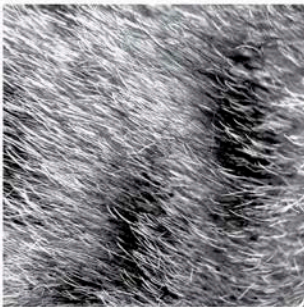
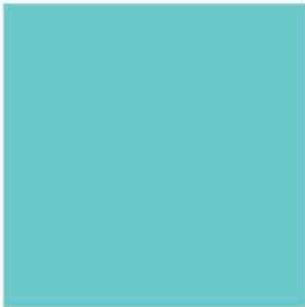
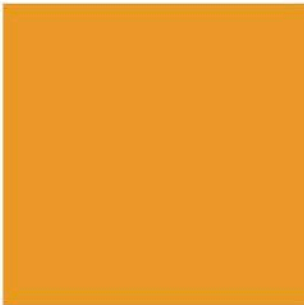
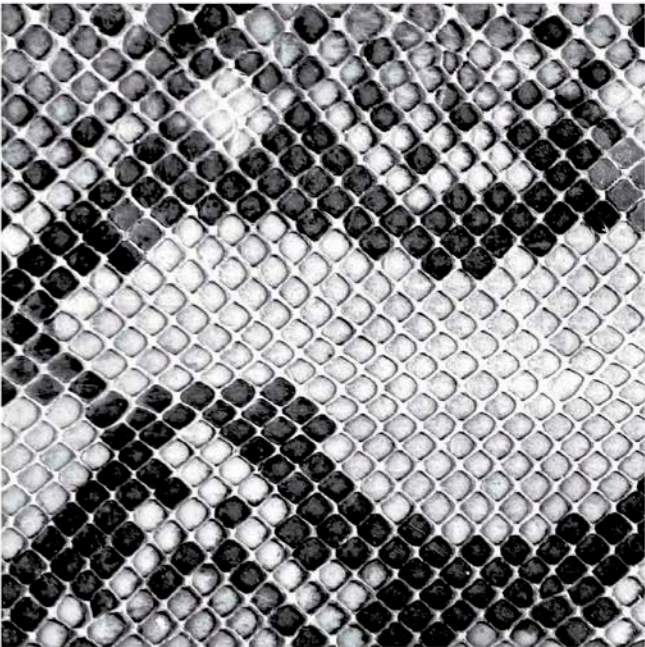
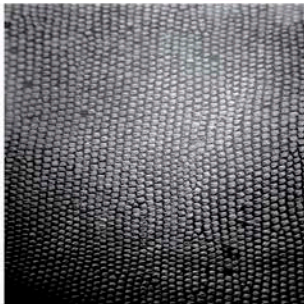




Goschen Project - Targeted Conservation Significant Fauna Survey

VHM Exploration Pty Ltd

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SUMMARY

VHM Exploration Pty Ltd (VHM Exploration) is planning to develop the Goschen Mineral Sands Project (the Project), which is located in the Lodden Mallee Region near the city of Swan Hill in Victoria. The Project is located approximately 280 kilometres (km) northwest of Melbourne and 20 km south of Swan Hill and includes two exploration licenses 5520 (EL 5520; 420 km²) and 6419 (EL 6419, under application). The exploration licenses are located within the Rural City of Swan Hill and the Gannawarra Shire. The town of Lalbert is located near the south west corner of the survey area. The southern boundary is Nalder Rd, the northern boundary is Fox Rd, the western boundary is Donald-Swan Hill Rd and the eastern boundary is Jampot Rd.

The survey area is approximately 20,872 ha. The majority of the survey area is farmlands and is relatively flat. Vegetation in the survey area is generally only present in road reserves, except for small pockets of remnant vegetation.

VHM Exploration commissioned Ecoscape Australia Pty Ltd (Ecoscape) to complete a targeted fauna assessment of the Goschen Mineral Sands Project. An Ecological Characterisation Assessment (ECA) of the project area was completed at the end of 2017 (Ecology and Heritage Partners Pty Ltd 2018 [Ecology & Heritage]). The scope of works for the targeted fauna assessment incorporated a review of the ECA (Ecology & Heritage 2018) to determine which conservation significant fauna species require target surveys and summarise justifications including appropriate survey seasons is for each species.

A targeted fauna survey was conducted by two experienced zoologists between 13 and 19 March 2018. Methods consisted of habitat assessments, bird surveys, active searches, nocturnal searches and road spotting, use of Motion Cameras and ultrasonic bat recorders.

Three broad fauna habitat types were recorded from the survey area: Agricultural land, Mallee woodland and salt lake. The Agricultural Land is the most common habitat type in the survey area. The Mallee woodland habitat type was the most valuable habitat type due to the diverse vegetation composition and structure, and the shelter and food it provides.

A total of three native non-volant mammal species, five bat species (plus calls from *Nyctophilus* sp. that may be attributed to a number of species), six introduced mammal species, 40 bird species, and two reptiles were recorded from within the survey area. Of these, two species were of conservation significance; the Superb Parrot (*Polytelis swainsoni*; Environmental Protection and Biodiversity Conservation Act 1999 (EPBC Act) Vulnerable, Fauna and Flora Guarantee Act 1988 (FFG Act) Threatened, Advisory List Endangered) and the Common Bearded Dragon (*Pogona barbata*; Advisory List-Vulnerable). During the previous survey, the Black Falcon (*Falco subniger*; Advisory List-Vulnerable) and the Brown Treecreeper (south-eastern) (*Climacteris picumnus victoriae*; Advisory List-Near Threatened) were also recorded from the survey area.

Additional species were also targeted during the survey. The Plains-wanderer (*Pedionomus torquatus*; EPBC Act Critically Endangered, FFG Act Threatened, Advisory List Critically Endangered) and Regent Parrot (eastern subspecies) (*Polytelis anthopeplus mocharchoides*; EPBC Act Vulnerable, FFG Act Threatened, Advisory List Vulnerable) have a moderate likelihood to occur at the survey area. The South-eastern long-eared bat (*Nyctophilus corbeni*; EPBC Act Vulnerable, FFG Act Threatened, Advisory List Endangered) and Malleefowl (*Leipoa ocellata*; EPBC Vulnerable, FFG Act Threatened, Advisory Act Endangered) have a low likelihood to occur due to the lack of suitable habitat.

The Mallee woodland road verge habitat is considered the habitat type with the most value for fauna species within the survey area. Any clearance or disturbance to this habitat type should be avoided or limited where possible.

1 INTRODUCTION

1.1 PROJECT BACKGROUND

VHM Exploration is planning to develop the Goschen Mineral Sands Project, which is located in the Lodden Mallee Region near the city of Swan Hill in Victoria. The Project is located approximately 280 km northwest of Melbourne and 20 km south of Swan Hill and includes two exploration licenses 5520 (EL 5520; 420 km²) and 6419 (EL 6419, under application). The exploration licenses are located within the Rural City of Swan Hill and the Gannawarra Shire. The town of Lalbert is located near the south west corner of the survey area. The southern boundary is Nalder Rd, the northern boundary is Fox Rd, the western boundary is Donald-Swan Hill Rd and the eastern boundary is Jampot Rd (see **Figure 1**).

The survey area is approximately 20,872 ha. The majority of the survey area is farmlands and is relatively flat. Vegetation in the survey area is generally only present in road reserves, except for small pockets of remnant vegetation. There is approximately 660 ha of vegetation present in the survey area. There are also some pockets of vegetation along fence lines within paddocks.

1.2 SCOPE OF WORK

VHM Exploration commissioned Ecoscape to complete a targeted fauna assessment of the Goschen Mineral Sands Project. An Ecological Characterisation Assessment (ECA) of the project area was completed at the end of 2017 (Ecology & Heritage 2018). The ECA incorporated a desktop assessment and field assessment to determine flora, vegetation and fauna values of the project area.

The scope of works for the targeted fauna assessment incorporated a review of the ECA (Ecology & Heritage 2018) to determine which conservation significant fauna species required target surveys and summarise justifications including appropriate survey seasons for each species. Once the targeted fauna survey requirements were completed, a targeted conservation significant fauna survey was completed as part of this scope focusing on species that require targeted assessments during the warm season. The targeted fauna survey was to conform to relevant Victorian and national legislation and guidelines and target species as identified in the desktop assessment as well as identification and mapping of foraging and critical habitats for EPBC Act listed species.

1.3 STATUTORY FRAMEWORK

The following targeted fauna assessment was conducted in accordance with the following Commonwealth and State legislation, as well as relevant survey guidelines:

- *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act)
- *Flora and Fauna Guarantee Act 1988* (FFG Act)
- Survey guidelines for Australia's threatened birds (Department of the Environment Water Heritage and the Arts [DEWHA] 2010b)
- Survey guidelines for Australia's threatened bat species (DEWHA 2010)
- Survey guidelines for Australia's threatened mammals (Department of Sustainability Environment Water Population and Communities [DSEWPaC] 2011a)
- Survey guidelines for Australia's threatened reptiles (DSEWPaC 2011b).



SCALE: 1:1,500,000 @ A4
 COORDINATE SYSTEM: WGS 1984 WEB MERCATOR AUXILIARY SPHERE
 PROJECTION: MERCATOR AUXILIARY SPHERE
 DATUM: WGS 1984
 UNITS: METER

PROJECT NO: 4134-18

REV	AUTHOR	APPROVED	DATE
0	DR	AF	06/04/2018
1	AF	JN	17/04/2018



ecoscape

**LOCATION OF
THE SURVEY AREA**
**GOSCHEN PROJECT - TARGETED
CONSERVATION SIGNIFICANT FAUNA SURVEY**
 CLIENT: VHM EXPLORATION PTY LTD

**FIGURE
01**

1.4 CONSERVATION SIGNIFICANT FAUNA

A desktop assessment has been completed to identify the likelihood of conservation significant fauna species to occur in the survey area. A total of 28 migratory and water bird species were identified that have been recorded in the region, but are unlikely to occur at the survey area due to the lack of suitable permanent wetland habitat, rivers and coastal shores. The species are listed in **Table 1**.

A total of 41 species of conservation significance identified as potentially occurring at the survey area are listed in **Table 2**. Of these, three species have a high likelihood to occur at the survey area, 18 species have a medium likelihood to occur and the remaining 20 species have a low likelihood to be present at the survey area.

Table 1: Migratory and Shore bird species unlikely to occur

Species Name	Common Name	Conservation Status		
		EPBC Act	FFG Act	Advisory List
MIGRATORY/WETLAND BIRDS				
<i>Calidris ferruginea</i>	Curlew Sandpiper	CR		EN
<i>Numenius madagascariensis</i>	Eastern Curlew	CR		VU
<i>Rostratula australis</i>	Australian Painted Snipe	EN	L	CR
<i>Botaurus poiciloptilus</i>	Australasian Bittern	EN	L	EN
<i>Tringa nebularia</i>	Common Greenshank	Mig		VU
<i>Tringa stagnatilis</i>	Marsh Sandpiper	Mig		VU
<i>Limosa</i>	Black-tailed Godwit	Mig		VU
<i>Actitis hypoleucos</i>	Common Sandpiper	Mig		VU
<i>Calidris melanotos</i>	Pectoral Sandpiper	Mig		NT
<i>Calidris ruficollis</i>	Red-necked Stint	Mig		
<i>Philomachus pugnax</i>	Ruff	Mig		
<i>Calidris acuminata</i>	Sharp-tailed Sandpiper	Mig		
<i>Apus pacificus</i>	Fork-tailed Swift	Mig		
<i>Charadrius bicinctus</i>	Double-banded Plover	Mig		
<i>Gallinago hardwickii</i>	Latham's Snipe	Mig		
<i>Gallinago megala</i>	Swinhoe's Snipe	Mig		
<i>Gallinago stenura</i>	Pin-tailed Snipe	Mig		
<i>Numenius minutus</i>	Little Curlew	Mig		
<i>Stictonetta naevosa</i>	Freckled Duck		L	EN
<i>Oxyura australis</i>	Blue-billed Duck		L	EN
<i>Ardea modesta</i>	Eastern Great Egret		L	VU
<i>Aythya australis</i>	Hardhead			VU
<i>Biziura lobata</i>	Musk Duck			VU
<i>Anas rhynchos</i>	Australasian Shoveler			VU
<i>Nycticorax caledonicus hillii</i>	Nankeen Night Heron			NT
<i>Chlidonias hybridus javanicus</i>	Whiskered Tern			NT
<i>Platalea regia</i>	Royal Spoonbill			NT
<i>Phalacrocorax varius</i>	Pied Cormorant			NT

Table 2: Conservation Significant fauna species potentially occurring at the survey area

Species Name	Common Name	Conservation Status			Habitat Requirements	Previous Records			Likelihood of Occurrences
		EPBC Act	FFG Act	Advisory List		NatureKit (40 km buffer)	VBA	PMST	
MAMMALS									
<i>Nyctophilus corbeni</i>	South-eastern Long-eared Bat	VU	L	EN	Large areas on forest and woodland with dense understory	Not recorded	N/A	Species or species habitat may be present	LOW – Habitat fragmentation reduces likelihood of occurrence
<i>Pteropus poliocephalus</i>	Grey-headed Flying-fox	VU	L	VU	Eucalypt forests and woodlands, rainforest and <i>Melaleuca</i> swamps and banksia woodlands	Not recorded	1 cell on eastern side of search area	N/A	LOW – study area outside of known distribution, with minimal foraging resources available
<i>Petauroides volans</i>	Greater Glider	VU		VU	Largely restricted to species diverse tall eucalypt forests and woodlands	Not recorded	N/A	Species or species habitat may be present	LOW – no suitable habitat within the search area. May occur in taller riverine forest to the north
<i>Phascolarctos cinereus</i> (combined populations of Qld, NSW and the ACT)	Koala	VU			Habitats include a range of temperate, sub-tropical and tropical forest, woodland and semi-arid communities dominated by <i>Eucalyptus</i> species	Not recorded	N/A	Species or species habitat may be present	LOW – no suitable habitat within search area. Species conservation status linked with presence in Qld, NSW and ACT.
<i>Sminthopsis crassicaudata</i>	Fat-tailed Dunnart			NT	Open habitats including open woodlands, low shrublands, arid shrublands and cracking clays. Can occur in agricultural areas on unimproved pasture	Not recorded	6 cells on eastern side of search area	N/A	MEDIUM – suitable habitat present however the agricultural land is tilled for cropping
<i>Notomys mitchelli</i>	Mitchell's Hopping Mouse			NT	Mallee Woodland with sandy soils and some dune formations	Not recorded	1 cell on eastern side of search area	N/A	LOW – limited suitable habitat which is also highly fragmented and high predation pressure
BIRDS									
<i>Pedionomus torquatus</i>	Plains-wanderers	CR	L	CR	Native grasslands with suitable composition of bare patches and grass tussocks	5 cells	7 cells across search area	Species or species habitat may be present	LOW – Suitable habitat located to the east of the study area. Habitats in study area not suitable
<i>Anthochaera phrygia</i>	Regent Honeyeater	CR	L	CR	Box-ironbark woodland, but also occurs in other forest types	Not recorded	1 cell on eastern side of the search area	N/A	LOW – Search area outside current distribution and mallee woodland habitat not considered suitable
<i>Polytelis anthopeplus monarchoides</i>	Regent Parrot (eastern)	VU	L	VU	Riparian or littoral River Red Gum forests or woodlands and adjacent Black Box woodlands. Nearby open mallee woodland or shrubland supporting various mallee eucalypts as well as Belah, Buloke or Slender Cypress Pine. Often occur in farmland, especially if the farmland supports remnant patches of woodland along roadsides or in paddocks	Not recorded	1 cell on the eastern edge	Species or species habitat likely to occur within area	MEDIUM – Search area on eastern edge of distribution. Dispersing individuals may utilise remnant vegetation in search area
<i>Pachycephala rufogularis</i>	Red-lored Whistler	VU	L	EN	Low mallee shrublands, heathlands and woodlands that have an open canopy and a moderately dense but patchy understory	Not recorded	1 cell on west side of search area	N/A	LOW – Distribution located to the west of the study area. Mallee habitats in search area have low open understory
<i>Grantiella picta</i>	Painted Honeyeater	VU	L	VU	Dry open forests and woodlands, and is strongly associated with mistletoe. It may also be found along rivers, on plains with scattered trees and on farmland with remnant vegetation	Not recorded	N/A	Species or species habitat likely to occur within area	MEDIUM – Suitable habitat and search area located within species distribution area
<i>Lathamus discolor</i>	Swift Parrot	CR	L	EN	Swift parrot disperses widely when they migrate to the mainland to forage on flowers and psyllid lerps in Eucalyptus species. In Victoria, swift parrots are predominantly found in the dry forests and woodlands of the box-ironbark	Not recorded	N/A	Species or species habitat likely to occur within area	LOW – no suitable foraging habitat. Swift parrots may utilise riverine forests located to the north of the search area
<i>Leipoa ocellata</i>	Malleefowl	VU	L	EN	Scrubland and woodland dominated by mallee and wattle species	Not recorded	N/A	Species or species habitat likely to occur within area	LOW – Remnant habitat is considered too open to be considered suitable Malleefowl habitat
<i>Pezoporus occidentalis</i>	Night Parrot	EN			Long unburnt spinifex with associated chenopod vegetation.	Not recorded	N/A	Extinct within area	LOW- No suitable habitat present.

Species Name	Common Name	Conservation Status			Habitat Requirements	Previous Records			Likelihood of Occurrences
		EPBC Act	FFG Act	Advisory List		NatureKit (40 km buffer)	VBA	PMST	
<i>Myiagra cyanoleuca</i>	Satin Flycatcher	Mig			Heavily vegetated gullies in eucalypt-dominated forests and taller woodlands, and on migration, occur in coastal forests, woodlands, mangroves and drier woodlands and open forests	Not recorded	N/A	Species or species habitat known to occur within area	LOW – no suitable habitat present is search area.
<i>Motacilla flava</i>	Yellow Wagtail	Mig			Damp or wet habitats with low vegetation, from rushy pastures, meadows, hay fields and marshes to damp steppe and grassy tundra	Not recorded	N/A	Species or species habitat may occur within area	LOW – low likelihood that suitable habitat would form in the cultivated agricultural areas.
<i>Ptilonorhynchus maculatus</i>	Spotted Bowerbird		L	CR	Black Box (<i>Eucalyptus largiflorens</i>) woodlands	Not recorded	4 cells along eastern edge of search area	N/A	LOW – Search area outside of range. Southern limit of distribution near Mildura / Robinvale
<i>Pomatostomus temporalis temporalis</i>	Grey-crowned Babbler		L	EN	Open forests and woodlands, favouring inland plains with an open shrub layer, little ground cover and plenty of fallen timber and leaf litter	1 records (1996) from 4 km north, 3 records (1997) 30 km east	17 cells across the search area	N/A	MEDIUM – remnant mallee habitats suitable and search area within species distribution
<i>Burhinus grallarius</i>	Bush Stone-curlew		L	EN	Grassy woodlands and farmland	1 Record (1979) Goschen area 15 km north	2 cells on the north and west sides of search area	N/A	MEDIUM – remnant mallee habitats and areas of farmland can form suitable habitat. Search area with species current distribution
<i>Ninox connivens</i>	Barking Owl		L	EN	Woodland and open forest, including fragmented remnants and partly cleared farmland.	Not recorded	1 cell on south east edge of search area	N/A	LOW – Habitat preference biased towards availability of dense patches of large trees (DBH >60cm)
<i>Lichenostomus cratitius</i>	Purple-gaped Honeyeater			VU	Mallee heathlands and less commonly in associated mallee with a more open understorey or river red gums bordering waterways	Not recorded	3 cells on western side of search area	N/A	MEDIUM – remnant mallee habitats may support foraging individuals. Few records adjacent to the search area however recorded from both east and west of the search area
<i>Coracina maxima</i>	Ground Cuckoo-shrike		L	VU	Variety of open woodland and shrubland habitats	Not recorded	6 cells across the search area	N/A	MEDIUM – suitable habitats present and search area within species distribution
<i>Lophocroa leadbeateri</i>	Major Mitchell's Cockatoo		L	VU	Recorded from dry woodlands in arid and semi-arid areas, usually in eucalypts or acacias dominated vegetation with old trees large enough to support suitable hollows	Not recorded	1 cell on eastern edge of search area	N/A	MEDIUM - suitable habitats present and search area within species distribution
<i>Climacteris affinis</i>	White-browed Treecreeper		L	VU	Tall shrubland and low woodland dominated by acacias, such as Mulga, Western Myall and Gidgee, or casuarinas, such as Buloke and Belah, or woodlands dominated by cypress-pines	Not recorded	1 cell on northeast corner of search area	N/A	MEDIUM - suitable habitats present and search area within species distribution
<i>Falco subniger</i>	Black Falcon			VU	Recorded from Tree-lined watercourses and in isolated woodlands, mainly in arid and semi-arid areas	1 record (1978) from Goschen area, 15 km north	4 cells across search area	N/A	HIGH – Recorded from the search area during initial flora and fauna assessments
<i>Stagonopleura guttata</i>	Diamond Firetail		L	NT	Open grassy woodland, heath and farmland or grassland with scattered trees	Not recorded	10 cells across search area	N/A	HIGH – Suitable habitats present in the search area and search area within distribution
<i>Melanodryas cucullata</i>	Hooded Robin		L	NT	Lightly wooded country, usually open eucalypt woodland, acacia scrub and mallee, however prefers structurally diverse habitats	6 records (1978-99) scattered around study area (within 10 km)	Majority of cells within search area	N/A	MEDIUM – Remnant mallee habitats may provide suitable habitat, however remnant vegetation has lost structural diversity
<i>Calamanthus campestris</i>	Rufous Fieldwren			NT	Low shrublands, particularly saltbush and bluebush communities, and also areas around inland saline lakes	Not recorded	4 cells along northern edge	N/A	LOW – Only one small area of suitable habitat and search area is at southern edge of distribution
<i>Cinclosoma castanotus</i>	Chestnut Quail-thrush			NT	Low shrubs and undergrowth of mallee scrub, but also in <i>Acacia</i> scrubs, dry sclerophyll woodland, heath, and native pine	Not recorded	5 cells across search area	N/A	LOW – distribution of records appears to be limited to large areas of native vegetation located to the west of the search area.

Species Name	Common Name	Conservation Status			Habitat Requirements	Previous Records			Likelihood of Occurrences
		EPBC Act	FFG Act	Advisory List		NatureKit (40 km buffer)	VBA	PMST	
<i>Oreoica gutturalis gutturalis</i>	Crested Bellbird		L	NT	Variety of habitats in arid areas including acacia shrublands, eucalypt woodlands, spinifex and chenopod (saltbush) plains or dunes	Not recorded	5 cells across the search area	N/A	MEDIUM - suitable habitats present and search area within species distribution
<i>Chrysococcyx osculans</i>	Black-eared Cuckoo			NT	Typically found in drier country where species such as mulga and mallee form open woodlands and shrublands particularly in vegetation along creek beds	Not recorded	7 cells across the search area	N/A	MEDIUM - suitable habitats present and search area within species distribution
<i>Circus assimilis</i>	Spotted Harrier			NT	Open wooded country in tropical and temperate Australia, particularly in arid and semi-arid areas	3 records (1970-1980) scattered to the north and east of the study area	N/A	N/A	MEDIUM - suitable habitats present and search area within species distribution
<i>Climacteris picumnus victoriae</i>	Brown Treecreeper (south-eastern ssp.)			NT	Critical habitats include relatively undisturbed grassy woodland with native understorey and large trees and fallen timber	12 records (1977-2001) scattered around study area	All cells within search area	N/A	MEDIUM - suitable habitats present and search area within species distribution
<i>Stiltia isabella</i>	Australian Pratincole			NT	Most commonly found close to water, in open inland plains, sparsely wooded plains and tussock grasslands. Also found in areas of gibber (stony plains) and stony ground, and areas with sparse vegetation including claypans	1 record (1987) from Lake Lookout, 13 km southeast	N/A	N/A	LOW – limited suitable habitat present within the search area
<i>Todiramphus pyrropygia pyrropygia</i>	Red-backed Kingfisher			NT	Recorded from dry forests, mulga and mallee woodlands and savannah grasslands. Summer visitor to south eastern Australia	2 records (1977,78) from Goschen area, 15 km north	N/A	N/A	MEDIUM - suitable habitats present and search area within species distribution
REPTILES									
<i>Varanus varius</i>	Lace Monitor			EN	Arboreal species that prefers forest and woodland habitats with large trees.	1 record (2010) from Lake Bael Bael, 23 km southeast	5 cells in the south eastern corner of search area	N/A	LOW – habitat recorded from the search area is not considered suitable.
<i>Morelia spilota metcalfei</i>	Carpet Python		L	EN	Rocky areas and riverine habitats, and previously occurred in mallee shrublands, Callitris woodlands and freshwater swamps. will move into open, disturbed areas during summer if high density rabbit populations are present	Not recorded	9 cells across search area	N/A	MEDIUM – may occur in the search area when rabbit population densities are high. Search area within species distribution
<i>Vermicella annulata</i>	Bandy Bandy		L	VU	Recorded from a wide variety of habitats across eastern Australia.	Not recorded	2 cells within search area along eastern edge	N/A	MEDIUM – search area within distribution. Habitats likely to support prey species (blind snakes)
<i>Morethia adelaidensis</i>	Samphire Skink		L	EN	Chenopod dominated shrublands and woodlands, particularly associated with margins of ephemeral lakes	Not recorded	4 cells along eastern edge	N/A	MEDIUM – records from adjacent lake systems. May occur in salt lake habitats located in the north east of the search area
<i>Pogona Barbata</i>	Common Bearded Dragon			VU	Dry woodlands, although it also occurs in agricultural land and urban areas	Not recorded	6 cells along the eastern edge of search area	N/A	HIGH – Recorded from the search area
<i>Pygopus schraderi</i>	Hooded Scaly-foot		L	CR	Wide range of habitats including stony plains, dry woodlands, arid mallee, mulga scrub and spinifex dominated desert grasslands	Not recorded	4 cells within search area	N/A	MEDIUM - suitable habitats present and search area within species distribution
AMPHIBIANS									
<i>Litoria raniformis</i>	Growling Grass Frog	VU	Listed	EN	Emergent vegetation, including bullrush, reeds and sedges, in or at the edges of still or slow-flowing water bodies such as lagoons, swamps, lakes, ponds and farm dams. Also occurs in: clays or well-watered sandy soils, open grassland, open forest, and ephemeral and permanent non-saline marshes and swamps.	2 Records, 7.5 km north (1982) and 35 km east (2004) of study area	4 cells around the edge of the search area	N/A	LOW – No suitable wetland habitats present in the search area to support Growling Grass Frog populations. Farm dams not expected to support permanent populations as they are generally dry and no longer have a water supply (irrigation channels have been filled in).

L=Listed, VU=Vulnerable, EN=Endangered, NT=Near Threatened, CR=Critically Endangered

2 METHODS

The project was undertaken in three stages. A desktop assessment was completed to identify any potential conservation significant fauna potentially occurring at the Goschen survey area.

DESKTOP ASSESSMENT

The desktop assessment included an Ecological Characterisation Assessment of the Goschen Project and determination of significant fauna species requiring targeted surveys using sources such as the following:

- EPBC Act Protected Matters Search Tool
- Biodiversity Interactive Maps maintained by the Department of Environment, Land, Water and Planning (DELWP)
- listed as threatened or nominated under the FFG Act
- fauna listed as critically endangered, endangered or vulnerable on the DELWP Advisory List (Department of Sustainability and Environment [DSE] 2013)
- Ecological Characterisation Assessment of the Proposed Goschen Mineral Sand Projects (Ecology & Heritage 2018).

A list of species of conservation significance potentially occurring was then completed (**Table 2**) and the most appropriate survey season (month) and survey methods for each species were determined. Following sources were used:

- Department of the Environment and Energy (DotEE) Species Profile and Threats Database (2017)
- Department of the Environment (DotE) Matters of National Environmental Significance Significant impact guidelines 1.1 *Environment Protection and Biodiversity Conservation Act 1999* (2013)
- DEWHA's Survey guidelines for Australia's threatened birds (2010c): Guidelines for detecting birds listed as threatened under the EPBC Act
- DEWPaC's Survey guidelines for Australia's threatened mammals (2011a): Guidelines for detecting mammals listed as threatened under the EPBC Act
- DEWHA's Survey guidelines for Australia's threatened bats (2010a): Guidelines for detecting bats listed as threatened under the EPBC Act
- Threatened Species Scientific Committee (TSSC) Conservation Advice *Nyctophilus corbeni* South-eastern long-eared bat (2015)
- DotE's Draft National Recovery Plan for the Plains-wanderer (*Pedionomus torquatus*) (2015b)
- DotE's Conservation Advice - Plains Wanderer *Pedionomus torquatus* (2015a).

Based on this desktop assessment, a targeted fauna survey was required to be undertaken during the warmer months. Target species are outlined below in **Table 3**.

FAUNA FIELD SURVEY

The targeted fauna survey was conducted using methods for all conservation significant fauna species identified to potentially occur (low to high likelihood, see **Table 2**). The targeted survey was completed in accordance with relevant Victorian and national legislation and guidelines. A team of two experienced zoologists completed the targeted survey over a seven day field event (13-19 March 2018). The field survey methods were selected based on the targeted species as listed in **Table 3**. The area able to be surveyed based upon landholder permission at time is displayed on **Map 1**.

The fauna habitat was assessed throughout the entire survey area. Opportunistic recordings of widespread species were also recorded during the survey to assist in the fauna habitat mapping (e.g. determining distinct fauna assemblages).

Survey site locations were selected based on the location of remnant vegetation (in particular patches of woodland and denser vegetated areas along road verges which support target fauna species and widespread fauna species), achieve a geographical spread across the survey area and to sample a variety of fauna habitats. Survey site locations are listed in **Table 6 (Appendix One)** and displayed on **Map 2**.

Table 3: Survey methods and target conservation significant species

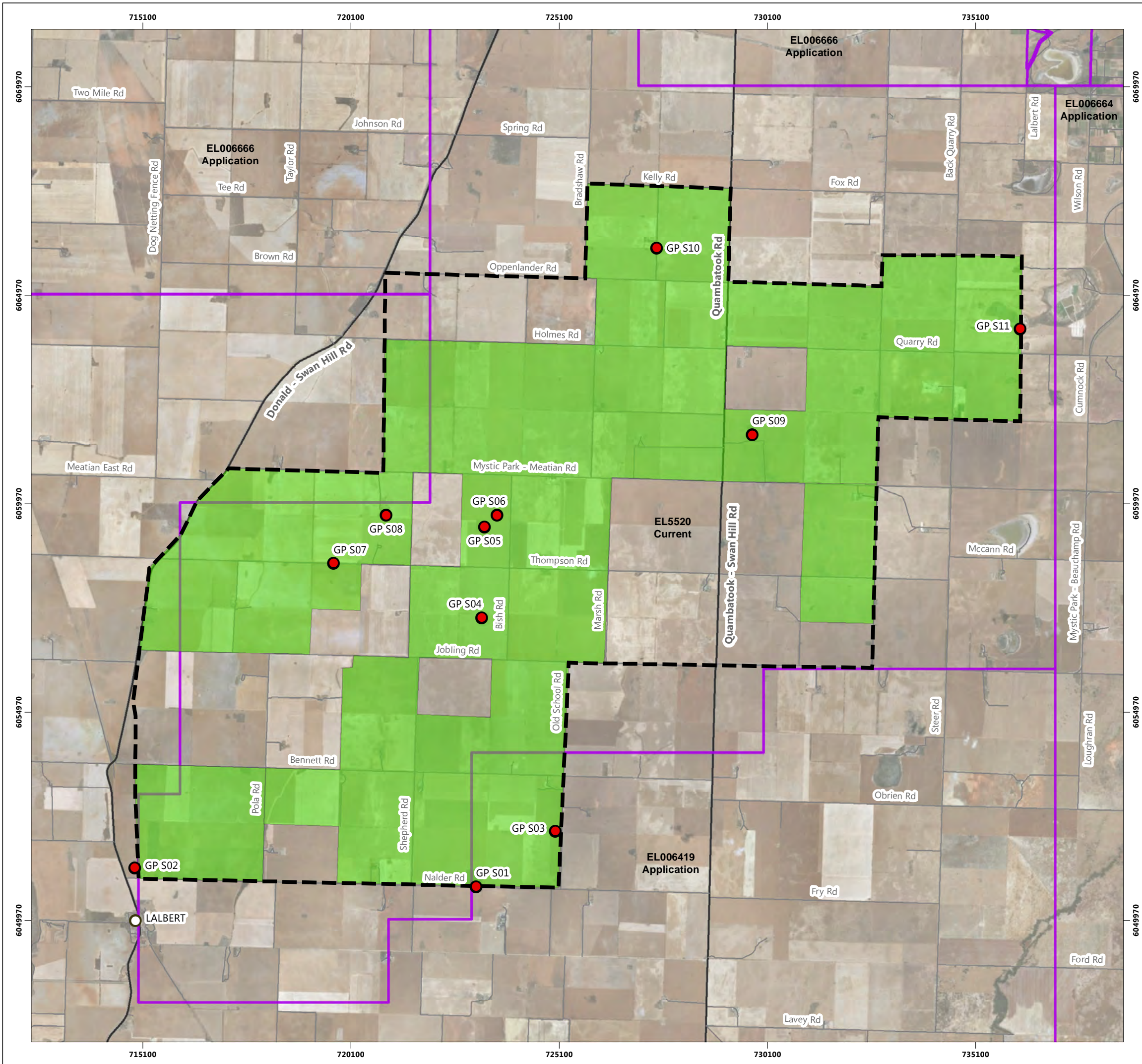
Survey Technique	Species Name	Common Name	Conservation Status		
			EPBC Act	FFG Act	DSE (2013)
Song Meter Ultrasonic Bat Recorders – Eight SM2Bat+ and SM4Bat FS recorders were placed along the edge of woodland habitats or other flyways for four consecutive nights.	<i>Nyctophilus corbeni</i>	South-eastern Long-eared Bat	VU	L	EN
	<i>Saccolaimus flaviventris</i>	Yellow-bellied Sheath-tail Bat		L	
	<i>Pteropus poliocephalus</i>	Grey-headed Flying-Fox	VU	L	VU
Reconyx Motion Camera – 18 Reconyx HC-500 motion cameras were deployed in areas of suitable remnant vegetation or other travel paths to record the presence of nocturnal/cryptic species.	<i>Macropus robustus</i>	Eastern Wallaroo		L	EN
	<i>Phascogale tapoatafa</i>	Brush-tailed Phascogale		L	
	<i>Notomys mitchelli</i>	Mitchell's Hopping Mouse			NT
	<i>Planigale gilesi</i>	Giles's Planigale		L	
	<i>Canis lupus</i> subsp. <i>dingo</i>	Dingo		L	
	<i>Leipoa ocellata</i>	Malleefowl	VU	L	EN
	<i>Pomatostomus temporalis</i>	Grey-crowned Babbler		L	EN
	<i>Burhinus grallarius</i>	Bush Stone-curlew		L	EN
Active Searching – Active searching (raking, searching under rocks and wood debris) of 1 ha areas in suitable remnant habitats was searched for 30 minutes. Secondary evidence of any species (scats, tracks, nests/mounds and remains) were also recorded.	<i>Macropus robustus</i>	Eastern Wallaroo		L	EN
	<i>Phascolarctos cinereus</i> (Qld, NSW, ACT)	Koala	VU		
	<i>Canis lupus</i> subsp. <i>dingo</i>	Dingo		L	
	<i>Leipoa ocellata</i>	Malleefowl	VU	L	EN
	<i>Varanus varius</i>	Lace Monitor			EN
	<i>Acanthophis antarcticus</i>	Common Death Adder		L	
	<i>Aprasia parapulchella</i>	Pink-tailed Worm-lizard		L	
	<i>Echiopsis curta</i>	Bardick		L	
Nocturnal Searches – 20 minute active searches of remnant vegetation sites were completed. In addition, road cruising was completed between search sites and when moving around the site. All species seen during the nocturnal searches were documented. Suitable Plains Wanderer habitat (native grasslands) was located during day searches and then targeted during the nocturnal searches.	<i>Pedionomus torquatus</i>	Plains wanderer	CR	L	CR
	<i>Petauroides volans</i>	Greater Glider	VU		VU
	<i>Pezoporus occidentalis</i>	Night Parrot	EN		
	<i>Macropus robustus robustus</i>	Eastern Wallaroo		L	EN
	<i>Phascogale tapoatafa</i>	Brush-tailed Phascogale		L	
	<i>Planigale gilesi</i>	Giles's Planigale		L	

Survey Technique	Species Name	Common Name	Conservation Status		
			EPBC Act	FFG Act	DSE (2013)
	<i>Canis lupus</i> subsp. <i>dingo</i>	Dingo		L	
	<i>Burhinus grallarius</i>	Bush Stone-curlew		L	EN
	<i>Litoria raniformis</i>	Growling Grass Frog	VU	L	EN
	<i>Limnodynastes interioris</i>	Giant Bullfrog		L	
	<i>Ninox connivens</i>	Barking Owl		L	EN
<p>Bird Surveys – standardised 20 minute searches of 1 ha areas were completed during the early morning and late afternoon when bird activity is highest. All bird species and abundances observed were recorded. Any opportunistic sightings of additional bird species was also recorded independently.</p>	<i>Pteropus poliocephalus</i>	Grey-headed Flying-Fox	VU	L	VU
	<i>Pachycephala rufogularis</i>	Red-lored Whistler	VU	L	EN
	<i>Grantiella picta</i>	Painted Honeyeater	VU	L	VU
	<i>Lathamus discolor</i>	Swift Parrot	CR	L	EN
	<i>Polytelis anthopeplus monarchoides</i>	Regent Parrot	VU	L	VU
	<i>Polytelis swainsonii</i>	Superb Parrot	VU	L	
	<i>Myiagra cyanoleuca</i>	Satin Flycatcher	Mig		
	<i>Motacilla flava</i>	Yellow Wagtail	Mig		
	<i>Ptilonorhynchus maculatus</i>	Spotted Bowerbird		L	CR
	<i>Ninox connivens</i>	Barking Owl		L	EN
	<i>Pomatostomus temporalis</i>	Grey-crowned Babbler		L	EN
	<i>Melanodryas cucullata</i>	Hooded Robin		L	NT
	<i>Oreoica gutturalis gutturalis</i>	Crested Bellbird		L	NT
	<i>Stagonopleura guttata</i>	Diamond Firetail		L	NT
	<i>Lophocroa leadbeateri</i>	Major Mitchell's Cockatoo		L	VU
	<i>Turnix pyrrhorthorax</i>	Red-chested Button-quail		L	VU
	<i>Coracina maxima</i>	Ground Cuckoo-shrike		L	VU
	<i>Climacteris affinis</i>	White-browed Treecreeper		L	VU
	<i>Struthidea cinerea</i>	Apostlebird		L	
	<i>Stipiturus mallee</i>	Mallee Emu-wren		L	
	<i>Pyrrholaemus brunneus</i>	Redthroat		L	
	<i>Accipiter novaehollandiae</i>	Grey Goshawk		L	
<i>Geopelia cuneata</i>	Diamond Dove		L		
<i>Circus assimilis</i>	Spotted Harrier			NT	

METHODS

Survey Technique	Species Name	Common Name	Conservation Status		
			EPBC Act	FFG Act	DSE (2013)
	<i>Climacteris picumnus victoriae</i>	Brown Treecreeper (south-eastern)			NT
	<i>Calamanthus campestris</i>	Rufous Fieldwren			NT
	<i>Cinclosoma castanotus</i>	Chestnut Quail-thrush			NT
	<i>Falco subniger</i>	Black Falcon			VU
	<i>Lichenostomus cratitius</i>	Purple-gaped Honeyeater			VU

L=Listed, VU=Vulnerable, EN=Endangered, NT=Near Threatened, CR=Critically Endangered



LEGEND

- Towns
- Fauna Sites
- Major Road
- Minor Road
- VHM Exploration Licences
- Survey Area
- Surveyed Extent

DATASOURCES :
 SOURCE DATA: DATA VIC ROADS, GEOSCIENCE AUSTRALIA TOWNS
 AERIAL: ESRI BASEMAP
 SERVICE LAYERS: SOURCE: ESRI, DIGITALGLOBE, GEOEYE, EARTHSTAR GEOGRAPHICS, CNES/AIRBUS DS, USDA, USGS, AEROGRID, IGN, AND THE GIS USER COMMUNITY



AREA SUBJECT TO SURVEY
VHM TARGETED FAUNA SURVEY
 VHM EXPLORATION PTY LTD

COORDINATE SYSTEM: GDA 1994 MGA ZONE 54
 PROJECTION: TRANSVERSE MERCATOR
 DATUM: GDA 1994
 UNITS: METER

SCALE: 1:90,000 @ A3

PROJECT NO: 4137-18

REV	AUTHOR	APPROVED	DATE
00	DR	AF	26/03/2018
01	JN	MW	19/04/2018

MAP 01

3 RESULTS AND DISCUSSION

3.1 FAUNA HABITATS

Three broad fauna habitat types were recorded from the survey area (**Table 4**): agricultural land, Mallee woodland and salt lake. The Agricultural Land is the most common habitat type in the survey area covering 20,023 ha. Each habitat type is described in detail below. The extent is listed in **Table 4** and displayed on **Map 2**.

Table 4: Fauna Habitat Types

Fauna Habitat	Area inside survey area (ha)	% of total survey area
Agricultural land	20,023.2	95.8
Mallee woodland	838.3	4.0
Salt lake	39.9	0.2
Total	20,901.4	-

3.1.1 FAUNA HABITAT DESCRIPTIONS

3.1.1.1 Agricultural Land

The majority of the survey area (95.8%) consisted of agricultural land and cleared paddocks (cropping) (**Map 2**). The value of this habitat type for native fauna species is very low due to the homogeneity of the vegetation layer. Food sources and shelter are generally low (apart from spilt grains) and the agriculture land is not classified as fauna habitat type as such due to the high level of degradation.

3.1.1.2 Mallee Woodland

Mallee woodland was recorded from patches of road verge vegetation but also from larger patches of remnant vegetation adjacent to agriculture land and tracks across the survey area (**Plate 1, Plate 2**). It is dominated by Yorrell (*Eucalyptus gracilis*), Red Mallee (*E. calycogona*), Grey Mallee (*E. socialis*), in particular along road verges but also consists of Black Mallee-Box (*E. dumosa*). The understorey is often sparse, consisting of low *Acacia oswaldii* and *A. myrtifolia* and only consists of mixed grasses (*Austrostipa elegantissima*, *Rytidosperma setacea*, *R. caespitosa*, *Enteropogon acicularis*), in particular in the Mallee woodland patches (**Plate 2**). This habitat type is the most valuable fauna habitat within the survey area due to the diverse vegetation composition and structure, and the shelter and food it provides. It can harbour a variety of fauna species, in particular during flowering season when insects and birds are attracted to nectars. Reptiles and mammal species such as kangaroos, wallabies and possums can also be found in this habitat type. Bat species forage for insects between the trees and canopies and may roost in hollow trees and under bark.



Plate 1: Mallee woodland habitat type - road verge



Plate 2: Mallee woodland habitat type - patch

3.1.1.3 Salt Lake

The salt lake habitat type was recorded from the north-west corner of the survey area. The salt lake consisted of moderate to open Saltbush (*Atriplex* spp.) vegetation with a lack of grasses or shrubs and trees. The substrate was sandy loam. The fringing vegetation consisted of a small patch of Mallee tree and Prickly Saltwort (*Salsola tragus*). This habitat type is generally open and does not provide a large amount of shelter or food for fauna species (**Plate 3**). After heavy rainfall event, this salt lake is likely to contain surface water which can attract a number of fauna species.

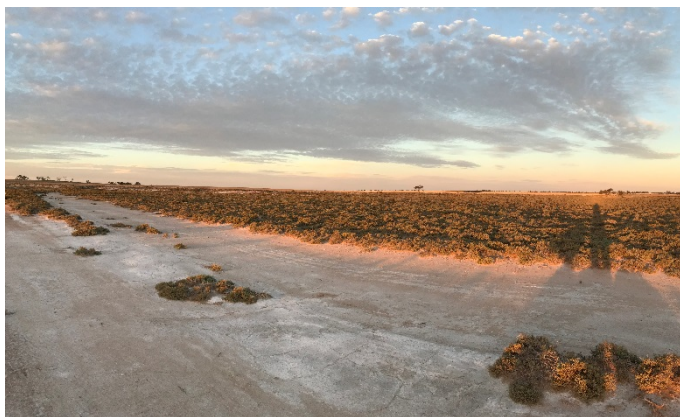


Plate 3: Salt lake habitat type

3.2 FAUNA ASSEMBLAGE

A total of three native non-volant mammal species, five bat species (plus calls from *Nyctophilus* sp. which may be attributed to a number of species¹), six introduced mammal species, 40 bird species, and two reptiles were recorded from within the survey area (**Table 5**). Of these, two species were of conservation significance: the Superb Parrot (*Polytelis swainsoni*; EPBC Vulnerable, FFG Act - Threatened, Advisory List - Endangered) and the Common Bearded Dragon (*Pogona barbata*; Advisory List - Vulnerable) (**Plate 4**). The Superb Parrot was recorded from road verge Mallee vegetation and the Bearded Dragon was recorded from a patch of remnant vegetation of Mallee woodland in the centre of the survey area (**Map 2**). The records are discussed in more detail in **Section 3.3**.

The Black Falcon (*Falco subniger*; Advisory List - Vulnerable) and the Brown Treecreeper (south-eastern) (*Climacteris picumnus victoriae*; Advisory List - Near Threatened) were recorded during the previous survey from the survey area (Ecology & Heritage 2018).

The Eastern Barn Owl (*Tyto alba*) was recorded from site S05 during nocturnal searches. A female adult individual was sighted over two nights which was feeding two young at a nesting site. The location is displayed in **Map 2**. The species is not listed as conservation significant and the Eastern Barn Owl finds suitable breeding and hunting conditions on farmland. The nesting site has been mapped and may be avoided during the clearing process if possible, in particular during breeding activities. Breeding is dependent on the availability of prey species (house mouse and rabbits), rather than being seasonal. Breeding of small mammals up to plague proportions have shown to attract a congregation of Eastern Barn Owl (Blakers *et al.* 1984). Outside the breeding season, the adult birds can move away from any disturbances and find suitable conditions elsewhere on farmland.

¹ calls of the South-eastern Long-eared Bat (*Nyctophilus corbeni*) are indistinguishable from calls of the Large-footed Myotis (*Myotis macropus*), Lesser Long-eared Bat (*Nyctophilus geoffroyi*) and Gould's Long-eared Bat (*Nyctophilus gouldi*).



Plate 4: Common Bearded Dragon recorded from survey area

Table 5: Fauna species recorded from the survey area (previous and current)

Family and Species	Common Name	Conservation Status			EHP (2017)	Current Survey (Ecoscape 2018)													
		EPBC Act	FFG Act	DSE (2013)		S01	S02	S03	S04	S05	S06	S07	S08	S09	S10	S11	S12	Opp	
MAMMALS																			
Tachyglossidae																			
<i>Tachyglossus aculeatus</i>	Short-beaked Echidna																		•
Phalangeridae																			
<i>Trichosurus vulpecula</i>	Brush-tail Possum								9										•
Macropodidae																			
<i>Macropus giganteus</i>	Eastern Grey Kangaroo					2	3				S								•
<i>Macropus fuliginosus</i>	Western Grey Kangaroo				•														
<i>Osphranter rufus</i>	Red Kangaroo				•														
Molossidae																			
<i>Austronomus australis</i>	White-striped Free-tailed Bat					•	•		•	•		•	•	•	•				
<i>Ozimops planiceps</i>	Southern Free-tailed Bat					•	•		•	•		•	•	•	•				
<i>Ozimops ridei</i>	Ride's Free-tailed Bat								NC				NC	NC	NC				
Vespertilionidae																			
<i>Chalinolobus gouldii</i>	Gould's Wattled Bat					•	•		•	•		•	•	•	•				
<i>Chalinolobus morio</i>	Chocolate Wattled Bat					•	•		•	•		•	•	•	•				
<i>Myotis macropus/Nyctophilus sp.</i>	Large-footed Myotis/Unidentified Long-eared Bat					NC	NC			NC		NC	NC	NC	NC				
<i>Scotorepens balstoni</i>	Inland Broad-nosed Bat											•			•				
<i>Vespadelus baverstocki / vulturnus</i>	Inland Forest Bat / Little Forest Bat						NC		NC	NC		NC			NC				
Introduced Mammals																			
<i>Mus musculus</i>	House Mouse				•					50+									•
<i>Vulpes vulpes</i>	Red Fox				•			1											•
<i>Felis catus</i>	Cat																		•
<i>Oryctolagus cuniculus</i>	European Rabbit				•		1						1						•
<i>Lepus europeaus</i>	European Hare				•														•
<i>Ovis aries</i>	Sheep							•											•
BIRDS																			
Podicipedidae																			
<i>Tachybaptus novaehollandiae</i>	Australasian Grebe																		R
<i>Poliiocephalus</i>	Hoary-headed Grebe																		R
Accipitridae																			
<i>Elanus caeruleus</i>	Black-shouldered Kite				•					1					1				•
<i>Aquila audax</i>	Wedge-tailed Eagle				•						1				1				•
<i>Accipiter fasciatus</i>	Brown Goshawk				•							1							
<i>Milvus migrans</i>	Black Kite																		•
<i>Haliastur sphenurus</i>	Whistling Kite				•														•
Charadriidae																			
<i>Vanellus miles</i>	Masked Lapwing																		R

Family and Species	Common Name	Conservation Status			EHP (2017)	Current Survey (Ecoscape 2018)													
		EPBC Act	FFG Act	DSE (2013)		S01	S02	S03	S04	S05	S06	S07	S08	S09	S10	S11	S12	Opp	
Columbidae																			
<i>Phaps chalcoptera</i>	Common Bronzewing				•														
<i>Ocyphaps lophotes</i>	Crested Pigeon				•	1	8	2		10	7		6	4				•	
<i>Geopelia striata</i>	Peaceful Dove				•														
Tytonidae																			
<i>Tyto alba</i>	Eastern Barn Owl				•					5								•	
Aegothelidae																			
<i>Aegotheles cristatus</i>	Australian Owlet-nightjar					1			1	4								•	
Falconidae																			
<i>Falco cenchroides</i>	Australian Kestrel				•											1		•	
<i>Falco berigora</i>	Brown Falcon																	•	
<i>Falco subniger</i>	Black Falcon		L	VU	•														
<i>Falco peregrinus</i>	Peregrine Falcon				•														
Cacatuidae																			
<i>Cacatua roseicapilla</i>	Galah				•	15		2	3	14	6	2	8					•	
<i>Cacatua</i> sp.	Corella				•														
<i>Nymphicus hollandicus</i>	Cockatiel												12						
Psittacidae																			
<i>Glossopsitta concinna</i>	Musk Lorikeet																	•	
<i>Platycercus eximius</i>	Eastern Rosella						8	1		12	4	2						•	
<i>Psephotus varius</i>	Mulga Parrot				•														
<i>Psephotus haematonotus</i>	Red-rumped Parrot				•						9							•	
<i>Northiella haematogaster</i>	Blue Bonnet				•		4											•	
<i>Polytelis swainsoni</i>	Superb Parrot	VU	L	EN								1							
Climacteridae																			
<i>Climacteris picumnus</i>	Brown Treecreeper			NT	•														
Maluridae																			
<i>Malurus splendens</i>	Splendid Fairy-wren				•														
<i>Malurus cyanues</i>	Superb Fairy-wren				•														
<i>Malurus leucopterus</i>	White-winged Fairy-wren						4									6		•	
Meliphagidae																			
<i>Acanthorhynchus tenuirostris</i>	Eastern Spinebill				•														
<i>Melithreptus brevirostris</i>	Brown-headed Honeyeater				•														
<i>Epthianura albifrons</i>	White-fronted Chat				•											8		•	
<i>Acanthagenys rufogularis</i>	Spiny-cheeked Honeyeater				•													•	
<i>Anthochaera carunculata</i>	Red Wattlebird				•														
<i>Lichenostomus fuscus</i>	Fuscous Honeyeater				•														
<i>Lichenostomus leucotis</i>	White-eared Honeyeater				•														
<i>Purnella albifrons</i>	White-fronted Honeyeater				•													•	

Family and Species	Common Name	Conservation Status			EHP (2017)	Current Survey (Ecoscape 2018)													
		EPBC Act	FFG Act	DSE (2013)		S01	S02	S03	S04	S05	S06	S07	S08	S09	S10	S11	S12	Opp	
<i>Manorina melanocephala</i>	Noisy Miner				•	10	5	4	3	11	5	2	8	3	1			•	
<i>Manorina flavigula</i>	Yellow-throated Miner				•														
<i>Gavicalis virescens</i>	Singing Honeyeater				•													•	
<i>Ptilotula ornata</i>	Yellow-plumed Honeyeater				•														
<i>Ptilotula penicillata</i>	White-plumed Honeyeater				•													•	
Pardalotidae																			
<i>Pardalotus punctatus</i>	Spotted Pardalote				•														
<i>Pardalotus striatus</i>	Striated Pardalote					10		1											
Acanthizidae																			
<i>Smicromis brevirostris</i>	Weebill				•	4	3			1									
<i>Acanthiza apicalis</i>	Broad-tailed Thornbill (Inland Thornbill)				•														
<i>Acanthiza nana</i>	Yellow Thornbill				•														
<i>Acanthiza uropygialis</i>	Chestnut-rumped Thornbill				•														
<i>Acanthiza reguloides</i>	Buff-rumped Thornbill				•														
<i>Acanthiza chrysorrhoa</i>	Yellow-rumped Thornbill				•													•	
Pomatostomidae																			
<i>Pomatostomus superciliosus</i>	White-browed Babbler				•														
Cracticidae																			
<i>Cracticus torquatus</i>	Grey Butcherbird				•														
<i>Cracticus nigrogularis</i>	Pied Butcherbird				•	1					3			1	1			•	
<i>Cracticus tibicen</i>	Australian Magpie				•	3		1	4	3	6	19	1	3	1			•	
<i>Strepera graculina</i>	Pied Currawong				•														
Campephagidae																			
<i>Coracina novaehollandiae</i>	Black-faced Cuckoo-shrike				•													•	
Neosittidae																			
<i>Daphoenositta chrysoptera</i>	Varied Sittella				•														
Pachycephalidae																			
<i>Colluricincla harmonica</i>	Grey Shrike-thrush				•														
Rhipiduridae																			
<i>Rhipidura leucophrys</i>	Willie Wagtail				•							1						•	
Monarchidae																			
<i>Grallina cyanoleuca</i>	Magpie-lark				•	2	2											•	
<i>Myiagra inquieta</i>	Restless Flycatcher				•														
Corvidae																			
<i>Corvus coronoides</i>	Australian Raven				•	2	2	3		1	1					3		•	
<i>Corvus mellori</i>	Little Raven				•													•	
Corcoracidae																			
<i>Corcorax melanorhamphos</i>	White-winged Chough				•	8		12				22						•	
Petroicidae																			

Family and Species	Common Name	Conservation Status			EHP (2017)	Current Survey (Ecoscape 2018)													
		EPBC Act	FFG Act	DSE (2013)		S01	S02	S03	S04	S05	S06	S07	S08	S09	S10	S11	S12	Opp	
<i>Microeca fascinans</i>	Jacky Winter				•														
Hirundinidae																			
<i>Hirundo neoxena</i>	Welcome Swallow																		•
<i>Petrochelidon ariel</i>	Fairy Martin				•														
Motacillidae																			
<i>Anthus australis</i>	Australian Pipit																4		•
Introduced Birds																			
<i>Columba livia</i>	Domestic Pigeon (Rock Dove)												2						•
<i>Sturnus vulgaris</i>	Common Starling				•								60					5	•
<i>Passer domesticus</i>	House Sparrow				•														•
REPTILES																			
Diplodactylidae																			
<i>Diplodactylus vittatus</i>	Eastern Stone Gecko				•														
Agamidae																			
<i>Pogona barbata</i>	Common Bearded Dragon			VU	•					1									
Scincidae																			
<i>Menetia greyi</i>	Grey's Skink				•														
<i>Morethia boulengeri</i>	Boulenger's Morethia				•														
<i>Pseudonaja textilis</i>	Eastern Brown Snake								S										

S = Secondary evidence (scats, tracks etc.)

R = Regional record outside of survey area

NC = Needs confirmation as species calls are not reliably distinguishable from other species



LEGEND

Fauna Sites

- Survey Site
- Motion Camera
- Ultrasonic Bat Recorder

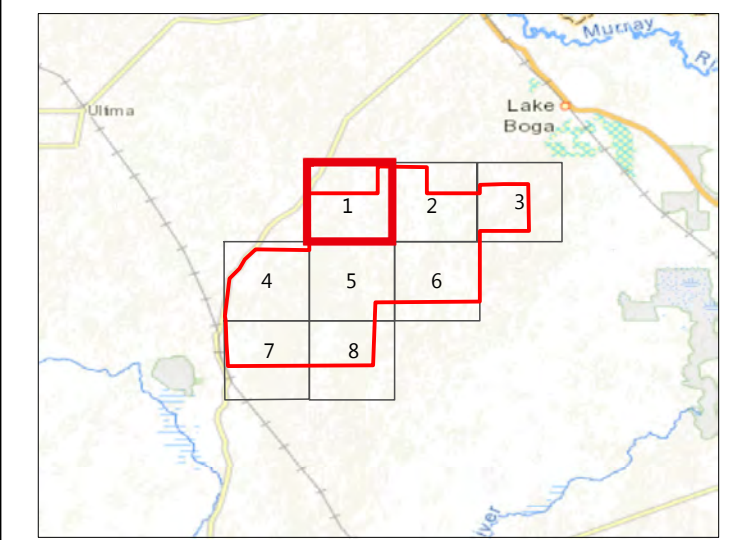
Roads and Drainage

- Major Road
- Minor Road
- Drainage lines
- ▭ Survey Area (50m Buffer)

Habitat Type

- Agricultural land
- Mallee Woodland

DATASOURCES :
 SOURCE DATA: DATA VIC
 AERIAL: WORLD IMAGERY BASEMAP
 SERVICE LAYERS: SOURCE: ESRI, DIGITALGLOBE, GEOEYE, EARTHSTAR GEOGRAPHICS, CNES/AIRBUS
 DS, USDA, USGS, AERGRID, IGN, AND THE GIS USER COMMUNITY



**HABITAT MAPPING, SURVEY SITES
 AND CONSERVATION SIGNIFICANT
 FAUNA LOCATIONS**

VHM TARGETED FAUNA SURVEY

VHM EXPLORATION

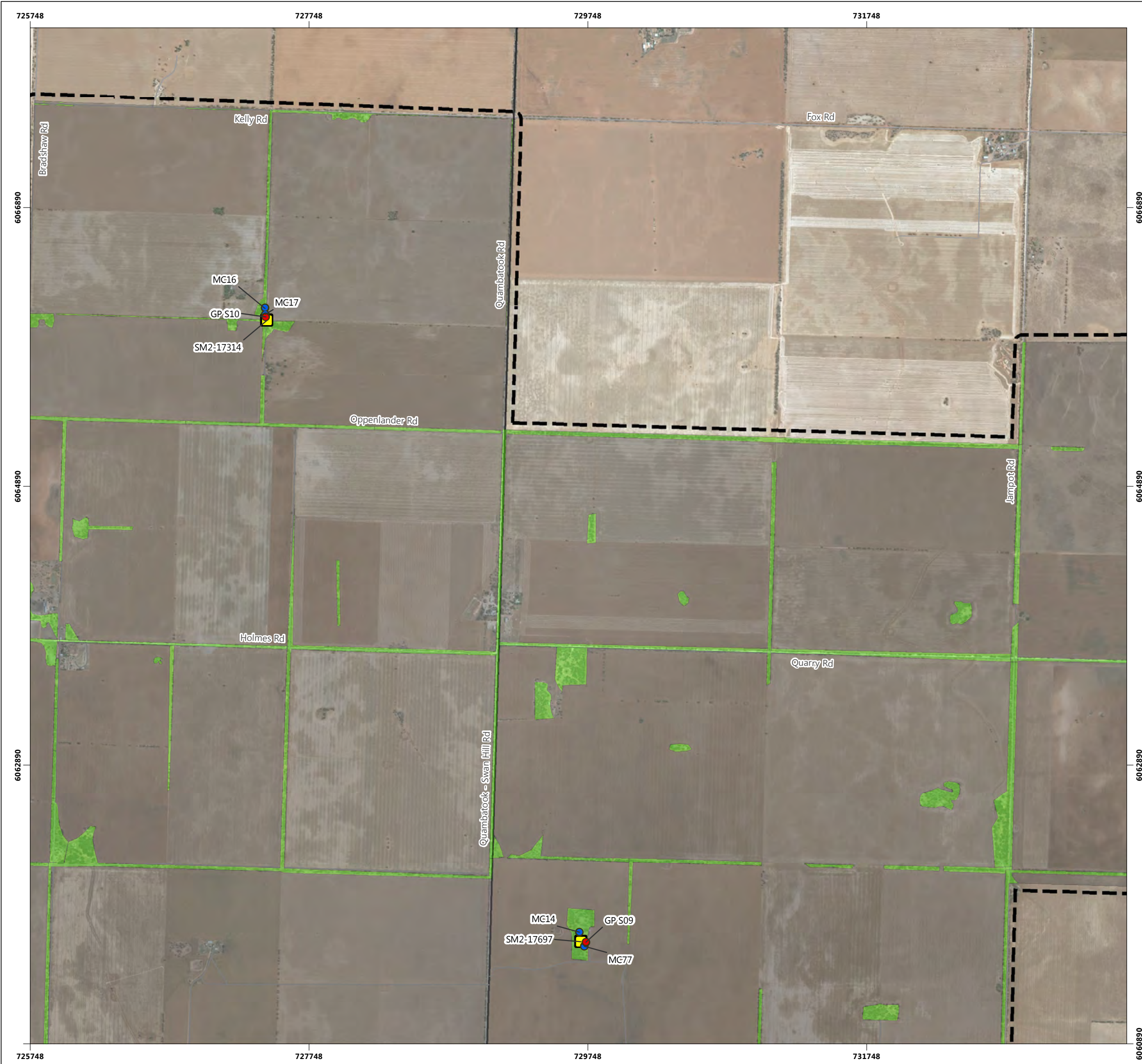
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 PROJECTION: TRANSVERSE MERCATOR
 DATUM: GDA 1994
 UNITS: METER



PROJECT NO: 4137-18

REV	AUTHOR	APPROVED	DATE
00	AF	DC	27/03/2018
01	JN	MW	19/04/2018

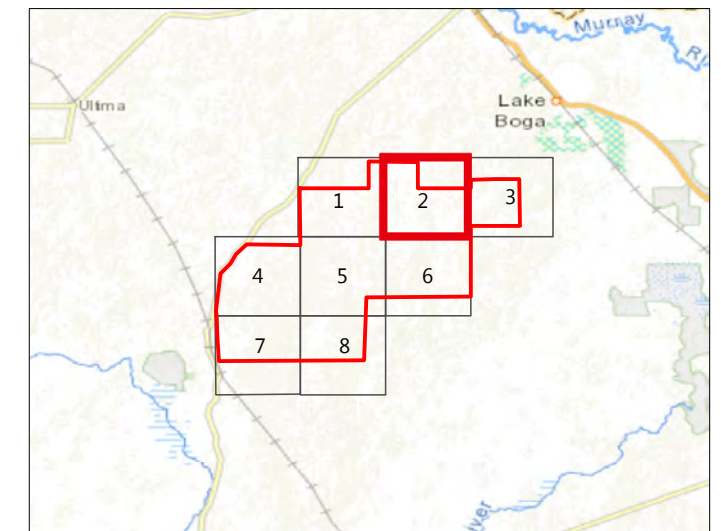
**MAP
 2-1**



LEGEND

- Fauna Sites**
- Survey Site
 - Motion Camera
 - Ultrasonic Bat Recorder
- Roads and Drainage**
- Major Road
 - Minor Road
 - Drainage lines
 - ⬜ Survey Area (50m Buffer)
- Habitat Type**
- Agricultural land
 - Mallee Woodland

DATASOURCES :
 SOURCE DATA: DATA VIC
 AERIAL: WORLD IMAGERY BASEMAP
 SERVICE LAYERS: SOURCE: ESRI, DIGITALGLOBE, GEOEYE, EARTHSTAR GEOGRAPHICS, CNES/AIRBUS DS, USDA, USGS, AERGRID, IGN, AND THE GIS USER COMMUNITY

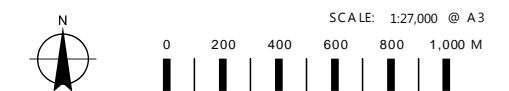


**HABITAT MAPPING, SURVEY SITES
 AND CONSERVATION SIGNIFICANT
 FAUNA LOCATIONS**

VHM TARGETED FAUNA SURVEY

VHM EXPLORATION

COORDINATE SYSTEM: GDA 1994 MGA ZONE 54
 PROJECTION: TRANSVERSE MERCATOR
 DATUM: GDA 1994
 UNITS: METER



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00	AF	DC	27/03/2018
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**MAP
 2 - 2**



LEGEND

Fauna Sites

- Survey Site
- Motion Camera

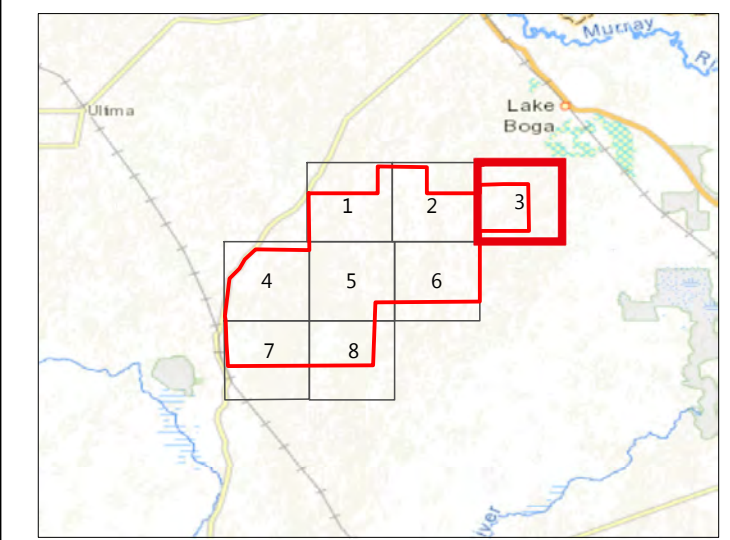
Roads and Drainage

- Major Road
- Minor Road
- Drainage lines
- ⬜ Survey Area (50m Buffer)

Habitat Type

- Agricultural land
- Mallee Woodland
- Salt Lake

DATASOURCES :
 SOURCE DATA: DATA VIC
 AERIAL: WORLD IMAGERY BASEMAP
 SERVICE LAYERS: SOURCE: ESRI, DIGITALGLOBE, GEOEYE, EARTHSTAR GEOGRAPHICS, CNES/AIRBUS DS, USDA, USGS, AERGRID, IGN, AND THE GIS USER COMMUNITY



**HABITAT MAPPING, SURVEY SITES
 AND CONSERVATION SIGNIFICANT
 FAUNA LOCATIONS**

VHM TARGETED FAUNA SURVEY

VHM EXPLORATION

COORDINATE SYSTEM: GDA 1994 MGA ZONE 54
 PROJECTION: TRANSVERSE MERCATOR
 DATUM: GDA 1994
 UNITS: METER



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REV	AUTHOR	APPROVED	DATE
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01	JN	MW	19/04/2018

MAP
2 - 3



LEGEND

Fauna Sites

- Survey Site
- Motion Camera
- Ultrasonic Bat Recorder
- Conservation Significant Fauna

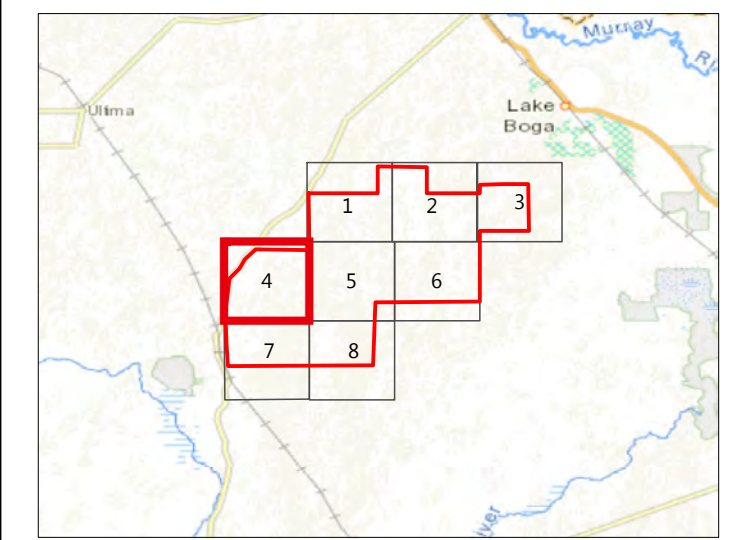
Roads and Drainage

- Major Road
- Minor Road
- Drainage lines
- ▭ Survey Area (50m Buffer)

Habitat Type

- Agricultural land
- Mallee Woodland

DATASOURCES :
 SOURCE DATA: DATA VIC
 AERIAL: WORLD IMAGERY BASEMAP
 SERVICE LAYERS: SOURCE: ESRI, DIGITALGLOBE, GEOEYE, EARTHSTAR GEOGRAPHICS, CNES/AIRBUS
 DS, USDA, USGS, AERGRID, IGN, AND THE GIS USER COMMUNITY



**HABITAT MAPPING, SURVEY SITES
 AND CONSERVATION SIGNIFICANT
 FAUNA LOCATIONS**

VHM TARGETED FAUNA SURVEY

VHM EXPLORATION

COORDINATE SYSTEM: GDA 1994 MGA ZONE 54
 PROJECTION: TRANSVERSE MERCATOR
 DATUM: GDA 1994
 UNITS: METER

SCALE: 1:27,000 @ A3

PROJECT NO: 4137-18

REV	AUTHOR	APPROVED	DATE
00	AF	DC	27/03/2018
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MAP
2-4



LEGEND

Fauna Sites

- Survey Site
- Motion Camera
- Ultrasonic Bat Recorder
- Conservation Significant Fauna
- Barn Owl Nesting Hollow

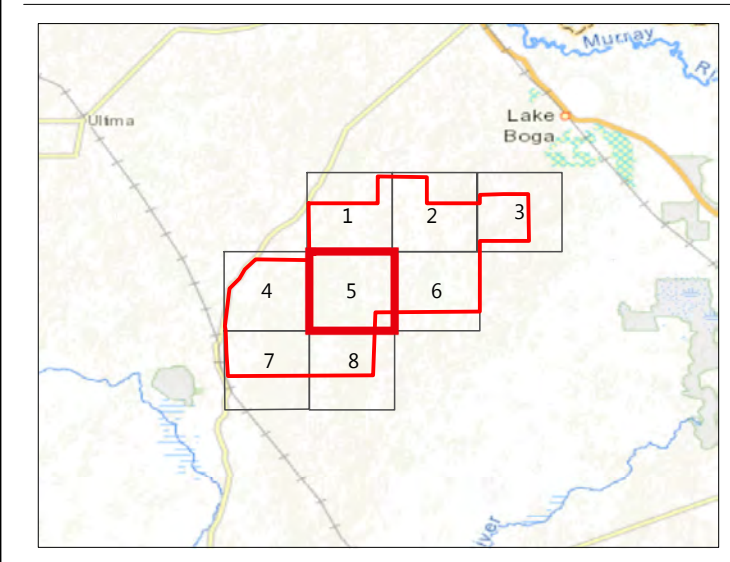
Roads and Drainage

- Major Road
- Minor Road
- Drainage lines
- ▭ Survey Area (50m Buffer)

Habitat Type

- Agricultural land
- Mallee Woodland

DATASOURCES :
 SOURCE DATA: DATA VIC
 AERIAL: WORLD IMAGERY BASEMAP
 SERVICE LAYERS: SOURCE: ESRI, DIGITALGLOBE, GEOEYE, EARTHSTAR GEOGRAPHICS, CNES/AIRBUS DS, USDA, USGS, AERGRID, IGN, AND THE GIS USER COMMUNITY



**HABITAT MAPPING, SURVEY SITES
 AND CONSERVATION SIGNIFICANT
 FAUNA LOCATIONS**

VHM TARGETED FAUNA SURVEY

VHM EXPLORATION

COORDINATE SYSTEM: GDA 1994 MGA ZONE 54
 PROJECTION: TRANSVERSE MERCATOR
 DATUM: GDA 1994
 UNITS: METER

SCALE: 1:27,000 @ A3

PROJECT NO: 4137-18

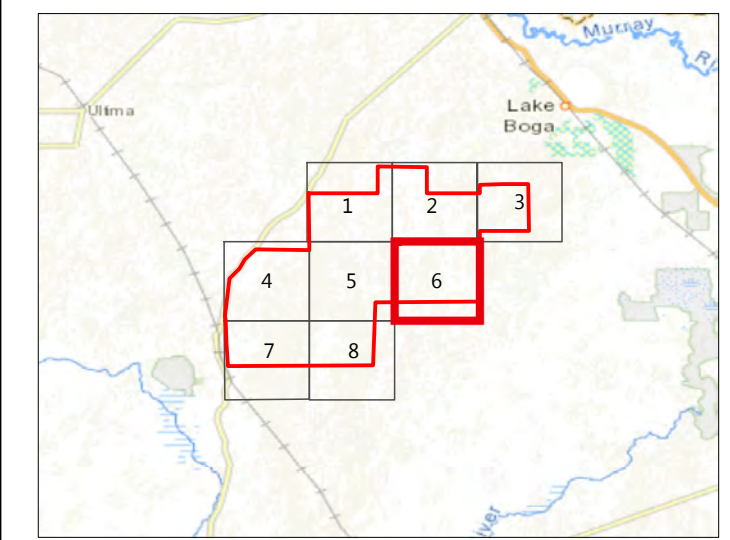
REV	AUTHOR	APPROVED	DATE
00	AF	DC	27/03/2018
01	JN	MW	19/04/2018

MAP
2-5



- LEGEND**
- Roads and Drainage**
- Major Road
 - Minor Road
 - Drainage lines
 - Survey Area (50m Buffer)
- Habitat Type**
- Agricultural land
 - Mallee Woodland

DATASOURCES :
 SOURCE DATA: DATA VIC
 AERIAL: WORLD IMAGERY BASEMAP
 SERVICE LAYERS: SOURCE: ESRI, DIGITALGLOBE, GEOEYE, EARTHSTAR GEOGRAPHICS, CNES/AIRBUS
 DS, USDA, USGS, AERGRID, IGN, AND THE GIS USER COMMUNITY

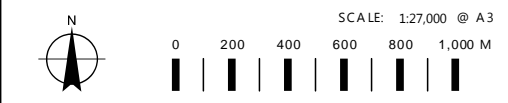


**HABITAT MAPPING, SURVEY SITES
 AND CONSERVATION SIGNIFICANT
 FAUNA LOCATIONS**

VHM TARGETED FAUNA SURVEY

VHM EXPLORATION

COORDINATE SYSTEM: GDA 1994 MGA ZONE 54
 PROJECTION: TRANSVERSE MERCATOR
 DATUM: GDA 1994
 UNITS: METER



PROJECT NO: 4137-18

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01	JN	MW	19/04/2018

MAP
2 - 6



LEGEND

Fauna Sites

- Survey Site
- Motion Camera
- Ultrasonic Bat Recorder

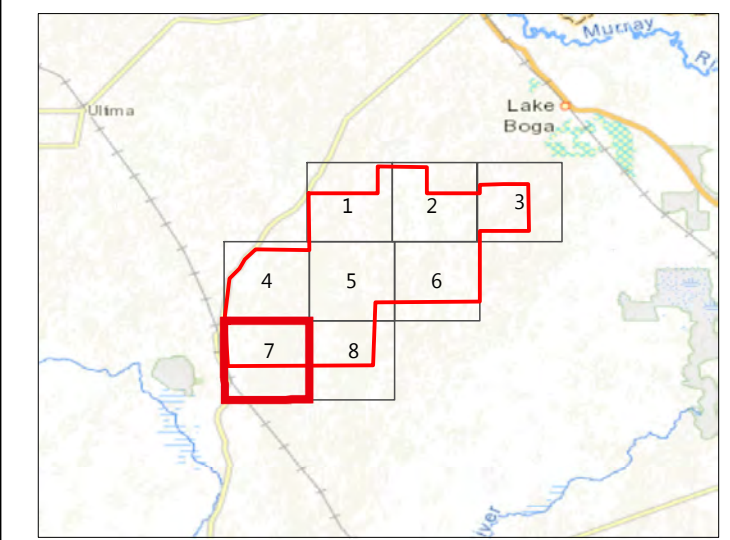
Roads and Drainage

- Major Road
- Minor Road
- Drainage lines
- Survey Area (50m Buffer)

Habitat Type

- Agricultural land
- Mallee Woodland

DATASOURCES :
 SOURCE DATA: DATA VIC
 AERIAL: WORLD IMAGERY BASEMAP
 SERVICE LAYERS: SOURCE: ESRI, DIGITALGLOBE, GEOEYE, EARTHSTAR GEOGRAPHICS, CNES/AIRBUS
 DS, USDA, USGS, AERGRID, IGN, AND THE GIS USER COMMUNITY

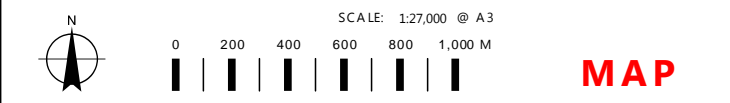


**HABITAT MAPPING, SURVEY SITES
 AND CONSERVATION SIGNIFICANT
 FAUNA LOCATIONS**

VHM TARGETED FAUNA SURVEY

VHM EXPLORATION

COORDINATE SYSTEM: GDA 1994 MGA ZONE 54
 PROJECTION: TRANSVERSE MERCATOR
 DATUM: GDA 1994
 UNITS: METER



PROJECT NO: 4137-18

REV	AUTHOR	APPROVED	DATE
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01	JN	MW	19/04/2018

MAP
2-7



LEGEND

Fauna Sites

- Survey Site
- Motion Camera
- Ultrasonic Bat Recorder

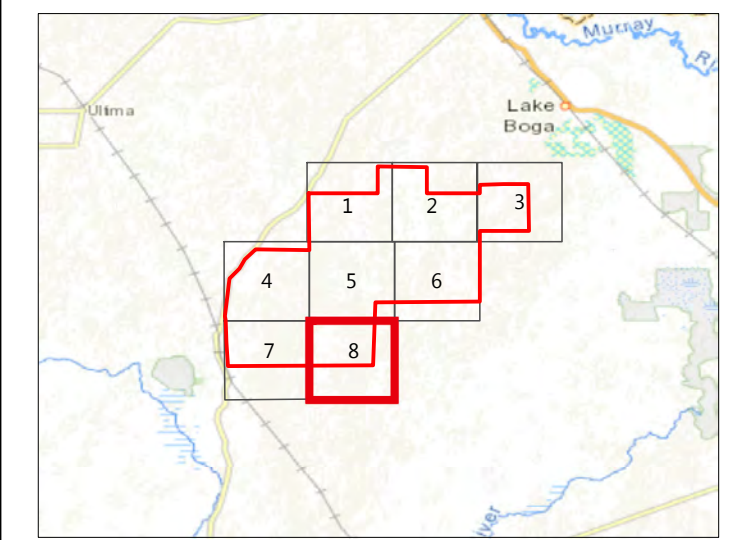
Roads and Drainage

- Major Road
- Minor Road
- Drainage lines
- ⬜ Survey Area (50m Buffer)

Habitat Type

- Agricultural land
- Mallee Woodland

DATASOURCES :
 SOURCE DATA: DATA VIC
 AERIAL: WORLD IMAGERY BASEMAP
 SERVICE LAYERS: SOURCE: ESRI, DIGITALGLOBE, GEOEYE, EARTHSTAR GEOGRAPHICS, CNES/AIRBUS DS, USDA, USGS, AERGRID, IGN, AND THE GIS USER COMMUNITY



**HABITAT MAPPING, SURVEY SITES
 AND CONSERVATION SIGNIFICANT
 FAUNA LOCATIONS**

VHM TARGETED FAUNA SURVEY

VHM EXPLORATION

COORDINATE SYSTEM: GDA 1994 MGA ZONE 54
 PROJECTION: TRANSVERSE MERCATOR
 DATUM: GDA 1994
 UNITS: METER

SCALE: 1:27,000 @ A3

PROJECT NO: 4137-18

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01	JN	MW	19/04/2018

3.3 CONSERVATION SIGNIFICANT FAUNA

The below section discusses all EPBC-listed species that have a high or medium likelihood to occur at the survey area (as identified in **Table 2**), conservation significant species that have been identified during the previous survey as likely to occur at the survey area (Ecology & Heritage 2018), and species that were recorded during the current and previous survey.

3.3.1 PLAINS-WANDERER (*PEDIONOMUS TORQUATUS*)

3.3.1.1 Conservation Status

EPBC Act – Critically Endangered, FFG Act – Threatened, Advisory List – Critically Endangered

3.3.1.2 Distribution and Habitat

Plains-wanderers are found across north-central Victoria, the Riverina region of NSW, eastern South Australia and west central Queensland (Department of the Environment 2015a). Four Key Biodiversity Areas (KBA) / Important Bird Areas (IBA) are associated with Plains-wanderer conservation in these areas; Patho Plains (Vic), Riverina Plains (N.S.W.), Boolcoomatta; Bindarra & Kalkaroo Stations (S.A.), Diamantina & Astrebla Grasslands (Qld) (Birdlife International 2018). The current distribution in Victoria is associated with the Northern Plains which includes the Patho, Lower Avoca and Bunguluke plain area (**Figure 2**). Additional scattered records occur across the state (**Figure 3**).

Suitable habitats are described as low sparse native grassland on hard, red-brown loams with about 40% native herbs and grasses, 50% bare ground and 10% fallen litter (Baker-Gabb *et al.* 1989; Parker & Oliver 2006). Grass tussocks are generally spaced 10–20 cm apart with most vegetation below 5 cm and rarely exceeding 30 cm in height. The small proportion above 5 cm is important for concealment from predators (Parker & Oliver 2006). Highest quality habitats have high species diversity (average of 75 plant species) and lichens on bare ground and numerous perennial plants (Parker & Oliver 2006).

Habitat mapping (Roberts & Roberts 2001) indicates that there is a spectrum of habitats ranging from primary habitat, ideal sparse open grassland, to less ideal secondary habitat which is denser and taller vegetation that is utilised during drought conditions when primary habitats are unsuitable (Parker & Oliver 2006). Period of increased rainfall can rapidly alter habitat structure, creating very dense and unsuitable grassland habitats, which appear to have greater potential impacts compared to drought periods which can cause habitats to become too sparse (Baker-Gabb *et al.* 2016)

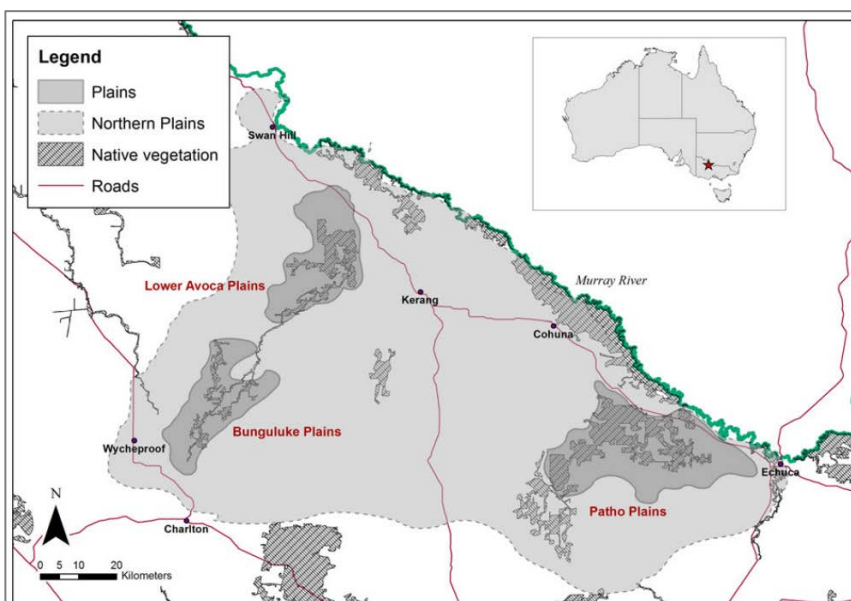
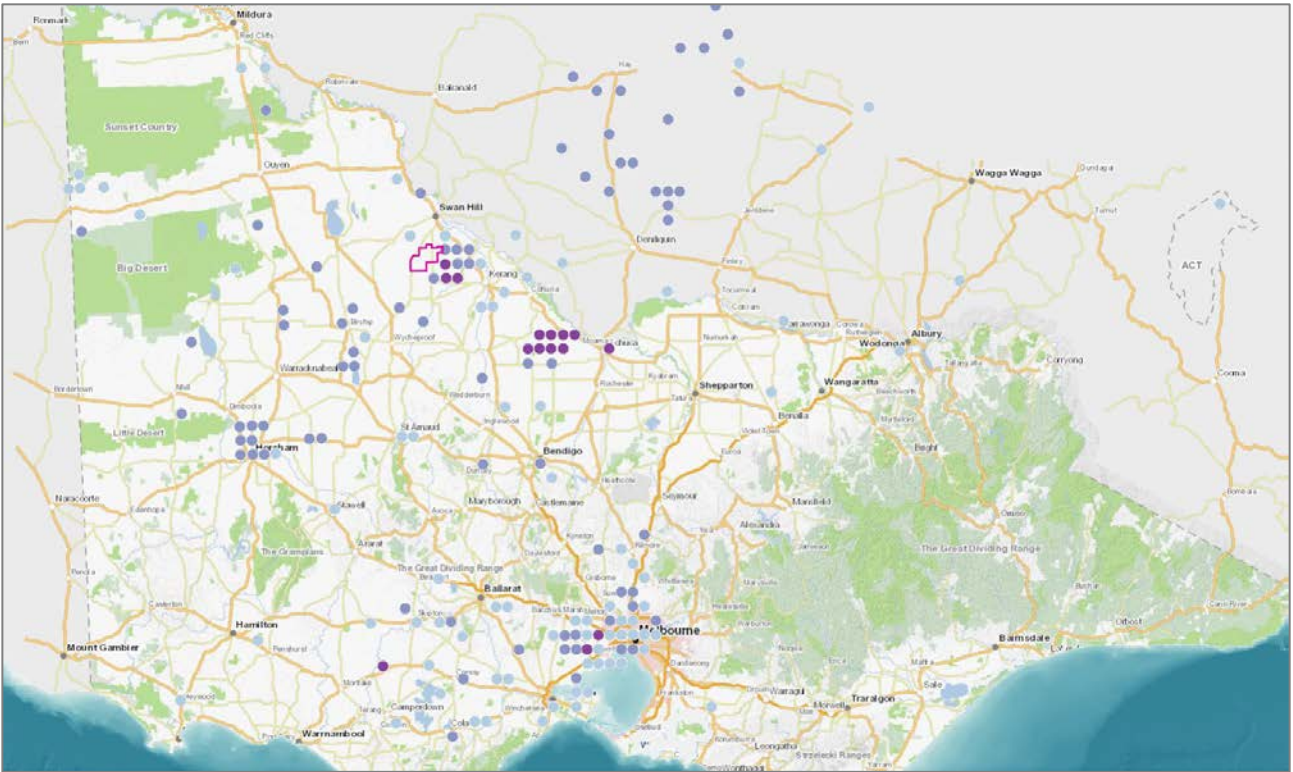


Figure 2: Northern Plain area showing remaining Plains-wanderer habitat (Baker-Gabb *et al.* 2016)



Purple=records from 2001-2018, blue/grey=records from 1976-2000; light blue/grey=records from 1788-1975

Figure 3: Plains-wanderer distribution (NatureKit 2018)

3.3.1.3 Ecology

Plains-wanderer exhibit very strong site fidelity behaviours with average home ranges of 12 ha estimated (range = 7 to 21 ha) with about half the home range overlapping with a bird of the opposite sex (Harrington *et al.* 1988). Populations density estimates indicate that 9 ha of suitable habitat per bird is required (Harrington *et al.* 1988). If disturbed/displaced, Plains-wanderer are unlikely to return to previously occupied territories.

Plains-wanderer diets comprise a mix of fallen grass, chenopod and other seeds (50-60%) and Arthropods (40-50%) with foraging behaviours occurring during the day and dawn/dusk periods (Baker-Gabb 1988). The diet and foraging behaviour are linked with the habitat requirements of this species as the Plains-wanderer requires both bare ground to forage for fallen seeds and ground dwelling arthropods and vegetation clumps to provide cover (Baker-Gabb 1988).

Plains-wanderer breed in spring with clutches of eggs (average five eggs) laid in late August to early November however summer rains may allow a second breeding period in January/February (Baker-Gabb *et al.* 1989; Harrington *et al.* 1988).

3.3.1.4 Threats

Major threats for the Plains-wanderer include historical loss of habitat due to clearing or overgrazing by stock. The species has a specific requirement for native grasslands and is often absent from areas where grass becomes too dense or too sparse (Department of the Environment 2015a). Due to their ground dwelling life style, the Plains-wanderer is also particularly susceptible to predation by feral cats and foxes.

3.3.1.5 Likelihood of Occurrence - Medium

No evidence of Plains-wanderer or suitable native grassland habitats were recorded from the survey area. All of the cleared agricultural land is cultivated for cropping which is not considered suitable agricultural type habitats except on a very occasional basis (Department of the Environment 2015a). All remnant vegetation consisted of Mallee woodland habitats of varying quality with one small claypan habitat located to the north east. Due to the survey area being located to the west of the Lower Avoca plains (**Figure 2**), Plains-wanderers may very occasionally utilise crops (stubble) when the habitat structure is suitable however Plains-wanderers are not known to persist in this habitat type (Department of the Environment 2015a).

3.3.2 SUPERB PARROT (*POLYTELIS SWAINSONII*)

3.3.2.1 Conservation Status

EPBC Act – Vulnerable, FFG Act – Threatened, Advisory List – Endangered

3.3.2.2 Distribution and Habitat

The Superb Parrot occurs in south-eastern Australia from northern Victoria and across NSW along the inland slopes of the Great Dividing Range (Manning *et al.* 2004) (**Figure 4**). In Victoria, Superb Parrots are typically found between Cobram and Echuca, with the Barmah forest area forming core habitats (Baker-Gabb 2011) (**Figure 5**).

The Superb Parrot uses a variety of habitats for different activities. It breeds in forests of River Red Gum (*Eucalyptus camaldulensis*), Blakely's Red Gum (*E. blakelyi*), Grey Box (*E. microcarpa*), Inland Red Box (*E. intertexta*), Yellow Box (*E. melliodoro*), White Box (*E. albens*), Apple Box (*E. bridgesiana*) or Red Box, close to watercourses (Webster 1988). Breeding habitat typically has extensive foraging habitat within 10 km of the nesting sites. Foraging habitat comprises of woodland dominated by gum or box eucalypt, Boree, native pine, Callitris, or box-native pine associations. The Superb Parrot can often be seen foraging on the ground, eating seeds of grasses such as Ringed Wallaby-grass (*Danthinae caespitosa*), barley-grasses (*Critesion* spp.), cereal crops, including wheat, oats and canola, and spilt grain (Webster 1988).

Superb Parrots are associated with highly productive soils which are also prized for agricultural uses, which has resulted in Superb Parrots utilising remnant vegetation with agricultural matrix areas (Manning *et al.* 2007). Superb Parrots prefer more open woodlands with tree cover between 0-30% and show a preference for Blakely's Gum (*Eucalyptus blakelyi*) (Manning *et al.* 2004; Manning *et al.* 2006).

3.3.2.3 Ecology

Superb Parrots breed between September and December along the Murray River (in Victoria) in areas of mature River Red Gum (*Eucalyptus camaldulensis*) (Webster 1988). The Superb Parrot depends on hollows for breeding and appears to prefer trees close to watercourses (25 m), with a large trunk diameter (diameter at breast height (DBH) >1 m) and also hollows in dead trees (Manning *et al.* 2004; Webster 1988).

After breeding (mid-January) Superb Parrots move away from breeding habitat, however the distribution and habitat use during this period (mid-January to early April) is unclear (Baker-Gabb 2011). Superb Parrots require foraging areas to be within 10 km of breeding areas linked by vegetated corridors (Baker-Gabb 2011).

Superb Parrots typically feed on the ground consuming a variety of seeds and fruits found in woodlands dominated by gum and box eucalypts (Christie 2004; Webster 1988).

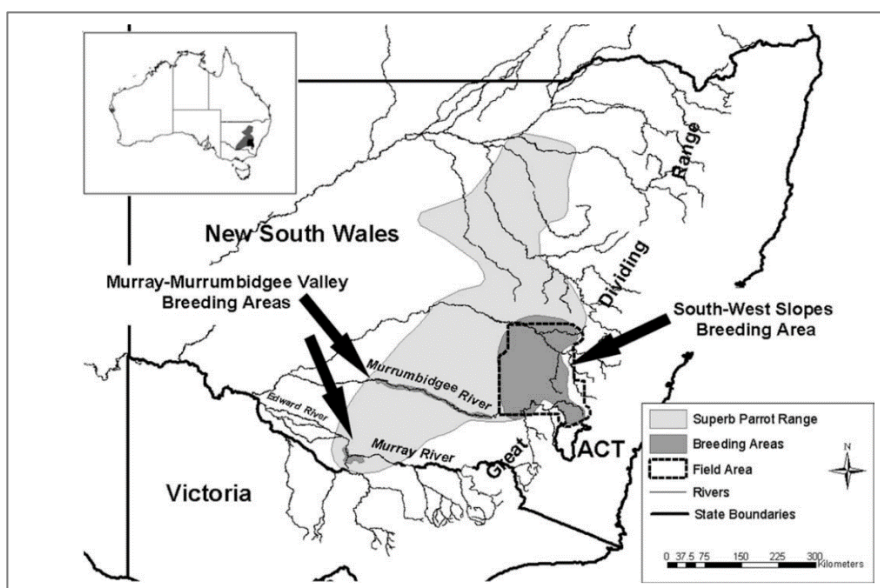
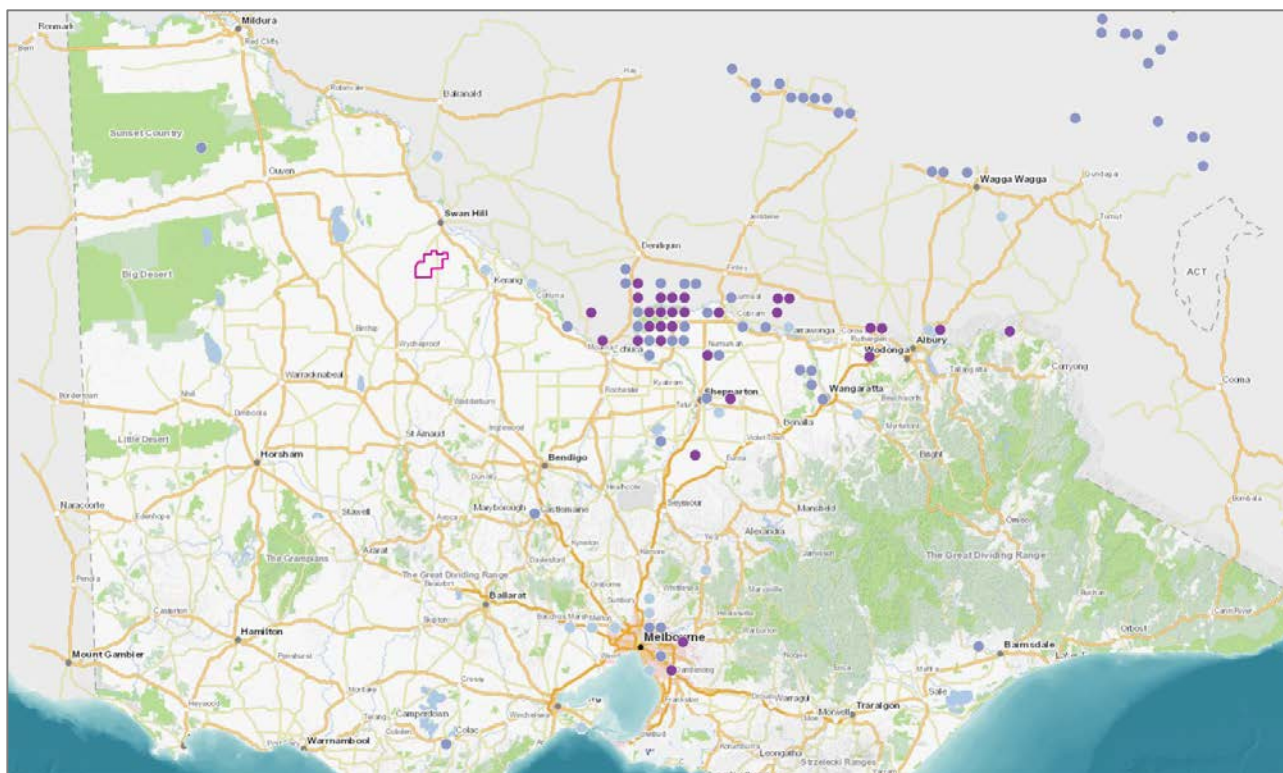


Figure 4: Distribution of Superb Parrot and Breeding Areas (Manning *et al.* 2004)



Purple=records from 2001-2018, blue/grey=records from 1976-2000; light blue/grey=records from 1788-1975

Figure 5: Superb Parrot distribution (NatureKit 2018)

3.3.2.4 Threats

Major threats to the Superb Parrot include habitat clearing and degradation of box woodland throughout the species' distribution. Breeding and foraging habitats, as well as corridors of vegetation used for regular seasonal movements are now fragmented. This process and the specific combination of nesting and foraging habitat required for successful breeding significantly impacts the species, making habitats unsuitable for breeding (Webster 1988). In addition, clearance of corridors that the species is utilising to move between breeding and non-breeding habitats are at threat. Fire also causes degradation of breeding and foraging habitats (Webster & Ahern 1992). Other threats include grazing by stock, competition with introduced species (such as Common Starling and Honey Bees) for nest sites, hydrological changes such as regulation of watercourses, and collisions by vehicles when foraging on the ground along road verges (Australian Government & DotEE 2018b).

3.3.2.5 Likelihood of Occurrence - Recorded

The Superb Parrot was recorded from the survey area during the targeted fauna survey (**Plate 5**). A single Male individual was observed foraging in remnant vegetation along Thompson Rd east of survey site GP S07 (Zone 54H, 721387 mE, 60587239 mN) (**Map 2**). The survey area is located over 100 km to the west of the currently recognised distribution of this species (**Figure 5**). This record is thought to be an example of an individual that has dispersed away from breeding habitats during the period when the distribution and preferred habitats of this species is poorly known (Baker-Gabb 2011). Individuals are then likely to move along corridors of woodland. It is expected that this individual has utilised the vegetated road corridors in this region to move away from the Murray River or nearby tributaries such as the Avoca River. The Superb Parrot is unlikely to breed in the survey area. Feeding may occur on an occasional basis along the road verge and fringing crops, and is not restricted to the survey area, or the location where it was recorded. The individual is in fact more likely to be moving through, before utilising more suitable foraging habitat outside the survey area. Clearance of smaller sections of this road verge habitat is not thought to impact the species; however, the preservation of scattered trees (approx. every 100 m) across cleared areas maintains some habitat connectivity, enables dispersal and minimises potential impacts on the species.



Plate 5: Superb Parrot recorded from survey area

3.3.1 SOUTH-EASTERN LONG-EARED BAT (*NYCTOPHILUS CORBENI*)

3.3.1.1 Conservation Status

EPBC Act – Vulnerable, FFG Act – Threatened, Advisory List – Endangered

3.3.1.2 Distribution and Habitat

The South-eastern Long-eared Bat was described in 2009 when the taxonomy of the Greater Long-eared Bat (*Nyctophilus timorensis*) species group was revised describing five distinct taxa (Parnaby 2009). The distribution of the South-east Long-eared Bat corresponds with the Murray Darling Basin (**Figure 6**) (Turbill & Ellis 2006). There are very few records from Victoria with a small number from near Mildura (Koehler 2006) and Robinvale (purple points in **Figure 7**).

Studies indicate that this species require large areas of continuous woodland habitat with larger remnants of box/ironbark/cypress woodland needed to support high population densities (Turbill & Ellis 2006). Highest abundances were recorded from habitats with a distinct canopy and dense cluttered understorey (Turbill & Ellis 2006). *Allocasuarina* and mallee communities and *Allocasuarina*, mallee, cypress and box communities are also described as suitable habitat (Dick & Barker 2000; Mazzer *et al.* 1998; Val *et al.* 2001).

Recent studies also showed that South-eastern Long-eared Bats require dense forest habitats including old regrowth which had the highest tree densities and that they avoided areas with lower tree densities (Law *et al.* 2016). Roost characterisation studies showed that South-eastern Long-eared Bats prefer dead hollow bearing trees and that they avoided roosting near riparian zones and that they are not roosting in large *Eucalyptus camaldulensis* trees. The species appears to prefer *Allocasuarina* spp. and *Casuarina* spp. (Law *et al.* 2016).

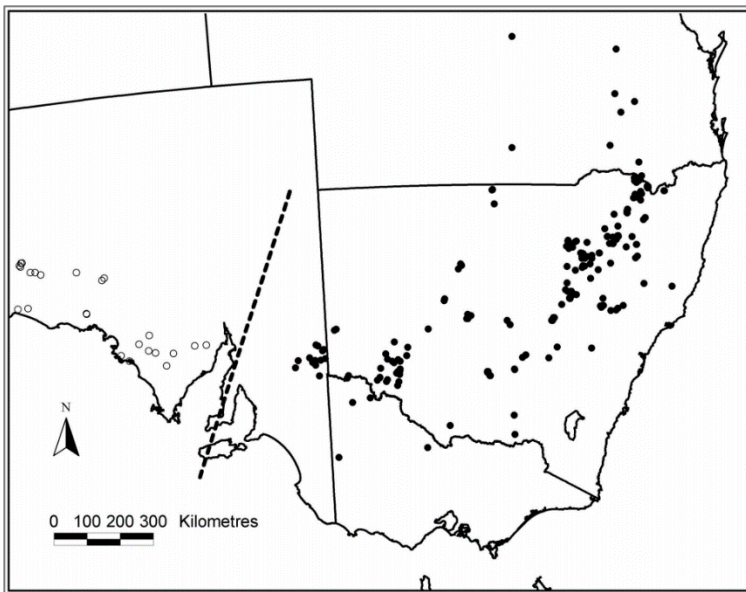
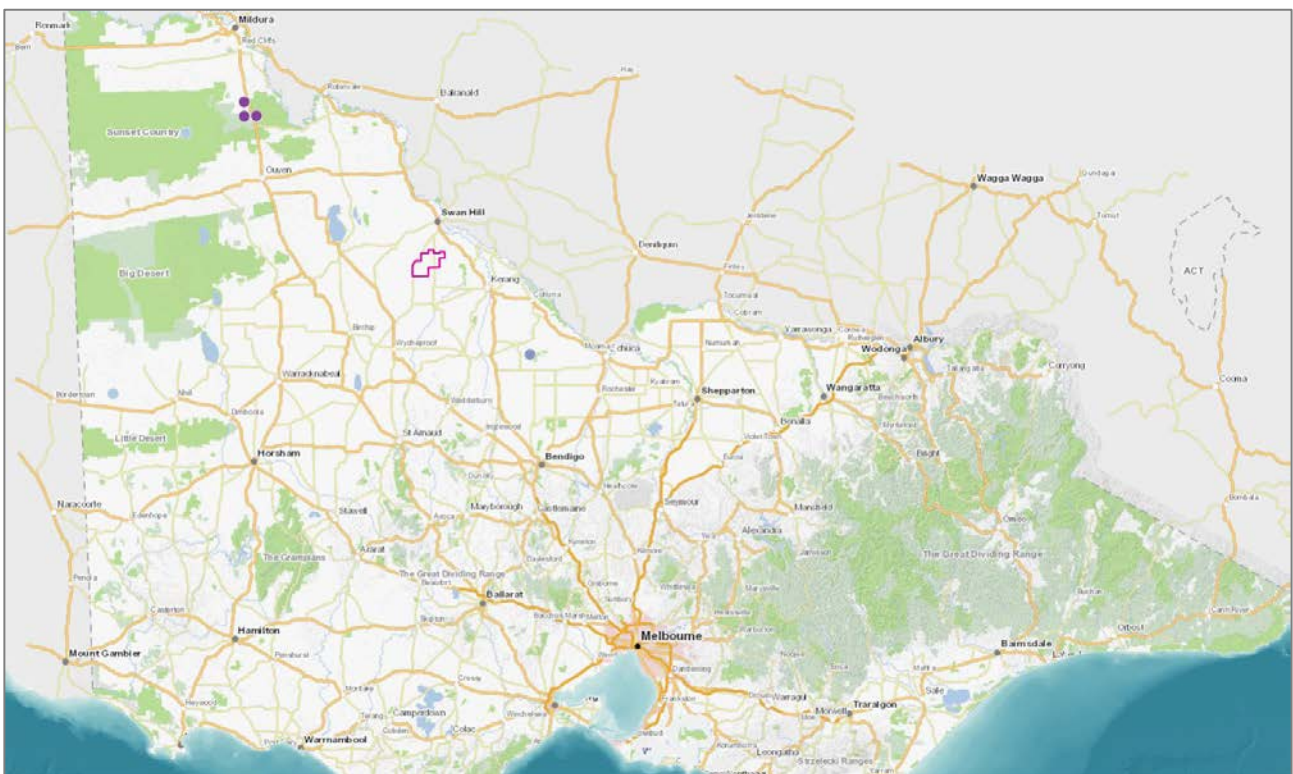


Figure 6: Distribution of South-east Long-eared Bat (Turbill & Ellis 2006)



Purple=records from 2001-2018, blue/grey=records from 1976-2000; light blue/grey=records from 1788-1975

Figure 7: South-eastern Long-eared Bat distribution (NatureKit 2018)

3.3.1.3 Ecology

The South-eastern Long-eared Bat is considered to be part of the narrow space bat guild, bats with that favour slow manoeuvrable flight within vegetation clutter, particularly forests (Hanspach *et al.* 2012; Law *et al.* 2016). The diet of the South-eastern Long-eared Bat comprises of a diverse range of invertebrate prey most consisting of moths but also including beetles, flies and lacewings (Law *et al.* 2016). Breeding occurs in early summer (November) with females forming small maternity colonies (<10 bats) in small hollows/fissures in dead trees with a small diameter (<40 cm DBH) (Law *et al.* 2016).

3.3.1.4 Threats

Threats to the South-eastern Long-eared Bat include habitat loss and fragmentation, fire and reduction of hollow availability (Australian Government & DotEE 2018a).

3.3.1.5 Likelihood of Occurrence – Low

Several factors indicated that there is a low likelihood of the South-eastern Long-eared Bat occurring within the survey area. Research indicates that the South-eastern Long-eared Bat prefers large tracts of dense forest and woodland habitats which is also indicated by the majority of previous records correspond with larger tracts of remnant vegetation located to the north. Although the vegetation communities recorded from the survey area correspond with suitable habitat types, the fragmentation of this remnant vegetation within the survey area and the lack of suitable large dense woodland habitats indicates that South-eastern Long-eared Bat has a low likelihood of occurrence within the survey area. The survey area is also located along the southern edge of the species distribution with the nearest significant population located approximately 100 km to the north (**Figure 6**).

Analysis of the ultrasonic acoustic recordings identified calls that were indistinguishable between three not listed species, Large-footed Myotis (*Myotis macropus*), Lesser Long-eared Bat (*Nyctophilus geoffroyi*), Gould's Long-eared Bat (*Nyctophilus gouldi*), and the conservation significant South-eastern Long-eared Bat (*Nyctophilus corbeni*) (**Appendix Two**). Additional trapping surveys would be required to identify the actual species present. However, the likelihood of the South-eastern Long-eared Bat to occur in the survey area is low based on the lack of suitable habitat and the absence of records in the surrounding.

3.3.2 MALLEEFOWL (*LEIPOA OCELLATA*)

3.3.2.1 Conservation Status

EPBC Act – Vulnerable, FFG Act – Threatened, Advisory List – Endangered

3.3.2.2 Distribution and Habitat

Malleefowl (*Megapodiidae*) occur in semi-arid to arid mallee, mulga or other dense litter-forming shrublands as well as dry forest dominated by other eucalypts, mulga and other *Acacia* species. The species has declined in range and occupancy due to clearing, inappropriate fire regime, introduced predators, and other local causes (Harewood 2007) (**Figure 8**). It is now limited to an area of remnant vegetation in the north-west of Victoria (**Figure 9**).

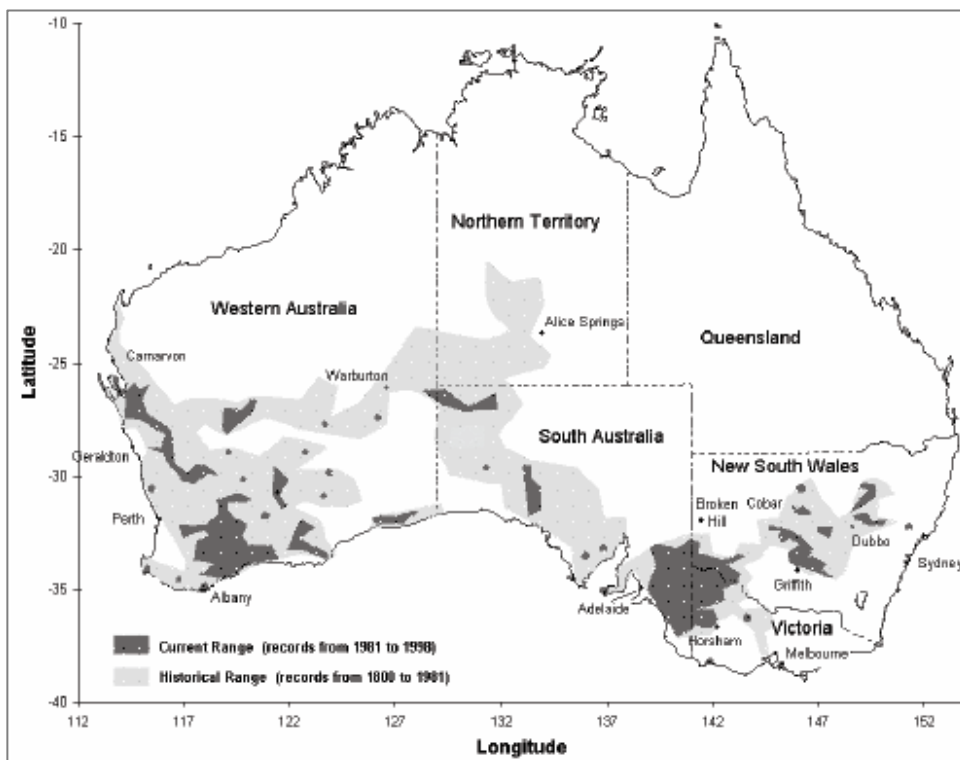
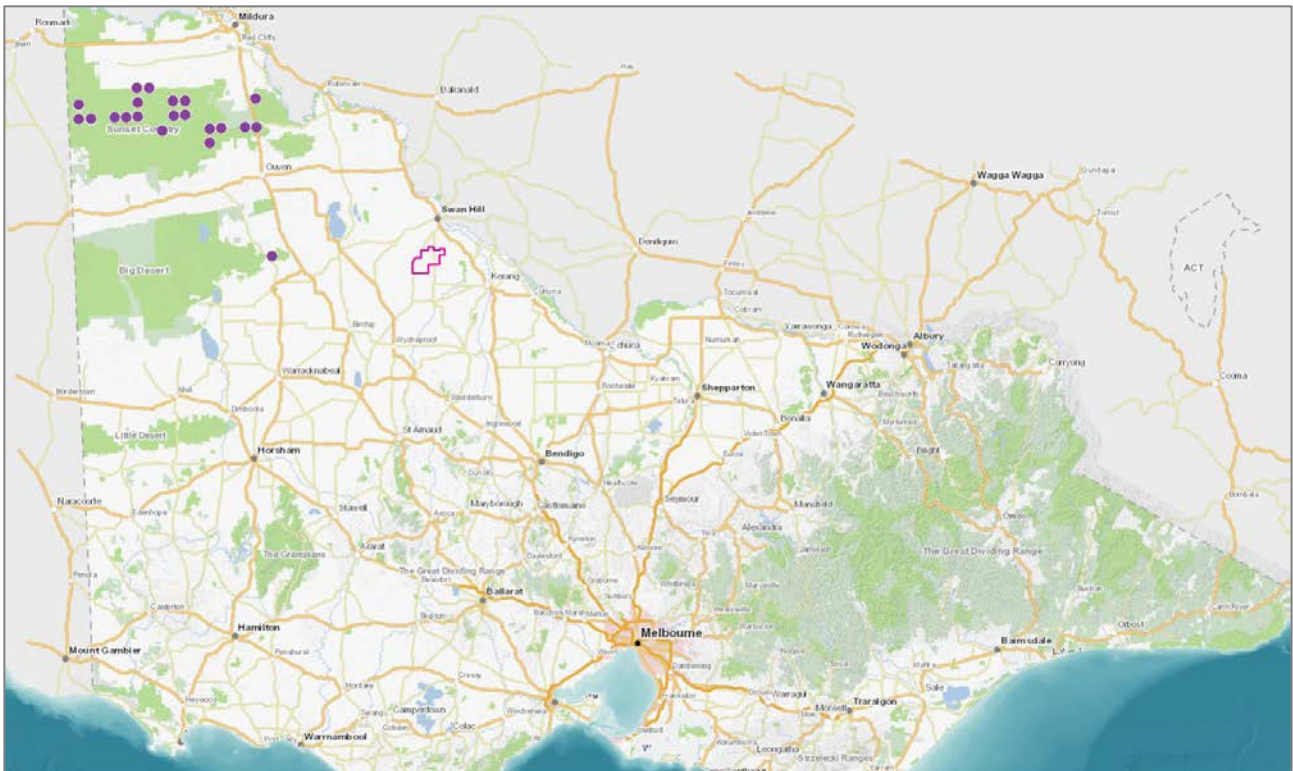


Figure 8: Current and historical distribution of Malleefowl (Benshemesh 2007)



Purple=records from 2001-2018, blue/grey=records from 1976-2000; light blue/grey=records from 1788-1975

Figure 9: Malleefowl distribution (NatureKit 2018)

3.3.2.3 Ecology

Pairs occupy permanent territories, cooperating to build or repair a nesting mound of sand and leaf litter (typically 3-5 m in diameter and 1 m high); after egg-laying, the male alone maintains the mound during incubation, attending it for 9-11 months each year. A sandy substrate is necessary for mound construction. The requirement for abundant litter means that they rarely breed in vegetation that has been burnt within the last 15 years, and the highest breeding densities appear to occur in vegetation that is at least 40 years post fire (Malleefowl Preservation Group Inc. 2011). Active mounds are continually modified in shape according to weather conditions and stage of incubation (Benshemesh 2007). Malleefowl feed on grain where they occur in agricultural areas, including spillage along roadsides; consequently, populations may become dependent on grain being grown annually (rather than at less frequent intervals) in habitats that would otherwise be marginal, and individuals are also at increased risk of mortality and injury from collision with vehicles (e.g. figure from Malleefowl Preservation Group Inc. 2011).

3.3.2.4 Threats

The main threats to the Malleefowl is a combination of permanent habitat loss due to clearing, grazing and fire, isolation of fragmented population and predation by the fox and dogs (Benshemesh 2007). The Malleefowl's habitat tends to overlap with areas of rich soil and relatively high rainfall (southern parts of Australia) which is predominantly cleared for wheat and sheep production. Remnant fragments of habitats that persist are often too small and isolated to support a population of Malleefowl (Benshemesh 2007).

3.3.2.5 Likelihood of Occurrence - Low

The Malleefowl is unlikely to occur in the survey area due to the lack of extensive areas of suitable habitat. The majority of habitat is dominated by cropping which is not considered as suitable habitat for the Malleefowl (Malleefowl Preservation Group Inc. 2011). All remnant vegetation consisted of Mallee woodland habitats of varying quality with one small claypan habitat located to the north east. The current distribution of the species lies 130 km north-west of the survey area where remnant vegetation still persists (**Figure 9**).

3.3.3 REGENT PARROT (EASTERN SUBSPECIES) (*POLYTELIS ANTHOPEPLUS MONARCHOIDES*)

3.3.3.1 Conservation Status

EPBC Act – Vulnerable, FFG Act – Threatened, Advisory List – Vulnerable

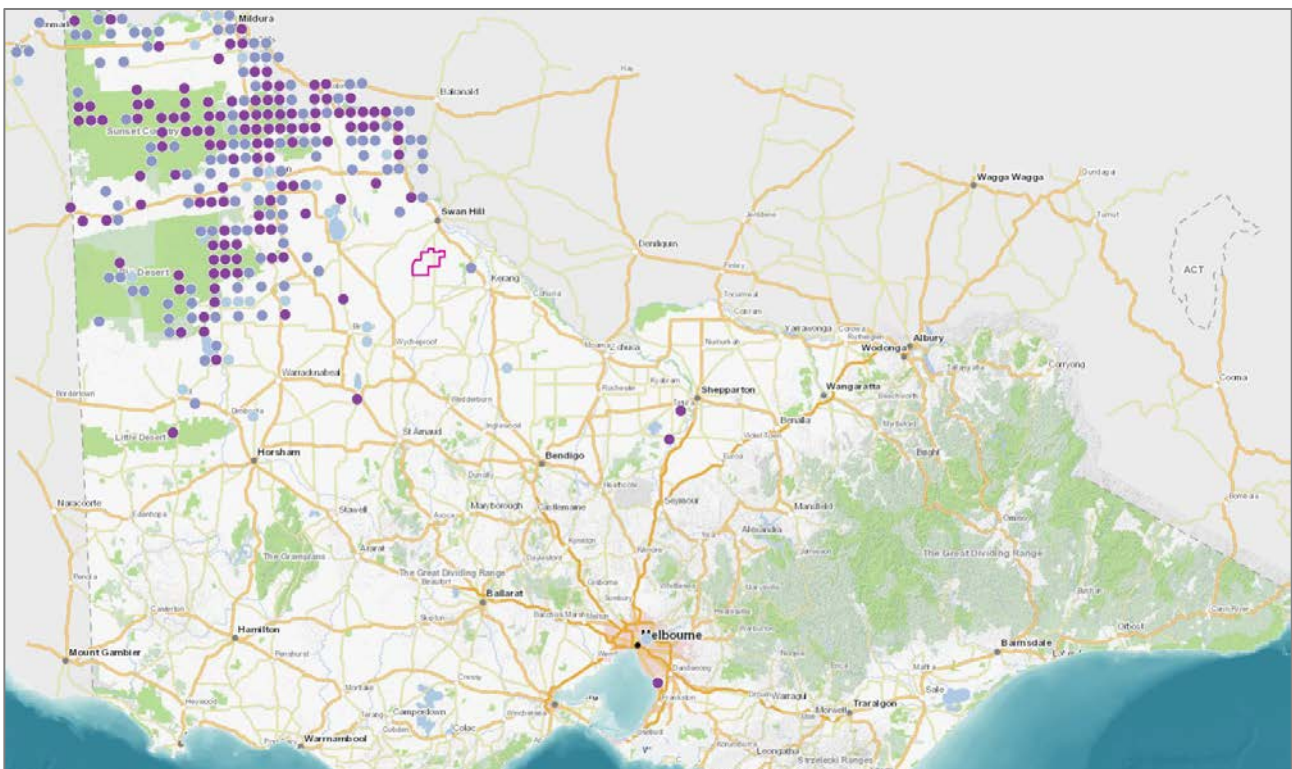
3.3.3.2 Distribution and Habitat

The eastern subspecies of the Regent Parrot (*Polytelis anthopeplus monarchoides*) is restricted to a single population which occurs in the lower Murray-Darling basin region of South Australia, New South Wales and Victoria (Baker-Gabb & Hurley 2011) (**Figure 10**).

The Regent Parrot (eastern) primarily inhabits riparian or littoral River Red Gum (*Eucalyptus camaldulensis*) forests or woodlands and adjacent Black Box (*E. largiflorens*) woodlands. Nearby open mallee woodland or shrubland, usually with a ground cover of spinifex (*Triodia*) or other grasses, supporting various eucalypts, especially Christmas Mallee (*E. socialis*) and Yellow Mallee (*E. costata*), as well as Belah (*Allocasuarina cristata*), Buloke (*A. leuhmannii*) or Slender Cypress Pine (*Callitris preissii*) also provide important habitat for this subspecies. They often occur in farmland, especially if the farmland supports remnant patches of woodland along roadsides or in paddocks. The subspecies rarely occurs in more extensively cleared areas (Australian Government & DotEE 2018b).

Foraging predominantly takes place in Christmas Mallee (*E. socialis*), Yellow Mallee (*E. incrassate*) over a shrub and herb layer which are possibly more important than the tree composition. They are not likely to forage in smaller Mallee remnants dominated by Dumosa Mallee (*E. dumosa*), Red Mallee (*E. oleosa*) and White Mallee (*E. gracilis*).

Nests are built in of River Red Gum (*Eucalyptus camaldulensis*), and occasionally in Black Box (*E. largiflorens*). Nest trees are typically large (>150 cm DBH and approximately 30 m tall), are usually located within 16 m of permanent water, or sometimes actually standing in water. Nest sites may sometimes occur near temporary water sources, such as ephemeral streams or seasonal billabongs, but these are usually within about 60 to 100 m of permanent water sites (Australian Government & DotEE 2018b).



Purple=records from 2001-2018, blue/grey=records from 1976-2000; light blue/grey=records from 1788-1975

Figure 10: Regent Parrot (Eastern) distribution (NatureKit 2018)

3.3.3.3 Ecology

The Regent Parrot is usually seen in pairs or small flocks, but much larger flocks may congregate around abundant sources of food. During the breeding season (August to December), when females are busy incubating the eggs, males may form single-sex flocks. The species is known to undergo extreme natural fluctuation in population numbers (Australian Government & DotEE 2018b).

The eastern Regent Parrot has declined significantly in range and abundance over the last 100 years. Major threats include in particular the clearing and degradation of nesting and foraging habitat, disturbance around nesting sites, competition for nest hollows. In 2011, the population was estimated to be no more than 1,500 adult breeding pairs across an area of 500 km² (Australian Government & DotEE 2018b; Baker-Gabb & Hurley 2011). Three key breeding areas are known from Victoria (Australian Government & DotEE 2018b).

The species is regularly travelling within 10 km from the nesting sites to the foraging sites, but never further than 20 km. Post-breeding dispersal take place from riparian nesting sites to mallee vegetation which can be in considerable distance from breeding areas, on either side of the Murray River (Australian Government & DotEE 2018b).

Regent Parrots appear to be reluctant to fly over open ground in search of feeding areas, preferring to move along vegetated corridors, such as roadsides or drainage lines and rivers. Due to the Regent Parrot feeding on the ground (herbs or spilt grains), the species often gets struck by passing vehicles (Australian Government & DotEE 2018b).

3.3.3.4 Threats

Regent Parrot habitat is often cleared and fragmented, or modified which makes it unsuitable for breeding, due to the loss of adjacent foraging habitat (mallee vegetation) within 20 km of the Murray River. This leaves the remaining habitat fragmented and separated too widely from breeding areas (Australian Government & DotEE 2018b). Regent Parrot avoid flying over extensive open areas and require corridors of vegetation to travel between breeding and foraging sites.

Overgrazing of mallee habitat, loss of breeding hollows due to logging and firewood collection, and shooting of adult birds as pests in orchards and crops are also considerable threats that significantly reduce the breeding population (Australian Government & DotEE 2018b).

3.3.3.5 Likelihood of Occurrence - Medium

The survey area lies south-west of the known distribution of the Regent Parrot (**Figure 10**). The closest sighting is from 1995, from within 15 km south-east of the survey area which is now not considered the species' current range. More recent records were made from 50 km north of the survey area (**Figure 10**). Some suitable habitat is present, in particular along the road verge vegetation that supports herbs and mixed lower shrubs; however, threats such as the presence of the Fox (predator) and the fact that no breeding habitat is present within 20 km of the survey area limits the use of the remnant vegetation as permanent foraging sites. The species may travel through the area during the post-breeding dispersal (January to July), and feed on grains and herbs along road sides on an occasional basis.

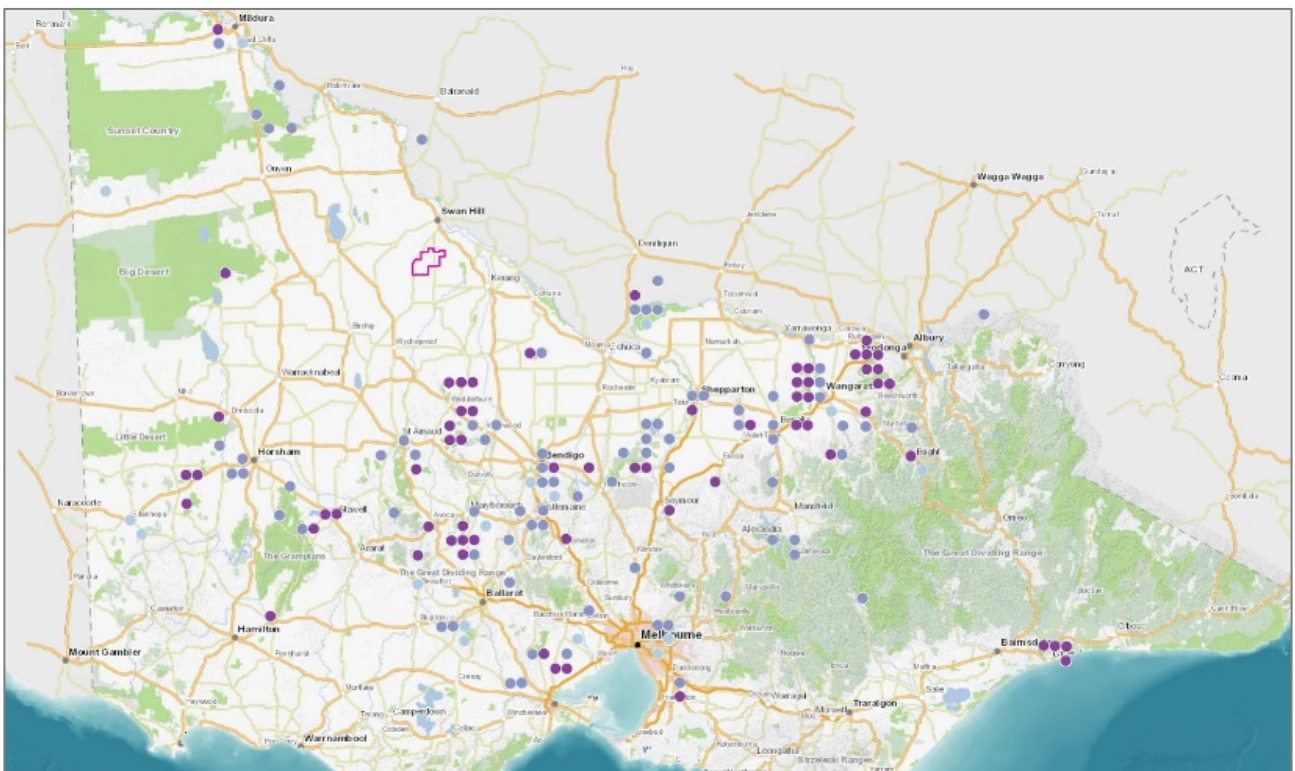
3.3.4 PAINTED HONEYEATER (*GRANTIELLA PICTA*)

3.3.4.1 Conservation Status

EPBC Act – Vulnerable, FFG Act – Threatened, Advisory List – Vulnerable

3.3.4.2 Distribution and Habitat

The Painted Honeyeater inhabits Boree/Weeping Myall (*Acacia pendula*), Brigalow (*A. harpophylla*) and Box-Gum Woodlands and Box-Ironbark Forests. It is strongly associated with mistletoe of the genus *Amyema*. It may also be found along rivers, on plains with scattered trees and on farmland with remnant vegetation (Garnett *et al.* 2011). The species is nomadic and can be commonly seen in the northern parts of its range during winter. It has significantly declined throughout its core range of eastern and south-eastern Australia. Breeding is now restricted to south-eastern Queensland and eastern NSW (Australian Wildlife Conservancy 2018).



Left: purple=records from 2001-2018, blue/grey=records from 1976-2000; light blue/grey=records from 1878-1975
Figure 11: Painted Honeyeater distribution according to NatureKit (2018)

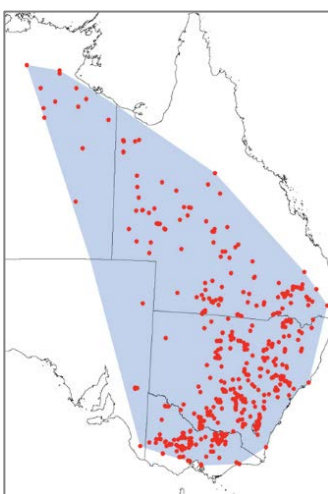


Figure 12: Painted Honeyeater distribution according to Garnett et al. (2011)

3.3.4.3 Ecology

The Painted Honeyeater is nomadic and occurs at low densities throughout its range. They feed alone or in small groups, on flowers of parasitic mistletoes that grow in trees. Their regular seasonal movements coincides therefore with the times when different species of mistletoes are blooming (Birdlife Australia 2018).

3.3.4.4 Threats

The Painted Honeyeater is threatened due to removal or degradation of open forest and woodland remnants, heavy grazing of grassy woodlands, removal of large trees with mistletoe occurrence, inappropriate fire regime, and competition with aggressive and overabundant Noise Miners (NSW Government & Office of Environment and Heritage 2018).

3.3.4.5 Likelihood of Occurrence - Medium

The Painted Honeyeater has not been recorded recently in the surrounding of the survey area (**Figure 11**); however, their occurrence can be sporadic and seasonal (depending on the flowering of mistletoes). Some suitable habitat is present within the survey area, although it is not known if mistletoes of the genus *Amyema* are present. The species may forage occasionally during flowering season (spring) along the road verge Mallee woodland if the appropriate vegetation composition is present. Breeding is not currently known from Victoria and is highly unlikely.

3.3.5 BLACK FALCON (*FALCO SUBNIGER*)

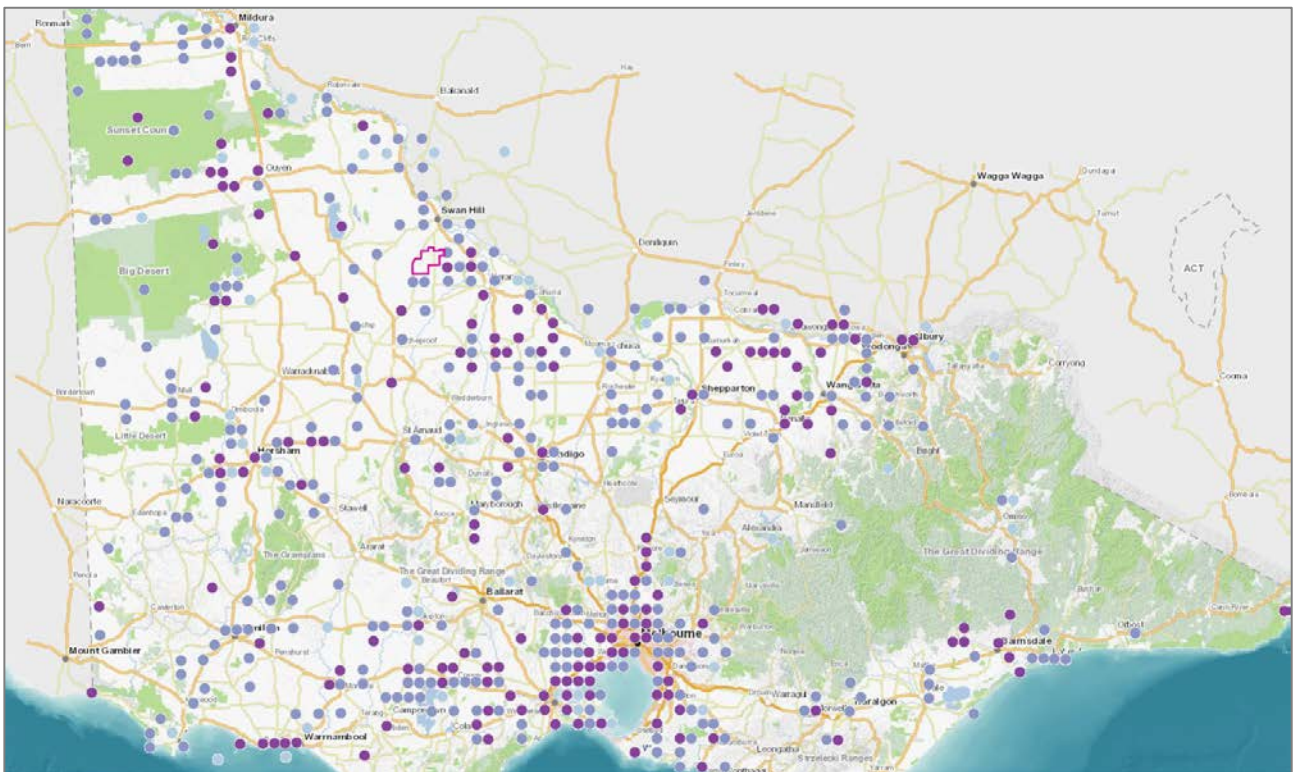
3.3.5.1 Conservation Status

Advisory List – Vulnerable

3.3.5.2 Distribution and Habitat

The Black Falcon occurs throughout Victoria, in particular in the south of the State (**Left**: purple=records from 2001-2018, blue/grey=records from 1976-2000; light blue/grey=records from 1788-1975

Figure 13). There have been recent sightings in the vicinity of the survey area. The Black Falcon is found along tree-lined watercourses and in isolated woodlands (Birdlife Australia 2018).



Left: purple=records from 2001-2018, blue/grey=records from 1976-2000; light blue/grey=records from 1788-1975

Figure 13: Black Falcon distribution (NatureKit 2018)

3.3.5.3 Ecology

The Black Falcon is a diurnal bird of prey. It can be seen roosting on power poles during the day or in trees at night. Prey items include small mammals, insects and reptiles but also other birds (Birdlife Australia 2018).

3.3.5.4 Threats

The Black Falcon is listed as Vulnerable under the Advisory Act due to the absence of data in regards to a potential decline of mature individuals; however the IUCN (Birdlife International 2016) considers the species to be stable and to not approach the threshold for Vulnerable under the range size criterion, or the population trend criterion, and is therefore considered as Least Concern.

The species is well adapted to farmland, with roost sites and a high density of prey items such as House Mice and Rabbits. The species may be at risk of secondary poisoning through rodent bait on farmland.

3.3.5.5 Likelihood of Occurrence - Recorded

The Black Falcon was recorded from the survey area during the fauna and flora survey in December 2017 (Ecology & Heritage 2018). The species is likely to find suitable hunting conditions along the road verges and across the Agricultural Land after harvest. Road verge Mallee woodland can also be used for roosting on an occasional basis.

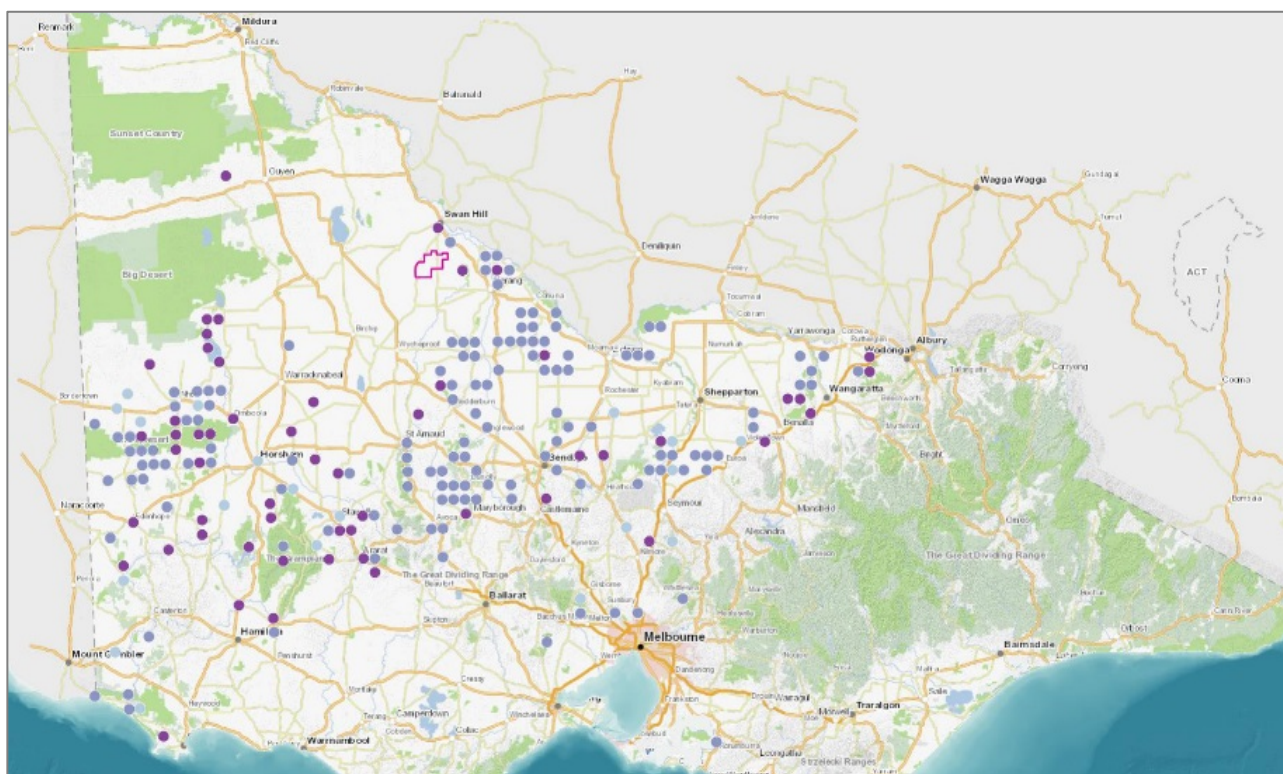
3.3.6 COMMON BEARDED DRAGON (*POGONA BARBATA*)

3.3.6.1 Conservation Status

Advisory List - Vulnerable

3.3.6.2 Distribution and Habitat

The Common Bearded Dragon occurs in patches of remnant woodland throughout its range in Victoria (**Figure 14**). It inhabits woodlands and perches on tree trunk where it can be conspicuous (Wilson & Swan 2017). The Common Bearded Dragon is not a specialised species but rather inhabits any remnant woodland, and can even be seen basking on fence stumps and on roads (Hutchinson 2010).



Left: purple=records from 2001-2018, blue=records from 1976-2000; light blue=records from 1788-1975

Figure 14: Common Bearded Dragon distribution according to NatureKit (2018)

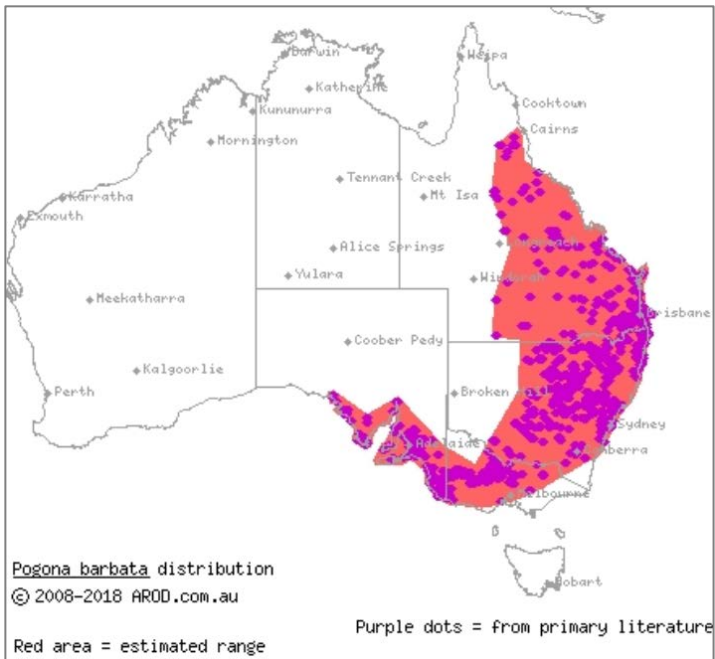


Figure 15: Common Bearded Dragon distribution according to Macdonald (Macdonald 2018)

3.3.6.3 Ecology

The Common Bearded Dragon feeds predominately on vegetable matter (up to 80-90%) such as leaves, berries, and fruits, but also insects such as grasshoppers and moths. The species is diurnal and sleeps on lower branches during night time.

The Common Bearded Dragon relies on its camouflage when perched on tree trunks. Eggs are laid in shallow holes in the soil in an open and sunny spot. Two or three clutches of eggs may be laid by a single female in a good season.

3.3.6.4 Threats

The Common Bearded Dragon is widespread throughout its range and the IUCN lists the species as Least Concern. However, habitat fragmentation and degradation due to land clearing and grazing by stock are a threat to the species and have reduced the species' abundance (Hutchinson 2010). Due to the species relying on its camouflage it is also susceptible to predation by foxes and cats.

3.3.6.5 Likelihood of Occurrence - Recorded

The Common Bearded Dragon was recorded during the current and previous survey (Ecology & Heritage 2018). During this survey, one individual was recorded from a patch of remnant Mallee woodland in the centre of the survey area (**Map 2**). It is likely that the species occurs across the majority of the remnant vegetation. The Bearded Dragon is not a habitat specialist and will utilise trees and any higher ground of remnant vegetation for perching and a variety of plant species for foraging. Predation by foxes and cats is likely higher in grazed woodlands and road verge vegetation, in particular because foxes tend to travel along road verges. The Bearded Dragon is more exposed to predation along road side vegetation and when basking on roads. Local Common Bearded Dragon populations are more likely to remain in a stable condition in larger patches of woodland.

3.3.7 BROWN TREECREEPER (SOUTH-EASTERN)(*CLIMACTERIS PICUMNUS VICTORIAE*)

3.3.7.1 Conservation Status

Advisory List – Near Threatened

3.3.7.2 Distribution and Habitat

The distribution of the southern-eastern subspecies of the Brown Treecreeper is currently not entirely clear and the survey area may or may not be located inside the survey area (**Figure 16**). The south-eastern Brown Treecreeper inhabits dry eucalypt woodlands and adjoining vegetation, and is absent from degraded woodland and rocky hills (Garnett *et al.* 2011). The eastern subspecies is not found in patches of remnant vegetation of less than 10 ha (Garnett *et al.* 2011).

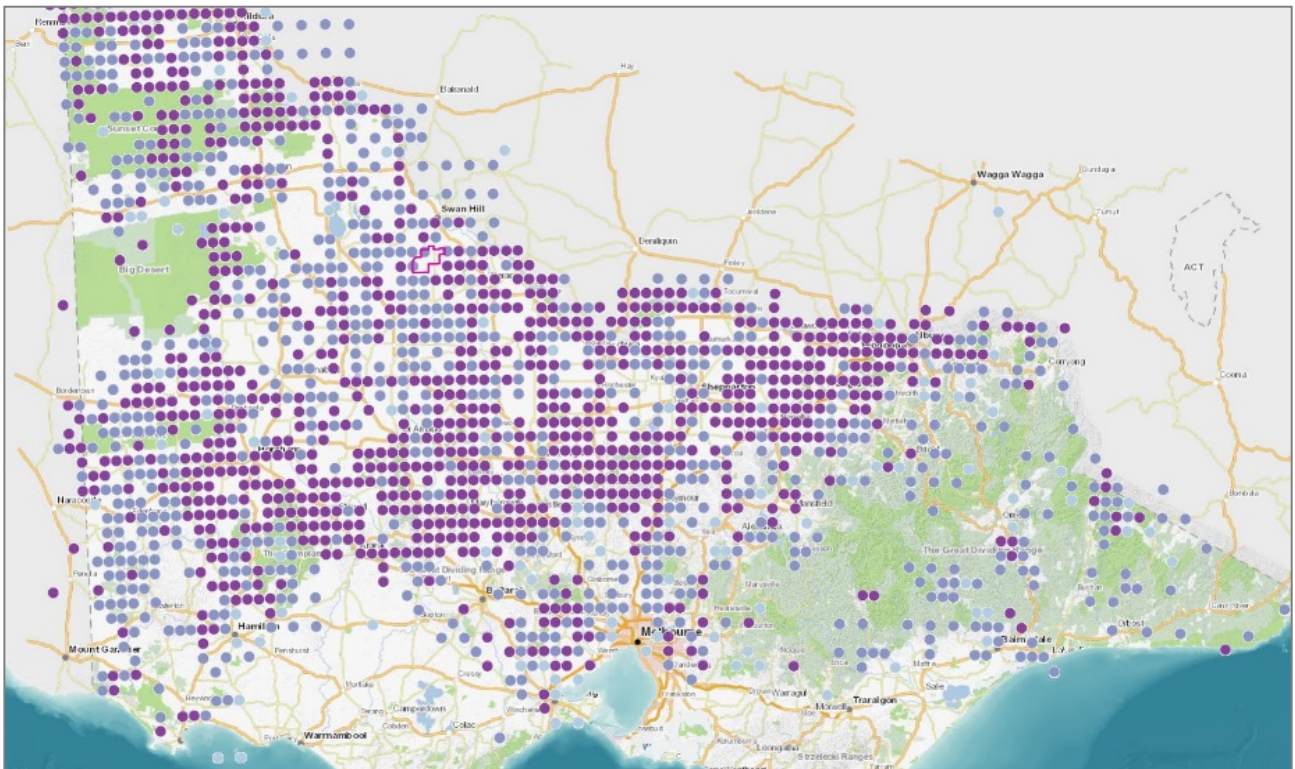


Figure 16: South-eastern Brown Treecreeper distribution according to NatureKit (2018)

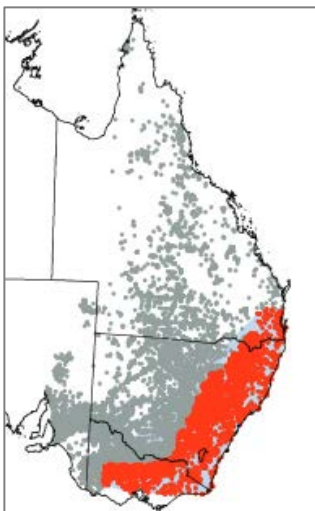


Figure 17 South-eastern Brown Treecreeper distribution according to Garnett *et al.* (2011)

3.3.7.3 Ecology

The South-eastern Brown Treecreeper prefers to breed in areas with a low shrub density, a moderate level of ground cover and a high density of invertebrates. It feeds on ants, beetles, larvae, which are foraged along the tree trunks (alive and dead trees). The South-eastern Brown Treecreeper starts breeding with 2 years of age and. It builds its nest in tree-hollows and lays 2-3 eggs (Garnett *et al.* 2011).

3.3.7.4 Threats

Due to the fragmentation of habitat across the species' range, females are not able to disperse. This South-eastern subspecies of the Brown Treecreeper avoids areas that are more than 700m separated to other woodland unless there are large trees less than 100 m apart for connectivity (Garnett *et al.* 2011). The species is therefore not able to recolonise isolated patches of habitat. In addition, grazing by stock, firewood collection, inappropriate fire regime, predation by introduced feral species and exclusion by aggressive bird species such as the Noisy Miner (*Manorina melanocephala*) are a threat, in particular along habitat edges (Garnett *et al.* 2011).

3.3.7.5 Likelihood of Occurrence – Recorded/Low

The species was recorded from the survey area during the fauna and flora survey in December 2017 (Ecology & Heritage 2018). Based on Garnett's distribution map, the recording from the December 2017 survey is more likely to be the widespread inland subspecies *C. p. picumnus* which is not listed (**Figure 16**).

The survey area does not contain suitably connected woodland habitat of an appropriate size for the South-eastern Brown Treecreeper. The larger patches of habitat present within the survey area are mostly isolated from other larger patches of woodland, disrupting the species recruitment and dispersal. The likelihood for the species is low, despite the record in 2017. Larger patches of woodland are of higher value inside the survey area. If road verge habitat is to be cleared, scattered trees every 80 -100 m may be kept to ensure connectivity.

4 CONCLUSION

The Mallee woodland road verges at the survey area are suitable for occasional foraging for the Regent Parrot and the Superb Parrot. Both species are highly unlikely to breed or permanently forage inside the survey area. They may disperse along the Mallee woodland and road verge habitat on an occasional basis during the non-breeding season.

The Black Falcon finds suitable conditions for foraging and roosting and it may be present throughout the majority of the year. Similarly, the Common Bearded Dragon is likely to permanently inhabit the remnant Mallee woodland patches. It is less likely to use the road verge habitats due to the small size of vegetation and the increased traffic of predators (fox and cats) which prefer to travel along roads and firebreaks.

The South-eastern Brown Treecreeper was recorded during a previous survey from within the survey area; however, the subspecies' distribution is not entirely clear. The preferred habitat of dry eucalypt woodland and adjacent vegetation is missing from the survey area. It is likely that the record in December 2017 was the widespread subspecies *C. p. picumnus* which is not listed.

The south-eastern Long-eared Bat (*Nyctophilus corbeni*) inhabits continuous woodland with larger remnants of box/ironbark/cypress woodland to support the species' high population densities. This habitat is not present within the survey area, therefore the species has a low likelihood to occur. Analysis of the ultrasonic acoustic recordings identified calls that were indistinguishable between three unlisted species; Large-footed Myotis (*Myotis macropus*), Lesser Long-eared Bat (*Nyctophilus geoffroyi*), Gould's Long-eared Bat (*Nyctophilus gouldi*), and the conservation significant South-eastern Long-eared Bat (*Nyctophilus corbeni*). The lack of suitable habitat suggests there is a low likelihood of presence of the South-eastern Long-eared Bat (*Nyctophilus corbeni*) however its occurrence within the survey area can't be ruled out due to the recording of *Nyctophilus*-like calls during the current survey.

It is advisable that clearing and degradation of the road verge vegetation and the Mallee woodland patches is avoided or kept to a minimum, if possible. In particular the road verges are used by native fauna species as dispersal corridor and foraging ground. Any clearance of these corridors may include the preservation of scattered trees every 100 m to maintain a level of habitat connectivity.

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APPENDIX ONE

SURVEY SITES

Table 6: Survey Site Locations

Site name	Survey Site type	Coordinates		Details
		Easting	Northing	
GP S01	Survey Site	723106	6050773	Habitat Assessment and Survey Site
GP S02	Survey Site	714915	6051232	Habitat Assessment and Survey Site
GP S03	Survey Site	725006	6052112	Habitat Assessment and Survey Site
GP S04	Survey Site	723245	6057233	Habitat Assessment and Survey Site
GP S05	Survey Site	723306	6059410	Habitat Assessment and Survey Site
GP S06	Survey Site	723613	6059696	Habitat Assessment and Survey Site
GP S07	Survey Site	719685	6058537	Habitat Assessment and Survey Site
GP S08	Survey Site	720944	6059697	Habitat Assessment and Survey Site
GP S09	Survey Site	729735	6061620	Habitat Assessment and Survey Site
GP S10	Survey Site	727438	6066107	Habitat Assessment and Survey Site
GP S11	Survey Site	736163	6064170	Habitat Assessment and Survey Site
MC001	Motion Camera	736094	6064327	1 MC installed for 4 nights
MC040	Motion Camera	714973	6051156	1 MC installed for 4 nights
MC073	Motion Camera	714972	6051250	1 MC installed for 4 nights
MC074	Motion Camera	723105	6050857	1 MC installed for 4 nights
MC083	Motion Camera	723127	6051028	1 MC installed for 4 nights
MC11	Motion Camera	723492	6059649	1 MC installed for 4 nights
MC12	Motion Camera	736137	6064196	1 MC installed for 4 nights
MC13	Motion Camera	720938	6059653	1 MC installed for 4 nights
MC14	Motion Camera	729689	6061690	1 MC installed for 4 nights
MC16	Motion Camera	727434	6066170	1 MC installed for 4 nights
MC17	Motion Camera	727436	6066124	1 MC installed for 4 nights
MC71	Motion Camera	723521	6059592	1 MC installed for 4 nights
MC76	Motion Camera	723244	6057291	1 MC installed for 4 nights
MC77	Motion Camera	729723	6061589	1 MC installed for 4 nights
MC78	Motion Camera	719987	6058532	1 MC installed for 4 nights
MC79	Motion Camera	719810	6058538	1 MC installed for 4 nights
MC80	Motion Camera	723274	6057185	1 MC installed for 4 nights
MC81	Motion Camera	720956	6059754	1 MC installed for 4 nights
SM2-17314	Ultrasonic Bat recorder	727445	6066080	1 Bat recorder installed for 4 nights
SM2-17697	Ultrasonic Bat recorder	729700	6061621	1 Bat recorder installed for 4 nights
SM2-177152	Ultrasonic Bat recorder	720891	6059689	1 Bat recorder installed for 4 nights
SM2-17769	Ultrasonic Bat recorder	723474	6059527	1 Bat recorder installed for 4 nights
SM4-01147	Ultrasonic Bat recorder	719689	6058525	1 Bat recorder installed for 4 nights
SM4-01233	Ultrasonic Bat recorder	714923	6051192	1 Bat recorder installed for 4 nights

Site name	Survey Site type	Coordinates		Details
		Easting	Northing	
SM4-01240	Ultrasonic Bat recorder	723119	6050818	1 Bat recorder installed for 4 nights
SM4-01247	Ultrasonic Bat recorder	723247	6057239	1 Bat recorder installed for 4 nights

Zone 54H, Datum: GDA96



Bat call identification from Swan Hill, Victoria

Type: Acoustic analysis

Prepared for: Ecoscape Australia Pty Ltd

Date: 29 March 2018

Job No.: SZ454

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This report should be included amongst the technical appendices of the main report, and cited as:

Specialised Zoological (2018). Bat call identification from Swan Hill, Victoria. Acoustic analysis. Unpublished report by Specialised Zoological for Ecoscape Australia Pty Ltd, 29 March 2017, Job number SZ454.

Summary

Bat identifications from acoustic recordings are provided from near Swan Hill, in northern Victoria. At least eight species of bat were identified as being present (**Tables 1** and **2**). Representative echolocation calls for each identification are illustrated (**Figure 1**), as recommended by the Australasian Bat Society (ABS 2006). Further data are available should verification be required.

Comments on identifications

The identification of bat species from full spectrum WAV-format recordings of their echolocation calls was based on measurements of characteristic frequency, observation of pulse shape, and the pattern of harmonics. Some calls could not be attributed unambiguously to one species.

The calls of long-eared bats *Nyctophilus* spp. are recognised as being difficult to identify to species because of their similarity in pulse shape and the overlap in variation of call measurements. They can also be difficult to distinguish from the calls of the Large-footed Myotis *Myotis macropus*, especially if recording quality is not optimal or there are insufficient examples. In this survey, two main call types were recognised (**Figure 1**; **Appendix 1**), which were attributable to either *M. macropus* or one or more of the: Lesser Long-eared Bat *Nyctophilus geoffroyi*, Gould's Long-eared Bat *Nyctophilus gouldi*, and Corben's Long-eared Bat *Nyctophilus corbeni*. Without associated captures, the source of the two call types 35 *bFM* and 40 *bFM* remains ambiguous.

Calls with a characteristic frequency between 45 and 50 kHz could be attributable to the Inland Forest Bat *Vespadelus baverstocki* and/or Little Forest Bat *Vespadelus vulturnus*. Some calls with a characteristic frequency just below 50 kHz could have also derived from the Chocolate Wattled Bat *Chalinolobus morio*, which appeared to be common in the recordings. Capture and confirmation of species using characters such as mouth wattles and penile morphology are more reliable indicators of the identity of these three bat species.

The calls of the Southern Free-tailed Bat *Ozimops* (= *Mormopterus*) *planiceps* and Ride's Free-tailed Bat *Ozimops* (= *Mormopterus*) *ridei* both overlap with the call variation of Gould's Wattled Bat *Chalinolobus gouldii*. In some cases, the two genera could be distinguished, especially the alternating low-high pattern of characteristic call frequency in *C. gouldii*. Calls

in non-alternating sequence with a characteristic frequency below 29 kHz were generally attributed to *O. planiceps*. Calls of *O. ridei* could not be identified unambiguously.

Methods

Data recorded in full spectrum WAC format with Wildlife Acoustics SM2BAT bat detectors (sampling rate 384 kHz, trigger 6 dB above background; set to turn on automatically at sunset and off at sunrise) was converted to high quality bitstream WAV format using Kaleidoscope 3.0.0 software. Data was also recorded in WAV format with SM4BAT detectors.

A multi-step acoustic analysis procedure developed to process large full spectrum echolocation recording datasets from insectivorous bats (Armstrong and Aplin 2014; Armstrong et al. 2016) was then applied to the recordings made on the survey. Firstly, the WAV files were scanned for bat echolocation calls using several parameter sets in the software SCAN'R version 1.7.7 (Binary Acoustic Technology), which also provides measurements (in "SonoBat™ compatible output") from each putative bat pulse. The output was then used to determine if putative bat pulses measured in SCAN'R could be identified to species. This was done using a custom [R] language script that performed three tasks: 1. undertook a Discriminant Function Analysis on training data from representative calls from eastern South Australia; 2. from the measurements of each putative bat pulse from SCAN'R, calculated values for the first two Discriminant Functions that could separate the echolocation call types derived from the analysis of training data, and plotted these resulting coordinates over confidence regions for the defined call types; and 3. facilitated an inspection in a spectrogram of multiple examples of each call type for each recording night by opening the original WAV files containing pulses of interest in Adobe Audition CS6 version 5.0.2. Species were identified based on information in Pennay et al. (2004) and Churchill (2008), and nomenclature follows Jackson and Groves (2015).

Limitations

The identifications presented in this report have been made within the following context:

1. The identifications made herein were based on the ultrasonic acoustic data recorded and provided by a 'third party' (the client named on the front of this report).
2. The scope of this report extended to providing information on the identification of bat species in bulk ultrasonic recordings. Further comment on these species and the possible impacts of a planned project on bat species were not part of the scope.

3. In the case of the present report, the recording equipment was set up and supplied by Specialised Zoological. The equipment was operated by the third party during the survey.
4. Other than the general locality of the study area, Specialised Zoological has not been provided with detailed information of the survey area, has not made a site visit to observe the habitats available for bats, nor have we visited the specific project areas on a previous occasion.
5. Specialised Zoological has had no input into the overall design of this bat survey. Specialised Zoological has had no input into the survey timing, recording site placement, nor degree of recording site replication on this survey.
6. While Specialised Zoological has made identifications to the best of our ability given the available materials, and reserves the right to re-examine the data and revise any identification following a query, it is the client's and / or proponent's responsibility to provide supporting evidence for any identification, which might require follow-up trapping effort or non-invasive methods such as video recordings. Specialised Zoological bears no liability for any follow-up work that may be required to support an identification based initially on the analysis of acoustic recordings undertaken and reported on here.
7. There are a variety of factors that affect the 'detectability' of each bat species, given the frequency, power and shape characteristics of their calls. Further information on the analysis and the various factors that can impinge on the reliability of identifications can be provided upon request.

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Table 1. Species identified in the present survey from all sites combined.

VESPERTILIONIDAE	
Gould's Wattled Bat	<i>Chalinolobus gouldii</i>
Chocolate Wattled Bat	<i>Chalinolobus morio</i>
Inland Broad-nosed Bat	<i>Scotorepens balstoni</i>
MOLOSSIDAE	
White-striped Free-tailed Bat	<i>Austronomus (=Tadarida) australis</i>
Southern Free-tailed Bat	<i>Ozimops (=Mormopterus) planiceps</i>
<i>Ambiguous identifications</i>	
Ride's Free-tailed Bat / and/or Gould's Wattled Bat	<i>Ozimops (=Mormopterus) ridei</i> / and/or <i>Chalinolobus gouldii</i>
Large-footed Myotis / and/or Unidentified long-eared bat	<i>Myotis macropus</i> and/or <i>Nyctophilus</i> sp.
Inland Forest Bat / and/or Little Forest Bat	<i>Vespadelus baverstocki</i> / and/or <i>Vespadelus vulturnus</i>

Table 2a. Species identifications, with the degree of confidence indicated by a code. Date and recording unit number correlates with site; see **Table 1** for full species names; **Appendix 1** for an explanation of call types.

Call type	<i>A. australis</i>	<i>C. gouldii</i>	<i>C. morio</i>	<i>O. planiceps</i>	<i>O. ridei</i>	<i>M. macropus / Nyctophilus sp.</i>	<i>M. macropus / Nyctophilus sp.</i>	<i>S. balstoni</i>	<i>V. baverstocki / V. vulturinus</i>
	12 cFM	30 cFM	50 sFM.d	28 cFM	30 cFM	35 bFM	40 bFM	35 cFM	48 cFM
SM2BAT 17314									
14/03/2018	◆	◆	◆	—	—	—	—	—	NC
15/03/2018	◆	◆	◆	—	—	—	NC	◆	NC
16/03/2018	◆	◆	◆	—	—	—	NC	◆	NC
17/03/2018	◆	◆	◆	◆	NC	—	—	◆	—
18/03/2018	—	—	—	—	—	—	—	—	—
SM2BAT 17697									
14/03/2018	◆	◆	◆	◆	NC	—	—	—	—
15/03/2018	—	◆	◆	◆	NC	—	NC	—	—
16/03/2018	◆	◆	◆	—	NC	—	NC	—	—
17/03/2018	◆	◆	◆	◆	NC	—	NC	—	—
18/03/2018	—	—	—	—	—	—	—	—	—
SM2BAT 17715									
14/03/2018	—	◆	◆	◆	NC	NC	NC	—	—
15/03/2018	◆	◆	◆	◆	NC	—	NC	—	—
16/03/2018	◆	◆	◆	◆	NC	NC	NC	—	—
17/03/2018	◆	◆	◆	◆	NC	—	NC	—	—
18/03/2018	◆	—	—	—	—	—	—	—	—
SM2BAT 17769									
14/03/2018	—	◆	◆	◆	—	NC	NC	—	NC
15/03/2018	◆	◆	◆	—	—	—	—	—	—
16/03/2018	◆	◆	◆	◆	—	—	NC	—	NC
17/03/2018	◆	◆	◆	◆	—	—	NC	—	NC
18/03/2018	—	◆	—	—	—	—	—	—	—

Definition of confidence level codes:

— Not detected.

◆ Unambiguous identification of the species at the site based on measured call characteristics and comparison with available reference material. Greater confidence in this ID would come only after capture and supported by morphological measurements or a DNA sequence.

NC Needs Confirmation. Either call quality was poor, or the species cannot be distinguished reliably from another that makes similar calls. Alternative identifications are indicated in the *Comments on identifications* section of this report. If this is a species of conservation significance, further survey work might be required to confirm the record.

Table 2b. Species identifications—*continued*.

	<i>A. australis</i>	<i>C. gouldii</i>	<i>C. morio</i>	<i>O. planiceps</i>	<i>O. ridei</i>	<i>M. macropus / Nyctophilus sp.</i>	<i>M. macropus / Nyctophilus sp.</i>	<i>S. balstoni</i>	<i>V. baverstocki / V. vulturinus</i>
Call type	12 cFM	30 cFM	50 sFM.d	28 cFM	30 cFM	35 bFM	40 bFM	35 cFM	48 cFM
SM4BAT 1147									
14/03/2018	◆	◆	◆	◆	—	—	NC	—	—
15/03/2018	◆	◆	◆	◆	—	—	—	—	—
16/03/2018	◆	◆	◆	◆	—	—	NC	—	NC
17/03/2018	◆	◆	◆	◆	—	—	NC	◆	NC
SM4BAT 1233									
14/03/2018	—	◆	◆	◆	—	—	NC	—	NC
15/03/2018	—	◆	◆	◆	—	—	NC	—	NC
16/03/2018	◆	◆	◆	◆	—	—	NC	—	NC
17/03/2018	◆	◆	◆	◆	—	—	NC	—	NC
18/03/2018	—	◆	—	—	—	—	—	—	NC
SM4BAT 1240									
14/03/2018	◆	◆	◆	◆	—	—	NC	—	—
15/03/2018	◆	◆	◆	◆	—	—	NC	—	—
16/03/2018	◆	◆	◆	◆	—	—	NC	—	—
17/03/2018	◆	◆	◆	◆	—	—	NC	—	—
18/03/2018	—	◆	—	—	—	—	—	—	—
SM4BAT 1247									
14/03/2018	◆	◆	◆	◆	NC	—	—	—	—
15/03/2018	◆	◆	◆	◆	—	—	—	—	—
16/03/2018	◆	◆	◆	◆	—	—	—	—	NC
17/03/2018	◆	◆	◆	◆	—	—	—	—	—
18/03/2018	—	◆	—	—	—	—	—	—	—

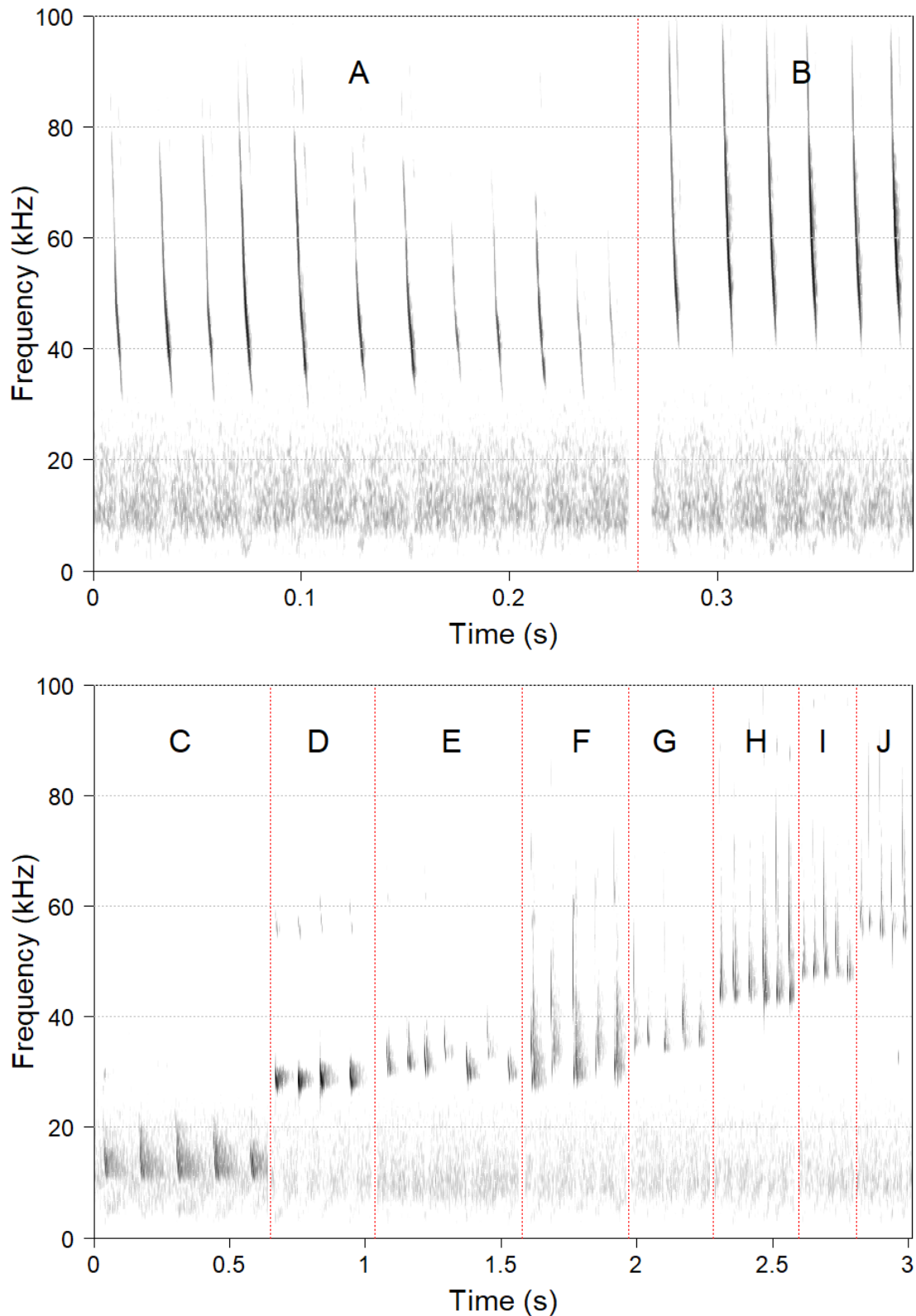


Figure 1. Representative call sequence portions of the species identified and call types recognised (time between pulses has been compressed). **A,B:** *Myotis macropus* / *Nyctophilus* sp.; **C:** *Austronomus australis*; **D:** *Ozimops planiceps*; **E:** *Chalinolobus gouldii* / *Ozimops ridei*; **F:** *Chalinolobus gouldii*; **G:** *Scotorepens balstoni*; **H,I:** *Vespadelus baverstocki* / *Vespadelus vulturnus*; **J:** *Chalinolobus morio*.

Appendix 1. Echolocation call categories based on the morphology of the dominant type of search-phase pulses in high quality sequences (adapted from de Oliveira (1998a,b), Corben and O'Farrell (1999), Gannon et al. (2004), Armstrong and Aplin (2011, 2014), Armstrong et al. (2015a,b); Armstrong 2017; examples are not scaled equally). Pulses generally consist of three main sections: an initial frequency sweep (IFS), followed by the main body (BST: Body Sub Type), and ending in a terminating frequency sweep (TFS). The shape of the pulse is represented by the codes in the form 'IFS.BST.TFS', prefixed by a value representing the mean characteristic frequency in kHz. Note that most CF pulses have a recognisable initial upward frequency sweep, and all have a terminating frequency sweep, so the IFS and TFS descriptors are not used for this Body Sub Type.

Code	Description	Example
CF <i>ICF</i> <i>mCF</i> <i>sCF</i>	Constant Frequency Body Sub Type (BST) ^{1,2} Long duration constant frequency pulse (>30 ms) Medium duration constant frequency pulse (15–30 ms) Short duration constant frequency pulse (<15 ms) ¹ Reserved for <i>Hipposideridae</i> and <i>Rhinolophidae</i> ² No use of IFS or TFS	
FM <i>bFM</i> <i>cFM</i> <i>fFM</i> <i>sFM</i>	Frequency Modulated Body Sub Type (BST) Broadband, slight curvature only, no significant development of serpentine component (<i>sFM</i>) Curved, simple or curvilinear trace Flat, no decrease, or a very slight decrease in frequency over the pulse body, not classed as <i>CF</i> Serpentine, generally S-shaped	
Ends <i>i.</i> <i>sh.</i> <i>st.</i>	Initial Frequency Sweep (IFS) Inclined, a narrowband increasing frequency sweep Short, shallow or narrowband frequency sweep Steeply decreasing, broadband frequency sweep	
<i>.d</i> <i>.h</i>	Terminating Frequency Sweep (TFS) Drooped, decreasing frequency sweep following the characteristic frequency in the main body of the call Hooked, increasing in frequency	

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