure 3, Appendix A. Song Meters recorded 29 opportunistic bird species however the presence of Masked Owl during both phases was not detected. A comprehensive detailed summary of the results of the Acoustic Song meters is provided in Appendix D.

Table 22 Bird families recorded during the field surveys

Bird Family	Number of species	
	Phase 1	Phase 2
Acanthizidae (Weebill/Gerygone)	13	5
Accipitridae (Diurnal birds of prey)	3	2
Aegothelidae (Nightjar)	1	1
Alcedinidae (Kingfisher)	2	1
Anatidae (Duck)	3	0
Artamidae (Magpie group)	4	1
Cacatuidae (Cockatoo group)	3	3
Campephagidae (Cuckoo-shrikes)	0	1
Casuariidae (Emu)	1	1
Climacteridae (Tree Creeper)	1	1
Columbidae (Pigeon)	1	1
Corvidae (Crow, Raven)	1	1
Cuculidae (Cuckoos)	2	2
Falconidae (Falcons)	1	1
Hirundinidae (Swallows)	2	1
Locustellidae (Songlark)	1	1
Maluridae (Wrens)	3	4
Meliphagidae (Honeyeaters)	8	8
Meropidae (Bee-eater)	0	1
Neosittidae (Sitellas)	1	1
Pachycephalidae (Whistlers)	4	4
Pardalotidae (Pardalotes)	1	2
Petroicidae (Robin)	3	3
Psittaculidae (Parrots)	4	6
Rhipiduridae (Fantail)	2	1
Rallidae (Rails)	1	0
Strigidae (True Owls)	1	2
Turnicidae (Quail)	0	1
Zosteropidae (Silvereye)	1	1
Total number of species	**68**	**57**

4.2.3 Amphibians

A combined total of 7 amphibians from three families were recorded during the Phase 1 and Phase 2 surveys. The most speciose family was Myobatrachidae (four species). No conservation significant amphibians were recorded. A breakdown of amphibians recorded during the survey is provided in Table 23.

Table 23 Amphibian families recorded during the field surveys

Amphibian Family	Number of species	
	Winter	Spring
Myobatrachidae (Quacking/Bleating Frog)	4	1
Limnodynastidae (Moaning Frog)	1	1
Pelodryadidae (Slender tree Frog)	1	2
Total number of species	**6**	**4**

4.2.4 Reptiles

A combined total of 23 reptile species from eight families were recorded during the Phase 1 and Phase 2 surveys. The most speciose family was Scincidae (8 species) followed by Elapidae (6 species). No conservation significant reptile species was recorded during the survey.

A breakdown of reptile families recorded is provided in Table 24.

Table 24 Reptile families recorded during the field surveys

Reptile Family	Number of species	
	Winter	Spring
Agamidae (Dragons)	0	1
Carphodactylidae (Terrestrial Geckoes)	1	1
Elapidae (Snakes)	3	5
Gekkonidae (Geckos)	0	1
Pygopodidae (Legless Lizards)	0	2
Scincidae (Skinks)	6	7
Typhlopidae (Blind Snakes)	1	1
Varanidae (Monitors)	1	2
Total number of species	**12**	**20**

4.2.5 Introduced Species

Mammals comprised the main group in which introduced fauna were recorded. In total five species were observed and included:

– Feral Pig (*Sus scrofa*)
– European Fox (*Vulpes vulpes*)
– European Rabbit (*Oryctolagus cuniculus*)
– Feral cat (*Felis catus*)
– Laughing Kookaburra (*Dacelo novaeguineae*).

These species are considered feral to the region.

4.3 Conservation Significant Fauna

Ten conservation significant fauna species were recorded within the Survey Area during the surveys. This includes:

- Baudin's Cockatoo (*Calyptorhynchus baudinii*) – listed as Endangered under the BC Act and Endangered under the EPBC Act.
- Carnaby's Cockatoo (*Calyptorhynchus latirostris*) – listed as Endangered under the BC Act and Endangered under the EPBC Act.
- Forest Red-tailed Black Cockatoo (*Calyptorhynchus banksii naso*) listed as Vulnerable under the BC Act and Vulnerable under the EPBC Act.
- Quokka (*Setonix brachyurus*) – listed as Vulnerable under the BC Act and the EPBC Act.
- Chuditch (*Dasyurus geoffroii*) listed as Vulnerable under the BC Act and Vulnerable under the EPBC Act.
- Peregrine Falcon (*Falco peregrinus*) listed as Special Protection (Schedule 7) under the BC Act.
- Brush-tailed Phascogale (*Phascogale tapoatafa wambenger*) listed as Conservation Dependent by DBCA.
- Quenda (*Isoodon fusciventer*) – listed as Priority 4 by the DBCA .
- Western Bush Wallaby (*Notamacropus Irma*) – listed as Priority 4 by the DBCA.
- Western False Pipistrelle (*Falsistrellus mackenziei*) listed as Priority 4 by the DBCA

Likelihood of occurrence assessment

In addition to the field survey results, an assessment of the likelihood of conservation significant species occurring in the Survey Area was undertaken. This assessment is based on species' biology, habitat requirements, the quality and availability of suitable habitat as determined during the field survey and records of the species in the Survey Area and locality. The NatureMap database identified 174 terrestrial vertebrate fauna species previously recorded within the Study Area. This total comprised of 101 birds, 34 reptiles, 26 mammals and 13 amphibians. Of the 174 fauna species previously recorded, 166 are native species and eight are naturalised (introduced) species. The EPBC Act PMST search detected an additional four threatened bird species as potentially occurring within the Study Area and the DBCA Threatened and Priority Fauna database returned one additional mammal within the Survey Area. Based on the above database searches and GHD observations, fourteen conservation significant terrestrial vertebrate taxa were identified as likely to occur or present within the Survey Area.

With regard to migratory shorebirds, the Survey Area lacks open suitable foraging habitat, namely shorelines or extensive shallow open water. The creek lines and vegetated seasonal dampland areas within the Survey Area are not considered suitable foraging habitat and in most cases are dry during the period of migratory bird use in the south west of WA. Therefore, they are unlikely to occur within the Survey Area, and any occurrence would be as rare vagrant.

Table 25 summarises the species of conservation significance that are either known or considered likely to occur in the Survey Area. A brief description of these species and their associated habitat types within the Survey Area are described below. The parameters of assessment for this likelihood of occurrence assessment and the full likelihood of occurrence assessment are provided in Appendix D.

Table 25 Summary of likelihood of occurrence assessment for conservation significant fauna

Species	EPBC Act	BC Act/ DBCA	Assessment outcome
Birds			
Baudin's Cockatoo (*Calyptorhynchus baudinii*)	EN	EN	**Known**. The species was recorded during the survey and shown in Figure 4a, Appendix A.
Carnaby's Cockatoo (*C. latirostris*)	EN	EN	**Known**. The species was recorded during the survey and shown in Figure 4a, Appendix A.
Forest Red-tailed Black Cockatoo (*C. banksii naso*)	VU	VU	**Known**. The species was recorded during the survey and shown in Figure 4b, Appendix A.
Peregrine Falcon (*Falco peregrinus*)	-	SP	**Known**. One individual was recorded during the survey and the Jarrah-Marri forest within the Survey Area is suitable nesting habitat.
Masked Owl (southwest) (*Tyto novaehollandiae novaehollandiae*)	-	P3	**Likely**. The species was not recorded on acoustic recorders during the survey however has been detected at the nearby Myara North site Suitable habitat exists within the Survey Area.
Mammals			
Woylie (*Bettongia penicillata ogilbyi*)	En	Cr	**Likely**. Two local records are known. Likely to occur at least on an occasional basis. The species was not recorded during the survey.
Western False Pipistrelle (*Falsistrellus mackenziei*)	-	P4	**Known**. This species was recorded on Song Meters in both the Phase 1 and Phase 2 surveys. Suitable habitat is available to support this species.
Chuditch (*Dasyurus geoffroii*)	VU	VU	**Known**. This species was recorded on two remote cameras during Phase 1 and Phase 2 of the survey. The Survey Area contains suitable breeding and foraging habitat to support this species.
Quenda (*Isoodon fusciventer*)	-	P4	**Known**. The species was recorded via remote cameras and diggings during the survey and are shown in Figure 4c,Appendix A.
Quokka (*Setonix brachyurus*)	VU	VU	**Known**. The species was recorded on remote camera during the Phase 1 and Phase 2 of the survey shown in Figure 4a, Appendix A. The species appears to be wide spread and associated with riparian areas and damplands.
Brush tailed Phascogale (*Phascogale tapoatafa wambenger*)	-	CD	**Known**. At least three individuals were recorded on one remote camera within the Survey Area. Suitable habitat occurs within Survey Area.
Western Brush Wallaby (*Notamacropus irma*)	-	P4	**Known**. The species was recorded throughout the Survey Area as shown in Figure 4c,Appendix A.
Rakali (*Hydromys chrysogaster*)		P4	**Likely**. The species was recorded at Myara North on remote camera. Yabbie remains were recorded during an assessment along the embankment of Kennedy Pool.
Reptiles			
Southern Death Adder (*Acanthophis antarcticus*)	-	P3	**Likely**. The species was recorded at the Myara North Survey Area near Serpentine Dam. Suitable habitat is available to support this species.
Dell's Skink (*Ctenotus dell*)	-	P4	**Likely**. Known to occur locally, Suitable habitat such as granite and lateritic clay supporting forest occurs within the Survey Area.
Legend: CD= Conservation dependent fauna CR = Critically endangered under the EPBC Act or BC Act EN = Endangered under the EPBC Act or BC Act VU = Vulnerable under the EPBC Act or BC Act			

Species	EPBC Act	BC Act/ DBCA	Assessment outcome
SP (S7) = Schedule 7, Special Protection under BC Act P3 = Priority 2 under DBCA, poorly known species. P4 = Priority 4 under DBCA, rare, near threatened and other species in need of monitoring			

Fauna species recorded in the Survey Area

Forest Red-tailed Black Cockatoo (Calyptorhynchus banksii naso)

The Forest Red-tailed Black Cockatoo is listed as Vulnerable under the EPBC Act and BC Act.

The Forest Red-tailed Black Cockatoo is endemic to the south-west humid and sub-humid zones of WA (Mawson and Johnstone 1997). It inhabits the dense Jarrah, Karri (*E. diversicolor*) and Marri forests receiving more than 600 mm of annual average rainfall. The current distribution is north of Perth and east to Mount Helena, Christmas Tree Well, North Banister, Mt Saddleback, Rocky Gully and the upper King River (Johnstone 1997). More recently the species has been utilising and persisting on the northern portions of the Swan Coastal Plain and is now considered a regular sighting (Johnstone *et al* 2017). Habitats in which Forest Red-tailed Black Cockatoos occur at Bungendore Park and Jarrahdale, have an understorey of Bull Banksia (*Banksia grandis*), Snottygobble (*Persoonia longifolia*), Sheoak (Allocasuarina fraseriana) and *Banksia* spp., with scattered Blackbutt (*E. patens*) and Wandoo (*E. wandoo*) (Johnstone & Kirkby 1999). Forest Red-tailed Black Cockatoos roost in Jarrah-Marri-Blackbutt habitat on road-sides, paddocks or forest blocks. While the Forest Red-tailed Black Cockatoo feeds on the seeds of other species, around 90 per cent of its diet is made up of the seeds from Marri and Jarrah fruits.

Forest Red-tailed Black Cockatoos have been recorded breeding in both Myara and Myara North, particularly at the Yamba area at the west of Myara and near the Tuart/Acacia Road area at the north-west of Myara North (T. Kirby, pers. comm.). Breeding is recorded in Jarrah, Marri (majority), Bullich and Blackbutt. Breeding has been recorded from adjacent areas including Serpentine National Park, Wungong Catchment, 39 Mile Brook area and Monadnocks Nature Reserve.

Significant Forest Red-tailed Black Cockatoos roost sites are known from the Myara North region at Jarrahdale Road/Albany Highway (350 birds but usually 50 to 60) and Jarrahdale Road near Jarrahdale (100 birds) (Johnstone & Kirkby unpublished data).

Forest Red-tailed Black Cockatoos were recorded at 100 locations throughout the Survey Area with approximately 51 physical observations recorded during Phase 1 and 49 physical observations during Phase 2. Individuals were recorded in flight, feeding or calling throughout the Survey Area predominantly in the northern, mid eastern and mid western portions of the Survey Area. Foraging evidence, predominantly chewed Marri and Jarrah nuts, was recorded throughout the Survey Area. All observations have been mapped and are presented in Figure 4b and Figure 4d, Appendix A.

Baudin's Cockatoo (Calyptorhynchus baudinii)

The Baudin's Cockatoo is listed as Endangered under the EPBC Act and BC Act.

Baudin's Cockatoo is endemic to the south-west of WA. The range of Baudin's Cockatoo varies considerably between the breeding and non-breeding seasons. During the breeding season (from October to January), the species nests in isolated pockets of the far south-west of WA within Jarrah, Marri and Karri forests which receive an average of 750 mm of rainfall annually. In addition to the south-west there is an isolated patch of known breeding recorded at Perth Hills, east of Armadale (Johnstone & Storr 1998, Johnstone & Kirkby 2008). Breeding generally occurs in woodland or forest, but may also occur in former woodland or forest now present as isolated trees. Nesting occurs in hollows of live or dead karri, marri, wandoo and tuart (*Eucalyptus gomphocephala*) trees (DSEWPaC 2012a). During the breeding season feeding primarily occurs in native vegetation, particularly Marri (DSEWPaC 2012a). The range then expands during the non-breeding season (from February) as flocks forage more widely, congregating on the central and northern parts of the Darling plateau, as far as Mundaring and Gidgegannup (DSEWPaC 2012a; Saunders 1974 & 1979).

Baudin's Cockatoo has been recorded breeding in both the Myara and Myara North regions, though only in low numbers. Most breeding appears to be in the Solus Road area at the border of the Myara and Myara North regions (Alcoa, T. Kirkby unpublished data). Limited breeding also occurs in Bullich and Marri at the border of the Wungong Catchment and 39 Mile Brook Catchment areas approximately 20 to 25 km to the north of the Survey Area however suitable breeding habitat is scattered throughout the Survey Area.

Baudin's Cockatoo were recorded in flight, feeding or calling throughout the Survey Area. In total Baudin's Cockatoo were recorded at 15 locations, with 4 physical observations recorded during Phase 1 and 10 physical observations during Phase 2. Additionally, individuals were also recorded once on bird acoustics. Most records were in the mid eastern portion of the Survey Area. Foraging evidence, predominantly chewed Marri nuts, was

recorded once in the far north western end of the Survey Area and several observations were recorded in the middle and the south eastern portion. All observations have been mapped and are presented in Figure 4b and 4d, Appendix A.

Carnaby's Cockatoo (Calyptorhynchus latirostris)

The Carnaby's Cockatoo is listed as Endangered under the EPBC Act and BC Act.

Carnaby's Cockatoo (*C. latirostris*) is endemic to the south-west of WA with a wide-spread distribution. Carnaby's Cockatoo nest in hollows of live or dead eucalypts, primarily smooth-barked Salmon Gum and Wandoo (Saunders 1979, 1982) though breeding has been reported in other Wheatbelt tree species and some tree species on the Swan Coastal Plain and Jarrah forest (Saunders 1979, 1982; Storr 1991; Johnstone & Storr 1998). Success in breeding is dependent on the quality and proximity of feeding habitat within 12 km of nesting sites (Saunders 1979, 1982; Saunders and Ingram 1987). Along with the trees that provide nest hollows, the protection, management and increase of this feeding habitat that supports the breeding of Carnaby's Cockatoo is a critical requirement for the conservation of the species.

Carnaby's Cockatoos have been recorded breeding in the Myara North region and two nests are present in Marri at the west of the area near Scarp Road. Breeding is expected to occur at the south of Myara North in the vicinity of Solus Road and Mountain Road based on seasonal observations (Alcoa, T. Kirkby unpublished data).

Carnaby's Cockatoo were recorded at four locations with two physical observations (in flight) recorded and one recording of individuals heard calling during Phase 2. Additionally individuals were also recorded at one location on bird acoustics. Recordings are in the north eastern portion and mid-western portion of the Survey Area. All observations have been mapped and are presented in Figure 4a, Appendix A

Pine plantation (Pinus) within the Study Area represent a high value seasonal foraging resource. Foraging resources across the site are of high value particularly given the presence of potential and known breeding trees present within and in proximity to the foraging habitat. Carnaby's Cockatoos foraging evidence was recorded at three locations on both Corymbia and Banksia. Foraging locations are presented in Figure 4d, Appendix A

Quenda (Isoodon fusciventer)

The Quenda is listed as Priority 4 under the BC Act.

The Quenda has patchy distribution through the Jarrah and Karri forest and on the Swan Coastal Plain. Its habitat is generally dense scrubby, often swampy, vegetation with dense cover up to one metre high, often feeds in adjacent forest and woodland that is burnt on a regular basis and in areas of pasture and cropland lying close to dense cover. Populations inhabiting Jarrah and Wandoo forests are usually associated with watercourses (Braithwaite, 1995).

Over the course of the surveys Quenda was recorded at 10 locations within the Survey Area via remote cameras (see Plate 1) and opportunistically. Two of these locations are on cameras and seven were opportunistic sightings with one being a targeted search. Quenda locations are spread mainly across the northern and southern portions of the Survey Area; with more than half (six of eight) records being from the northern portion. Habitat preference tends to be associated with areas of low dense vegetation along drainage lines and damplands. These areas are providing adequate cover from predators.

All observations have been mapped and are presented in Figure 4c, Appendix A.

Plate 1: Quenda captured on camera during Phase 1 survey

Quokka (Setonix brachyurus)

The Quokka is listed as Vulnerable under the BC Act and the EPBC Act.

The current distribution of the mainland quokka includes areas through the south-west forests from Jarrahdale to Walpole. The mainland quokka lives in the Darling Range and south-west regions of WA, mostly inhabiting densely vegetated swamps and sometimes tea-tree thickets on sandy soils along creek systems and dense heath on slopes. Mainland quokkas tend to hide in runs among vegetation during the day and forage along the swamp margins at night (Kitchener 1995).

In the southern forest, quokkas occupy a range of forest, woodland and wetland ecotypes. The most commonly occupied sites comprise Jarrah (*Eucalyptus marginata*), Marri (*Corymbia calophylla*), Karri *(E. diversicolor*) or Tingle (*E. jacksonii* or *E. guilfoylei*) forest and riparian habitats with a sedge dominated understorey (DEC 2013). Habitat supporting a low density of near-surface fuel, a complex vegetation structure and burn patchiness are the factors favouring quokka occupancy in the southern forest (DEC 2013). The habitat critical to survival for the south coast subpopulation includes a wider range of vegetation types (floristically and structurally) than in the northern Jarrah forest, including swamps, riparian areas, incised gullies and dense coastal heath (de Tores et al. 2007). Habitat occupied at the Swan Coastal Plain site at Muddy Lakes consists of fringing wetland vegetation of dense bulrush (*Typha orientalis*)/pale rush (*Juncus pallidus*) sedgeland with other sedges including jointed rush (*Baumea articulata*), *Typha domingensis* and coast sword-sedge (*Lepidosperma gladiatum*) (Keighery *et al*. 2002) (DEC 2013).

During the surveys Quokkas were recorded at a total of 12 locations across the Survey Area, each associated with riparian vegetation or damplands (Figure 4a, Appendix A). This comprises the presence of Quokka from signs (scat, prints or runnels) at four locations and the recordings of Quokka on 7 remote cameras. During Phase 1 fifteen individual Quokka (from 21 camera captures) were recorded and three individuals (from 7 camera captures) during Phase 2 on camera. The camera capture recordings were based on camera independence, animal size, pouch young size, hair loss and ear damage. A quokka individual can be seen below in Plate 2. Between one and 15 individuals were recorded per site based on independent characteristics, with the number of individuals likely higher due to animals being similar. During both phases a number of females either had pouch young or young at foot suggesting recruitment across the Survey Area.

Quokka detection locations were widespread across the Survey Area including the conveyor corridor but limited to areas of dense vegetation associated with drainage lines and damplands. The majority of detections were in the central portion favouring the northern end of the Survey Area. These areas are providing sufficient cover for shelter from predators, food and are movement corridors through the landscape. It is likely Quokka are present in the region wherever drainage lines and damplands are present with long unburnt vegetation. During this survey it was found animals were persisting in dense regrowth of approximately 5-6 years old after fire. This is probably occurring due to baiting in the region under capitalise as few foxes were recorded on camera.

Plate 2: Quokka captured on camera during Phase 1 survey

Western Brush Wallaby (Notamacropus irma)

The Western Brush Wallaby is listed as Priority 4 by the DBCA.

Western Brush Wallaby are locally common in dry sclerophyll forest and woodlands in the southwest of WA (Menkhorst & Knight 2010). They are predominantly diurnal, grazing on grasses and forbs.

Western Brush Wallaby were recorded throughout much of the Survey Area with a total of 48 observations of individuals (predominantly opportunistic and remote camera) recorded during the surveys. Sightings occurred mainly amongst the Jarrah - Marri forest, the dominant fauna habitat type, and were more prevalent in the northern and central portions of the Survey Area as well as the conveyor corridor. Remote cameras recorded approximately 15 records of Western Brush Wallaby over the deployment period (see Plate 3).

Locations of Western Brush Wallaby observations recorded during the survey are presented in Figure 4c, Appendix A.

Plate 3: Western Brush Wallaby captured on camera during Phase 2 survey

Chuditch (Dasyurus geoffroii)

The Western Quoll or Chuditch is listed as Vulnerable under the BC Act and EPBC Act.

The Chuditch is WA's largest carnivorous marsupial and is endemic to south-west WA. It has mostly brown fur with distinctive white spots (4 to 7 white spots on its body but not on its tail). The tail is 21 to 35 cm long. The Chuditch is a carnivore and feeds mostly on large invertebrates. It also easts small lizards, birds and mammals. They are also known to consume the red pulp on Zamia seeds, small fruits and part of flowers. They utilise hollow logs or burrows during the day and hunt at night. It is an excellent climber, which makes it easier to catch tree-dwelling animals. Historically, Chuditch inhabited a wide range of habitats, but today it survives mostly in Jarrah (*E. marginata*) forests and woodlands, mallee shrublands and heathlands (DBCA 2017a).

During the field survey the Chuditch was caught in caged traps (see Plate 4) at various locations several days throughout both phases of the survey and on some occasions were carrying pouch young. Additionally the species was recorded on eight remote cameras (see Plate 5) at several locations - the conveyor corridor, the central (both eastern and western sides) portion as well as the southern portion of the Survey Area Figure 4a, Appendix A). The fact that the species were trapped consecutively for several days during both phases of the survey and some were carrying pouch young indicates the Survey Area contains suitable breeding and foraging/hunting habitat to support this species and a population of the species in the Survey Area.

Plate 4: A Chuditch caught during Phase 2 survey

Plate 5: Chuditch recorded on remote cameras during Phase 1 survey

Peregrine Falcon (Falco peregrinus)

The Peregrine Falcon is listed as Special Protection (Schedule 7) under the BC Act.

The Peregrine Falcon is a large falcon species which predominantly preys aerially on medium sized birds such as Pigeon, Galah and ducks. The species prefers areas with deep gorges or large cliff faces with riparian or plain habitat surrounding. Within the south-west this species utilised forest trees as suitable nest habitat, foraging in surrounding forests and clearings. The Peregrine Falcon nests primarily on ledges of cliffs, shallow tree hollows, and ledges of buildings in cities (Morcombe 2004). The Peregrine Falcon is wide ranging, mobile and aerial in nature, and therefore is likely to utilise forest and woodland habitats within the Survey Area.

During the Phase 2 survey one Peregrine Falcon was recorded opportunistically flying above (Figure 4c, Appendix A) in the middle portion of the Survey Area. The Survey Area contains suitable breeding and hunting habitat to support this species.

Western False Pipistrelle (Falsistrellus mackenziei)

The Western False Pipistrelle is listed as Priority 4 under DBCA managed species list.

The Western False Pipistrelle is a vespertilionid bat that occurs in Southwest Australia. It is an insectivore associated with old large trees that provides the species with its preferred foraging opportunities. Namely, flying insects are hunted around tall forest canopy in the valley between trees tops or the open areas above the mid-storey (Kitchener, Caputi & Jones, 1986). Their range is dominated by wet sclerophyll eucalypt forest and semi woodland of the southwest. Roosting sites are usually associated with old growth eucalypts containing hollows as well as within branches or tree stumps. The Western False Pipistrelle has been recorded on the Swan Coastal Plain in Banksia woodland (Kitchener, Caputi & Jones 1986).

The Western False Pipistrelle was recorded at 17 sites during both phases of the Survey Area (Figure 4c, Appendix A), suggesting a large portion of the Survey Area, including eucalyptus forest and woodland habitats are utilised for foraging and roosting.

Brush tailed Phascogale (Phascogale tapoatafa)

The Brush tailed Phascogale is listed as Conservation Dependent (CD) under the BC Act.

It occurs at low densities in the northern Jarrah forest with highest densities occurring in the Perup/Kingston area, Collie River valley and near Margaret River and Busselton. This species has been observed in dry sclerophyll forests and open woodlands that contain hollow-bearing trees but a sparse ground cover. Records are less common from wetter forests. They are most active between dusk and dawn (though emerging later in mid-winter) and forage almost exclusively among the tree canopy. Nest sites include hollow tree limbs, rotten stumps and

even bird's nests. Lactating females show a preference for large tree cavities with small entrances. They are opportunistic feeders including invertebrates, nectar, small birds and small mammals (DBCA 2017b).

The Brush-tailed Phascogale was detected during Phase 2 of the survey via an Elliot trap within the Jarrah-Marri forest with Sheoak understory within the southern part of the Survey Area (see Plate 6). Additionally it was captured via remote camera from Jarrah – Marri forest with Sheoak understory within the southern portion of the Survey Area (see Plate 7 and Figure 4c, Appendix A).

Plate 6: Brush-tailed Phascogale caught during Phase 2 from Elliot trap

Plate 7: Brush-tailed Phascogale caught during Phase 2 on camera

Carter's Freshwater Mussel (Westralunio carteri)

Carter's Freshwater Mussel is listed as Vulnerable by the DBCA.

Carter's Freshwater Mussel is the only freshwater mussel species in the south-west of WA. Its range has contracted by 49% in less than 50 years, principally as a result of secondary salinsation (Klunzinger *et al*. 2011). The species is now confined to non-salinised rivers and streams, principally in forested catchments along the west and south coasts. Carter's Freshwater Mussel population has previously been located (Klunzinger 2012) at Serpentine River pipehead dam.

Carter's Freshwater Mussel shells were recorded at two locations during Phase 1 of the survey, both on the western side just outside of the Survey Area. This targeted search occurred at the original conveyor corridor Survey Area (which is now outside of the current Survey Area) however has still been recorded and included for regional context. This observation is mapped in Figure 4a, Appendix A and a photo presented in Plate 8. Despite numerous assessments and search effort throughout the Survey Area (details provided in section 4.3.6) no further records of this species occurred.

Plate 8: Carter's freshwater mussel located during Phase 1

4.3.1 Accumulation curve

An accumulation curve was run for the data collected during the field survey within 8 models in Primer V6 (refer Plate 9). Jacknife1, Chao1, Chao2 and Jacknife2 curves demonstrate poor fit to the data, while the remaining curves reach a curve asymptote (very few new species were recorded) after trap night 10-12. The Bootstrap, Sobs, MM and UGE curve demonstrate a moderate degree of levelling by the end of the Phase 2 survey indicating that of the species active at the time of the survey, the majority of them were sampled prior to the end of the Survey.

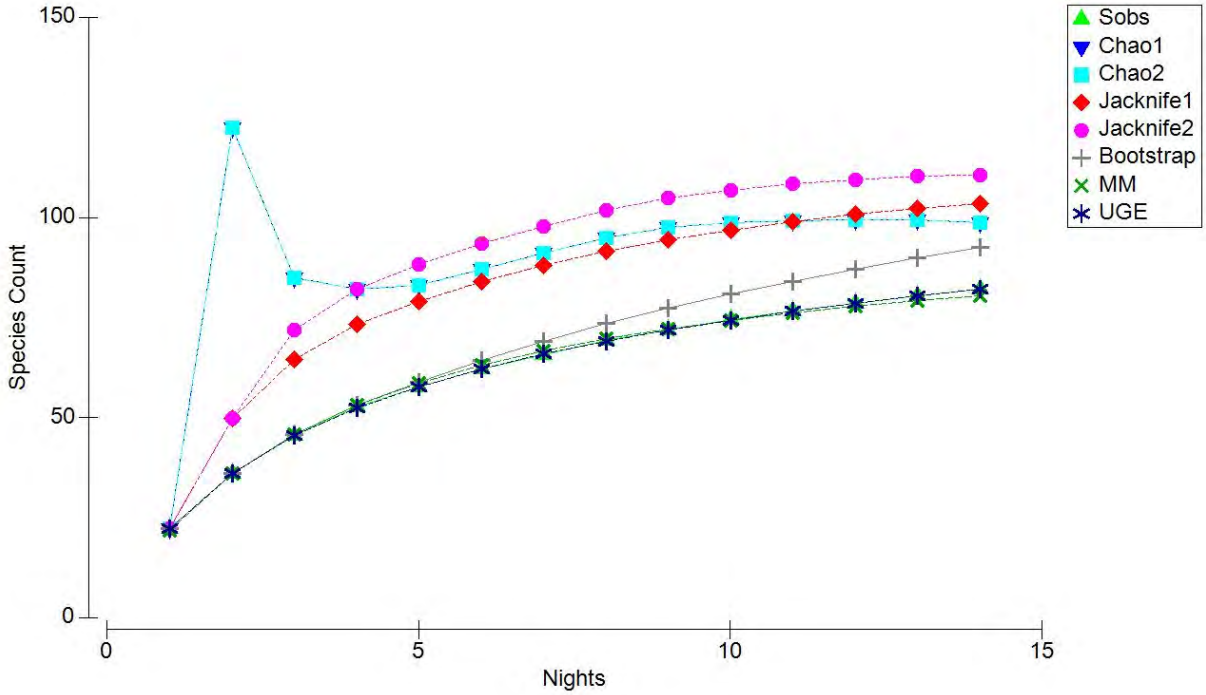

Plate 9: Species accumulation curve over time

4.3.2 Black cockatoo habitat

The Black cockatoo habitat assessment focussed on qualifying and quantifying the breeding habitat values for Black Cockatoo species occurring within the Survey Area. Due to the scale of the Survey Area, twenty eight (28) three hectare habitat assessment plots were sampled to determine habitat usage and potential value for Baudin's, Carnaby's, and Forest Red-tailed Black Cockatoo as described in section 2.3.7. Table 26 presents results on potential and actual usage of cockatoo breeding habitat within the Study Area. Table 27 provides a comparison of potential breeding habitat values for the fauna habitats across the Survey Area. Table 28 presents a quality assessment of the foraging habitat within the different habitat types.

4.3.3 Breeding habitat

From this study and Alcoa's existing data from the Study Area one main area occurs where current breeding activity has been recorded. This area is within and around the Marri habitat in the northern western portion of the Study Area (Figure 4d, Appendix A). Several other potential breeding trees are scattered throughout the central portion on the Survey Area. The northern portion appears to be more Forest Red-tailed Black dominated with respect to sightings while the central region Baudin's Cockatoo.

Transect data undertaken within the Study Area identified that Blackbutt, Flooded Gum Woodland and Jarrah-Marri Forest that had the greatest number of trees per hectare with a DBH of >50 cm at 25, 19 and 17 respectively (refer Table 27).

4.3.4 Foraging habitat

In total 57 foraging sites were recorded consisting of 52 of Forest Red-tailed Black Cockatoo, one of Carnaby's Cockatoo and three from Baudin's Cockatoo. Throughout the seven habitat types foraging quality varies from low to excellent depending on habitat type and cockatoo species (see Table 28). Flooded gum woodland (associated with Melaleuca damplands) appears to be particularly impacted by recent fires in the region with few foraging species present at the time of the survey. All six habitats are useable by either one or more Black Cockatoo species as a food source to varying degrees based on quantity and type of plant species present throughout the habitat type.

Table 28 presents a quality assessment of the foraging habitat within the different habitat types.

4.3.5 Roosting habitat

No roosting sites were recorded within the Holyoake Survey Area. Additionally no evidence of roosting was observed. It is likely roost locations are present particularly for the Forest Red-tailed Black Cockatoo in the Survey Area due to the large numbers of bird records (119 consisting of 15 Carnaby's, four Baudin's and 100 Forest Red-tailed Black Cockatoo) recorded in the Survey Area. It is likely that location of any possible roosting site is dependent on habitat quality in relation to fire history, timber harvesting, dieback or other anthropomorphic behaviour.

Table 26 Black Cockatoo habitat usage

Habitat usage	Presence within the Survey Area	Evidence
Foraging habitat	Yes, Marri, Jarrah and Banksia	Chewed Marri and/or Jarrah nuts, feeding evidence at Casuarina and Banksia trees at 57 locations however the entire Survey Area excluding granite outcrops (actual granite not supportive vegetation) is assessed as foraging habitat.
Actual Breeding Events	No	No actual breeding events were recorded.
Potential breeding hollows	Yes, this data is based on transect surveys only	5 potential breeding trees > 500 mm DBH of either Jarrah and Blackbutt in the Survey Area. One Marri tree with large hollows (>200 mm) suitable for breeding however no actual breeding events were recorded.
Likely Breeding hollows	Yes, this data is based on transect surveys only	One Marri tree with two large hollows (>200mm) was identified as being likely/suitable breeding hollows. This tree identified had chews present at the entrance to both hollows however no actual breeding events were recorded.
Roosting habitat	No	No evidence of roosting was recorded within the Survey Area
Potential breeding trees per hectare	Yes	Potential breeding trees identified derived from transect data (see Table 27 for further detail).
Legend: Potential breeding hollow: breeding hollow of an adequate size for use. Likely breeding hollow: breeding hollow previously known/recorded to have been used, active chew marks present or other evidence hollow has been used.		

Table 27 Black Cockatoo potential breeding trees from transect data

	Area of habitat within Survey Area (ha)	Area of habitat within cockatoo assessment transects (ha)	Number of trees >50cm DBH within transects	Mean density trees >50cm DBH (trees/ha) within transects	Number of trees identified with potential hollows within transects	Number of trees identified with likely hollows within transects	Range of density potential breeding trees (DBH>50cm)/ha
Bullich Forest	298	2.21	1	2	0	0	0
Granite Outcrop Association	0.2	0	0	<1	0	0	0
Blackbutt Forest	301	2.68	69	25	3	0	0-1
Flooded Gum Woodland	391	11.25	220	19	0	0	0
Jarrah Marri Forest	9310	79.69	1403	17	2	1	0-1
Pine Plantation	19	0	0	<1	0	0	0
Cleared areas	45	0	0	0	0	0	0
Rehabilitation areas	176	0	0	<1	0	0	0
Total	**10541**	**95.84**	**1693**	**64**	**5**	**1**	**0**

Table 28 Black Cockatoo foraging habitat assessment

Habitat type	Vegetation type	Baudin's Cockatoo			Carnaby's Cockatoo			Forest Red-tailed Black Cockatoo		
		Foraging species present	Evidence of foraging	Quality of foraging habitat	Foraging species present	Evidence of foraging	Quality of foraging habitat	Foraging species present	Evidence of foraging	Quality of foraging habitat
Bullich Forest	W, WA, WD	Limited. Proteaceous species e.g. Sparse Banksia littoralis.	Low	Low-Moderate	Limited. Proteaceous species e.g. Sparse Banksia littoralis	Low	Low-moderate	Limited.	Low	Low-moderate
Granite Outcrop Association	R, RG, G, G1, G2	Granite Outcrop Association, scattered or occasional proteaceous shrubs, Jarrah, Marri	None	Low-	Granite Outcrop Association, scattered or occasional proteaceous shrubs, Jarrah, Marri	Limited. Jarrah, Marri	Low-Moderate	Granite Outcrop Association, scattered or occasional Jarrah, Marr	Limited. Jarrah, Marri	Low-Moderate
Open Blackbutt Forest	CW, AW, AW/AX, AW/CW, C	Limited to sparse or occasional Marri and Proteaceous species.	None	Low	Limited	Limited to sparse or occasional Marri and Proteaceous species.	Low	Blackbutt seasonally flowering, sparse or occasional Marri and Proteaceous species	Limited	Moderate
Flooded Gum Woodland	AC, AD, AX	Limited. Proteaceous species e.g. Sparse *Banksia littoralis*.	Low	Low-Moderate	Limited. Proteaceous species e.g. Sparse *Banksia littoralis*	Low	Low-moderate	Limited.	Low	Low-moderate
Jarrah Marri Forest	D, DA, DG, E, J, M, P, PG, PJ, PT, PS, PW, S, SP, ST, T, SW, TP, TS, Q	Marri and proteaceous species.	Limited Marri pods	High	Extensive. Jarrah, Marri, Banksia, and proteaceous species	Extensive foraging sign, Jarrah, Marri,	High	High Dominant feeding habitat for this species, mainly Jarrah, Marri and Casuarina	Extensive. Jarrah, Marri, Banksia, on *Hakea undulata*	Excellent
Pine Plantation	PL	Exotic pine - *Pinus pinaster*, *Pinus radiata*	None	Moderate - High	Exotic pine - *Pinus pinaster*, *Pinus radiata*	None	Moderate – High	Exotic pine - *Pinus pinaster*, *Pinus radiata*	None	Low
Mine rehabilitation area	Rehab	Limited, immature eucalyptus and proteaceous and Acacia species	None	Low	Limited, immature eucalyptus and proteaceous species	none	low	Limited, immature eucalyptus species	none	low

Legend:

Evidence of foraging- None (no foraging residue recorded), Limited (some species present but not dominant, rarely recorded foraging evidence), Low (paucity of foraging residue occasionally recorded), Extensive (habitat is dominated with feeding species, numerous signs of foraging evidence recorded).

4.3.6 Carter's Freshwater Mussel

Seven locations (with between one and 15 transects per location) were searched for Carter's Freshwater Mussel within the Survey Area with only one sign of mussels recorded (see Figure 4a, Appendix A for results). It should be noted that the locations of the mussel shells were recorded during Phase 1 during a targeted assessment along the original conveyor corridor. As the corridor location was changed after Phase 1 the location of the mussel is currently outside of the Survey Area but has still been included in the report for regional context.

Of the remaining surveyed transects, most were dry or reduced to small standing water puddles at the time of survey (November/December 2020) indicating that the waterways are dry for over four months of the year. The duration of dry streams is noted to be well outside of the five-day exposure experiments undertaken in controlled conditions (Klunzinger 2012). However, under protected muddy conditions in a creek bed they are likely to survive longer.

Some transects also contained rocky substrate which may be sub-optimal for Carter's Freshwater Mussel as it requires sandy and clay substrate in which to bury (Klunzinger 2012). None of the targeted assessments had water features suitable to maintain Carter's Fresh Water Mussel, with the exception of the find outside of the Study Area. Additionally, none of the transects identified any mussels remains or shells of the species on banks. In these areas the species may be present albeit in very low numbers or below detectable numbers. When adequate stream water is present, the species may occasionally or sporadically be present following dispersal of young mussels up stream within host fish, however unlikely to survive long term due to the dry nature of this portion of the forest.

5. Conclusion

Five broad fauna habitat types were delineated in the Survey Area during the field survey based on flora species, hydrology, soil and topography. They include: Bullich forest, Blackbutt forest, Flooded Gum woodland and Jarrah - Marri forest being the most extensive habitat that accounts for approximately 88% of the Survey Area. Accounting for a relatively scarce proportion of fauna habitat, in contrast to Myara North mine area is granite outcrop (0.002%). In addition to the fauna habitats listed above, highly disturbed areas make up small proportion of the Survey Area (1.85%) and include pine plantation, mine rehabilitation areas, and rural/clearing.

The conservation value of each fauna habitat type is specific to the locally occurring conservation significant fauna species and the type of usage by those species. For example, Flooded Gum woodlands over dense Melaleuca and riparian areas amongst Bullich Forest, Blackbutt Forest and Jarrah-Marri Forest support populations of Quokka with records scattered throughout the Study Area. Additionally, Black Cockatoo (all three species) were recorded predominantly throughout the Jarrah-Marri Forest, however all habitat types will be utilised for foraging by either one or all of the species.

In total ten conservation significant species were recorded in the Study Area including the Quokka, Chuditch, Brush-tailed Phascogale, Western Brush Wallaby, Forest Red-tailed Black Cockatoo, Baudin's Cockatoo, Carnaby's Cockatoo, Western False Pipistrelle, Quenda, and Peregrine Falcon. One additional species, Carter's Freshwater Mussel was recorded outside but in close proximity of the Survey Area.

Except for Carter's Freshwater Mussel, all other conservation significant species identified are likely to have significant populations and habitat present within the Survey Area. Carter's Freshwater Mussel is unlikely due to the lack of permanent surface water bodies within the Survey Area. The Survey Area has extensive foraging habitat for the three Black Cockatoo species, and potential breeding habitat for Carnaby's and Forest Red-tailed Black Cockatoo.

The DBCA NatureMap search identifies that 174 vertebrate fauna taxa previously recorded within 20 km radius of the Survey Area. This total included 26 mammals, 101 birds, 34 reptiles and 13 amphibians.

The detailed and targeted program recorded 129 vertebrate fauna species utilising the Study Area, including 22 mammals, 77 birds, 23 reptiles and seven amphibians. Of these eight introduced species were identified and were all mammals and birds.

The most evident major threatening process identified during the survey was the frequency, size and intensity of fire. Large areas of the Study Area had been burnt within the last tow to three years impacting large portions of habitat. During the survey the north west portion of the Survey Area was prescribed burned in October 2020.

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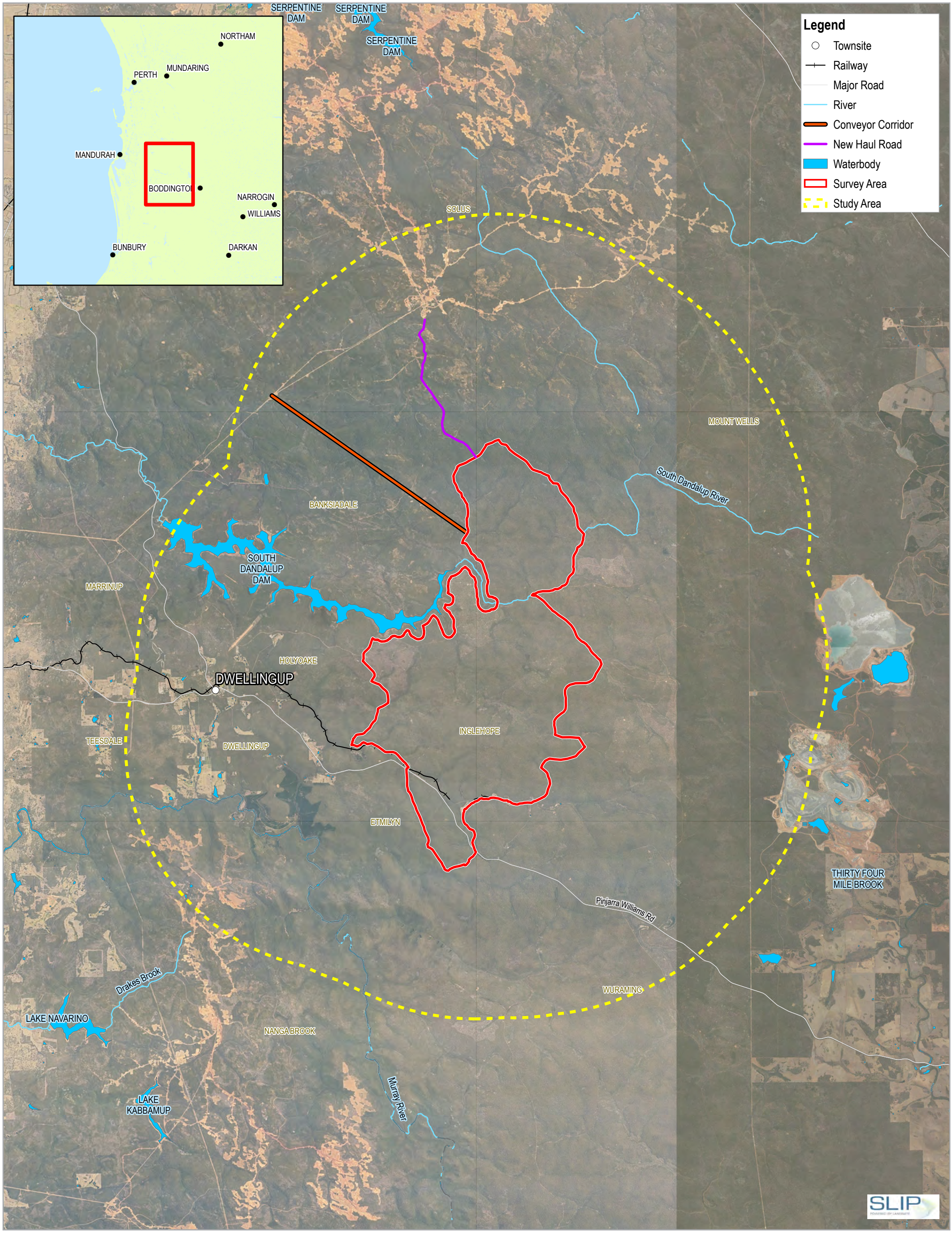
Appendices

Appendix A

Map Figures



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Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 50

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GHD

Alcoa of Australia Limited
Pinjarra Alumina Refinery Revised Proposal

Location of Survey Area

Project No. **12520591**
Revision No. **0**
Date **8/27/2021**

FIGURE 1

\\ghdnet.internal\ghd\AU\Perth\Projects\61\12520591\GIS\Maps\Working\12520591_HolyoakeEcologyReport\12520591_HolyoakeEcologyReport.aprx\12520591_001_LocationofSurveyArea_Rev0
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SERPENTINE DAM
SERPENTINE DAM
SERPENTINE DAM
South Western Hwy
Albany Hwy
NORTH DANDALUP DAM
SOUTH DANDALUP DAM
South Dandalup River
THIRTY FOUR MILE BROOK
Pinjarra Williams Rd
SLIP

Legend

- Townsite

Fauna Conservation Categories

- Critically Endangered Species (CR)
- Endangered Species (EN)
- Vulnerable Species (VU)
- Species of Special Conservation Interest (CD)
- Migratory Species Protected under International Agreement (MI)
- Other Specially Protected Species (OS)
- Priority 1 (P1)
- Priority 2 (P2)
- Priority 3 (P3)
- Priority 4 (P4)
- Chuditch
- Railway
- River
- Waterbody
- Regional Ecological Linkage
- Survey Area

DBCA Legislated Lands and Water

- Conservation Park
- Nature Reserve
- State Forest
- Section 5(1)(g) Reserve
- Section 5(1)(h) Reserve

Vegetation Complex

- Cooke
- Coolakin
- Darling Scarp
- Dwellingup
- Helena 1
- Michibin
- Murray 1
- Pindalup
- Swamp
- Williams
- Yalanbee
- Yarragil 1
- Yarragil 2

Vegetation Association

- 3
- 4
- 128
- 968

Paper Size ISO A3

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Kilometres

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Alcoa of Australia Limited
Pinjarra Alumina Refinery Revised Proposal

Project No. **12520591**
Revision No. **0**
Date **8/27/2021**

Environmental Constraints

FIGURE 2

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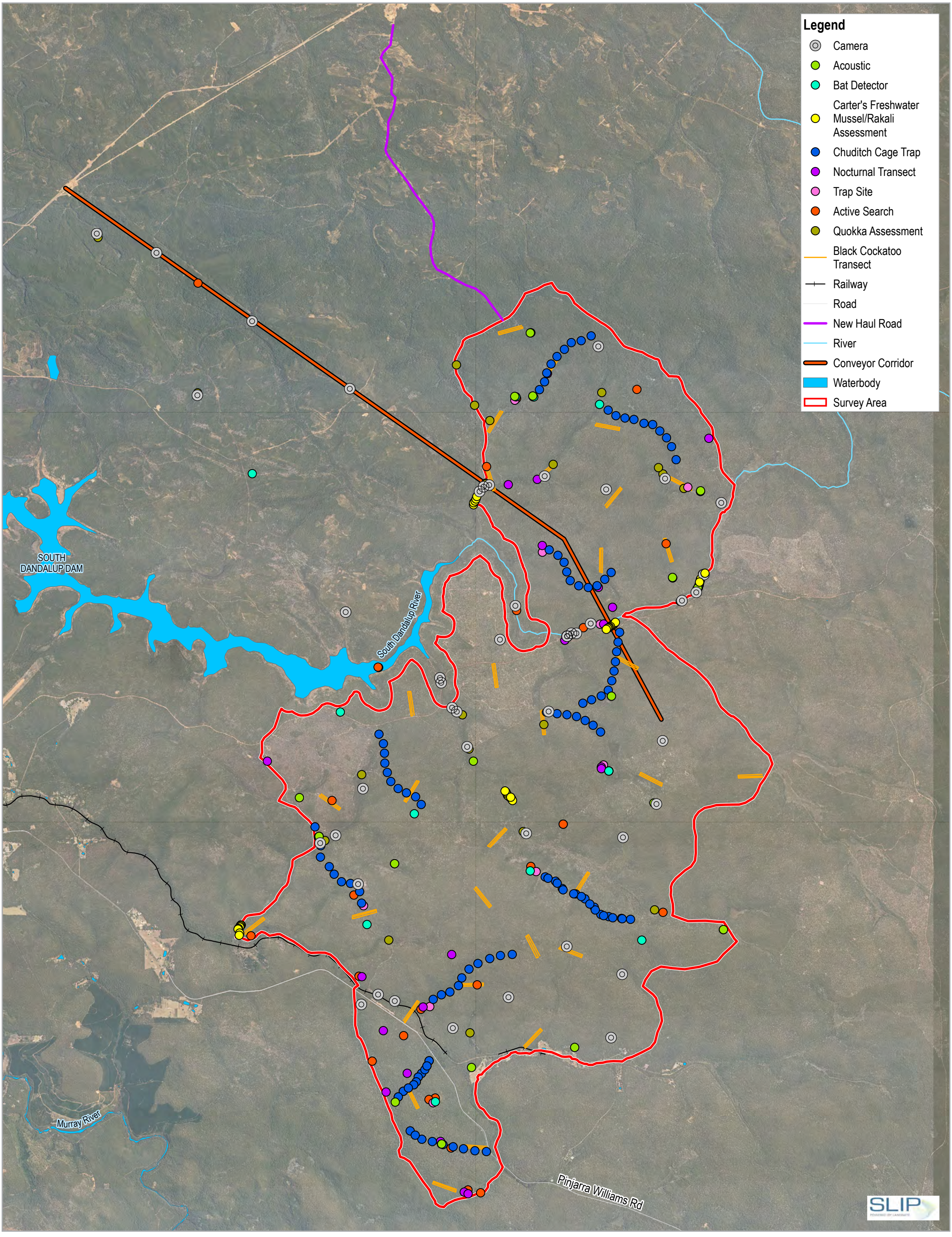

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Alcoa of Australia Limited
Pinjarra Alumina Refinery Revised Proposal

Project No. **12520591**
Revision No. **0**
Date **8/27/2021**

Fauna Survey Methods

FIGURE 3

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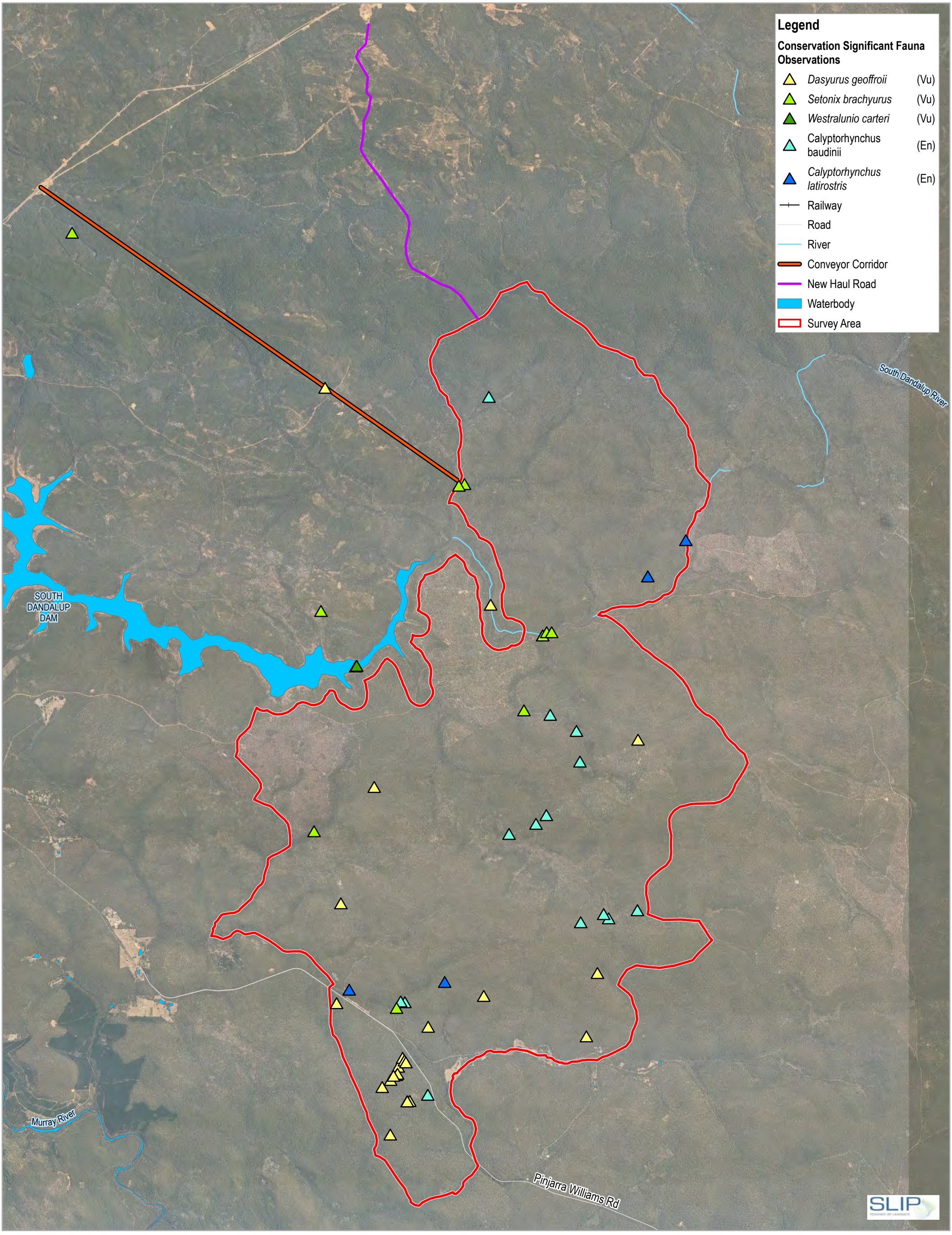

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Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 50

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Pinjarra Alumina Refinery Revised Proposal

Threatened Fauna Species

Project No. **12520591**
Revision No. **0**
Date **29/10/2021**

FIGURE 4A

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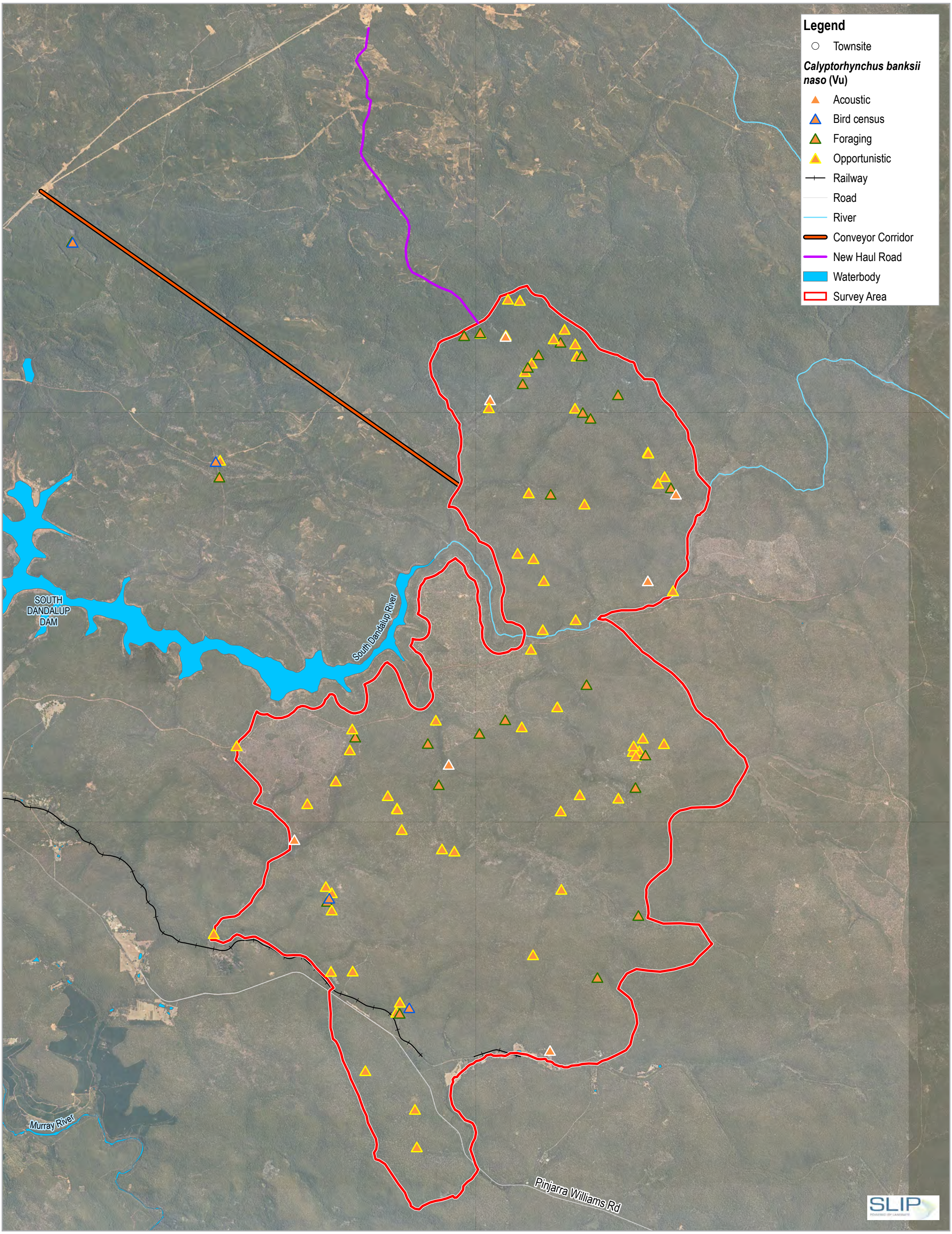

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Grid: GDA 1994 MGA Zone 50

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Alcoa of Australia Limited
Pinjarra Alumina Refinery Revised Proposal

Forest Red-tailed Black Cockatoo Recordings

Project No. **12520591**
Revision No. **0**
Date **8/27/2021**

FIGURE 4B

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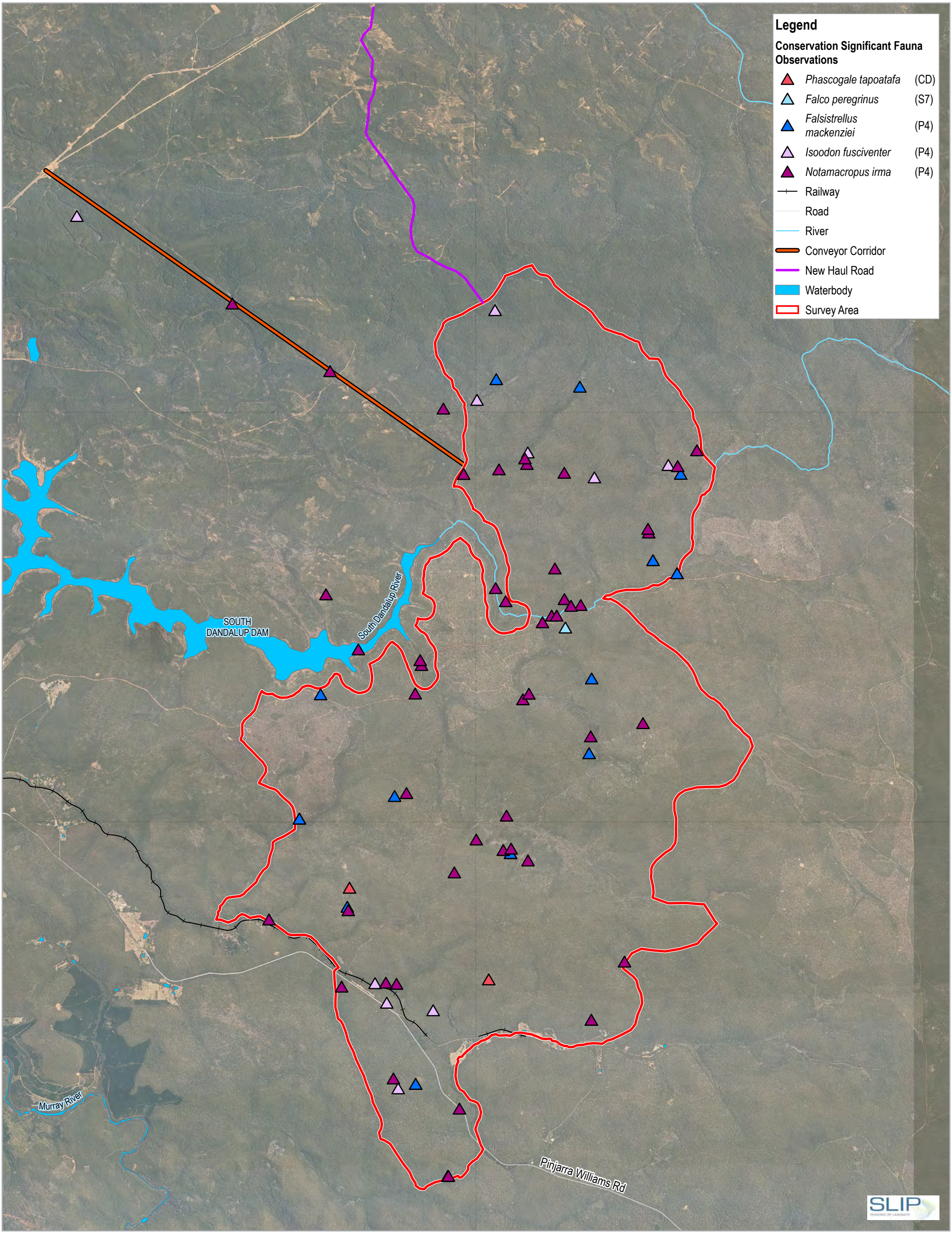

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Alcoa of Australia Limited
Pinjarra Alumina Refinery Revised Proposal

Priority and Other Conservation Significant Fauna

Project No. **12520591**
Revision No. **0**
Date **8/27/2021**

FIGURE 4C

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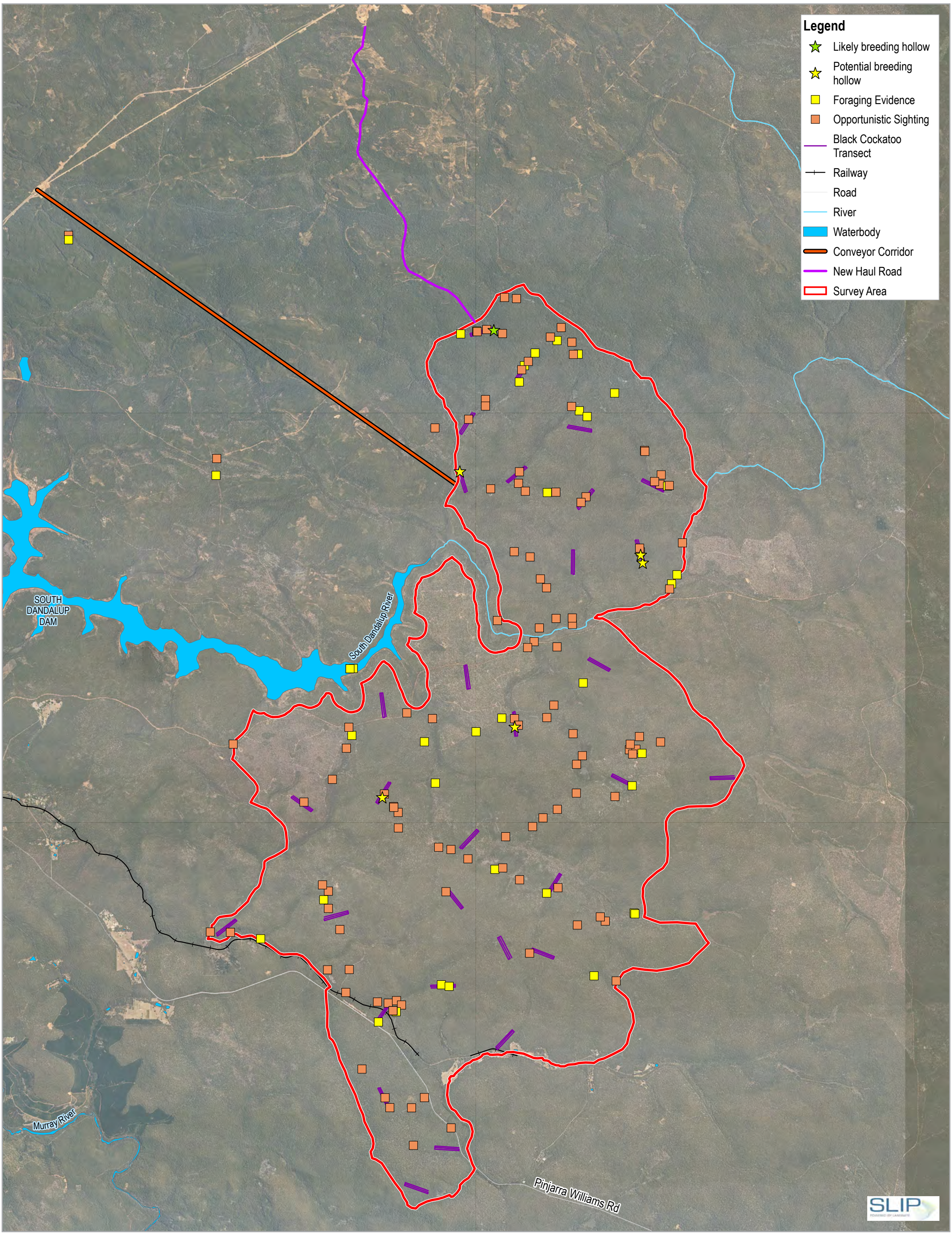

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Alcoa of Australia Limited
Pinjarra Alumina Refinery Revised Proposal

Black Cockatoo Results

Project No. **12520591**
Revision No. **0**
Date **8/27/2021**

FIGURE 4D

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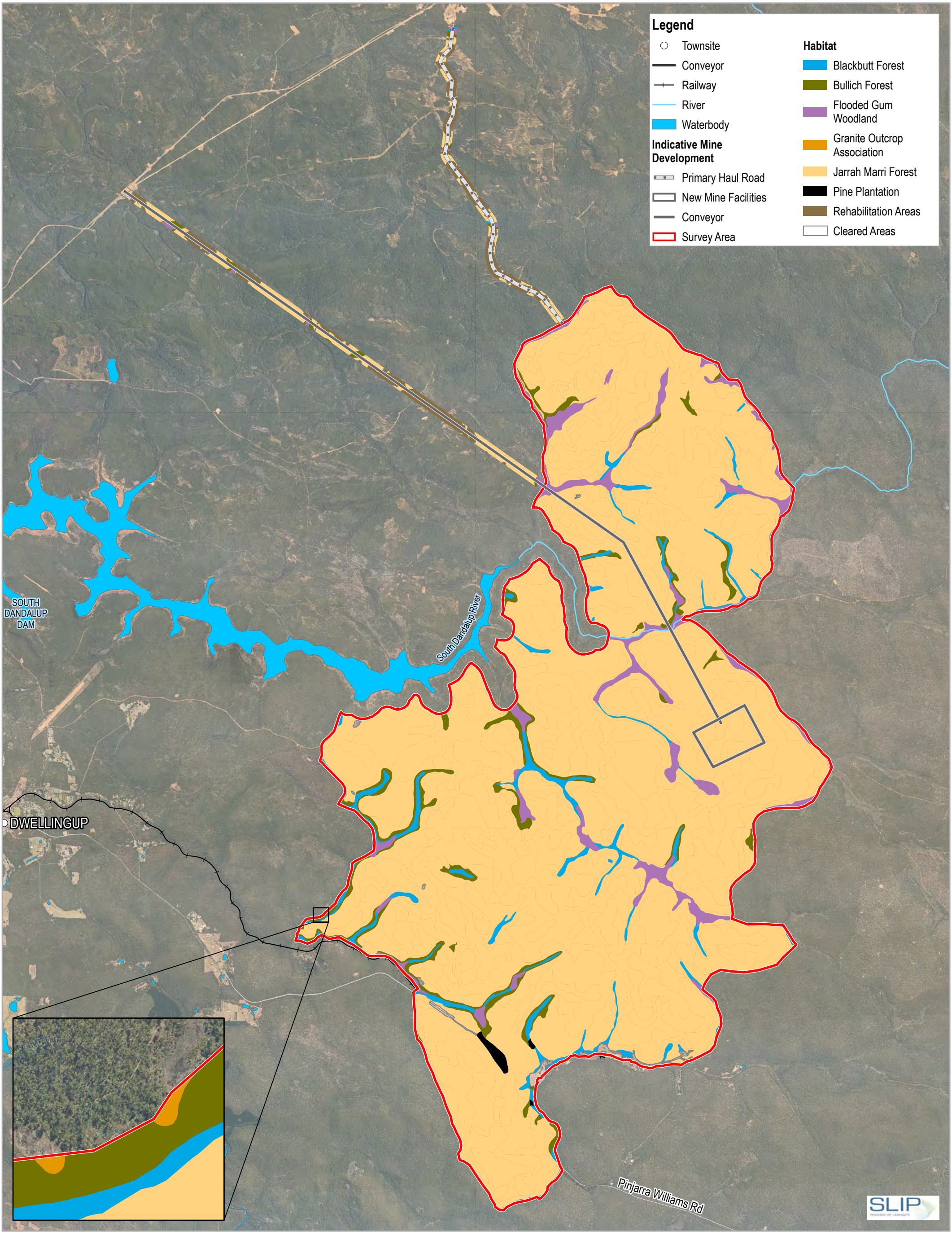

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Alcoa of Australia Limited
Pinjarra Alumina Refinery Revised Proposal

Project No. **12520591**
Revision No. **0**
Date **8/27/2021**

Fauna Habitats

FIGURE 5

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Appendix B

Relevant legislation, background information and conservation codes

Relevant legislation

Federal *Environment Protection and Biodiversity Conservation Act 1999*

The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) is the Federal Government's central piece of environmental legislation. It provides a legal framework to protect and manage nationally and internationally important flora, fauna, ecological communities and heritage places, which are defined in the EPBC Act as Matters of National Environmental Significance (MNES).

The biological aspects listed as MNES include:

– Nationally threatened flora and fauna species and ecological communities
– Migratory species

A person must not undertake an action that has, will have, or is likely to have a significant impact (direct or indirect) on MNES, without approval from the Federal Minister for the Environment.

The EPBC Act is administered by the Department of the Environment and Energy (DEE).

State *Environment Protection Act 1986*

The *Environmental Protection Act 1986* (EP Act) is the primary legislative Act dealing with the protection of the environment in Western Australia. The Act allows the Environmental Protection Authority (EPA), to prevent, control and abate pollution and environmental harm, for the conservation, preservation, protection, enhancement and management of the environment and for matters incidental to or connected with the foregoing. Part IV of the EP Act is administered by the EPA and makes provisions for the EPA to undertake environmental impact assessment of significant proposals, strategic proposals and land use planning schemes.

The Department of Water and Environment Regulation (DWER) is responsible for administering the clearing provisions of the EP Act (Part V). Clearing of native vegetation in Western Australia requires a permit from the DWER, unless exemptions apply. Applications for clearing permits are assessed by the Department and decisions are made to grant or refuse the application in accordance with the Act. When making a decision the assessment considers clearing against the ten clearing principles as specified in Schedule 5 of the EP Act:

a. Native vegetation should not be cleared if it comprises a high level of biodiversity.
b. Native vegetation should not be cleared if it comprises the whole or a part of, or is necessary for the maintenance of a significance habitat for fauna indigenous to Western Australia.
c. Native vegetation should not be cleared if it includes, or is necessary, for the continued existence of rare flora.
d. Native vegetation should not be cleared if it comprises the whole or part of native vegetation in an area that has been extensively cleared.
e. Native vegetation should not be cleared if it is significant as a remnant of native vegetation in an area that has been extensively cleared.
f. Native vegetation should not be cleared if it is growing in, or in association with, an environment associated with a watercourse or wetland.
g. Native vegetation should not be cleared if the clearing of the vegetation is likely to have an impact on the environmental values of any adjacent or nearby conservation area.
h. Native vegetation should not be cleared if the clearing of the vegetation is likely to cause appreciable land degradation.
i. Native vegetation should not be cleared if the clearing of the vegetation is likely to cause deterioration in the quality of surface or underground water.

j. Native vegetation should not be cleared if clearing the vegetation is likely to cause, or exacerbate, the incidence of flooding.

Exemptions for clearing include clearing that is a requirement of a written law or authorised under certain statutory processes (listed in Schedule 6 of the EP Act) and exemptions for prescribed low impact day-to-day activities (prescribed in the Environmental Protection (Clearing of Native Vegetation) Regulations 2004); these exemptions do not apply in environmentally sensitive areas (ESAs).

State *Biodiversity and Conservation Act 2016*

The *Biodiversity Conservation Act 2016* (BC Act) provides for the conservation and protection of biodiversity and biodiversity components, as well as the promotion of the ecologically sustainable use of biodiversity components in Western Australia. The BC Act replaces both the repealed *Wildlife Conservation Act 1950* (WC Act) and the *Sandalwood Act 1929* (Sandalwood Act), as well as their associated regulations. To attain the objectives of the BC Act, principles of ecological sustainable development have been established:

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

The BC Act is administered by the Department of Biodiversity Conservation and Attractions (DBCA).

State *Biosecurity and Agriculture Management Act 2007*

The *Biosecurity and Agriculture Management Act 2007* (BAM Act) and associated regulations are administered by the Department of Primary Industries and Regional Development (DPIRD) and replace the repealed *Agriculture and Related Resources Protection Act 1976*. The main purposes of the BAM Act and its regulations are to:

Prevent new animal and plant pests (vermin and weeds) and diseases from entering WA Manage the impact and spread of those pests already present in the state

Safely manage the use of agricultural and veterinary chemicals

Increased control over the sale of agricultural products that contain violative chemical residues.

The Western Australian Organism List (WAOL) provides the status of organisms which have been categorised under the BAM Act. A Declared Pest is a prohibited organism or an organism for which a declaration under Section 22(2) of the Act is in force. Declared Pests may be assigned a control category including: C1 (exclusion), C2 (eradication) and C3 (management). The category may apply to the whole of the State, LGAs, districts, individual properties or even paddocks, and all landholders are obliged to comply with the specific category of control. Categories of control are defined below.

DPIRD Categories for Declared Pests under the BAM Act

Control class code	Description
C1 (Exclusion)	Pests will be assigned to this category if they are not established in Western Australia and control measures are to be taken, including border checks, in order to prevent them entering and establishing in the State.
C2 (Eradication)	Pests will be assigned to this category if they are present in Western Australia in low enough numbers or in sufficiently limited areas that their eradication is still a possibility.
C3 (Management)	Pests will be assigned to this category if they are established in Western Australia but it is feasible, or desirable, to manage them in order to limit their damage. Control measures can prevent a C3 pest from increasing in population size or density or moving from an area in which it is established into an area which is currently is free of that pest.

Fauna Conservation codes

Conservation significant fauna

The Federal conservation level of fauna species and their significance status is assessed under the EPBC Act. The significance levels for fauna used in the EPBC Act align with the International Union for Conservation of Nature (IUCN) Red List criteria, which are internationally recognised as providing best practice for assigning the conservation status of species. The EPBC Act also protects land and migratory species that are listed under International Agreements. The list of migratory species established under section 209 of the EPBC Act comprises:

– Migratory species which are native to Australia and are included in the appendices to the Bonn Convention (Convention on the Conservation of Migratory Species of Wild Animals Appendices I and II)
– Migratory species included in annexes established under the Japan-Australia Migratory Bird Agreement (JAMBA) and the China–Australia Migratory Bird Agreement (CAMBA)
– Native, migratory species identified in a list established under, or an instrument made under, an international agreement approved by the Minister, such as the republic of Korea–Australia Migratory Bird Agreement (ROKAMBA)

The State conservation level of fauna species and their significance status also follows the IUCN Red List criteria. Under the BC Act fauna can be listed as Threatened, Extinct and as Specially Protected species.

Threatened species are those are species which have been adequately searched for and are deemed to be, in the wild, either rare, under identifiable threat of extinction, or otherwise in need of special protection, and have been gazetted as such. The assessment of the conservation status of Threatened species is based on their national extent and ranked according to their level of threat using IUCN Red List categories and criteria. Specially protected species meet one or more of the following categories: species of special conservation interest; migratory species; cetaceans; species subject to international agreement; or species otherwise in need of special protection. Species that are listed as Threatened or Extinct species under the BC Act cannot also be listed as Specially Protected species.

Possibly threatened species that do not meet survey criteria, or are otherwise data deficient, are added to the Priority Fauna List under Priorities 1, 2 or 3. These three categories are ranked in order of priority for survey and evaluation of conservation status so that consideration can be given to their declaration as threatened flora or fauna.

Species that are adequately known, are rare but not threatened, or meet criteria for near threatened, or that have been recently removed from the threatened species or other specially protected fauna lists for other than taxonomic reasons, are placed in Priority 4. These species require regular monitoring.

Assessment of Priority codes is based on the Western Australian distribution of the species, unless the distribution in WA is part of a contiguous population extending into adjacent States, as defined by the known spread of locations.

For the purposes of this assessment, all species listed under the EPBC Act, BC Act and DBCA Priority species are considered conservation significant.

Conservation categories and definitions for EPBC Act and BC Act listed fauna species

Conservation category	Definition
Threatened species	
Critically Endangered (CR)	Threatened species considered to be "facing an extremely high risk of extinction in the wild in the immediate future, as determined in accordance with criteria set out in the ministerial guidelines". Listed as critically endangered under section 19(1)(a) of the BC Act in accordance with criteria set out in section 20 and the ministerial guidelines.
Endangered (EN)	Threatened species considered to be "facing a very high risk of extinction in the wild in the near future, as determined in accordance with criteria set out in the ministerial guidelines". Listed as endangered under section 19(1)(b) of the BC Act in accordance with the criteria set out in section 21 and the ministerial guidelines.
Vulnerable (VU)	Threatened species considered to be "facing a high risk of extinction in the wild in the medium term future as determined in accordance with criteria set out in the ministerial guidelines". Listed as vulnerable under section 19(1)(c) of the BC Act in accordance with the criteria set out in section 22 and the ministerial guidelines.
Extinct species	
Extinct (EX)	Species where "there is no reasonable doubt that the last member of the species has died", and listing is otherwise in accordance with the ministerial guidelines (section 24 of the BC Act).
Extinct in the Wild (EW)	Species that "is known only to survive in cultivation, in captivity or as a naturalized population well outside its past range, and it has not been recorded in its known habitat, at appropriate seasons, anywhere in its past range, despite surveys over a time frame appropriate to its lifecycle and form", and listing is otherwise in accordance with the ministerial guidelines (section 25 of the BC Act).
Specially protected species	
Migratory (MI)	Fauna that periodically or occasionally visit Australia or an external Territory or the exclusive economic zone; or the species is subject of an international agreement that relates to the protection of migratory species and that binds the Commonwealth; and listing is otherwise in accordance with the ministerial guidelines (section 15 of the BC Act). Includes birds that are subject to an agreement between the government of Australia and the governments of Japan (JAMBA), China (CAMBA) and The Republic of Korea (ROKAMBA), and fauna subject to the Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention), an environmental treaty under the United Nations Environment Program. Migratory species listed under the BC Act are a subsetof the migratory animals, that are known to visit Western Australia, protected under the international agreements or treaties, excluding species that are listed as Threatened species.
Species of special conservation interest (conservation dependent fauna) (CD)	Fauna of special conservation need being species dependent on ongoing conservation intervention to prevent it becoming eligible for listing as threatened.
Other specially protected fauna (OS)	Fauna otherwise in need of special protection to ensure their conservation, and listing is otherwise in accordance with the ministerial guidelines (section 18 of the BC Act).

Conservation codes for DBCA listed Priority fauna

Priority category	Definition
Priority 1	Poorly-known taxa Species that are known from one or a few locations (generally five or less) which are potentially at risk. All occurrences are either: very small; or on lands not managed for conservation, e.g. agricultural or pastoral lands, urban areas, road and rail reserves, gravel reserves and active mineral leases; or otherwise under threat of habitat destruction or degradation. Species may be included if they are comparatively well known from one or more locations but do not meet adequacy of survey requirements and appear to be under immediate threat from known threatening processes. Such species are in urgent need of further survey.
Priority 2	Poorly-known taxa Species that are known from one or a few locations (generally five or less), some of which are on lands managed primarily for nature conservation, e.g. national parks, conservation parks, nature reserves and other lands with secure tenure being managed for conservation. Species may be included if they are comparatively well known from one or more locations but do not meet adequacy of survey requirements andappear to be under threat from known threatening processes. Such species are in urgent need of further survey.
Priority 3	Poorly-known taxa Species that are known from several locations, and the species does not appear to be under imminent threat, or from few but widespread locations with either large population size or significant remaining areas of apparently suitable habitat, much of it not under imminent threat. Species may be included if they are comparatively well known from several locations but do not meet adequacy of survey requirements and known threatening processes exist that could affect them. Such species are in need of further survey.
Priority 4	Rare, Near Threatened and other taxa in need of monitoring Rare: Taxa that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection, but could beif present circumstances change. These taxa are usually represented on conservation lands. Near Threatened. Taxa that are considered to have been adequately surveyed and that do not qualifyfor Conservation Dependent, but that are close to qualifying for Vulnerable. Taxa that have been removed from the list of threatened taxa during the past five years for reasonsother than taxonomy.

Other significant fauna

Fauna species may be significant for a range of reasons other than those protected by international agreement or treaty, Specially Protected or Priority Fauna. Significant fauna may include short-range endemic species, species that have declining populations or declining distributions, species at the extremes of their range, or isolated outlying populations, or species which may be undescribed (EPA 2010).

References

ANZECC 2000, *Core Environmental Indicators for Reporting on the State of Environment*, ANZECC State of the Environment Reporting Task Force.

Commonwealth of Australia 2001, *National Targets and Objectives for Biodiversity Conservation 2001–2005*, Canberra, AGPS.

EPA 2010, *Technical Guide – Terrestrial Fauna Surveys*, EPA, Perth, WA

Appendix C

Desktop searches

NatureMap Species Report

EPBC Act Protected Matter Search Tool Report

NatureMap
Mapping Western Australia's biodiversity

NatureMap Species Report

Created By Guest user on 22/05/2020

Current Names Only	Yes
Core Datasets Only	Yes
Data Source	Atlas of Australian Birds or Birdata - Birdlife Australia or Carnaby's Cockatoo Observations
Method	or Carnaby's Cockatoo Roost Sites or Fauna Survey Returns Database or Fauna Survey
Centre	Returns Database (New) or FaunaFile - Western Shield Monitoring Database or Quenda
Buffer	Community Survey or Rakali Community Survey or Southern Forest Fauna Transect
Group By	Detections or WA Threatened Fauna Database or Western Australian Museum Bird
	Database or Western Australian Museum Mammal Database or Western Australian
	Museum Reptile Database
	'By Circle'
	116° 10' 22" E,32° 42' 57" S
	20km
	Conservation Status

Conservation Status	Species	Records
Non-conservation taxon	166	12958
Other specially protected fauna	3	24
Priority 3	1	1
Priority 4	6	332
Protected under international agreement	2	2
Rare or likely to become extinct	12	456
TOTAL	**190**	**13773**

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
Rare or likely to become extinct					
1.	24358	*Atrichornis clamosus (Noisy Scrub-bird, tjimiluk)*		T	
2.	24162	*Bettongia penicillata subsp. ogilbyi (Woylie, Brush-tailed Bettong)*		T	
3.	24731	*Calyptorhynchus banksii subsp. naso (Forest Red-tailed Black Cockatoo)*		T	
4.	24733	*Calyptorhynchus baudinii (Baudin's Cockatoo, White-tailed Long-billed Black Cockatoo)*		T	
5.	24734	*Calyptorhynchus latirostris (Carnaby's Cockatoo, White-tailed Short-billed Black Cockatoo)*		T	
6.	48400	*Calyptorhynchus sp. (white-tailed black cockatoo)*		T	
7.	24092	*Dasyurus geoffroii (Chuditch, Western Quoll)*		T	
8.	24557	*Leipoa ocellata (Malleefowl)*		T	
9.	24146	*Myrmecobius fasciatus (Numbat, Walpurti)*		T	
10.	24798	*Numenius madagascariensis (Eastern Curlew)*		T	
11.	24145	*Setonix brachyurus (Quokka)*		T	
12.	34113	*Westralunio carteri (Carter's Freshwater Mussel)*		T	
Protected under international agreement					
13.	30932	*Limosa lapponica (Bar-tailed Godwit)*		IA	
14.	48591	*Pandion cristatus (Osprey, Eastern Osprey)*		IA	
Other specially protected fauna					
15.	25624	*Falco peregrinus (Peregrine Falcon)*		S	
16.	24098	*Phascogale calura (Red-tailed Phascogale, Kenngoor)*		S	
17.	48070	*Phascogale tapoatafa subsp. wambenger (South-western Brush-tailed Phascogale, Wambenger)*		S	
Priority 3					
18.	34030	*Geotria australis (Pouched Lamprey)*		P3	
Priority 4					
19.	25035	*Ctenotus delli (Dell's skink, Darling Range southwest Ctenotus)*		P4	
20.	24189	*Falsistrellus mackenziei (Western False Pipistrelle, Western Falsistrelle)*		P4	
21.	24215	*Hydromys chrysogaster (Water-rat, Rakali)*		P4	
22.	48588	*Isoodon fusciventer (Quenda, southwestern brown bandicoot)*		P4	
23.	48022	*Notamacropus irma (Western Brush Wallaby)*		P4	
24.	24803	*Tringa brevipes (Grey-tailed Tattler)*		P4	

Non-conservation taxon

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
25.	24260	*Acanthiza apicalis (Broad-tailed Thornbill, Inland Thornbill)*			
26.	24261	*Acanthiza chrysorrhoa (Yellow-rumped Thornbill)*			
27.	24262	*Acanthiza inornata (Western Thornbill)*			
28.	24560	*Acanthorhynchus superciliosus (Western Spinebill)*			
29.	25535	*Accipiter cirrocephalus (Collared Sparrowhawk)*			
30.	25536	*Accipiter fasciatus (Brown Goshawk)*			
31.	42368	*Acritoscincus trilineatus (Western Three-lined Skink)*			
32.	25544	*Aegotheles cristatus (Australian Owlet-nightjar)*			
33.	24301	*Aegotheles cristatus subsp. cristatus (Australian Owlet-nightjar)*			
34.	24312	*Anas gracilis (Grey Teal)*			
35.	24316	*Anas superciliosa (Pacific Black Duck)*			
36.	24088	*Antechinus flavipes subsp. leucogaster (Yellow-footed Antechinus, Mardo)*			
37.	24561	*Anthochaera carunculata (Red Wattlebird)*			
38.	24562	*Anthochaera lunulata (Western Little Wattlebird)*			
39.	24990	*Aprasia pulchella (Granite Worm-lizard)*			
40.	24991	*Aprasia repens (Sand-plain Worm-lizard)*			
41.	24285	*Aquila audax (Wedge-tailed Eagle)*			
42.	41324	*Ardea modesta (great egret, white egret)*			
43.	25566	*Artamus cinereus (Black-faced Woodswallow)*			
44.	24353	*Artamus cyanopterus (Dusky Woodswallow)*			
45.	33972	*Austromerope poultoni (earwigfly (southwest), scorpionfly)*			
46.		*Barnardius zonarius*			
47.	25598	*Cacomantis flabelliformis (Fan-tailed Cuckoo)*			
48.	42307	*Cacomantis pallidus (Pallid Cuckoo)*			
49.	25717	*Calyptorhynchus banksii (Red-tailed Black-Cockatoo)*			
50.	24086	*Cercartetus concinnus (Western Pygmy-possum, Mundarda)*			
51.	24186	*Chalinolobus gouldii (Gould's Wattled Bat)*			
52.	24187	*Chalinolobus morio (Chocolate Wattled Bat)*			
53.	24321	*Chenonetta jubata (Australian Wood Duck, Wood Duck)*			
54.	24980	*Christinus marmoratus (Marbled Gecko)*			
55.	25675	*Colluricincla harmonica (Grey Shrike-thrush)*			
56.	25568	*Coracina novaehollandiae (Black-faced Cuckoo-shrike)*			
57.	25592	*Corvus coronoides (Australian Raven)*			
58.	25595	*Cracticus tibicen (Australian Magpie)*			
59.	25596	*Cracticus torquatus (Grey Butcherbird)*			
60.	25398	*Crinia georgiana (Quacking Frog)*			
61.	25399	*Crinia glauerti (Clicking Frog)*			
62.	25401	*Crinia pseudinsignifera (Bleating Froglet)*			
63.	30893	*Cryptoblepharus buchananii*			
64.	25020	*Cryptoblepharus plagiocephalus*			
65.	25039	*Ctenotus fallens*			
66.	25049	*Ctenotus labillardieri*			
67.	24322	*Cygnus atratus (Black Swan)*			
68.	30901	*Dacelo novaeguineae (Laughing Kookaburra)*	Y		
69.	25673	*Daphoenositta chrysoptera (Varied Sittella)*			
70.	44654	*Diplodactylus lateroides (Speckled Stone Gecko)*			
71.	24939	*Diplodactylus polyophthalmus*			
72.	24896	*Diporiphora pindan (Pindan Dragon)*			
73.	24470	*Dromaius novaehollandiae (Emu)*			
74.	25096	*Egernia kingii (King's Skink)*			
75.	25100	*Egernia napoleonis*			
76.		*Egretta novaehollandiae*			
77.	24651	*Eopsaltria australis subsp. griseogularis (Western Yellow Robin)*			
78.	24652	*Eopsaltria georgiana (White-breasted Robin)*			
79.	24567	*Epthianura albifrons (White-fronted Chat)*			
80.	25623	*Falco longipennis (Australian Hobby)*			
81.		*Gallus gallus*			
82.	24959	*Gehyra variegata*			
83.	25404	*Geocrinia leai (Ticking Frog)*			
84.	25530	*Gerygone fusca (Western Gerygone)*			
85.	47962	*Glyciphila melanops (Tawny-crowned Honeyeater)*			
86.	24443	*Grallina cyanoleuca (Magpie-lark)*			
87.	25627	*Haematopus fuliginosus (Sooty Oystercatcher)*			
88.	24487	*Haematopus longirostris (Pied Oystercatcher)*			
89.	24293	*Haliaeetus leucogaster (White-bellied Sea-Eagle)*			
90.	24295	*Haliastur sphenurus (Whistling Kite)*			
91.	25409	*Heleioporus barycragus (Hooting Frog)*			
92.	25410	*Heleioporus eyrei (Moaning Frog)*			
93.	25411	*Heleioporus inornatus (Whooping Frog)*			

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
94.	25412	*Heleioporus psammophilus (Sand Frog)*			
95.	30919	*Hemiergis gracilipes (skink)*			
96.	25474	*Hemiergis initialis*			
97.	25115	*Hemiergis initialis subsp. initialis*			
98.	47965	*Hieraaetus morphnoides (Little Eagle)*			
99.	24491	*Hirundo neoxena (Welcome Swallow)*			
100.	25131	*Lerista distinguenda*			
101.	25154	*Lerista microtis subsp. microtis*			
102.	25005	*Lialis burtonis*			
103.	25661	*Lichmera indistincta (Brown Honeyeater)*			
104.	41416	*Liopholis pulchra subsp. pulchra (South-western Rock Skink, Spectacled Rock Skink)*			
105.	42413	*Lissolepis luctuosa (Western Swamp Skink)*			
106.	25378	*Litoria adelaidensis (Slender Tree Frog)*			
107.	25388	*Litoria moorei (Motorbike Frog)*			
108.	24132	*Macropus fuliginosus (Western Grey Kangaroo)*			
109.	25650	*Malurus elegans (Red-winged Fairy-wren)*			
110.	24551	*Malurus pulcherrimus (Blue-breasted Fairy-wren)*			
111.	25654	*Malurus splendens (Splendid Fairy-wren)*			
112.	24552	*Malurus splendens subsp. splendens (Splendid Fairy-wren)*			
113.	47997	*Melanodryas cucullata (Hooded Robin)*			
114.	25663	*Melithreptus brevirostris (Brown-headed Honeyeater)*			
115.	24587	*Melithreptus chloropsis (Western White-naped Honeyeater)*			
116.	25184	*Menetia greyii*			
117.	24598	*Merops ornatus (Rainbow Bee-eater)*			
118.		*Microcarbo melanoleucos*			
119.	25240	*Morelia spilota subsp. imbricata (Carpet Python)*			
120.	25192	*Morethia obscura*			
121.	24223	*Mus musculus (House Mouse)*	Y		
122.	25610	*Myiagra inquieta (Restless Flycatcher)*			
123.	25426	*Neobatrachus pelobatoides (Humming Frog)*			
124.	25252	*Notechis scutatus (Tiger Snake)*			
125.	25564	*Nycticorax caledonicus (Rufous Night Heron)*			
126.	24194	*Nyctophilus geoffroyi (Lesser Long-eared Bat)*			
127.	24195	*Nyctophilus gouldi (Gould's Long-eared Bat)*			
128.	41424	*Nyctophilus major (Greater Long-eared Bat)*			
129.	24407	*Ocyphaps lophotes (Crested Pigeon)*			
130.	24618	*Oreoica gutturalis (Crested Bellbird)*			
131.	25680	*Pachycephala rufiventris (Rufous Whistler)*			
132.	25253	*Parasuta gouldii*			
133.	25255	*Parasuta nigriceps*			
134.	25681	*Pardalotus punctatus (Spotted Pardalote)*			
135.	25682	*Pardalotus striatus (Striated Pardalote)*			
136.	24630	*Pardalotus striatus subsp. westraliensis (Striated Pardalote)*			
137.	48061	*Petrochelidon nigricans (Tree Martin)*			
138.	48066	*Petroica boodang (Scarlet Robin)*			
139.	24659	*Petroica goodenovii (Red-capped Robin)*			
140.	24667	*Phalacrocorax sulcirostris (Little Black Cormorant)*			
141.	25699	*Phalacrocorax varius (Pied Cormorant)*			
142.	24409	*Phaps chalcoptera (Common Bronzewing)*			
143.	25587	*Phaps elegans (Brush Bronzewing)*			
144.	48071	*Phylidonyris niger (White-cheeked Honeyeater)*			
145.	24596	*Phylidonyris novaehollandiae (New Holland Honeyeater)*			
146.	25720	*Platycercus icterotis (Western Rosella)*			
147.	24745	*Platycercus icterotis subsp. icterotis (Western Rosella)*			
148.	24747	*Platycercus spurius (Red-capped Parrot)*			
149.	25721	*Platycercus zonarius (Australian Ringneck, Ring-necked Parrot)*			
150.	24750	*Platycercus zonarius subsp. semitorquatus (Twenty-eight Parrot)*			
151.	25703	*Podargus strigoides (Tawny Frogmouth)*			
152.	24679	*Podargus strigoides subsp. brachypterus (Tawny Frogmouth)*			
153.	25510	*Pogona minor (Dwarf Bearded Dragon)*			
154.	24907	*Pogona minor subsp. minor (Dwarf Bearded Dragon)*			
155.	24771	*Porzana tabuensis (Spotless Crake)*			
156.	25261	*Pseudechis australis (Mulga Snake)*			
157.	25259	*Pseudonaja affinis subsp. affinis (Dugite)*			
158.		*Purpureicephalus spurius*			
159.	25008	*Pygopus lepidopodus (Common Scaly Foot)*			
160.	24245	*Rattus rattus (Black Rat)*	Y		
161.	48096	*Rhipidura albiscapa (Grey Fantail)*			
162.	25614	*Rhipidura leucophrys (Willie Wagtail)*			
163.	25534	*Sericornis frontalis (White-browed Scrubwren)*			

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
164.	30948	*Smicrornis brevirostris (Weebill)*			
165.	24111	*Sminthopsis gilberti (Gilbert's Dunnart)*			
166.	25515	*Sminthopsis griseoventer (Grey-bellied Dunnart)*			
167.		*Sminthopsis murina*			
168.	24645	*Stagonopleura oculata (Red-eared Firetail)*			
169.	25597	*Strepera versicolor (Grey Currawong)*			
170.	24259	*Sus scrofa (Pig)*	Y		
171.	24207	*Tachyglossus aculeatus (Short-beaked Echidna)*			
172.	24331	*Tadorna tadornoides (Australian Shelduck, Mountain Duck)*			
173.	24845	*Threskiornis spinicollis (Straw-necked Ibis)*			
174.	25519	*Tiliqua rugosa*			
175.	25206	*Tiliqua rugosa subsp. palarra*			
176.	25207	*Tiliqua rugosa subsp. rugosa*			
177.	25549	*Todiramphus sanctus (Sacred Kingfisher)*			
178.	25723	*Trichoglossus haematodus (Rainbow Lorikeet)*			
179.	25521	*Trichosurus vulpecula (Common Brushtail Possum)*			
180.	24158	*Trichosurus vulpecula subsp. vulpecula (Common Brushtail Possum)*			
181.	48147	*Turnix varius (Painted Button-quail)*			
182.	24069	*Tursiops truncatus (Bottlenose Dolphin)*			
183.	24852	*Tyto alba subsp. delicatula (Barn Owl)*			
184.	25764	*Tyto novaehollandiae (Masked Owl)*			
185.	24983	*Underwoodisaurus milii (Barking Gecko)*			
186.	25577	*Vanellus miles (Masked Lapwing)*			
187.	25218	*Varanus gouldii (Bungarra or Sand Monitor)*			
188.	25225	*Varanus rosenbergi (Heath Monitor)*			
189.	24206	*Vespadelus regulus (Southern Forest Bat)*			
190.	25765	*Zosterops lateralis (Grey-breasted White-eye, Silvereye)*			

Conservation Codes
T - Rare or likely to become extinct
X - Presumed extinct
IA - Protected under international agreement
S - Other specially protected fauna
1 - Priority 1
2 - Priority 2
3 - Priority 3
4 - Priority 4
5 - Priority 5

[1] For NatureMap's purposes, species flagged as endemic are those whose records are wholely contained within the search area. Note that only those records complying with the search criterion are included in the calculation. For example, if you limit records to those from a specific datasource, only records from that datasource are used to determine if a species is restricted to the query area.

Australian Government
Department of the Environment and Energy

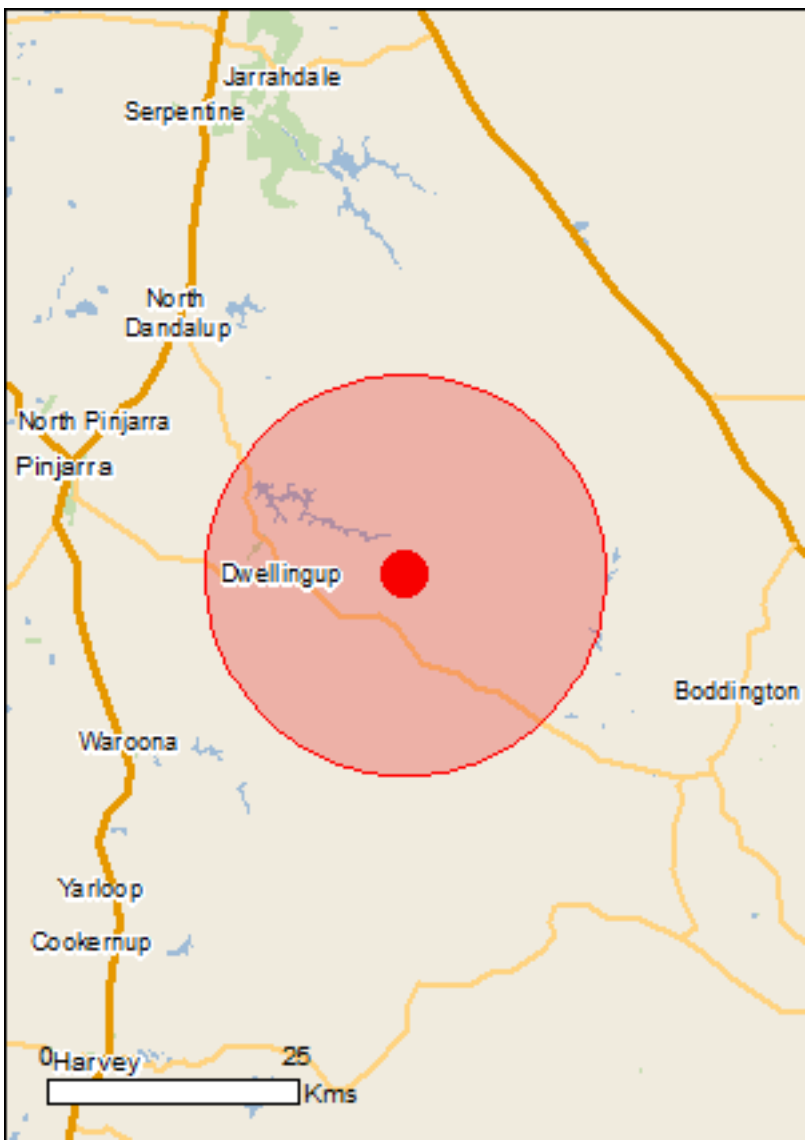
EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected.

Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

Information is available about Environment Assessments and the EPBC Act including significance guidelines, forms and application process details.

Report created: 18/06/20 16:03:29



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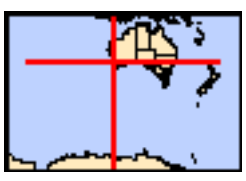
Coordinates

Buffer: 20.0Km



Summary

Matters of National Environmental Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance.

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance:	1
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	None
Listed Threatened Ecological Communities:	1
Listed Threatened Species:	20
Listed Migratory Species:	8

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at http://www.environment.gov.au/heritage

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Land:	1
Commonwealth Heritage Places:	None
Listed Marine Species:	14
Whales and Other Cetaceans:	None
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	None

Extra Information

This part of the report provides information that may also be relevant to the area you have nominated.

State and Territory Reserves:	3
Regional Forest Agreements:	1
Invasive Species:	23
Nationally Important Wetlands:	None
Key Ecological Features (Marine)	None

Details

Matters of National Environmental Significance

Wetlands of International Importance (Ramsar)	[Resource Information]
Name	Proximity
Peel-yalgorup system	20 - 30km upstream

Listed Threatened Ecological Communities		[Resource Information]

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Name	Status	Type of Presence
Banksia Woodlands of the Swan Coastal Plain ecological community	Endangered	Community may occur within area

Listed Threatened Species		[Resource Information]
Name	Status	Type of Presence
Birds		
Atrichornis clamosus Noisy Scrub-bird, Tjimiluk [654]	Endangered	Species or species habitat may occur within area
Botaurus poiciloptilus Australasian Bittern [1001]	Endangered	Species or species habitat known to occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Calyptorhynchus banksii naso Forest Red-tailed Black-Cockatoo, Karrak [67034]	Vulnerable	Species or species habitat known to occur within area
Calyptorhynchus baudinii Baudin's Cockatoo, Long-billed Black-Cockatoo [769]	Endangered	Roosting known to occur within area
Calyptorhynchus latirostris Carnaby's Cockatoo, Short-billed Black-Cockatoo [59523]	Endangered	Species or species habitat known to occur within area
Leipoa ocellata Malleefowl [934]	Vulnerable	Species or species habitat known to occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Rostratula australis Australian Painted Snipe [77037]	Endangered	Species or species habitat may occur within area
Mammals		
Bettongia penicillata ogilbyi Woylie [66844]	Endangered	Species or species habitat known to occur within area

Name	Status	Type of Presence
Dasyurus geoffroii		
Chuditch, Western Quoll [330]	Vulnerable	Species or species habitat known to occur within area
Pseudocheirus occidentalis		
Western Ringtail Possum, Ngwayir, Womp, Woder, Ngoor, Ngoolangit [25911]	Critically Endangered	Species or species habitat may occur within area
Setonix brachyurus		
Quokka [229]	Vulnerable	Species or species habitat known to occur within area
Other		
Westralunio carteri		
Carter's Freshwater Mussel, Freshwater Mussel [86266]	Vulnerable	Species or species habitat known to occur within area
Plants		
Anthocercis gracilis		
Slender Tailflower [11103]	Vulnerable	Species or species habitat likely to occur within area
Diuris micrantha		
Dwarf Bee-orchid [55082]	Vulnerable	Species or species habitat likely to occur within area
Diuris purdiei		
Purdie's Donkey-orchid [12950]	Endangered	Species or species habitat may occur within area
Lasiopetalum pterocarpum		
Wing-fruited Lasiopetalum [64922]	Endangered	Species or species habitat may occur within area
Thelymitra dedmaniarum		
Cinnamon Sun Orchid [65105]	Endangered	Species or species habitat may occur within area
Thelymitra stellata		
Star Sun-orchid [7060]	Endangered	Species or species habitat may occur within area

Listed Migratory Species [Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Migratory Marine Birds		
Apus pacificus		
Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Migratory Terrestrial Species		
Motacilla cinerea		
Grey Wagtail [642]		Species or species habitat may occur within area
Migratory Wetlands Species		
Actitis hypoleucos		
Common Sandpiper [59309]		Species or species habitat may occur within area
Calidris acuminata		
Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area
Calidris ferruginea		
Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Calidris melanotos		
Pectoral Sandpiper [858]		Species or species habitat may occur within

Name	Threatened	Type of Presence
		area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Pandion haliaetus Osprey [952]		Species or species habitat likely to occur within area

Other Matters Protected by the EPBC Act

Commonwealth Land [Resource Information]

The Commonwealth area listed below may indicate the presence of Commonwealth land in this vicinity. Due to the unreliability of the data source, all proposals should be checked as to whether it impacts on a Commonwealth area, before making a definitive decision. Contact the State or Territory government land department for further information.

Name
Commonwealth Land -

Listed Marine Species [Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Birds		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat may occur within area
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardea alba Great Egret, White Egret [59541]		Species or species habitat likely to occur within area
Ardea ibis Cattle Egret [59542]		Species or species habitat may occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat may occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within

Name	Threatened	Type of Presence
		area
Motacilla cinerea Grey Wagtail [642]		Species or species habitat may occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Pandion haliaetus Osprey [952]		Species or species habitat likely to occur within area
Rostratula benghalensis (sensu lato) Painted Snipe [889]	Endangered*	Species or species habitat may occur within area
Thinornis rubricollis Hooded Plover [59510]		Species or species habitat may occur within area

Extra Information

State and Territory Reserves	[Resource Information]
Name	State
Lane Poole Reserve	WA
Lane Poole Reserve	WA
Unnamed WA04596	WA

Regional Forest Agreements	[Resource Information]

Note that all areas with completed RFAs have been included.

Name	State
South West WA RFA	Western Australia

Invasive Species	[Resource Information]

Weeds reported here are the 20 species of national significance (WoNS), along with other introduced plants that are considered by the States and Territories to pose a particularly significant threat to biodiversity. The following feral animals are reported: Goat, Red Fox, Cat, Rabbit, Pig, Water Buffalo and Cane Toad. Maps from Landscape Health Project, National Land and Water Resouces Audit, 2001.

Name	Status	Type of Presence
Birds		
Anas platyrhynchos Mallard [974]		Species or species habitat likely to occur within area
Columba livia Rock Pigeon, Rock Dove, Domestic Pigeon [803]		Species or species habitat likely to occur within area
Passer domesticus House Sparrow [405]		Species or species habitat likely to occur within area
Passer montanus Eurasian Tree Sparrow [406]		Species or species habitat likely to occur within area
Streptopelia chinensis Spotted Turtle-Dove [780]		Species or species habitat likely to occur within area
Streptopelia senegalensis Laughing Turtle-dove, Laughing Dove [781]		Species or species habitat likely to occur within area
Mammals		
Canis lupus familiaris Domestic Dog [82654]		Species or species

Name	Status	Type of Presence
		habitat likely to occur within area
Felis catus Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
Feral deer Feral deer species in Australia [85733]		Species or species habitat likely to occur within area
Mus musculus House Mouse [120]		Species or species habitat likely to occur within area
Oryctolagus cuniculus Rabbit, European Rabbit [128]		Species or species habitat likely to occur within area
Rattus rattus Black Rat, Ship Rat [84]		Species or species habitat likely to occur within area
Sus scrofa Pig [6]		Species or species habitat likely to occur within area
Vulpes vulpes Red Fox, Fox [18]		Species or species habitat likely to occur within area
Plants		
Asparagus asparagoides Bridal Creeper, Bridal Veil Creeper, Smilax, Florist's Smilax, Smilax Asparagus [22473]		Species or species habitat likely to occur within area
Chrysanthemoides monilifera Bitou Bush, Boneseed [18983]		Species or species habitat may occur within area
Chrysanthemoides monilifera subsp. monilifera Boneseed [16905]		Species or species habitat likely to occur within area
Eichhornia crassipes Water Hyacinth, Water Orchid, Nile Lily [13466]		Species or species habitat likely to occur within area
Genista sp. X Genista monspessulana Broom [67538]		Species or species habitat may occur within area
Lantana camara Lantana, Common Lantana, Kamara Lantana, Large-leaf Lantana, Pink Flowered Lantana, Red Flowered Lantana, Red-Flowered Sage, White Sage, Wild Sage [10892]		Species or species habitat likely to occur within area
Lycium ferocissimum African Boxthorn, Boxthorn [19235]		Species or species habitat likely to occur within area
Pinus radiata Radiata Pine Monterey Pine, Insignis Pine, Wilding Pine [20780]		Species or species habitat may occur within area
Rubus fruticosus aggregate Blackberry, European Blackberry [68406]		Species or species habitat likely to occur within area

Caveat

The information presented in this report has been provided by a range of data sources as acknowledged at the end of the report.

This report is designed to assist in identifying the locations of places which may be relevant in determining obligations under the Environment Protection and Biodiversity Conservation Act 1999. It holds mapped locations of World and National Heritage properties, Wetlands of International and National Importance, Commonwealth and State/Territory reserves, listed threatened, migratory and marine species and listed threatened ecological communities. Mapping of Commonwealth land is not complete at this stage. Maps have been collated from a range of sources at various resolutions.

Not all species listed under the EPBC Act have been mapped (see below) and therefore a report is a general guide only. Where available data supports mapping, the type of presence that can be determined from the data is indicated in general terms. People using this information in making a referral may need to consider the qualifications below and may need to seek and consider other information sources.

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Threatened, migratory and marine species distributions have been derived through a variety of methods. Where distributions are well known and if time permits, maps are derived using either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc) together with point locations and described habitat; or environmental modelling (MAXENT or BIOCLIM habitat modelling) using point locations and environmental data layers.

Where very little information is available for species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc). In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More reliable distribution mapping methods are used to update these distributions as time permits.

Only selected species covered by the following provisions of the EPBC Act have been mapped:

- migratory and
- marine

The following species and ecological communities have not been mapped and do not appear in reports produced from this database:

- threatened species listed as extinct or considered as vagrants
- some species and ecological communities that have only recently been listed
- some terrestrial species that overfly the Commonwealth marine area
- migratory species that are very widespread, vagrant, or only occur in small numbers

The following groups have been mapped, but may not cover the complete distribution of the species:

- non-threatened seabirds which have only been mapped for recorded breeding sites
- seals which have only been mapped for breeding sites near the Australian continent

Such breeding sites may be important for the protection of the Commonwealth Marine environment.

Coordinates

-32.71561 116.17397

Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

-Office of Environment and Heritage, New South Wales
-Department of Environment and Primary Industries, Victoria
-Department of Primary Industries, Parks, Water and Environment, Tasmania
-Department of Environment, Water and Natural Resources, South Australia
-Department of Land and Resource Management, Northern Territory
-Department of Environmental and Heritage Protection, Queensland
-Department of Parks and Wildlife, Western Australia
-Environment and Planning Directorate, ACT
-Birdlife Australia
-Australian Bird and Bat Banding Scheme
-Australian National Wildlife Collection
-Natural history museums of Australia
-Museum Victoria
-Australian Museum
-South Australian Museum
-Queensland Museum
-Online Zoological Collections of Australian Museums
-Queensland Herbarium
-National Herbarium of NSW
-Royal Botanic Gardens and National Herbarium of Victoria
-Tasmanian Herbarium
-State Herbarium of South Australia
-Northern Territory Herbarium
-Western Australian Herbarium
-Australian National Herbarium, Canberra
-University of New England
-Ocean Biogeographic Information System
-Australian Government, Department of Defence
Forestry Corporation, NSW
-Geoscience Australia
-CSIRO
-Australian Tropical Herbarium, Cairns
-eBird Australia
-Australian Government – Australian Antarctic Data Centre
-Museum and Art Gallery of the Northern Territory
-Australian Government National Environmental Science Program
-Australian Institute of Marine Science
-Reef Life Survey Australia
-American Museum of Natural History
-Queen Victoria Museum and Art Gallery, Inveresk, Tasmania
-Tasmanian Museum and Art Gallery, Hobart, Tasmania
-Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the Contact Us page.

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Appendix D

Fauna field data

Fauna likelihood of occurrence assessment guideline and definitions

Fauna likelihood of occurrence assessment

Combined phase species list

Phase 1 survey data

Phase 2 survey data

Trap Line habitat assessment

Results from bird acoustic analysis

Results from bat acoustic analysis

Carter’s Freshwater Mussel transect and Rakali transect data

Chuditch Capture Physical Assessment data

Species recorded from studies and database searches

The table presents all vertebrate fauna species recorded in previous studies within or in proximity to the Survey Area, and database searches within a 20 kilometre radius of the Survey Area.

Fauna likelihood of occurrence assessment guidelines

Assessment outcome	Description
Known	Species recorded during the field survey or from recent, reliable records from within or close proximity to the Survey Area.
Likely	Species are **likely** to occur in the Survey Area where there is suitable habitat within the Survey Area and there are recent records of occurrence of the species in close proximity to the Survey Area. OR Species known distribution overlaps with the Survey Area and there is suitable habitat within the Survey Area.
Unlikely	Species assessed as **unlikely** include those species previously recorded within 40 km of the Survey Area however: There is limited (i.e. the type, quality and quantity of the habitat is generally poor or restricted) habitat in the Survey Area. The suitable habitat within the Survey Area is isolated from other areas of suitable habitat and the species has no capacity to migrate into the Survey Area. OR Those species that have a known distribution overlapping with the Survey Area however: There is limited habitat in the Survey Area (i.e. the type, quality and quantity of the habitat is generally poor or restricted). The suitable habitat within the Survey Area is isolated from other areas of suitable habitat and the species has no capacity to migrate into the Survey Area.
Highly unlikely	Species that are considered highly unlikely to occur in the Survey Area include: Those species that have no suitable habitat within the Survey Area. Those species that have become locally extinct, or are not known to have ever been present in the region of the Survey Area.

Source information - desktop searches

NM – *DBCA NatureMap* (accessed May 2020)

PMST – DAWE Protected Matters Search Tool (PMST) to identify fauna listed under the EPBC Act potentially occurring within the Survey Area (accessed June 2020)

Definitions

Term	Description
Database search area	a 10 km buffer around the Survey Area
Survey Area	the area subject to the current survey
CR	Critically endangered under the EPBC Act or BC Act
EN	Endangered under the EPBC Act or BC Act
VU	Vulnerable under the EPBC Act or BC Act
IA	Migratory birds protected under an international agreement
MI, MA	Migratory, Marine
CD	Conservation dependent fauna
OS	Other specially protected fauna under the BC Act
P1	Priority 1: Poorly known fauna. Species that are known from one or a few locations (generally five or less) which are potentially at risk. All occurrences are either: very small; or on lands not managed for conservation, e.g. agricultural or pastoral lands, urban areas, road and rail reserves, gravel reserves and active mineral leases; or otherwise under threat of habitat destruction or degradation. Species may be included if they are comparatively well known from one or more locations but do not meet adequacy of survey requirements and appear to be under immediate threat from known threatening processes. Such species are in urgent need of further survey.
P2	Priority 2: Poorly known species. Species that are known from one or a few locations (generally five or less), some of which are on lands managed primarily for nature conservation, e.g. national parks, conservation parks, nature reserves and other lands with secure tenure being managed for conservation. Species may be included if they are comparatively well known from one or more locations but do not meet adequacy of survey requirements and appear to be under threat from known threatening processes. Such species are in urgent need of further survey.
P3	Priority 3: Poorly known species. Species that are known from several locations, and the species does not appear to be under imminent threat, or from few but widespread locations with either large population size or significant remaining areas of apparently suitable habitat, much of it not under imminent threat. Species may be included if they are comparatively well known from several locations but do not meet adequacy of survey requirements and known threatening processes exist that could affect them. Such species are in need of further survey.
P4	Priority 4: Rare, Near Threatened and other species in need of monitoring. (a) Rare. Species that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection, but could be if present circumstances change. These species are usually represented on conservation lands. (b) Near Threatened. Species that are considered to have been adequately surveyed and that are close to qualifying for Vulnerable, but are not listed as Conservation Dependent. (c) Species that have been removed from the list of threatened species during the past five years for reasons other than taxonomy.

Fauna likelihood of occurrence assessment of conservation significant species identified in the desktop assessment as potentially occurring within the Survey Area.

Species name	Common name	Status		Source			Habitat requirements	Likelihood of occurrence
		State	Federal	NatureMap	PMST	DBCA		
Birds								
Atrichornis clamosus	Noisy Scrub-bird	EN	EN	X			The Noisy Scrub-bird inhabits areas with dense understorey or lower stratum of sedges and shrubs, dense leaf litter and abundant litter-dwelling invertebrates. It mainly occurs in low closed forests 5–15 m in height that are dominated by Eucalyptus or Agonis and *Banksia littoralis*, and occur in the steep and wetter gullies, and drainage lines of hills and granite mountains (Eucalyptus), and on the margins of freshwater lakes (Agonis and *B. littoralis*). It is also common in low closed forests up to 5 m in height that are dominated by *Hakea elliptica*, Eucalyptus or Agonis and *B. littoralis* and occur around granite outcrops, in shallower and drier gullies and on the margins of freshwater lakes. It mostly occurs at sites that have not been burnt for 10 or more years. It occurs at two locations in the south west; on the mainland in coastal areas from Two Peoples Bay Nature Reserve to Cheyne Beach, and on Bald Island (DAWE 2021a).	**Unlikely** This species is restricted to two known sub-populations on the south coast of WA. A historical sub-population from the northern Jarrah forest is locally extinct.
Cacatua pastinator pastinator	Muir's Corella	CD		X		X	Muir's Corella lives in woodland on the drier, eastern side of the main forest block in the south west, in woodlands that are dominated by Wandoo (*E. wandoo*), Marri, (*Corymbia calophylla*), or Jarrah, (*Eucalyptus marginata*). Most suitable habitat for this species now consists of remnant patches that occur in or adjacent to farmland, or along roadsides, paddock boundaries or watercourses, and sometimes as a few, isolated shade trees in otherwise cleared paddocks (Garnett & Crowley 2000). The bird nests in large hollows in trees at least 160 years old. It now has a restricted distribution in the Tone Bridge, Rocky Gully, Frankland River and Lake Muir area (TSSC 2016a).	**Highly unlikely** Restricted to a localised area of the southern Jarrah forest.
Calyptorhynchus banksii naso	Forest Red-tailed Black Cockatoo	VU	VU	X	X	X	The Forest Red-tailed Black Cockatoo inhabits the dense Jarrah, karri, and Marri forests receiving more than 600 mm annual average rainfall but also occurs in a range of other forest and woodland types, including Blackbutt (*E. patens*), Wandoo (*E. wandoo*), Tuart (*E. gomphocephala*), Albany Blackbutt (*E. staeri*), Yate (*E. cornuta*), and Flooded Gum (*E. rudis*) (DAWE 2021b). Habitats tend to have an understorey of balga (*Xanthorrhoea* spp.), kingia (*Kingia australis*), snottygobble (*Persoonia* spp.), parrot bush (*Banksia sessillis*), holly-leaved mirbelia (*Mirbelia dilatata*), bull banksia (*B. grandis*), bullich (*Taxandria* spp.) and sheoak (*Allocasuraina fraseriana*). They are most common in the Jarrah forest region of the northern Darling Range from Collie north to Mundaring and are very local throughout the lower south-west. They can be found on the Swan Coastal Plain, mainly in search of food the exotic white cedar (*Melia azedarach*). There are also several small isolated populations in the eastern parts of its range (DAWE 2021b).	**Known** Known to occur within Survey Area. Recorded sightings, foraging, and potentially breeds within the Survey Area.
Calyptorhynchus baudinii	Baudin's Black Cockatoo	EN	EN	X	X	X	Baudin's Black Cockatoo mainly occurs in eucalypt forests, especially Jarrah, Marri and karri forest that receives 750 mm of annual rainfall. The species is less frequently in woodlands of wandoo (*Eucalyptus wandoo*), blackbutt (*E. patens*), flooded gum (*E. rudis*), yate (*E. cornuta*), partly cleared farmlands and urban areas. The range of the species extends from Albany northward to Gidgegannup and Mundaring (east of Perth), and inland to the Stirling Ranges and near Kojonup. Preferred roosts are in areas with a dense canopy close to permanent sources of water (DAWE 2021c).	**Known** This species was recorded during of the survey. The Survey Area contains suitable foraging habitat for this species.
Calyptorhynchus latirostris	Carnaby's Black Cockatoo	EN	EN	X	X	X	Carnaby's Cockatoo occurs in uncleared or remnant native eucalypt woodlands, especially those that contain Salmon gum, Wandoo, Marri, Jarrah and Karri, and in shrubland or kwongan heathland dominated by Hakea, Dryandra, Banksia and Grevillea species. Breeding activity is restricted to eucalypt woodlands mainly in the semiarid and subhumid interior, from Kalbarri in the north, Three Springs District south to the Stirling Range, west to Cockleshell Gully and east to Manmanning. The species has expanded its breeding range westward and south into the Jarrah-Marri forests of the Darling Scarp and into the tuart forests of the Swan Coastal Plain, including the Yanchep area, Lake Clifton and near Bunbury. It nests in trees older than 120-150 years (DAWE 2021d).	**Known** Known to occur within Survey Area. Recorded sightings, foraging, and potentially breeds within the Survey Area.
Falco peregrinus	Peregrine Falcon	OS		X		X	The Peregrine Falcon is found on and near cliffs, gorges, timbered watercourses, riverine environments, wetlands, plains, open woodlands, and pylons and spires of buildings, though less frequently in desert regions (Morcombe 2004; Pizzey & Knight 2012). They are not common but can be found almost anywhere throughout WA and in the southwest, including particularly at Fitzgerald River, Stirling Range, Porongurup National Parks, Kondinin, and Peak Charles, with many more locations north of Perth (Nevill 2013).	**Known** One individual of this species was recorded during the Phase 2 survey and suitable habitat is available within the Survey Area.
Leipoa ocellata	Malleefowl	VU	VU & MI	X	X	X	The Malleefowl generally occurs in semi-arid areas of WA, in shrublands and low woodlands that are dominated by mallee vegetation, as well as native pine Callitris woodlands, Acacia shrublands, paperbark, sheoak, Broombush *Melaleuca uncinata* vegetation, eucalypt woodlands, or coastal heathlands. Mostly they are found where there are sandy or gravel soils. The nest is a large mound of sand or soil and organic matter (Jones & Goth 2008; Morcombe 2004; Nevill 2013). In WA they are found from the southwest Nullarbor to Albany, north, and then west from Moore River up to Shark Bay, past Cue, across to Wiluna and east to the northern Victoria Desert south of the Blackstone Ranges (Nevill 2013; Pizzey & Knight 2012).	**Highly unlikely** The Survey Area does not contain suitable habitat to support this species.
Limosa lapponica baueri	Bar-tailed godwit (Western Alaskan)	VU& MI	VU	X			The Bar-tailed godwit (Western Alaskan) occurs mainly in coastal habitats such as large intertidal sandflats, banks, mudflats, estuaries, inlets, harbours, coastal lagoons and bays. It has also been recorded in coastal sewage farms and saltworks, saltlakes and brackish wetlands near coasts, sandy ocean beaches, rock platforms, and coral reef-flats. It is widespread around the coast, from Eyre to Derby (TSSC 2016b). They are uncommon in the south west, but can be sighted from Geraldton to Bunbury, at Alfred Cove, and then at a few estuaries on the south coast including Kalgan River Mouth and Oyster Harbour (Nevill 2013).	**Unlikely**. The Survey Area lacks suitable wetland or shoreline habitat.

Species name	Common name	Status		Source			Habitat requirements	Likelihood of occurrence
		State	Federal	NatureMap	PMST	DBCA		
Numenius madagascariensis	Eastern Curlew	CR	CR & MI	X	X		The Eastern Curlew is most commonly associated with sheltered coasts, especially estuaries, bays, harbours, inlets and coastal lagoons, with large intertidal mudflats or sandflats, often with beds of seagrass. Occasionally, the species occurs on ocean beaches (often near estuaries), and coral reefs, rock platforms, or rocky islets. The birds are often recorded among saltmarsh and on mudflats fringed by mangroves, sometimes within the mangroves, and in coastal saltworks and sewage farms. In the south west, Eastern Curlews are recorded from Eyre, and there are scattered records from Stokes Inlet to Peel Inlet (Marchant & Higgins 1993). They are uncommon further south of Geraldton, but can be spotted in Alfred Cove, Peel Inlet and the Albany region (Nevill 2013).	**Unlikely** Suitable habitat such as open shallow flood plain or tidal mud flat is not present to support this species. However, the species may occasionally occur along the shore of the nearby Serpentine Dam. Occurrence within the Survey Area would be as a vagrant at best.
Tringa brevipes	Grey-tailed Tattler	Mi & P4	IA	X			Within Australia, the Grey-tailed Tattler has a primarily northern coastal distribution and is found in most coastal regions. It is found in the south-west between Augusta and Cervantes (DAWE 2021d).	**Unlikely**. The Survey Area lacks suitable wetland or shoreline habitat.
Tyto novaehollandiae subsp. *novaehollandiae*	Masked Owl (southern subsp)	P3		X		X	The Masked Owl is found in forests (wet and dry sclerophyll, non-eucalypt dominated), open woodlands, farmlands or scrub with large trees (12-20 m) and adjacent cleared country, timbered watercourses, paperbark woodlands, and caves (Pizzey & Knight 2012). It requires large hollows in old growth eucalypts or bare sand or the earth of a cave for nesting, and often favours areas with dense understorey or ecotones comprising dense and sparse ground cover. It is often recorded foraging within 100-300 m of the boundary of two vegetation types (Bell & Mooney 2002). The bird is restricted to the thicker humid forests of the south west region, particularly in the Pemberton and Manjimup area and along the Murray River in the Lane Poole area. It nests in hollows in large Karri (*Eucalyptus diversicolor*), Marri (*Corymbia calophylla*)and Jarrah (*E. marginata*) trees (Nevill 2013).	**Likely** This species was not detected during the survey however is known to occur at the nearby Myara North site. Suitable habitat exists within the Survey Area.
Bettongia penicillata ogilbyi	Woylie	CR	EN	X	X	X	Preferred habitat for the Woylie includes dense undergrowth, logs and rock-cavities and occasionally in burrows (Burbidge 2004). Scattered Woylie populations may be found throughout the Jarrah forest in the south-west corner of WA. Extant naturally occurring populations of the species are restricted to three small wheatbelt reserves – Dryandra Woodland, Tutanning Nature Reserve and Perup Forest. All are characterised by the presence of thickets of the plant *Gastrolobium* (Van Dyck and Strahan 2008). The species is now restricted to forests and areas where predation has been controlled (or excluded). It rests during the day in a well-concealed nest, built over a shallow depression. The nest is most commonly built using long strands, of grasses, but other material such as strips of bark are also used (in the forest) or dried seagrass and/or triodia (in arid coastal areas) (Freegard 2007).	**Unlikely** Suitable habitat is present within the Survey Area. The Woylie is known to be previously recorded in Dwellingup area (many years ago) but there are no current local records in Holyoake and Jarrahdale forests. Due to fire frequency and presence of feral predators (such as foxes and cats) they are unlikely to be currently present. There is a possibility of vagrant occurrence but unlikely a current population in the survey area.
Dasyurus geoffroii	Chuditch	VU	VU	X	X	X	The Chuditch inhabits eucalypt forest (especially Jarrah, *Eucalyptus marginata*), dry woodland, mallee shrublands, heaths, and desert, particularly in the south coast of WA. They also occur at lower densities in drier woodland and mallee shrubland in the goldfields and wheatbelt, as well as in Kalbarri National Park (translocated). Chuditch require adequate numbers of suitable den and refuge sites (horizontal hollow logs or earth burrows) to survive (DEC 2011). In Jarrah forest, Chuditch populations occur in both moist, densely vegetated, steeply sloping forest and drier, open, gently sloping forest (Van Dyck & Strahan 2008). The species can travel large distances, and for this reason requires habitats that are of a suitable size and not excessively fragmented.	**Known** This species was recorded during the survey in caged traps and on remote cameras. The Survey Area provides suitable denning and foraging/hunting habitat to support this species.
Hydromys chrysogaster	Rakali, Water-rat	P4		X		X	The Water Rat lives in the vicinity of permanent bodies of fresh, brackish, or marine water, lakes and farm dams, and on sheltered coastal beaches, mangroves and offshore islands. In the south-west of WA they have been shown to prefer areas with riparian vegetation, better water quality and a degree of habitat complexity. Woody debris, rock ledges and wetland islands are likely to be important areas for feeding and refuge (DEC 2012). It is an occasional vagrant to temporary waters. Water Rat's dens are made at the end of tunnels in banks and occasionally in logs (Van Dyck & Strahan 2008).	**Likely** This species was not recorded during the survey however yabbies remains were recorded on the embankment of Kennedy Pool that bisects the South Dandalup Dam. There are also major tributaries that are down-stream of the Survey Area that are suitable habitat, and the species may occur occasionally as a vagrant.
Isoodon fusciventer	Quenda (Southern Brown Bandicoot)	P4		X		X	The Quenda prefers dense scrubby, often swampy, vegetation with dense cover up to one metre high. However, it also occurs in woodlands, and may use less ideal habitat where this habitat occurs adjacent to the thicker, more desirable vegetation. The species often feeds in adjacent forest and woodland that is burnt on a regular basis and in areas of pasture and cropland lying close to dense cover (Van Dyck & Strahan 2008).	**Known** This species was recorded during the survey via both remote cameras, diggings and trapping. The Survey Area provides suitable breeding and foraging habitat to support this species.

Species name	Common name	Status		Source			Habitat requirements	Likelihood of occurrence
		State	Federal	NatureMap	PMST	DBCA		
Myrmecobius fasciatus	Numbat	EN	EN	X		X	Current Numbat populations occupy several different habitat types: upland Jarrah forest, open eucalypt woodland, banksia woodland and tall closed shrubland. The only remaining original subpopulations are at Dryandra Woodland and the Upper Warren area (including Tone Perup Nature Reserve, Greater Kingston National Park and adjoining State Forest). In WA there are nine translocation sites, including Boyagin Nature Reserve, Tutanning Nature Reserve, Batalling block and Karroun Hill Nature Reserve (see DPaW 2015 for complete list and details). At Dryandra, numbats inhabit brown mallet (*Eucalyptus astringens*) plantations. Habitats usually have an abundance of termites in the soil, and hollow logs, tree hollows, burrows and branches for shelter (DAWE 2021d; Van Dyck & Strahan 2008).	**Unlikely** The Survey Area is outside the current known range of the Numbat. Former areas of records include the Jarradale forest and wandoo areas in the southwest. A resident population is occurring in the Narrogin area, introduced populations at Boyagin rock and a recent unpublished record at Marradong. This recent record in the Marradong area suggest they are recolonising however this record is still 40 km south east of the survey area. The likelihood of them occurring in or close to the Survey Area is still unlikely at this stage.
Notamacropus irma	Western Brush Wallaby	P4		X		X	The Western Brush Wallaby is found primarily in open forest or woodland, particularly favouring open, seasonally- wet flats with low grasses and open scrubby thickets. It is also found in some areas of mallee and heathland and is uncommon in karri forest (DEC 2011; Van Dyck & Strahan 2008).	**Known** This species was recorded numerously during the survey. The Survey Area provides suitable breeding and foraging habitat to support this species.
Phascogale tapoatafa	Brush Tailed Phascogale	CD		X		X	The Brush-tailed Phascogale is sparsely distributed outside the semi-arid zone in dry sclerophyll forest and monsoonal forest and woodland. The species is generally rare and threatened by habitat fragmentation in the south west of WA.	**Known** This species was caught in an elliot trap within the south-eastern portion of the Survey Area and suitable habitat is available to support this species.
Phascogale calura	Red-tailed Phascogale	CD	VU	X		X	The Red-tailed Phascogale is restricted to parts of south-western Australia that receive an annual rainfall of 300-600 mm, and is found within remnant vegetation in the southern Wheatbelt, from Brookton to Katanning. Sparse records extend west to the margin of the Jarrah Forest, east to Hyden and Newdegate and south to Bremer Bay. There are outlying records along the east of the species range, at Marvel Loch (south of Southern Cross) and Jerdacuttup, and at Dwellingup in the Jarrah Forest region. They occur in isolated patches of forest, its preferred being the denser and taller climax vegetation communities within old-growth hollow-producing wandoo (Eucalyptus wandoo), York gum (E. loxophleba) and Rock Sheoak (Allocasuarina huegeliana) woodlands. The species prefers vegetation that is unburnt for a long time (DEC 2007; TSSC 2016c; Van Dyck & Strahan 2008).	**Unlikely** A historical record from Dwellingup in 1988. The Survey Area is considered to be located beyond the north-western limit of this species current range.
Pseudocheirus occidentalis	Western Ringtail Possum	CR	CR	X	X		The Western Ringtail Possum occurs in coastal and near coastal and Peppermint Tree (*Agonis flexuosa*) forest and Tuart (*Eucalyptus gomphocephala*) dominated forest with a Peppermint Tree understorey from Bunbury to Albany. Also occurs in Jarrah (*E. marginata*) forest and Jarrah-Marri *(Corymbia calophylla*) forest associated with Peppermint Tree (Van Dyck & Strahan 2008).	**Unlikely** Suitable habitat (Tuart over peppermint understory) is not present to support this species and the Study Area is beyond the current local range of the species.
Setonix brachyurus	Quokka	Vu	Vu	X	X	X	The current distribution of the Quokka includes Rottnest and Bald Islands, and at least 25 sites on the mainland, including Two Peoples Bay Nature Reserve and Torndirrup, Mt Manypeaks and Walpole-Nornalup National Parks, and swamp areas through the south-west forests from Jarrahdale to Walpole. The last known population on the Swan Coastal Plain occurs in Muddy Lakes near Bunbury. Quokkas have also been reintroduced to Karakamia Sanctuary (DEC 2013). They occupy dense forests and thickets, streamside vegetation, heaths, shrublands, *Agonis linearifolia*-dominated swamps in the Jarrah (*Eucalyptus marginata*) forest, and sometimes tea-tree thickets on sandy soils along creek systems. The northern extent on the mainland is in the Jarrah forest immediately south-east of the Perth metropolitan area, from where it extends southward through the southern Jarrah, Marri and Karri forests to the south coast, but largely confined throughout to areas receiving an annual rainfall of 1,000 mm or more (DEC 2013; Van Dyck & Strahan 2008).	**Known** This species was recorded during the survey on remote cameras. The Survey Area provided suitable breeding and foraging habitat to support this species.
Reptiles								
Acanthophis antarcticus	Southern Death Adder	P3		X		X	The Southern Death Adder habitat ranges from rainforest to shrublands and heaths. This species is declining in many areas, probably due to habitat destruction and altered fire regimes (Wilson & Swan 2013).	**Likely**. Two individuals were recorded during the Mattiske vegetation and flora survey (2020).at Myara North. Habitat supports this species however it was not detected at Holyoake during the survey.

Species name	Common name	Status		Source			Habitat requirements	Likelihood of occurrence
		State	Federal	NatureMap	PMST	DBCA		
Ctenotus delli	Dell's Skink	P4		X		X	Dell's Skink is associated with Jarrah-Marri woodland that has a shrub-dominated understorey, on laterite, sandy or clay soils. It is found in the north Darling Range and inhabits dry sclerophyll forest on granite outcrops, stony hills and ranges. It is absent from the Swan Coastal Plain (Cogger 2014; Wilson & Swan 2013).	**Likely** The Survey Area contains suitable breeding and foraging habitat such as granite and lateritic clay to support this species however it was not detected during the surveys.
Geotria australis	Pouched Lamprey	P3		X		X	This species utilises freshwater streams in the south west (Perth to Albany) to breed and grow before migrating to the ocean to mature (Allen *et al*. 2002). Dams and weirs are the main obstacles for the species. Sporadic records exist throughout the South West Coast Drainage Division between Perth and Albany including the Swan, Canning, Serpentine, Margaret, Donnelly, Warren and Goodga rivers.	**Unlikely** Recorded locally within the upper Murray River near lane Poole Reserve approximately 5.5 km southwest of the Survey Area, although Survey Area lacks suitable streams, and presumed locally extinct upstream of South Dandalup Dam.
Other								
Westralunio carteri	Carter's Freshwater Mussel	Vu	Vu		X		Carter's Freshwater Mussel is usually found in freshwater river pools. They are most common in areas with muddy, silty and sandy bottoms and flowing permanent water. Environmental tolerances of *W. carteri* are not precisely known but they can be found where water temperatures range from 4° C to over 30° C. Formerly this species occurred widely through the southwest including interior rivers of southwest such as Avon, Murray and Blackwood, however Salination of many waterways has severely reduced this species distribution.	**Unlikely** The species shells were recorded nearby immediately adjacent to the western boundary, just outside of the Survey Area. However inside the Survey Area the habitat of non-saline permanent water bodies is very limited to non-existent to support the species in the Survey Area

Combined Phase Species List

Family	Scientific Name	Species	EPBC listing	DBCA listing	Phase 1	Phase 2
Mammals						
Burramyidae	*Cercartetus concinnus*	Western Pygmy Possum				X
Canidae	*Vulpes*	Fox	Int	Int	X	X
Dasyuridae	*Sminthopsis gilberti*	Gilberts Dunnart			X	X
Dasyuridae	*Phascogale tapoatafa*	Brush-tailed Phascogale		CD		X
Dasyuridae	*Antechinus flavipes*	Mardo			X	X
Dasyuridae	*Dasyurus geoffroii*	Chuditch	Vu	Vu	X	X
Felidae	*Felis catus*	Feral Cat	Int	Int		X
Leporidae	*Oryctolagus cuniculus*	European Rabbit	Int	Int	X	X
Macropodidae	*Notamacropus irma*	Western Brush Wallaby		P4	X	X
Macropodidae	*Macropus fuliginosus*	Western Grey Kangaroo			X	X
Macropodidae	*Setonix brachyurus*	Quokka	Vu	Vu	X	X
Molossidae	*Austronomus australis*	White-striped Free-tailed Bat			X	X
Molossidae	*Ozimops kitcheneri*	South-western Free-tailed Bat			X	X
Muridae	*Rattus rattus*	Black Rat			X	
Peramelidae	*Isoodon fusciventer*	Quenda		P4	X	
Phalangeridae	*Trichosurus vulpecula*	Common Brushtail Possum			X	
Suidae	*Sus scrofa*	Feral Pig	Int	Int	X	X
Tachyglossidae	*Tachyglossus aculeatus*	Short-beaked Echidna			X	X
Vespertilionidae	*Chalinolobus gouldii*	Gould's Wattled Bat			X	X
Vespertilionidae	*Chalinolobus morio*	Chocolate Wattled Bat			X	X
Vespertilionidae	*Falsistrellus mackenziei*	Western False Pipistrelle		P4	X	X
Vespertilionidae	Vespadelus regulus	Southern Forest Bat			X	X
Birds						
Acanthizidae	*Acanthiza apicalis*	Inland Thornbill			X	X
Acanthizidae	*Smicrornis brevirostris*	Weebill			X	X

Family	Scientific Name	Species	EPBC listing	DBCA listing	Phase 1	Phase 2
Acanthizidae	*Gergoyne fusca*	Western Gerygone			X	X
Acanthizidae	*Acanthiza inornata*	Western Thornbill			X	X
Acanthizidae	*Sericornis frontalis*	White-browed Scrubwren			X	X
Acanthizidae	*Sericornis maculatus*	Spotted scrubwren			X	
Acanthizidae	*Acanthiza chrysorrhoa*	Yellow-rumped Thornbill			X	
Accipitridae	*Accipiter cirrocephalus*	Collared sparrow hawk			X	X
Accipitridae	*Aquila audax*	Wedge-tailed Eagle			X	
Accipitridae	*Haliastur sphenurus*	Whistling Kite			X	X
Aegothelidae	*Aegotheles cristatus*	Australian Owlet-nightjar			X	X
Alcedinidae	*Dacelo novaeguineae*	Laughing Kookaburra		Int	X	X
Alcedinidae	*Todiramphus sanctus*	Sacred Kingfisher			X	
Anatidae	*Chenonetta jubata*	Australian Wood Duck			X	
Anatidae	*Anas superciliosa*	Pacific Black Duck			X	
Anatidae	*Cygnus atratus*	Black Swan			X	
Artamidae	*Cracticus torquatus*	Grey Butcherbird			X	
Artamidae	*Cracticus nigrogularis*	Pied Butcherbird			X	
Artamidae	*Strepera versicolor*	Grey Currawong			X	X
Artamidae	*Cracticus tibicen*	Australian Magpie			X	
Cacatuidae	*Calyptorhynchus baudinii*	Baudin’s Cockatoo	En	En	X	X
Cacatuidae	*Calyptorhynchus latirostris*	Carnaby's Cockatoo	En	En	X	X
Cacatuidae	*Calyptorhynchus banksii*	Forest Red-tailed Black Cockatoo	Vu	Vu	X	X
Campephagidae	*Coracina novaehollandiae*	Black-faced Cuckoo-shrike				X
Casuariidae	*Dromaius novaehollandiae*	Emu			X	X
Climacteridae	*Climacteris rufus*	Rufous Tree Creeper			X	X
Columbidae	*Phaps chalcoptera*	Common Bronzewing			X	X
Corvidae	*Corvus coronoides*	Australian Raven			X	X
Cuculidae	*Chalcites basalis*	Horsfield's Bronze Cuckoo			X	X
Cuculidae	*Cacomantis flabelliformis*	Fan-tailed Cuckoo			X	

Family	Scientific Name	Species	EPBC listing	DBCA listing	Phase 1	Phase 2
Cuculidae	*Chrysococcyx lucidus*	Shining Bronze-cuckoo				X
Falconidae	*Falco longipennis*	Australian Hobby Falcon			X	
Falconidae	*Falco peregrinus*	Peregrine Falcon		OS		X
Hirundinidae	*Petrochelidon ariel*	Fairy Martin			X	
Hirundinidae	*Petrochelidon nigricans*	Tree Martin			X	X
Locustellidae	*Cincloramphus mathewsi*	Rufous Songlark				X
Locustellidae	*Cincloramphus cruralis*	Brown songlark			X	
Maluridae	*Malurus pulcherrimus*	Blue breasted fairy wren			X	
Maluridae	*Malurus elegans*	Red-winged Fairywren			X	X
Maluridae	*Malurus splendens*	Splendid Fairywren			X	X
Maluridae	*Malurus leucopterus*	White winged fairy wren				X
Meliphagidae	*Phylidonyris novaehollandiae*	New Holland Honeyeater			X	X
Meliphagidae	*Anthochaera carunculata*	Red Wattlebird			X	X
Meliphagidae	*Acanthorhynchus superciliosus*	Western Spinebill			X	X
Meliphagidae	*Lichmera indistincta*	Brown Honeyeater				X
Meliphagidae	*Melithreptus brevirostris*	Brown-headed Honeyeater			X	X
Meliphagidae	*Anthochaera lunulata*	Western Wattlebird			X	X
Meliphagidae	*Melithreptus lunatus*	White-napped Honeyeater			X	X
Meliphagidae	*Phylidonyris niger*	White cheeked honeyeater			X	X
Meliphagidae	*Lichenostomus ornatus*	Yellow plumed honeyeater			X	
Meropidae	*Merops ornatus*	Rainbow Bee-eater				X
Monarchidae	*Myiagra inquieta*	Restless Flycatcher			X	
Monarchidae	*Grallina cyanoleuca*	Magpie-lark				X
Neosittidae	*Daphoenositta chrysoptera*	Varied Sitella			X	X
Pachycephalidae	*Pachycephala pectoralis*	Golden Whistler			X	X
Pachycephalidae	*Pachycephala occidentalis*	Western Whistler			X	X
Pachycephalidae	*Colluricincla harmonica*	Grey Strike Thrush			X	X
Pachycephalidae	*Pachycephala rufiventris*	Rufous Whistler			X	X

Family	Scientific Name	Species	EPBC listing	DBCA listing	Phase 1	Phase 2
Pardalotidae	*Pardalotus punctatus*	Spotted Pardalote			X	X
Pardalotidae	*Pardalotus striatus*	Striated Pardalote				X
Petroicidae	*Petroica boodang*	Scarlet Robin			X	
Petroicidae	*Eopsaltria griseogularis*	Western Yellow Robin			X	X
Petroicidae	*Eopsaltria georgiana*	White-breasted Robin			X	X
Pomatostomidae	*Pomatostomus superciliosus*	White browed babbler				X
Psittaculidae	*Platycercus zonarius*	Australian Ringneck Parrot			X	X
Psittaculidae	*Purpureicephalus spurius*	Red-capped Parrot			X	X
Psittaculidae	*Platycercus icterotis*	Western Rosella			X	X
Psittaculidae	*Neophema elegans*	Elegant Parrot				X
Psittaculidae	*Polytelis anthopeplus*	Regent Parrot				X
Psittaculidae	*Parvipsitta porphyrocephala*	Purple-crowned Lorikeet			X	X
Rallidae	*Gallirallus philippensis*	Buff Banded Rail			X	
Rhipiduridae	*Rhipidura albiscapa*	Grey Fantail			X	X
Rhipiduridae	*Rhipidua leucophrys*	Willie wagtail			X	
Strigidae	*Tyto alba*	Eastern Barn Owl				X
Strigidae	*Ninox boobook*	Southern Boobook			X	X
Turnicidae	*Turnix varius*	Painted Button Quail				X
Zosteropidae.	*Zosterops lateralis*	Silvereye			X	X
Reptiles						
Agamidae	*Pogona minor*	Western Bearded Dragon				X
Boidae	*Morelia spilota*	Carpet Python			X	
Carphodactylidae	*Underwoodisaurus milii*	Barking Gecko			X	X
Elapidae	*Pseudonaja affinis*	Dugite snake			X	X
Elapidae	*Parasuta gouldii*	Gould's Hooded Snake			X	
Elapidae	*Suta nigriceps*	Mallee Black-backed Snake			X	X
Elapidae	*Notechis scutatus*	Tiger Snake				X
Elapidae	*Elapognathus coronatus*	Western Crowned snake				X

Family	Scientific Name	Species	EPBC listing	DBCA listing	Phase 1	Phase 2
Gekkonidae	*Christinus marmoratus*	Marbled Gecko				X
Pygopodidae	*Aprasia pulchella*	Pretty Worm-lizard				X
Pygopodidae	*Delma Fraseri*	Fraser's Delma				X
Scincidae	*Tiliqua rugosa*	Bobtail			X	X
Scincidae	*Menetia greyii*	Common Dwarf Skink				X
Scincidae	*Ctenotus labillardieri*	Common south-west Ctenotus			X	X
Scincidae	*Egernia napoleonis*	Napoleon Skink			X	X
Scincidae	*Morethia obscura*	Shrubland Skink			X	X
Scincidae	*Acritoscincus trilineatus*	South-western cool-skink				X
Scincidae	*Hemiergis initialis*	South-western earless skink			X	X
Scincidae	*Lerista distinguenda*	South-western Orange-tailed Slider			X	X
Typhlopidae	*Anilios australis*	Southern Blind Snake			X	X
Varanidae	*Varanus gouldii*	Gould's Monitor				X
Varanidae	*Varanus rosenbergi*	Rosenburg's Monitor			X	X
Amphibians						
Limnodynastidae	*Heleioporus eyrei*	Moaning Frog			X	X
Myobatrachidae	*Crinia pseudinsignifera*	Bleating Froglet			X	
Myobatrachidae	*Crinia georgiana*	Quacking Frog			X	X
Myobatrachidae	*Crinia glauerti*	Rattling Froglet			X	
Myobatrachidae	*Geocrinia leai*	Leas (ticking) frog			X	
Pelodryadidae	*Litoria Moorei*	Motorbike Frog				X
Pelodryadidae	*Litoria adelaidensis*	Slender Tree Frog			X	X

Phase 1 (July/August 2020): Species recorded during the trapping program including bat detection, bird acoustic, bird census, opportunistic observations, active searches and remote cameras

Family	Taxa	Common name	TL 1	TL2	TL3	TL4	TL5	TL6	TL7	TL8	TL9	Cage Trap	Other (eg. active search etc)	Bird acoustic	Bat acoustic	Camera	Total
Mammals																	
Canidae	*Vulpes vulpes*	Fox	0	0	0	0	0	0	0	0	0	0	2			0	**2**
Dasyuridae	*Sminthopsis gilberti*	Gilberts Dunnart	0	0	0	0	0	0	1	0	0	0	1			0	**2**
Dasyuridae	*Antechinus flavipes*	Mardo	1	12	0	0	9	0	0	2	0	4	0			362	**390**
Dasyuridae	*Dasyurus geoffroii*	Chuditch	0	0	0	0	0	0	0	0	0	26	0			64	**320**
Felidae	*Felis catus*	Domestic Cat	0	0	0	0	0	0	0	0	0	0	0			3	**3**
Leporidae	*Oryctolagus cuniculus*	European Rabbit	0	0	0	0	0	0	0	0	0	0	X			2	**2**
Macropodidae	*Notamacropus irma*	Western Brush Wallaby	0	0	0	0	0	0	0	1	0	0	16			12	**29**
Macropodidae	*Macropus fuliginosus*	Western Grey Kangaroo	1	0	1	0	1	1	0	1	0	0	8			22	**35**
Macropodidae	*Setonix brachyurus*	Quokka	0	0	0	0	0	0	0	0	0	0	4			21	**25**
Molossidae	*Austronomus australis*	White-striped Free-tailed Bat	0	0	0	0	0	0	0	0	0	0	0		1	0	**1**
Molossidae	*Ozimops kitcheneri*	South-western Free-tailed Bat	0	0	0	0	0	0	0	0	0	0	0		87	0	**87**
Muridae	*Rattus rattus*	Black Rat	0	0	0	0	0	0	0	0	0	0	0			19	**19**
Peramelidae	*Isoodon fusciventer*	Quenda	0	0	0	0	0	0	0	0	0	0	11			3	**14**
Phalangeridae	*Trichosurus vulpecula*	Common Brushtail Possum	0	0	0	0	0	0	0	1	0	0	2			0	**2**
Suidae	*Sus scrofa*	Feral Pig	0	0	0	0	1	1	0	0	0	0	0			0	**2**
Tachyglossidae	*Tachyglossus aculeatus*	Short-beaked Echidna	1	0	0	0	0	1	0	0	0	0	X			11	**12**
Vespertilionidae	*Chalinolobus gouldii*	Gould's Wattled Bat	0	0	0	0	0	0	0	0	0	0	0		15	0	**15**
Vespertilionidae	*Chalinolobus morio*	Chocolate Wattled Bat	0	0	0	0	0	0	0	0	0	0	0		42	0	**24**
Vespertilionidae	*Falsistrellus mackenziei*	Western False Pipistrelle	0	0	0	0	0	0	0	0	0	0	0		13	0	**13**
Vespertilionidae	*Vespadelus regulus*	Southern Forest Bat	0	0	0	0	0	0	0	0	0	0	0		35	0	**35**
Birds																	
Acanthizidae	*Acanthiza apicalis*	Inland Thornbill	0	0	0	5	0	4	0	4	0	0	0	X		0	13
Acanthizidae	*Sericornis maculatus*	Spotted Scrub-wren	0	0	0	0	0	0	0	0	0	0	0	4		0	4
Acanthizidae	*Smicrornis brevirostris*	Weebill	4	3	3	2	8	4	0	10	8	0	12			0	54
Acanthizidae	*Gerygone fusca*	Western Gerygone	0	0	2	1	0	0	1	0	0	0	3			0	7
Acanthizidae	*Acanthiza inornata*	Western Thornbill	3	0	0	0	5	0	0	1	2	0	8			4	23
Acanthizidae	*Sericornis frontalis*	White-browed Scrub-wren	0	1	1	1	2	4	2	0	2	0	6			6	25
Acanthizidae	*Acanthiza chrysorrhoa*	Yellow-rumped thornbill	0	0	0	0	0	0	0	0	0	0	6			0	6
Accipitridae	*Accipiter cirrocephalus*	Collared sparrow hawk	0	0	0	0	0	0	0	0	0	0	1			0	1
Aegothelidae	*Aegotheles cristatus*	Owlet Nightjar	0	0	0	0	0	0	0	0	0	0	2	1		1	**4**
Alcedinidae	*Dacelo novaeguineae*	Laughing Kookaburra	1	0	1	0	0	0	0	0	0	0	14	5		0	**21**

Family	Taxa	Common name	TL 1	TL2	TL3	TL4	TL5	TL6	TL7	TL8	TL9	Cage Trap	Other (eg. active search etc)	Bird acoustic	Bat acoustic	Camera	Total
Alcedinidae	*Todiramphus sanctus*	Sacred Kingfisher	0	0	1	0	0	0	0	0	0	0				0	**1**
Anatidae	*Cygnus atratus*	Black Swan	0	0	0	0	0	0	0	0	0	0	0	1		0	**1**
Anatidae	*Chenonetta jubata*	Australian Wood Duck	0	0	0	0	0	0	0	0	0	0	0	4		0	**4**
Anatidae	*Anas superciliosa*	Pacific Black Duck	0	0	0	0	0	0	0	0	0	0	1	1		0	**2**
Artamidae	*Cracticus torquatus*	Grey Butcherbird	1	1	0	0	0	0	0	0	0	0	0			0	**2**
Artamidae	*Cracticus nigrogularis*	Pied Butcherbird	0	0	0	0	0	0	0	0	0	0	1			0	**1**
Artamidae	*Strepera versicolor*	Grey Currawong	2	2	1	1	0	0	0	0	3	0	9	2		0	**20**
Artamidae	*Cracticus tibicen*	Magpie	2	2	0	0	0	0	0	0	0	0	2	1		0	**7**
Cacatuidae	*Calyptorhynchus baudinii*	Baudin’s Cockatoo	0	1	0	0	0	0	0	0	18	0	22			0	**41**
Cacatuidae	*Calyptorhynchus latirostris*	Carnaby's Cockatoo	2	0	0	0	0	0	0	0	0	0	10			0	**12**
Cacatuidae	*Calyptorhynchus banksii*	Forest Red-tailed Black Cockatoo	2	4	2	0	0	2	1	0	3	0	57	7		0	**78**
Casuariidae	*Dromaius novaehollandiae*	Emu	1	0	0	0	0	1	0	0	0	0	9			0	**11**
Climacteridae	*Climacteris rufus*	Rufous Tree Creeper	0	0	2	1	0	0	0	0	1	0	2			0	**6**
Columbidae	*Phaps chalcoptera*	Common Bronzewing		0	0	1	0	0	0	0	0		10			0	**11**
Corvidae	*Corvus coronoides*	Australian Raven	2	0	1	0	1	0	0	1	2	2	12	6		0	**27**
Cuculidae	*Cacomantis flabelliformis*	Fan-tailed Cuckoo	0	0	0	0	0	0	0	0	0	0	2	3		0	**5**
Cuculidae	*Chalcites basalis*	Horsfield's Bronze Cuckoo	0	0	0	0	0	0	0	0	0	0	0			1	**1**
Falconidae	*Falco longipennis*	Australian Hobby Falcon	0	0	0	0	0	0	0	0	0	0	1			0	**1**
Hirundinidae	*Petrochelidon ariel*	Fairy Martin	0	0	0	0	0	18	3	2	0		6			0	**29**
Hirundinidae	*Petrochelidon nigricans*	Tree Martin	0	0	0	0	0	0	0	0	0	0	6			0	**6**
Locustellidae	*Cincloramphus cruralis*	Brown Songlark	0	0	0	0	0	0	0	0	0	0	0			1	**1**
Maluridae	*Malurus pulcherrimus*	Blue-breasted Fairywren	0	0	0	0	0	0	0	0	0	0	0			7	**7**
Maluridae	*Malurus elegans*	Red-winged Fairywren	0	0	0	1	0	0	0	0	0	0	12	X		1	**14**
Maluridae	*Malurus splendens*	Splendid Fairywren	0	0	1	0	0	0	0	0	0	0	14			34	**49**
Maluridae	*Sericornis maculatus*	Spotted Scrub-wren	0	0	0	0	0	0	0	0	0	0	0	4		0	**4**
Meliphagidae	*Melithreptus brevirostris*	Brown headed honeyeater	0	0	0	0	0	2	0	1	1	0	0			0	**4**
Meliphagidae	*Phylidonyris novaehollandiae*	New Holland Honeyeater	0	0	0	0	0	0	0	0	0	0	4	4		0	**8**
Meliphagidae	*Anthochaera carunculata*	Red Wattlebird	1	0	0	0	0	0	0	0	1	0	0			0	**2**
Meliphagidae	*Anthochaera lunulata*	Western Wattlebird	0	0	0	0	0	0	0	0	0	0	0			1	**1**
Meliphagidae	*Acanthorhynchus superciliosus*	Western Spinebill	0	0	0	0	0	4	0	1	0	0	5	X		0	**10**
Meliphagidae	*Phylidonyris niger*	White cheeked honeyeater	0	0	0	0	0	0	0	0	0	0	1			0	**1**

Family	Taxa	Common name	TL 1	TL2	TL3	TL4	TL5	TL6	TL7	TL8	TL9	Cage Trap	Other (eg. active search etc)	Bird acoustic	Bat acoustic	Camera	Total
Meliphagidae	*Melithreptus lunatus*	White naped honeyeater	1	1	0	0	0	8	3	4	0	0	1			0	**18**
Meliphagidae	*Lichenostomus ornatus*	Yellow plumed honeyeater	0	0	0	0	0	0	0	0	0	0	1			0	**1**
Monarchidae	*Myiagra inquieta*	Restless Flycatcher	0	0	0	0	0	0	0	0	0	0	1			0	**1**
Neosittidae	*Daphoenositta chrysoptera*	Varied Sitella	0	0	0	0	0	0	0	0	0	0	26			0	**26**
Pachycephalidae	*Pachycephala pectoralis*	Golden Whistler	0	0	0	0	0	1	3	0	1	0	0			0	**5**
Pachycephalidae	*Colluricincla harmonica*	Grey Strike Thrush	1	1	1	0	4	1	0	2	0	0	4	X		0	**14**
Pachycephalidae	*Pachycephala rufiventris*	Rufous Whistler	1	0	0	0	0	0	0	1	0	0	5			0	**7**
Pachycephalidae	*Pachycephala occidentalis*	Western Golden Whistler	0	0	0	0	0	0	0	0	0	0		2		0	**2**
Pardalotidae	*Pardalotus punctatus*	Spotted Pardalote	1	0	0	0	0	0	2	2	0	0	1			0	**6**
Petroicidae	*Petroica boodang*	Scarlet Robin	0	0	1	1	0	1	1	0	1	0	7	3		0	**15**
Petroicidae	*Eopsaltria griseogularis*	Western Yellow Robin	0	1	0	0	0	4	0	0	0	0	7	2		0	**14**
Petroicidae	*Eopsaltria georgiana*	White-breasted Robin	1	0	0	0	0	0	0	1	0	0	1			74	**77**
Psittaculidae	*Glossopsitta porphyrocephala*	Purple crowned Lorikeet	0	2	0	0	0	0	0	0	0	0				0	**2**
Psittaculidae	*Platycercus zonarius*	Australian Ringneck Parrot	0	1	4	2	3		3	2	0	0	14	4		0	**33**
Psittaculidae	*Purpureicephalus spurius*	Red-capped Parrot	3	0	0	0	1	2	1	0	0	0	2			1	**10**
Psittaculidae	*Platycercus icterotis*	Western Rosella	0	0	0	0	0	0	0	0	2	0	4			0	**6**
Rallidae	*Gallirallus philippensis*	Buff Banded Rail	0	0	0	0	0	0	0	0	0	0	1			0	**1**
Rhipiduridae	*Rhipidura albiscapa*	Grey Fantail	0	1	1	0	4	4	2	1	2	0	11	2		1	**29**
Rhipiduridae	*Rhipidua leucophrys*	Willie Wagtail	0	0	0	0	0	0	0	0	0	0	3			0	**3**
Strigidae	*Ninox boobook*	Southern Boobook	0	0	0	0	0	0	0	0	2	0	1	3		0	**6**
Zosteropidae	*Zosterops lateralis*	Silvereye	0	0	1	0	0	8	0	4	0	0	6			0	**19**
Reptiles																	
Boidae	*Morelia spilota imbricata*	Carpet Python	0	0	0	0	0	0	0	0	0	0	X			0	**1**
Carphodactylidae	*Underwoodisaurus milii*	Barking Gecko	0	0	0	0	0	0	0	0	0	0	22			0	**22**
Elapidae	*Suta nigriceps*	Mallee Black backed snake	0	0	0	0	0	0	0	0	0	0	3				**3**
Elapidae	*Pseudonaja affinis*	Dugite snake	0	0	0	0	0	0	0	0	0	0	1			0	**1**
Elapidae	*Suta gouldii*	Gould's hooded snake	0	0	0	0	0	0	0	0	0	0	4			0	**4**
Scincidae	*Tiliqua rugosa*	Bobtail	0	0	0	0	0	0	0	0	0	0	0			30	**30**
Scincidae	*Ctenotus labillardieri*	Common south-west Ctenotus	0	0	0	0	0	0	0	0	0	0	1			0	**1**
Scincidae	*Morethia obscura*	Shrubland Skink	0	0	0	0	0	1	0	0	0	0	6			0	**7**
Scincidae	*Egernia Napoleonis*	South western crevice skink	0	0	0	0	0	0	0	0	0	0	0			2	**2**
Scincidae	*Hemiergis initialis*	Southwestern earless skink	3	0	1	1	0	2	0	0	0	0	8			0	**15**

Family	Taxa	Common name	TL 1	TL2	TL3	TL4	TL5	TL6	TL7	TL8	TL9	Cage Trap	Other (eg. active search etc)	Bird acoustic	Bat acoustic	Camera	Total
Scincidae	*Lerista distinguenda*	South-western Orange-tailed Slider	0	0	0	0	0	0	0	0	0	0	2			0	**2**
Typhlopidae	*Anilios australis*	Southern blind snake	1	0	0	0	0	0	0	0	0	0	0			0	**1**
Varanidae	*Varanus rosenbergi*	Rosenberg's Monitor	0	0	0	0	0	1	0	0	0	0	0			1	**2**
Amphibians																	
Limnodynastidae	*Heleioporus eyrei*	Moaning Frog	0	0	0	0	0		0	1	0	0	1			0	**2**
Myobatrachidae	*Crinia pseudinsignifera*	Bleating Froglet	0	0	0	0	0	0	0	0	0	0	27			0	**27**
Myobatrachidae	*Crinia georgiana*	Quacking Frog	0	0	0	0	0	3	1	1	0	0	19			0	**24**
Myobatrachidae	*Crinia glauerti*	Glauert's Froglet	0	0	0	0	0	0	0	0	0	0	1			0	**1**
Myobatrachidae	*Geocrinia leai*	Lea's (ticking) frog	0	0	0	0	0	0	0	0	0	0	5			0	**5**
Pelodryadidae	*Litoria adelaidensis*	Slender Tree Frog	0	0	0	0	0	1	0	0	0	0	1			0	**2**

*Note: numbers per trap line include animals physically captured in traps as well as those detected via active search, bird census or opportunistically at that trap site.

X – indicates the presence of a species detected either by signs (scat, tracks, feathers, etc.) as well as those detected on an acoustic recorder where number of individuals could not be determined however presence of species could be confirmed

Phase 2 (November/December 2020): Species recorded during the trapping program including bat detection, bird acoustic, bird census, opportunistic observations, active searches and remote cameras

Family	Taxa	Common name	TL 1	TL2	TL3	TL4	TL5	TL6	TL7	TL8	TL9	Cage Trap	Other (eg. active search etc)	Bird acoustic	Bat acoustic	Camera	Total
Mammals																	
Burramyidae	*Cercartetus concinnus*	Western Pygmy Possum	0	0	0	0	0	0	0	0	0	0	0	5			**5**
Canidae	*Vulpes vulpes*	Fox	0	0	0	0	0	0	0	0	0	0	0	2			**2**
Dasyuridae	*Sminthopsis gilberti*	Gilberts Dunnart	0	0	0	1	0	0	0	0	0	0	0	0			**1**
Dasyuridae	*Phascogale tapoatafa*	Brush-tailed Phascogale	0	0	0	1	0	0	0	0	0	0	0	2			**3**
Dasyuridae	*Antechinus flavipes*	Mardo	0	1	0	0	1	0	2	0	0	2	0	83			**89**
Dasyuridae	*Dasyurus geoffroii*	Chuditch	3	0	0	0	0	0	0	0	0	6	0	5			**14**
Felidae	*Felis catus*	Feral Cat	0	0	0	0	0	0	0	0	0	0	0	3			**3**
Leporidae	*Oryctolagus cuniculus*	European Rabbit	0	0	0	0	0	0	0	0	0	0	0	2			**2**
Macropodidae	*Notamacropus irma*	Western Brush Wallaby	0	0	0	0	0	0	0	0	0	0	9	36			**45**
Macropodidae	*Macropus fuliginosus*	Western Grey Kangaroo	0	0	0	0	0	0	0	0	0	0	9	16			**25**
Macropodidae	*Setonix brachyurus*	Quokka	0	0	0	0	0	0	0	0	0	0	1	7			**8**
Molossidae	*Austronomus australis*	White-striped Free-tailed Bat	0	0	0	0	0	0	0	0	0	0	4	0	16		**20**
Molossidae	*Ozimops kitcheneri*	South-western Free-tailed Bat													10		**10**
Suidae	*Sus scrofa*	Feral Pig	0	0	0	0	0	0	0	0	0	0	X	1			**1**
Vespertilionidae	*Chalinolobus gouldii*	Gould's Wattled Bat	0	0	0	0	0	0	0	0	0	0	0	0	6		**6**
Vespertilionidae	*Chalinolobus morio*	Chocolate Wattled Bat	0	0	0	0	0	0	0	0	0	0	0	0	14		**14**
Vespertilionidae	*Falsistrellus mackenziei*	Western False Pipistrelle	0	0	0	0	0	0	0	0	0	0	0	0	2		**2**
Vespertilionidae	*Vespadelus regulus*	Southern Forest Bat	0	0	0	0	0	0	0	0	0	0	2	0	18		**20**
Tachyglossidae	*Tachyglossus aculeatus*	Short-beaked Echidna	0	0	0	1	0	0	0	0	0	0		10			**11**
Birds																	
Acanthizidae	*Acanthiza apicalis*	Inland Thornbill	0	0	4	0	0	0	1	0	0	0		0			**5**
Acanthizidae	*Smicrornis brevirostris*	Weebill	1	0	0	0	3	3	3	7	0	0	2	0			**19**
Acanthizidae	*Gerygone fusca*	Western Gerygone	3	2	4	1	5	4	5	6	0	0	16	0			**46**
Acanthizidae	*Acanthiza inornata*	Western Thornbill	0	0	4	0	0	0	0	1	0	0	1	5			**11**
Acanthizidae	*Sericornis frontalis*	White-browed Scrub-wren	0	0	0	0	1	1	0	0	0	0	0	1			**3**
Accipitridae	*Accipiter cirrocephalus*	Collared sparrowhawk	0	0	0	0	0	0	0	0	0	0	1	0			**1**
Accipitridae	*Haliastur sphenurus*	Whistling Kite	0	1	0	0	0	0	0	0	0	0	0	0			**1**
Aegothelidae	*Aegotheles cristatus*	Australian Owlet Nightjar	0	0	0	0	0	0	0	0	0	0	0	0		1	**1**
Alcedinidae	*Dacelo novaeguineae*	Laughing Kookaburra	1	0	0	1	0	0	0	0	2	0	0	0		3	**7**
Artamidae	*Strepera versicolor*	Grey Currawong	0	0	0	1	3	0	0	0	1	0	0	1		2	**8**
Cacatuidae	*Calyptorhynchus baudinii*	Baudin's Cockatoo	0	2	0	0	0	0	0	0	0	0	35	0		1	**38**

Family	Taxa	Common name	TL 1	TL2	TL3	TL4	TL5	TL6	TL7	TL8	TL9	Cage Trap	Other (eg. active search etc)	Bird acoustic	Bat acoustic	Camera	Total
Cacatuidae	*Calyptorhynchus latirostris*	Carnaby's Cockatoo	0	0	0	0	0	0	0	0	3	0	4	0		1	**8**
Cacatuidae	*Calyptorhynchus banksii naso*	Forest Red-tailed Black Cockatoo	4	0	3	2	0	2	0	5	0	0	53	0		3	**72**
Campephagidae	*Coracina novaehollandiae*	Black-faced Cuckoo-shrike	0	0	0	0	1	1	1	0	0	0	0	0			**3**
Casuariidae	*Dromaius novaehollandiae*	Emu	1	0	0	3	2	1	0	0	0	0	2	1			**10**
Climacteridae	*Climacteris rufus*	Rufous Treecreeper	0	0	2	0	0	0	0	0	1	0	0	12			**15**
Columbidae	*Phaps chalcoptera*	Common Bronzewing	0	0	0	1	0	0	0	0	0	0	1	1			**3**
Corvidae	*Corvus coronoides*	Australian Raven	0	0	0	0	0	0	0	0	0	1	0	4			**5**
Cuculidae	*Chrysococcyx lucidus*	Shining Bronze-cuckoo	1	3	0	0	0	0	0	1	0	0	0	0			**5**
Cuculidae	*Chalcites basalis*	Horsfield's Bronze Cuckoo	0	1	0	0	0	0	0	0	0	0	0	0			**1**
Falconidae	*Falco peregrinus*	Peregrine Falcon	0	0	0	0	0	0	0	0	0	0	1	0			**1**
Hirundinidae	*Petrochelidon nigricans*	Tree Martin	0	3	5	0	0	0	0	1	0	0	6	0			**15**
Locustellidae	*Cincloramphus mathewsi*	Rufous Songlark	0	0	0	0	0	0	0	0	0	0	1	0			**1**
Maluridae	*Malurus pulcherrimus*	Blue breasted fairy wren	0	0	0	0	0	0	0	0	0	0	3	0			**3**
Maluridae	*Malurus elegans*	Red-winged Fairywren	0	0	0	0	0	0	0	0	0	0	2	0			**2**
Maluridae	*Malurus splendens*	Splendid Fairywren	0	0	0	0	0	0	0	1	0	0	0	5			**6**
Maluridae	*Malurus leucopterus*	White winged fairy wren	0	0	0	0	0	0	0	0	0	0	1	0			**1**
Meliphagidae	*Lichmera indistincta*	Brown Honeyeater	0	13	0	2	4	3	1	14	18	0	11	0		3	**69**
Meliphagidae	*Melithreptus brevirostris*	Brown-headed Honeyeater	0	0	0	0	0	2	0	0	0	0	0	0			**2**
Meliphagidae	*Phylidonyris novaehollandiae*	New Holland Honeyeater	0	2	0	0	0	0	0	0	0	0	5	0			**7**
Meliphagidae	*Anthochaera carunculata*	Red Wattlebird	12	8	1	1	1	0	2	0	20	0	5	0			**50**
Meliphagidae	*Anthochaera lunulata*	Western Wattlebird	0	7	6	1	0	2	2	6	0	0	4	0		1	**29**
Meliphagidae	*Acanthorhynchus superciliosus*	Western Spinebill	0	1	0	0	1	0	0	2	0	0	0	0			**4**
Meliphagidae	*Melithreptus lunatus*	White-napped Honeyeater	0	0	0	1	0	1	0	0	0	0	0	0			**2**
Meropidae	*Merops ornatus*	Rainbow Bee-eater	0	0	0	0	0	2	0	0	0	0	0	0			**2**
Monarchidae	*Grallina cyanoleuca*	Magpie-lark	0	2	0	0	0	0	0	0	0	0	0	0			**2**
Neosittidae	*Daphoenositta chrysoptera*	Varied Sitella	0	0	0	0	0	0	0	0	2	0	6	0			**8**
Pachycephalidae	*Pachycephala occidentalis*	Western Whistler	0	0	0	0	0	0	0	0	0	0	0	0		3	**3**
Pachycephalidae	*Pachycephala pectoralis*	Golden Whistler	1	0	0	0	2	0	1	0	0	0	9	1			**14**
Pachycephalidae	*Colluricincla harmonica*	Grey Shrike Thrush	0	2	1	0	1	0	0	1	0	0	0	1			**6**
Pachycephalidae	*Pachycephala rufiventris*	Rufous Whistler	0	0	0	0	0	0	0	0	0	0	2	0			**2**
Pardalotidae	*Pardalotus punctatus*	Spotted Pardalote	0	1	0	0	2	0	0	0	1	0	5	0			**9**
Hirundinidae	*Petrochelidon nigricans*	Tree Martin	0	3	5	0	0	0	0	1	0	0	6	0			**15**
Pardalotidae	*Pardalotus striatus*	Striated Pardalote	5	8	10	1	10	2	3	5	7	0	11	1			**63**
Petroicidae	*Eopsaltria georgiana*	White-breasted Robin	0	0	0	0	0	0	0	0	0	0	0	9			**9**

Family	Taxa	Common name	TL 1	TL2	TL3	TL4	TL5	TL6	TL7	TL8	TL9	Cage Trap	Other (eg. active search etc)	Bird acoustic	Bat acoustic	Camera	Total
Petroicidae	*Petroica boodang*	Scarlet Robin	0	0	0	0	0	2	0	0	0	0	2	0			**4**
Petroicidae	*Eopsaltria griseogularis*	Western Yellow Robin	0	1	0	0	0	0	0	0	0	0	2	1		1	**5**
Pomatostomidae	*Pomatostomus superciliosus*	White browed babbler	0	5	0	0	0	0	0	0	0	0	0	0			**5**
Psittaculidae	*Platycercus zonarius*	Australian Ringneck Parrot	0	5	1	2	0	0	2	2	7	0	3	0		2	**24**
Psittaculidae	*Neophema elegans*	Elegant Parrot	0	2	0	0	0	0	0	0	0	0	0	0			**2**
Psittaculidae	*Parvipsitta porphyrocephala*	Purple-crowned Lorikeet	0	4	0	0	0	4	4	1	0	0	2	0			**15**
Psittaculidae	*Purpureicephalus spurius*	Red-capped Parrot	0	3	1	0	1	0	0	1	2	0	3	0			**11**
Psittaculidae	*Polytelis anthopeplus*	Regent Parrot	0	1	0	0	0	0	0	0	0	0	0	0			**1**
Psittaculidae	*Platycercus icterotis*	Western Rosella	0	0	0	0	0	2	0	0	0	0	0	0			**2**
Rhipiduridae	*Rhipidura albiscapa*	Grey Fantail	2	2	2	1	1	4	5	0	1	0	5	0		2	**25**
Strigidae	*Tyto alba*	Eastern Barn Owl	0	0	0	0	0	0	0	0	0	0	2	0			**2**
Strigidae	*Ninox boobook*	Southern Boobook	0	0	0	0	0	0	0	0	0	0	6	0		3	**9**
Turnicidae	*Turnix varius*	Painted Button Quail	0	0	0	0	0	0	0	0	0	0	2	0			**2**
Zosteropidae	*Zosterops lateralis*	Silvereye	0	1	5	0	3	0	0	3	3	0	8	0			**23**
Reptiles																	
Agamidae	*Pogona minor*	Western Bearded Dragon	2	0	0	0	0	2	0	0	0	0	0	0			**4**
Carphodactylidae	*Underwoodisaurus milii*	Barking Gecko	0	0	0	0	0	0	0	0	0	0	12	0			**12**
Elapidae	*Pseudonaja affinis*	Dugite snake	0	0	0	0	0	0	0	0	0	0	0	1			**1**
Elapidae	*Notechis scutatus*	Tiger Snake	0	0	0	0	0	0	0	0	0	0	0	1			**1**
Elapidae	*Parasuta nigriceps*	Black-backed Snake	0	0	0	0	0	0	0	0	0	0	1	0			**1**
Elapidae	*Elapognathus coronatus*	Western Crowned snake	0	0	0	0	0	1	0	0	0	0	0	0			**1**
Gekkonidae	*Christinus marmoratus*	Marbled Gecko	1	0	0	0	0	3	0	0	0	0	0	0			**4**
Pygopodidae	*Aprasia pulchella*	Pretty Worm-lizard	3	0	0	2	3	4	2	1	0	0	0	0			**15**
Pygopodidae	*Delma Fraseri*	Fraser's Delma	0	0	0	0	0	0	0	1	0	0	0	0			**1**
Scincidae	*Tiliqua rugosa*	Bobtail	0	0	1	0	4	0	2	0	0	0	0	2			**9**
Scincidae	*Menetia greyii*	Common Dwarf Skink	3	3	3	2	1	1	1	0	2	0	4	0			**20**
Scincidae	*Ctenotus labillardieri*	Common south-west Ctenotus	1	0	0	1	1	0	0	0	0	0	0	0			**3**
Scincidae	*Egernia napoleonis*	Napoleon Skink	2	2	1	1	4	2	4	1	3	0	1	99			**120**
Scincidae	*Morethia obscura*	Shrubland Skink	2	3	5	3	5	9	6	2	9	0	0	1			**45**
Scincidae	*Acritoscincus trilineatus*	South western cool-skink	0	0	0	1	3	1	7	2	4	0	0	0			**18**
Scincidae	*Hemiergis initialis*	Southwestern earless skink	1	0	2	4	3	4	6	0	9	0	9	0			**38**
Scincidae	*Lerista distinguenda*	South-western Orange-tailed Slider	3	0	0	4	2	8	5	1	1	0	7	0			**31**
Typhlopidae	*Anilios australis*	Southern Blind Snake	1	0	0	0	0	1	0	2	0	0	0	0			**4**
Varanidae	*Varanus gouldii*	Gould's Monitor	0	0	0	0	0	0	0	0	0	0	3	0			**3**

Family	Taxa	Common name	TL 1	TL2	TL3	TL4	TL5	TL6	TL7	TL8	TL9	Cage Trap	Other (eg. active search etc)	Bird acoustic	Bat acoustic	Camera	Total
Varanidae	*Varanus rosenbergi*	Rosenburg's Monitor	0	0	0	0	0	1	0	0	0	3	0	24			**28**
Amphibians																	
Limnodynastidae	*Heleioporus eyrei*	Moaning Frog	0	0	0	0	1	1	0	10	4	0	10	0			**26**
Myobatrachidae	*Crinia georgiana*	Quacking Frog	0	0	0	0	0	0	4	0	0	0	0	0			**4**
Pelodryadidae	*Litoria Moorei*	Motorbike Frog	0	0	0	0	0	0	1	0	0	0	16	0			**17**
Pelodryadidae	*Litoria adelaidensis*	Slender Tree Frog	0	0	0	0	0	0	0	0	0	0	1	0			**1**

*Note: numbers per trap line include animals physically captured in traps as well as those detected via active search, bird census or opportunistically at that trap site.

X – indicates the presence of a species detected either by signs (scat, tracks, feathers, etc.) as well as those detected on an acoustic recorder where number of individuals could not be determined however presence of species could be confirmed

Trap line Habitat Assessment summary

Trap Line I.D	Location		Habitat type/structure	Veg condition	Aspect	Slope	Soil type	Soil colour	Drainage	Bare ground cover	Litter cover	Last fire	Disturbance
	Easting	Northing											
Trap Line 1	422196.3783	6374149.945	Jarrah marri forest	Very Good	-	Moderate	Loam	black	Good	<2%	31-70%	Recent (0 to 2 yr)	fire
Trap Line 2	422128.344	6376133.546	Jarrah marri forest	Very Good	South/ West	Gentle	Sandy Loam	orange	Good	<2%	>70%	Recent (0 to 2 yr)	fire, tracks
Trap Line 3	424323.2157	6378918.887	Jarrah marri forest	Very Good	North/ East	Gentle	Sandy Loam	orange	Good	<2%	>70%	Recent (0 to 2 yr)	fire
Trap Line 4	420760.5427	6378214.741	Jarrah marri forest over Sheoak,	Very Good	South/ West	Negligible	Sandy Loam	orange	Good	<2%	>70%	Moderate (3 to 5 yr)	fire
Trap Line 5	424452.4204	6385508.408	Open Blackbutt forest	Very Good	West	Negligible	Sandy Loam	yellow - orange	Seasonal wet	<2%	>70%	Moderate (3 to 5 yr)	fire
Trap Line 6	427453.7364	6386849.331	Open Blackbutt forest and scattered Marri over Melaleuca	Very Good	North/ East	Negligible	Clay	yellow - orange	Seasonal wet	2-10%	31-70%	Moderate (3 to 5 yr)	fire
Trap Line 7	423883.6381	6388643.537	Open Blackbutt forest and scattered Eucalyptus rudis	Excellent	West	Negligible	Clay	yellow - brown	Seasonal wet	11-30%	31-70%	Moderate (3 to 5 yr)	fire
Trap Line 8	425643.1928	6384023.226	Open Jarrah marri forest with Eucalyptus rudis	Excellent	-	Gentle	Clay	dark gold-brown	Seasonal wet	2-10%	>70%	Moderate (3 to 5 yr)	fire

Trap Line I.D	Location		Habitat type/structure	Veg condition	Aspect	Slope	Soil type	Soil colour	Drainage	Bare ground cover	Litter cover	Last fire	Disturbance
	Easting	Northing											
Trap Line 9	425713.347	6381117.7	Jarrah marri forest with, scattered Blackbutt	Excellent	-	Moderate	Sandy Loam	brown - orange	Good	2-10%	>70%	Moderate (3 to 5 yr)	old fire scarring

Results from bird acoustic analysis

Bird call analysis summary report

GHD conducted sampling for the Masked Owl (*Tyto novaehollandiae*) at Holyoake from late-July to early-August 2020 (Phase 1) and late November to early December 2020 (Phase 2). Song Meter 4 (Wildlife Acoustics, MA, USA) acoustic recorders were deployed at 9 sites for Phase 1 and 3 sites for Phase 2, and recorded a combined total of 54 nights in the Survey Area (see Table 9). Files were provided in WAV format (1,428 files; 239.3 GB). Each recorder was programmed to record continuously from sunset to sunrise (approximately 10-14 hours per night).

The analysis was undertaken using the software Kaleidoscope Pro v 5.2.1, targeting the frequency range of 500 – 3500 Hz for which the peak frequencies of typical calls (i.e. screech and chatter) of the Masked Owl are distributed within (Kavanagh 1997; Todd *et al*. 2018). Searching for calls over a large frequency range such as this is likely to produce a high number of false-positive results due to other bird species calling at similar frequencies. However, it is a necessary procedure in order to capture Masked Owls vocalisations, particularly faint screeches and chatter calls in general.

Potential calls detected during the analysis were compared against reference calls of Masked Owls from the south-west of WA, including several screech and chatter call examples recorded by N. Jackett in the vicinity of Jarrahdale (i.e. close to the Survey Area).

Kaleidoscope Pro detection accuracy was assessed by comparing the number of Kaleidoscope detections with manually detected calls, from the subset of sound files containing Kaleidoscope detections. 128 Masked Owl screech calls were manually detected from the subset of sound files, of which 111 (86.7%) were automatically detected by Kaleidoscope Pro. Using Kaleidoscope Pro, calls not detected were typically faint (i.e. likely distant from the acoustic recorder), or occurred during light rain, or wind gusts. The probability of non-detection of a true-positive screech call was 13.3%; two consecutive true-positive screech calls was 1.8%; etc. Of the data tested, the median number of consecutive (spaced at <10 minutes apart) calls in a screech sequence when Masked Owls were recorded was 5 (1–21, n=18). The probability of at least one screech call being detected within a sequence of median length was >99.9%. Based on previous analyses of datasets containing Masked Owl vocalisations, the probability of at least one screech call being detected within a sequence of median length is >99.9%.

Combined Phase Bird Acoustics Locations

Object ID	Acoustic	Easting	Northing	Start Date	End date	Total nights
Phase 1						
78	SM4AC2	427659.4957	6384774.97	29/07/2020	02/08/2020	**4**
79	SM4AC1	422989.2	6374878	30/07/2020	02/08/2020	**3**
81	SM4AC3	425118.4	6375292	30/07/2020	03/08/2020	**4**
95	SM4AC4	419843	6379645	31/07/2020	05/08/2020	**5**
119	SM4AC1	421415.1	6374163	02/08/2020	06/08/2020	**4**
132	SM4AC3	423027.7	6381197	03/08/2020	05/08/2020	**2**
160/185	SM4AC2	423881.5	6388723	02/08/2020	04/08/2020	**2**
184	SM4AC2	424201.3787	6390031.804	04/08/2020	07/08/2020	**3**
Total Phase 1						**29**
Phase 2						
S4A01000	SM4AC1	427137	6384987	24/11/2020	03/12/2020	**3**
		425878	6382538	27/11/2020	30/11/2020	**3**
		428188	6377722	30/11/2020	3/12/2020	**3**
S4A02000	SM4AC2	424253	6388731	24/11/2020	27/11/2020	**3**
		421402	6379081	27/11/2020	30/11/2020	**3**

		422373	6373299	30/11/2020	03/12/2020	**3**
S4A030	SM4AC3	426752	6380334	264/11/2020	03/12/2020	**4**
		419437	6380444	30/11/2020	3/12/2020	**3**
Total Phase 2						**25**
Phase 1 and Phase 2 Combined Total						**54**

Results Summary report

A total of 37,325 Kaleidoscope detections were manually assessed (across Myara North and Holyoake Survey Areas) for Masked Owl vocalisations, and as expected, a high percentage (>99.6% of all detections in this analysis) were false positives. The Masked Owl was not recorded at Holyoake during the Phase 1 or Phase 2 survey periods.

The quality of all recordings during was considered good, with minimal noise interference. Light rain interference occurred on the nights of the 30 July and 2–4 August at Holyoake affecting most sites for short periods each night. Background frog noise at SM4AC2 (OBJECT ID 78) broadly interfered with the target frequency (~2000 Hz), potentially obscuring Masked Owl screech calls.

Non-target bird species were detected across all nights (21 species during Phase 1 and 13 species during Phase 2. The frequency range and call duration of many of the non-target bird species (e.g. Red-tailed Black-Cockatoo) detected overlaps with the calls of the Masked Owl. It can therefore be expected that Masked Owl vocalisations would have been detected during the analysis had they occurred within a reasonable distance of a unit.

Bird species detected during the Phase 1 Acoustic analysis

Species Name	Object ID 78 (SM4AC2)	Object ID 79 (SM4AC1)	Object ID 81 (SM4AC3)	Object ID 95 (SM4AC4)	Object ID 119 (SM4AC1)	Object ID 132 (SM4AC3)	Object ID 160/185 (SM4AC2)	Object ID 184 (SM4AC2)	Object ID 191 (SM4AC3)
Black Swan (*Cygnus atratus*)				X					
Pacific Black Duck (*Anas superciliosa*)	X								
Australian Wood Duck (*Chenonetta jubata*)	X	X	X	X			X		
Fan tailed Cuckoo (*Cacomantis flabelliformis*)		X	X			X			
Owlet Night jar (*Aegotheles cristatus*)				X					
Southern Boobook (*Ninox boobook*)	X	X	X						
Laughing Kookaburra (*Dacelo novaeguineae*)		X	X	X					
Red tailed Black Cockatoo (*Calyptorhynchus banksia*)	X		X	X		X	X	X	X
Australian ringneck (*Barnardius zonarius*)		X				X			
New holland honeyeater (Phylidonyris novaehollandiae)	X			X	X		X		
Western Spinebill (*Acanthorhynchus superciliosus*)					X				
Spotted scrub-wren (*Sericornis maculatus*)		X	X	X		X			
Inland thornbill (*Acanthiza apicalis*)								X	
Australian magpie (*Cracticus tibicen*)		X							
Grey currawong (*Strepera versicolor*)		X		X					
Grey shrike thrush (*Colluricincla harmonica*)					X				
Western whistler (*Pachycephala fuliginosa*)			X				X		
Scarlet Robin (*Petroica boodang*)		X	X			X			
Western yellow robin (*Eopsaltria griseogularis*)			X					X	
Grey Fantail (*Rhipidura albiscapa*)			X	X					
Australian Raven (*Corvus coronoides*)		X	X	X	X	X	X		

Bird species detected during the Phase 2 Acoustic analysis

Species Name	SM4AC1	SM4AC2	SM4AC3
Owlet Night jar (*Aegotheles cristatus*)			X
Southern Boobook (*Ninox boobook*)	X	X	X
Laughing Kookaburra (*Dacelo novaeguineae*)	X	X	X
Red tailed Black Cockatoo (*Calyptorhynchus banksiI naso*)	X	X	X
Carnaby's Black Cockatoo (*Calyptorhynchus latirostris*)	X		
Baudin's Black Cockatoo (*Calyptorhynchus baudinii*)	X		
Australian ringneck (*Barnardius zonarius*)	X	X	
Western Wattlebird (*Anthochaera lunulate*)	X		
Brown Honeyeater (*Lichmera indistincta*)	X	X	X
Grey currawong (*Strepera versicolor*)	X	X	
Western whistler (*Pachycephala fuliginosa*)	X	X	X
Western yellow robin (*Eopsaltria griseogularis*)			X
Grey Fantail (*Rhipidura albiscapa*)	X		

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Results from bat acoustic analysis

Bat call analysis summary report

Call identification was assisted by consulting distribution information for potential species (Armstrong 2011; Churchill 2008; Van Dyck *et al*. 2013) and records from NatureMap (2020). No reference calls were collected during the survey.

Data was processed and analysed using a combination of manual review and automated processes using Kaleidoscope Pro (Wildlife Acoustic, version 5.3.6) and Anabat Insight (Titley Scientific, version 1.9.2) using the following process:

Files were downloaded from the units and saved to an external hard drive (back up copy) following the survey for later processing and analysis

For compressed .wav4 and .wac files (full spectrum) collected using the Song Meter units, files were converted to standard .wav using the conversion function in Kaleidoscope Pro

For each night data was manually reviewed for bat calls using Kaleidoscope Pro or Anabat Insight from sunset onwards for approximately 30 minutes by visually comparing the time-frequency graph and call characteristics (e.g. peak frequency, characteristic frequency and call shape) with species call descriptions from published guidelines (e.g. Webala *et al*. 2010, Burgar *et al* various dates)

Data was then processed using Wildlife Acoustic Kaleidoscope Pro signal parameter batch processing, then cluster analysis features

Data from the cluster analysis process was then labelled and reviewed against the data labelled during step 3 for validation purposes to accurately identify species.

A call (pass) was defined as a sequence of three or more consecutive pulses of similar frequency. Calls with less than three defined consecutive pulses of similar frequency and shape were not unambiguously identified to a species but may be used as part of the activity count for the Survey Area. Due to variability in the quality of calls and the difficulty in distinguishing some species the identification of each call was assigned a confidence rating (see Mills *et al*. 1996 & Duffy *et al*. 2000) during the manual validation process as summarised in the table below.

Confidence rating applied to calls

Identification	Description
D - Definite	Species identification not in doubt.
PR - Probable	Call most likely to represent a particular species, but there exists a low probability of confusion with species of similar call type or call lacks sufficient detail.
SG - Species Group	Call made by one of two or more species. Call characteristics overlap, particularly poor quality calls or mixed species calls making it difficult to distinguish between species.

Bat detector effort and site location

Bat detector site	Phase	Detector name	Start Date	End Date	Easting	Northing	Location details
1	1	SM4-5	27/07/2020	30/07/2020	422243	6374171	Upland Jarrah forest at Trap line 1
2		SM4-2	29/07/2020	2/08/2020	421808	6380111	Nil information recorded
3		SM4 -4	29/07/2020	2/08/2020	427638	6384707	Set near drainage line
4		SM4-1	29/07/2020	3/08/2020	425823	6380993	Set on water point in low lying area
5		SM4- 5	30/07/2020	2/08/2020	426503	6377504	Nil information
6		SM4-6	30/07/2020	3/08/2020	424200	6378933	Upland Jarrah, Marri, fly away track
7		SM4 -4	31/07/2020	5/08/2020	419843	6379645	Old growth forest
8		SM4-4	2/08/2020	4/08/2020	423907	6388713	Nil information recorded
9		SM4- 2	2/08/2020	6/08/2020	420832	6377826	Nil information recorded
10		SM4-6	3/08/2020	5/08/2020	420280	6382210	Upland Jarrah forest, adjacent major track/flyaway
11		SM4-1	3/08/2020	6/08/2020	425632	6388557	Nil information recorded
12		SM4-5	3/08/2020	7/08/2020	418463	6387128	Nil information recorded
13		SM4-4	4/08/2020	7/08/2020	424214	6390035	Nil information recorded
14		SM4-6	5/08/2020	7/08/2020	427713	6386759	Set in drainage line, clearing/flyaway.
15	2	SM4-1	24/11/2020	27/11/2020	427141	6384977	Nil information recorded
16		SM4 -2	24/11/2020	27/11/2020	424275	6388710	Nil information recorded
17		SM4-1	27/11/2020	30/11/2020	421400	6379082	Nil information recorded
18		SM4-2	27/11/2020	30/11/2020	425876	6382537	Nil information recorded
19		SM4-1	30/11/2020	3/12/2020	422367	6373299	Nil information recorded
20		SM4-2	30/11/2020	3/12/2020	428187	6377721	Nil information recorded

Results

Approximately 90,351 full spectrum .wav files were analysed (all sights and all nights combined). At least seven species were positively (Definite) identified of the 10 or so species that are known to occur from the locality of the Study Area. As many as two other species may also have been recorded, but poor data quality and/or interspecific call similarities precluded reliable identification of additional species. Table 3 and 4 provides a list of definite and probable species recorded for each night. No threatened species listed under the Biodiversity Conservation Act 2016 and Environment Protection and Biodiversity Conservation Act 1999 were recorded (Definite) as a result of call analysis

Holyoake Phase 2 bat call analysis results per site

Site / date	**White-striped Free-tailed Bat *Austronomus australis***	**South-Western Free-tailed Bat *Ozimops kitcheneri***	**Gould's Wattled Bat Chalinolobus gouldii**	**C. gouldii/ F. mackenzie**	**Western False Pipistrelle *Falsistrellus mackenziei***	**Southern Forest Bat *Vespadelus regulus***	**Chocolate Wattled Bat *Chalinolobus morio***	**Long-eared Bat sp. Nyctophilus geoffroyi/gouldi/major**
SM4-1								
24-25/11/2020	D	D	PR	SG	D	D	D	SG
25-26/11/2020	D		PR	SG		D	D	SG
26-27/11/2020	D					D	D	
27-28/11/2020	D				PR	D	D	SG
28-29/11/2020	D				PR	D	D	SG
29-30/11/2020	D	D				D	D	SG
30/11-1/12/2020	D	D				D	D	
1-2/12/2020	D					D	D	
2-3/12/2020	D			SG		D	D	
SM4-2								
24-25/11/2020	D	D	D	SG		D	D	
25-26/11/2020	D	D	D	SG	PR	D	D	
26-27/11/2020	D	D	D	SG		D		
27-28/11/2020	D	D		SG		D		
28-29/11/2020	D	D	D	SG	D	D		

Site / date	White-striped Free-tailed Bat *Austronomus australis*	South-Western Free-tailed Bat *Ozimops kitcheneri*	Gould's Wattled Bat Chalinolobus gouldii	C. gouldii/ F. mackenzie	Western False Pipistrelle *Falsistrellus mackenziei*	Southern Forest Bat *Vespadelus regulus*	Chocolate Wattled Bat *Chalinolobus morio*	Long-eared Bat sp. Nyctophilus geoffroyi/gouldi/major
29-30/11/2020	D	D				D		SG
30/11-1/12/2020	D				PR	D	D	
1-2/12/2020			D			D	D	
2-3/12/2020		D	D	SG		D	D	

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Carter's Freshwater Mussel Plot Assessments

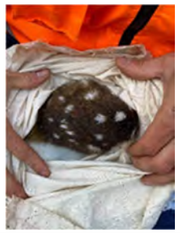
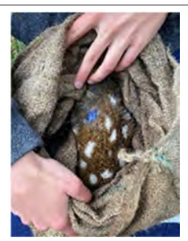
Holyoake Carter's Freshwater Mussel													Suitability
Plot	Date	Easting	Northing	type	size (wdth)	bank (hght)	substrate (type)	vegetation (Broad type)	TsFire (yrs)	water present/ size (cm)	condition	Mussel evidence	Rakali evidence
CFM1													
1	3/08/2020	421107.8669	6383127.615	creek	3m	1m	Sandy clay/rock substrate	Swamp reeds	>5 yr	Yes full pool	Excellent	yes numerous shells	Nil
2	3/08/2020	421128.7124	6383141.614	creek	3m	1m	Sandy clay/rock substrate	Swamp reeds	>5 yr	Yes full pool	Excellent		
3	3/08/2020	421060.0645	6383137.363	creek	3m	1m	Sandy clay/rock substrate	Swamp reeds	>5 yr	Yes full pool	Excellent		
CFM2													
1	25/11/2020	425865.9963	6383989.983	creek	2m	1m	Sandy clay	Riparian vegetation of Rudis over mixed shrubs	>5 yr	dry	Excellent	Nil Western grey kangaroo and pig evidence	Not suitable, too seasonal
2	25/11/2020	425900.7543	6384001.641	creek	2m	1m	Sandy clay	Riparian vegetation of Rudis over mixed shrubs	>5 yr	dry	Excellent	Nil No water	Not suitable, too seasonal
3	25/11/2020	425920.936	6384013.033	creek	2m	1m	Sandy clay	Riparian vegetation of Rudis over mixed shrubs	>5 yr	Small puddle 1m x 1m x 10cm	Excellent	Nil Tadpoles, C. Georgiana,, water plant	Not suitable, too seasonal Crayfish burrows and small school of Galacticus
4	25/11/2020	425935.5693	6384040.491	creek	2m	1m	mud	Riparian vegetation of Rudis over mixed shrubs	>5 yr	dry, damp	Excellent	Nil Water plant, western grey kangaroo evidence	Not suitable, too seasonal
5	25/11/2020	425959.268	6384061.264	creek	2m	1m	mud	Riparian vegetation of Rudis over mixed shrubs	>5 yr	dry, damp	Excellent	Nil Water plant, western grey kangaroo evidence	Not suitable, too seasonal
6	25/11/2020	425857.9512	6383974.936	creek	2m	1m	Sandy clay	Riparian vegetation of Rudis over mixed shrubs	>5 yr	dry	Excellent	Nil Water plant, western grey kangaroo evidence	Not suitable, too seasonal
7	25/11/2020	425835.1751	6383959.073	creek	2m	1m	Sandy clay	Riparian vegetation of Rudis over mixed shrubs	>5 yr	dry	Excellent	Nil Water plant, western grey kangaroo evidence	Not suitable, too seasonal
8	25/11/2020	425815.5559	6383953.085	creek	2m	1m	Sandy clay	Riparian vegetation of Rudis over mixed shrubs	>5 yr	dry	Excellent	Nil Water plant, western grey kangaroo evidence	Not suitable, too seasonal
9	25/11/2020	425796.2449	6383938.907	creek	2m	1m	Sandy clay	Riparian vegetation of Rudis over mixed shrubs	>5 yr	dry	Excellent	Nil Water plant, western grey kangaroo evidence	Not suitable, too seasonal
10	25/11/2020	425771.0639	6383917.239	creek	2m	1m	Sandy clay	Riparian vegetation of Rudis over mixed shrubs	>5 yr	dry	Excellent	Nil Water plant, western grey kangaroo evidence	Not suitable, too seasonal
CFM3													
1	25/11/2020	423282.1333	6386913.116	No creek	-	-	-	Riparian vegetation of Rudis over mixed shrubs	3-5y	dry	-	Not suitable, no creek present. Damp land and headwater to creek south seasonally inundated but not suitable for CFM or rakali	
CFM4													

Holyoake Carter's Freshwater Mussel													Suitability
Plot	Date	Easting	Northing	type	size	bank	substrate	vegetation	TsFire	water present/ size	condition	Mussel evidence	Rakali evidence
					(wdth)	(hght)	(type)	(Broad type)	(yrs)	(cm)			
1	25/11/2020	423797.2238	6380448.43	creek	2.5m	0.5m	Rock stony	Low mixed shrubs over Marri/Jarrah/Flooded gum	3-5y	dry	Excellent	Nil	Not suitable, too seasonal
2	25/11/2020	423805.4	6380429.688	creek	2.5m	0.5m	Rock stony	Low mixed shrubs over Marri/Jarrah/Flooded gum	3-5y	dry	Excellent	Nil	Not suitable, too seasonal
3	25/11/2020	423817.482	6380421.29	creek	2.5m	0.5m	Rock stony	Low mixed shrubs over Marri/Jarrah/Flooded gum	3-5y	dry	Excellent	Nil	Not suitable, too seasonal
4	25/11/2020	423823.9283	6380404.464	creek	2.5m	0.5m	Rock stony	Low mixed shrubs over Marri/Jarrah/Flooded gum	3-5y	dry	Excellent	Nil	Not suitable, too seasonal
5	25/11/2020	423835.1814	6380385.783	creek	2.5m	0.5m	Rock stony	Low mixed shrubs over Marri/Jarrah/Flooded gum	3-5y	dry	Excellent	Nil	Not suitable, too seasonal
6	25/11/2020	423762.7926	6380465.526	creek	2.5m	0.5m	Rock stony	Low mixed shrubs over Marri/Jarrah/Flooded gum	3-5y	dry	Excellent	Nil	Not suitable, too seasonal
7	25/11/2020	423733.3668	6380489.092	creek	3m	1m	sand/rock/ stony	Low mixed shrubs over Marri/Jarrah/Flooded gum	3-5y	damp	Signs of erosion	Nil	Not suitable, too seasonal
8	25/11/2020	423719.2705	6380524.633	creek	3m	0.5m	sand/rock/ stony	Low mixed shrubs over Marri/Jarrah/Flooded gum	3-5y	dry	Good	Nil	Not suitable, too seasonal
9	25/11/2020	423701.2951	6380559.183	creek	3m	0.5m	sand/rock/ stony	Low mixed shrubs over Marri/Jarrah/Flooded gum	3-5y	dry	Good	Nil	Not suitable, too seasonal
10	25/11/2020	423680.9066	6380582.451	creek	3m	0.5m	sand/rock/ stony	Low mixed shrubs over Marri/Jarrah/Flooded gum	3-5y	dry	Good	Nil	Not suitable, too seasonal
11	25/11/2020	423798.0068	6380452.864	creek	3m	0.5m	sand/rock/ stony	Low mixed shrubs over Marri/Jarrah/Flooded gum	3-5y	dry	Good	Nil	Not suitable, too seasonal
CFM5													
1	25/11/2020	418227.8373	6377815.62	creek	2m	0.5m	clay	regrowth of dense mixed shrub/no bare ground	>5yr	Dry/damp	Excellent	Nil	Not suitable, too seasonal
2	25/11/2020	418227.8373	6377815.62	creek	2m	0.5m	clay	regrowth of dense mixed shrub/no bare ground	>5yr	Dry/damp	Excellent	Nil	Not suitable, too seasonal
3	25/11/2020	418214.4623	6377797.999	creek	2m	0.5m	clay	regrowth of dense mixed shrub/no bare ground	>5yr	Dry/damp	Excellent	Nil	Not suitable, too seasonal
4	25/11/2020	418207.7526	6377774.55	creek	3m	0.5m	clay	regrowth mixed shrub, logs, leaf litter	>5yr	Dry/damp	Excellent	Nil	Not suitable, too seasonal

Holyoake Carter's Freshwater Mussel													Suitability
Plot	Date	Easting	Northing	type	size	bank	substrate	vegetation	TsFire	water present/ size	condition	Mussel evidence	Rakali evidence
					(wdth)	(hght)	(type)	(Broad type)	(yrs)	(cm)			
5	25/11/2020	418178.3184	6377746.675	creek	3m	0.5m	clay	regrowth mixed shrub, logs, leaf litter	>5yr	Dry/damp	Excellent	Nil	Not suitable, too seasonal
6	25/11/2020	418170.2025	6377731.08	creek	3m	0.5m	clay	regrowth mixed shrub, logs, leaf litter	>5yr	Dry/damp	Excellent	Nil	Not suitable, too seasonal
7	25/11/2020	418203.5678	6377651.109	creek	3m	0.5m	clay	regrowth mixed shrub, logs, leaf litter. Granite rockface on edge of bed.	>5yr	Dry	Excellent	Nil	Not suitable, too seasonal
8	25/11/2020	418194.3568	6377605.376	creek	3m	0.5m	clay	regrowth mixed shrub, logs, leaf litter. Granite rockface on edge of bed.	>5yr	Dry	Excellent	Nil	Not suitable, too seasonal
CFM6													
1	25/11/2020	423030.941	6386487.24	creek	5m	1m	sand	Riparian vegetation of rudis over mixed shrubs	>5 yr	Dry	Excellent	Nil	Not suitable, too seasonal (potential dampland)
2	25/11/2020	423033.5268	6386529.123	creek	5m	1m	sand	Riparian vegetation of rudis over mixed shrubs	>5 yr	Dry	Excellent	Nil	Not suitable, too seasonal (potential dampland)
3	25/11/2020	423062.8768	6386564.616	creek	3m	1m	Sandy clay (damp)	Riparian vegetation of rudis over mixed shrubs	>5 yr	Dry	Excellent	Nil Western Grey kangaroo and pig evidence	Not suitable, too seasonal (potential dampland)
4	25/11/2020	423082.5865	6386607.248	creek	3m	1m	Sandy clay (damp)	Riparian vegetation of rudis over mixed shrubs	>5 yr	Dry	Excellent	Nil Western Grey kangaroo and pig evidence	Not suitable, too seasonal (potential dampland)
5	25/11/2020	423099.5862	6386658.322	creek	3m	1m	Sandy clay (damp)	Riparian vegetation of rudis over mixed shrubs	>5 yr	Dry	Excellent	Western Grey kangaroo and pig evidence	Not suitable, too seasonal (potential dampland)
CFM7													
1	25/11/2020	427625.8994	6384677.106	Small pond/dam	3m	1.5m	Sandy clay	Rudis flooded gum over tea tree thicket with reeds	>5 yr	Water 30 m x 10m x 2m deep	Excellent	Nil	Not suitable, too seasonal
2	25/11/2020	427613.3965	6384668.225	Small pond/dam	3m	1.5m	Sandy clay	Rudis flooded gum over tea tree thicket with reeds	>5 yr	Water 30 m x 10m x 2m deep	Excellent	Nil	Not suitable, too seasonal
3	25/11/2020	427634.7296	6384692.017	Small pond/dam	3m	1.5m	Sandy clay	Rudis flooded gum over tea tree thicket with reeds	>5 yr	Water 30 m x 10m x 2m deep	Excellent	Nil	Not suitable, too seasonal
4	25/11/2020	427639.413	6384712.678	Small pond/dam	3m	1.5m	Sandy clay	Rudis flooded gum over tea tree thicket with reeds	>5 yr	Water 30 m x 10m x 2m deep	Excellent	Nil	Not suitable, too seasonal
5	25/11/2020	427650.5621	6384734.652	Small pond/dam	3m	1.5m	Sandy clay	Dense tea tree thicket	>5 yr	Water 30 m x 10m x 2m deep	Excellent	Nil	Not suitable, too seasonal
6	25/11/2020	427656.2923	6384756.788	Small pond/dam	3m	1.5m	Sandy clay	Rudis flooded gum over tea tree thicket with reeds	>5 yr	Water 30 m x 10m x 2m deep	Excellent	Nil	Not suitable, too seasonal
7	25/11/2020	427671.093	6384773.936	Small pond/dam	3m	1.5m	Sandy clay	Rudis flooded gum over tea tree thicket with reeds	>5 yr	Water 30 m x 10m x 2m deep	Excellent	Nil	Not suitable, too seasonal

Holyoake Carter's Freshwater Mussel													Suitability
Plot	Date	Easting	Northing	type	size	bank	substrate	vegetation	TsFire	water present/ size	condition	Mussel evidence	Rakali evidence
					(wdth)	(hght)	(type)	(Broad type)	(yrs)	(cm)			
8	25/11/2020	427672.8405	6384787.881	drainage line	3m	1.5m	Clay	sparse rudis flooded gum over tea tree thicket	>5 yr	damp	Excellent	Nil	Not suitable, too seasonal
9	25/11/2020	427677.2371	6384813.615	drainage line	3m	1.5m	Clay	sparse rudis flooded gum over tea tree thicket	>5 yr	damp	Excellent	Nil	Not suitable, too seasonal
10	25/11/2020	427687.9303	6384826.839	drainage line	3m	1.5m	Clay	sparse rudis flooded gum over tea tree thicket	>5 yr	damp	Excellent	Nil	Not suitable, too seasonal
11	25/11/2020	427693.0339	6384855.077	drainage line	3m	1.5m	Clay	sparse rudis flooded gum over tea tree thicket	>5 yr	damp	Excellent	Nil	Not suitable, too seasonal
12	25/11/2020	427695.5673	6384885.52	drainage line	3m	1.5m	Clay	sparse rudis flooded gum over tea tree thicket	>5 yr	damp	Excellent	Nil	Potential Rakali feeding residue -yabby remains
13	25/11/2020	427710.8041	6384923.11	drainage line	3m	1.5m	Clay	sparse rudis flooded gum over tea tree thicket	>5 yr	damp	Excellent	Nil	Not suitable, too seasonal
14	25/11/2020	427714.3448	6384948.269	drainage line	3m	1.5m	Clay	sparse rudis flooded gum over tea tree thicket	>5 yr	damp	Excellent	Nil	Not suitable, too seasonal
15	25/11/2020	427723.9119	6384965.906	drainage line	3m	1.5m	Clay	sparse rudis flooded gum over tea tree thicket	>5 yr	damp	Excellent	Nil	Not suitable, too seasonal

Chuditch Cage Capture (Dasyurus geoffroii) Physical Assessment data

Chuditch ID	Cage trap ID	Eastings	Northings	Date	ID marks	Gender	Weight (approx grams)	Image of spot pattern	Reproductive status	Physical conditions	Index Score (1-3)
Chuditch 1	Cage 7	421987	6374866	29/07/2020	Small red mark centre of back	F	615		Six young in pouch (15mm long)	Appears healthy	2
Chuditch 2	Cage 2	422076	6375050	29/07/2020	Red dot on off- side flank	F	910		Four pouch young (15mm long)	Appears healthy	3
	Cage 4	421958	6374756	30/07/2020	Recapture of Chuditch 2						
Chuditch 3	Cage 5	421829	6374594	29/07/2020	Small red mark centre right	F	615		Six pouch young (15mm long)	Appears healthy	2
Chuditch 4	Cage 5	421889	6374679	30/07/2020	Red dot on rear near side of back	F	615		Six pouch young (15mm long)	Appears healthy	2
	Cage 5	421889	6374679	31/07/2020	Recapture of Chuditch 4						
Chuditch 5	Cage 45	420802	6378239	3/08/2020	Blue dot centre of shoulder blades	F	600		Four pouch young (10mm long)	Scratch on nose and tail	2
Chuditch 6	Cage 68	421822	6373467	4/08/2020	Blue dot large centre off side closer to tail end	M	700		N/A	Appears healthy	2
Chuditch 7	Cage 47	421490	6380641	6/08/2020	Black dot centre of back	M	600		N/A	Appears healthy - young	2

Chuditch 8	TL1 cage	422174	6374151	23/11/2020	Black spot on shoulder blade on off side	F	600		Two teats	Appears healthy	3
		422223	6374159	26/11/2020	Recapture of Chuditch 8						
Chuditch 9	Cage 4	421952	6374696	26/11/2020	Blue spot on top of rump on near side	M	600		N/A	Small, appears healthy	3
Chuditch 10	TL1 cage	422113	6374994	1/12/2020	Two black dots on top of back	F	700		Lactating (cage closed)	Scab on back of neck	3
Chuditch 11	Cage 2	422144	6374957	30/11/2020	Small black dot on rear spot	F	600		Immature, not lactating	Appears healthy	3
Chuditch 12	Cage 2	422172	6374154	30/11/2020	Black dot on top of rump	F	800		Lactating (pouch young)	Appears healthy	2
Chuditch 13	Cage 8	421655	6374447	3/12/2020	Not marked	F	700		Lactating (not recapture - all cages closed)	Appears healthy	2

Chuditch Camera Capture (Dasyurus geoffroii) Physical Assessment data

Spot patterns of Chuditch were examined in detail and used to identify individuals from camera trap photographs. In order to use these patterns to identify individuals, accurate and proportionate sketches were made of the top of the head, back, left and right sides of individual Chuditch from the photographs taken by the remote cameras. Each sketch aimed to provide a useful summary that strongly aided subsequent recognition of individuals (Hohnen *et a*l 2015). The spot patterns were examined to determine whether the Chuditch in question was new or a previously viewed individual. Often two or more key spot patterns were visible in a photograph of a single side (e.g. one group on the shoulder and one on the haunch). When these key collections of spots could be matched and no area of the coat had con-complementary patterns, it was deemed to be the same individual. Therefore a clear view of a single side was sufficient to confirm the identify of the individual, if that individual had been previously identified. Only good quality images showing two or more clear spot patterns were used for identification and photographs with obscured or blurred patterns were not used (Hohnen *et al* 2015).

Chuditch ID	Camera ID	Eastings	Northings	Date	ID marks	Spot pattern diagram	Remote camera Image
Chuditch 14	CAM 42	422604	6375690	26/07/2020	Triangle pattern on left rear with two dots close together underneath on thigh.		
Chuditch 15	CAM SG1	420715	6376178	05/08/2020	Four dots above shoulder in square pattern on right side Two distinct larger dots on left side		
Chuditch 16	CAM 4SG	420477	6388880	25/09/2020	Pattern of 4 large dots in square on left side of back in middle portion of back		
Chuditch 17	CAM 29	426935	6381616	16/12/2020	Two distinct dots close together above right thigh on back with two less distinct dots underneath closer to tail		

Chuditch ID	Camera ID	Eastings	Northings	Date	ID marks	Spot pattern diagram	Remote camera Image
Chuditch 18	CAM 4SG	426098	6376800	17/01/2021	Four spots very close together (not distinct) on left shoulder in a vertical line.		
Chuditch 19	B1	425869	6375493	4/12/2020	Two dots close together on top of right shoulder		
Chuditch 20	CAM PRO 1	423752	6376328	5/12/2020	Immature, bushy tail. Triangle of larger dots in middle left side of back		
Chuditch 21	CAM PRO 1	423752	6376328	12/12/20	Immature, tail not brushy. Three dots close together horizontally on top of left shoulder		

Reference

Hohnen, R, Ashby, J, Tuft, K, & McGregor, H 2012, *'Individual identification of northern quolls (Dasyurus hallacatus) using remote cameras'*, Australian Mammalogy, CSIRO Publishing. http://dx.doi.org/10.1071/AM12015.

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