



**Kanmantoo Copper Mine**  
**Fauna Survey 2022**

# Kanmantoo Copper Mine Fauna Survey 2022

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Prepared by EBS Ecology for Hillgrove Resources Limited

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Cover photograph: Sunset over the Kanmantoo SEB area before the start of targeted surveys for Common Brushtail Possum (*Trichosurus vulpecula*).

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## GLOSSARY AND ABBREVIATION OF TERMS

BOM	Bureau of Meteorology
EBS	Environment and Biodiversity Services Pty Ltd – trading as EBS Ecology
EPBC	<i>Environment Protection and Biodiversity Conservation Act 1999</i>
ha	Hectares
Hillgrove	Hillgrove Resources Limited
Kanmantoo	Kanmantoo Copper Mine
km	Kilometre(s)
LOM	Life of Mine
ML	Mining Lease
mm	millimetre(s)
PEPR	Program for Environment Protection and Rehabilitation
Project Area	Kanmantoo Mining Lease (ML) and Significant Environmental Benefit areas
SA	South Australia/South Australian
SEB	Significant Environmental Benefit

## EXECUTIVE SUMMARY

EBS Ecology (EBS) has been engaged by Hillgrove Resources Limited (Hillgrove) since 2011 to conduct an annual fauna monitoring program over the Kanmantoo Copper Mine (Kanmantoo) Mining Lease (ML). The fauna monitoring program was undertaken in accordance with the conditions and outcomes required in the Program for Environment Protection and Rehabilitation (PEPR) for Kanmantoo:

ML6345 – Schedule 2 Condition 13	<p><b>Fauna</b></p> <p>The Lessee must in constructing and operating the Lease, ensure that there are no net adverse impacts from the site operations on the native fauna abundance or diversity in the Lease area and in adjacent areas.</p>	<p><b>Outcome 21</b></p> <p>No net adverse impacts from the site operations on native fauna abundance or diversity in the lease area and in adjacent areas.</p>
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As such, there must be no net adverse impacts on native fauna abundance or diversity in the ML and in adjacent areas.

The fauna monitoring program includes:

- Conducting roaming transect surveys to record the abundance and diversity of birds;
- Performing targeted spotlighting surveys to record the abundance of the Common Brushtail Possum (*Trichosurus vulpecula*) as well as other nocturnal fauna; and
- Opportunistically recording all other fauna species encountered within the Project Area.

This report details the results of the 2022 survey, which is the 12<sup>th</sup> year monitoring fauna at the mining lease site, the 8<sup>th</sup> year of monitoring birds at the Significant Environmental Benefit (SEB) site and 9<sup>th</sup> year of monitoring possums at the SEB site.

The 2022 bird surveys recorded a total of 897 birds from 57 species over the Project Area. This included three State threatened species.

Species richness has increased over the last few years at Kanmantoo with only one past year of monitoring in 2012 (59 species) recording a higher species richness than in 2022. The abundance of birds in 2022 was high again after low abundances in 2018 and 2019 due to very low rainfall with 700 and 686 individuals observed respectively. Over the lifetime of the fauna monitoring program, the abundance and species richness of birds has shown annual fluctuations, which may be driven by factors such as rainfall, availability of food resources and the presence (or absence) of nomadic and flocking avian species.

Thirty (30) Common Brushtail Possums were observed within the ML during the 2022 spotlight survey, while no individuals were observed in the SEB area. To date there have been no observations of Common Brushtail Possums within the SEB area due to an absence of suitable habitat. Over the lifetime of the fauna monitoring program the number of Common Brushtail Possums has remained relatively stable, despite annual fluctuations.

The results from the 2022 fauna monitoring program confirm that there is no change in native fauna abundance or diversity within the ML and in adjacent areas. Hence, Hillgrove has satisfied PEPR condition (13) and outcome (21) required relating to the conservation of fauna.

EBS recommends that the following measures should be taken into account to improve the ongoing management and monitoring of fauna within the Kanmantoo Project Area:

- Continue the fauna monitoring program at the same time each year (early spring);

- Change to biennial spotlighting in the SEB areas due to the low likelihood of Common Brushtail Possums using/colonising these areas in the short-term;
- Ensure aerial and flying over avian species are not included in total bird counts and diversity for the site;
- Include results and discussion on bird species richness and abundance between the ML and SEB areas; and
- Conduct a control program to reduce the numbers of Western Grey Kangaroos (*Macropus fuliginosus*), European Rabbits (*Oryctolagus cuniculus*) and European Brown Hares (*Lepus europaeus*) within the Project Area to reduce grazing impacts on remnant and planted native vegetation.

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# 1 INTRODUCTION

EBS Ecology (EBS) has been engaged by Hillgrove Resources Limited (Hillgrove) since 2011 to conduct an annual fauna monitoring program over the Kanmantoo Copper Mine (Kanmantoo hereafter) Mining Lease (ML). The 2022 monitoring program marks the 12<sup>th</sup> year of fauna monitoring at the mining lease site. It is the 8<sup>th</sup> year of monitoring birds at the Significant Environmental Benefit (SEB) and the 9<sup>th</sup> year that EBS has also monitored possums within the SEB areas, located adjacent to the Kanmantoo ML.

The Kanmantoo ML and the Kanmantoo SEB area in combination are named herein as the Project Area. The fauna monitoring program was undertaken in accordance with the conditions and outcomes required in the Program for Environment Protection and Rehabilitation (PEPR) for Kanmantoo.

## 1.1 Objectives

The objective of the fauna monitoring program is to meet the conditions and outcomes as outlined in the PEPR. With regards to fauna (Condition 13), *“the lessee must in constructing and operating the Lease, ensure that there is no adverse impacts from the site operations on the native fauna abundance or diversity in the Lease area and in adjacent areas”*. As such, the Outcome (21) required is *“no net adverse impacts from the site operations on native fauna abundance or diversity in the lease area and in adjacent areas”*. More specifically, the fauna monitoring program aimed to determine the abundance and diversity of fauna within the Project Area by:

- Conducting roaming transect surveys to record the abundance and diversity of birds;
- Performing a targeted spotlighting survey to record the abundance of Common Brushtail Possums (*Trichosurus vulpecula*) as well as other nocturnal fauna species; and
- Opportunistically recording all other fauna species encountered within the Project Area.

## 1.2 Project Area

The Project Area is located approximately 45 kilometres (km) south-east of Adelaide in the eastern Mount Lofty Ranges of South Australia (SA) and 1.5 km south-west of the Kanmantoo township (Figure 1). The area is representative of a transitional zone on the eastern face of the Mount Lofty Ranges, between the Adelaide Hills woodland regions and the Murray River Plains mallee. It has a long-term average rainfall of 469 millimetre (mm) (BOM 2022a) and encompasses a variety of soil types and geological structures, conducive to an assortment of vegetation types and habitat niches.

The Project Area has a history of mining activity, which started in the mid-nineteenth century and then continued between 1971 and 1976 (Hillgrove Resources 2007). Over the past 150 years, much of the ML has been extensively cleared for cropping, whilst most of the vegetated areas have been grazed by domestic stock. As a result, only small remnant patches of native vegetation in the ML have persisted, including native grasslands and woodland communities.

The SEB offset areas are located adjacent to Kanmantoo (Figure 2). SEB offset areas associated with the Life of Mine (LOM) extension have been located as near as possible to the ML on suitable Hillgrove Resources owned land parcels. The SEB areas are approximately 109.5 hectares (ha) and comprised of



five properties (Figure 2), which have been managed under a mixed cropping / sheep grazing regime for over 100 years. Cropping has been confined to the flats and grazing has been on crop stubble and the higher/rockier areas. Consequently, only small remnant patches of native vegetation remain in the SEB areas, including native grasslands and a mallee community.

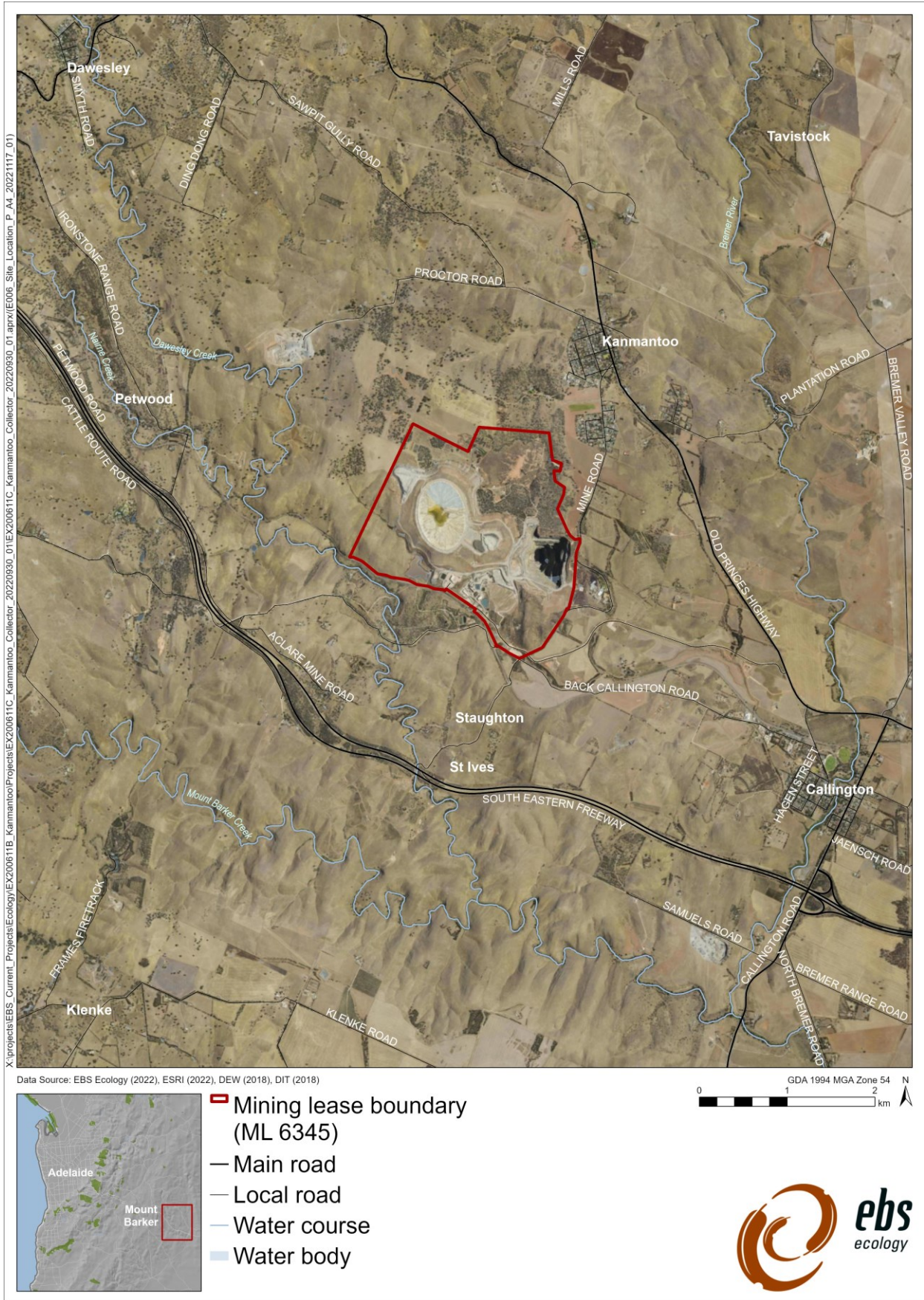


Figure 1. Location of the Kanmantoo Mine with respect to local townships and Adelaide, South Australia.



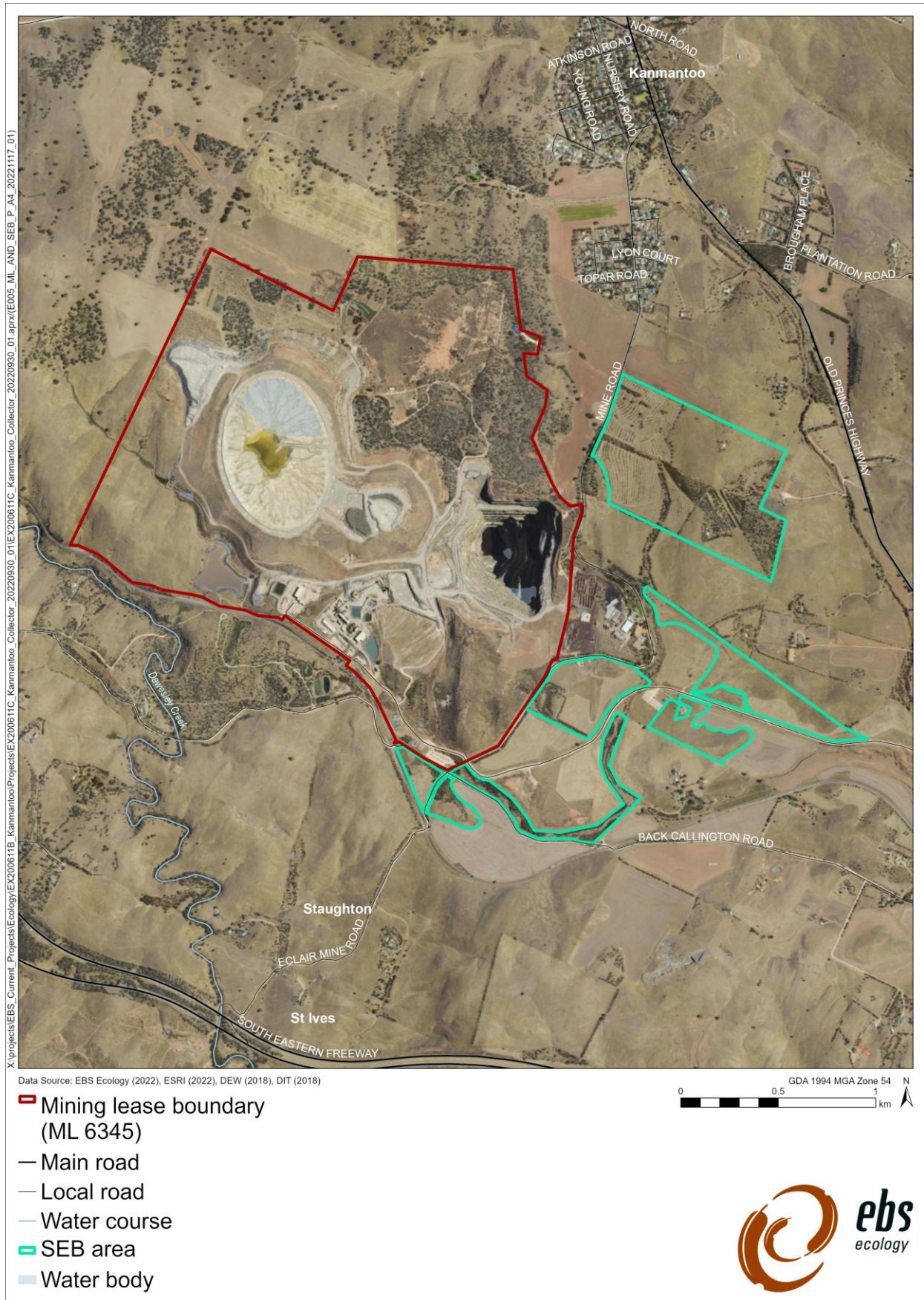


Figure 2. Location of the Kanmantoo ML and SEB areas over the Project Area.

## 2 METHODS

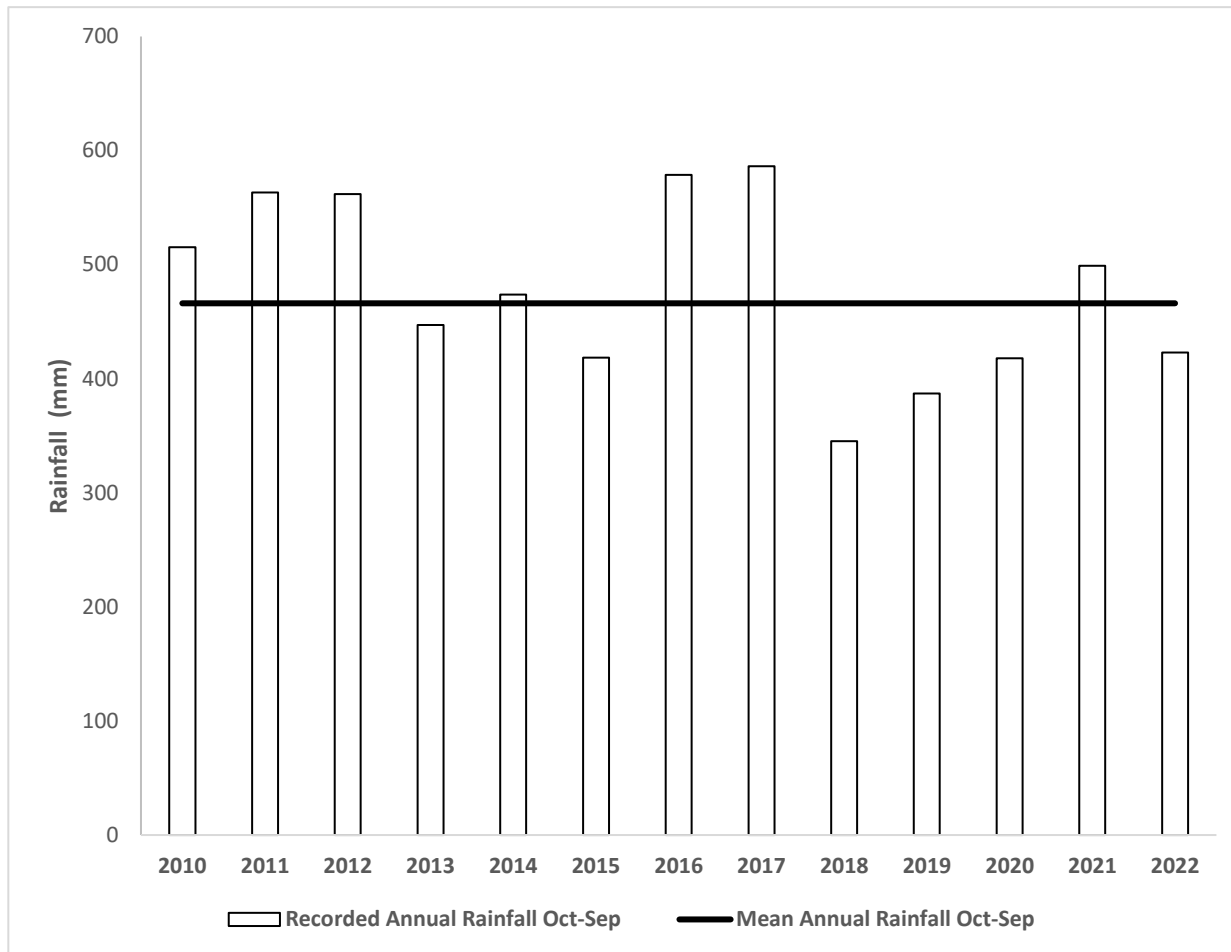
### 2.1 Field survey timing

The 2022 field survey was conducted in early October (4<sup>th</sup> to the 7<sup>th</sup> inclusive), a similar period to previous surveys.

#### 2.1.1 *Weather condition and rainfall*

Weather conditions over the 2022 fauna survey period were characterised by cool to mild mornings and afternoon temperatures (BOM 2022b) with both winds and rainfall varying from light to strong/heavy. Long term rainfall data (1874-2022) was primarily sourced from the Kanmantoo weather station (BOM 2022a) with consideration and reference to the Murray Bridge (Pallamana Aerodrome) weather station (BOM 2022b). Both weather stations were utilised to better reflect long term averages and recent high rainfall events. Annual rainfall data was analysed from the Kanmantoo weather station across the 12 months from October to September so that data from the end of the previous year and into the current survey year was incorporated (i.e. for 2022 rainfall data was analysed from October 2021 to September 2022 inclusive). This better reflects the survey period and ensures that as much data as possible is analysed.

Rainfall at Kanmantoo shows annual variability, particularly over the 2011 to 2022 timeframe, as annual rainfall ranged from the lowest in 2018 (345.4 mm) to the highest in 2016 (578.8 mm) (BOM 2022a). Overall, 2010-2012, 2014, 2016-2017, 2021 had above average rainfall (> 466 mm), while 2013, 2015, 2018-2020 had below average rainfall (Figure 3) (BOM 2022a). Rainfall in 2022 from the Kanmantoo weather station data is less than the long-term average, however rainfall data for 2022 is limited to the months Oct-Aug, as at the time of the current report rainfall records for September were not yet available. Therefore, rainfall totals for 2022 are likely to be greater than the values presented in Figure 3, particularly with recent rainfall events in November of 2022. For example, on the 8<sup>th</sup> of September 14.6mm of rainfall was recorded at the Murray Bridge weather station (BOM 2022b). Additionally, it must be noted that there is missing rainfall data for the years 2012, 2017 and 2019 and therefore rainfall totals in these years may be greater than the values presented in Figure 3.



**Figure 3. Mean annual rainfall from October to September inclusive at Kanmantoo weather station (23724) from 2011 to 2022.**

*Note: There is missing data for Oct 2012, Oct 2017 and Dec 2019 and therefore, the total rainfall for these years may be lower than the true value (BOM 2022). Rainfall data for 2022 is limited to the months Oct-Aug, as at the time of the reporting rainfall records for September 2022 were unavailable. Therefore, the total rainfall for 2022 may be higher than the true value (BOM 2022a).*

### 2.1.2 Survey effort per year

#### Mining Lease

Fauna within the ML has been monitored annually since 2011 (Table 1). Bird monitoring transects within the ML varied in number (11 to 15 transects) before the sites were formalised and standardized in 2015. Since 2015, the same bird monitoring transects have been monitored annually.

The spotlighting transect locations have remained consistent since the inaugural year of monitoring in 2011. However, the number of spotlighting nights has reduced from three nights (2011) to one night (2014 to present).

#### Significant Environmental Benefit Areas

The SEB areas were monitored for the first time in 2014 (Table 1). Monitoring in 2014 solely focused on spotlighting possums, but opportune observations of birds were also made. The number of spotlight nights (1) and the transects surveyed have remained consistent since inception of SEB monitoring in 2014. In 2015, nine bird monitoring transects were established within the SEB area. Each bird monitoring transect is monitored annually.

**Table 1. Fauna survey effort per year within the ML and SEB areas of Kanmantoo.**

Year	ML		SEB	
	Bird transects	Spotlight nights	Bird sites	Spotlight nights
2011	15*	3	N.M.	N.M.
2012	11*	2	N.M.	N.M.
2013	11*	2	N.M.	N.M.
2014	12*	1	N.M.	1
2015	14	1	9	1
2016	14	1	9	1
2017	14	1	9	1
2018	14	1	9	1
2019	14	1	9	1
2020	14	1	9	1
2021	14	1	9	1
2022	14	1	9	1

\*Sites not formalised  
N.M. = not monitored

### **2.1.3 Bird surveys**

Twenty-three (23) bird transects are located over the Project Area; 14 in the ML and nine in the SEB area (Figure 4). These transects have been strategically positioned to represent the main habitat types and rehabilitation areas across the Project Area. Each transect was surveyed by one or two surveyors, who walked the entire length of the transect. Surveys were conducted only during suitable weather conditions (i.e. fine, cool-mild weather with light or no wind). Surveys are not conducted during periods of strong wind or precipitation. The following information was recorded for each bird observed:

- Species;
- Number of individuals per species;
- Behaviour of individuals (foraging, resting, or flying); and
- The substrates individual birds were using (ground, shrub, or tree).

Furthermore, all birds heard were recorded to species and the number of individuals estimated.

Any other avian species not previously observed during the transect surveys were opportunistically recorded while traversing the site.

### **2.1.4 Common Brushtail Possum targeted survey**

Spotlighting was conducted over repeated routes within the ML and SEB areas to systemically determine the numbers of Common Brushtail Possums in the Project Area (Figure 4). The ML and SEB areas were surveyed from a vehicle. The spotlighting routes within the ML and SEB were surveyed over one night for two hours each. All surveys commenced at least one hour after sunset.

The following information was recorded for each possum observed:

- Number of individuals;
- GPS location; and



- Habitat.

Any other fauna species observed opportunistically during spotlighting were also recorded.

#### **2.1.5 Opportunistic observations**

Any fauna species (excluding birds) recorded within the ML or SEB area outside of systematic surveys were noted as opportune. For each opportune record, the following information was recorded:

- Species;
- Number of individuals;
- GPS location;
- Method, i.e. sight or sound; and
- Habitat.

#### **2.1.6 Limitations**

The avian survey period is considered short, and such conditions at the time of the survey represent a snapshot in time. Additionally, the possum spotlight survey is only conducted over one night, as such the conditions may result in differences to possum behaviour that may affect detectability.

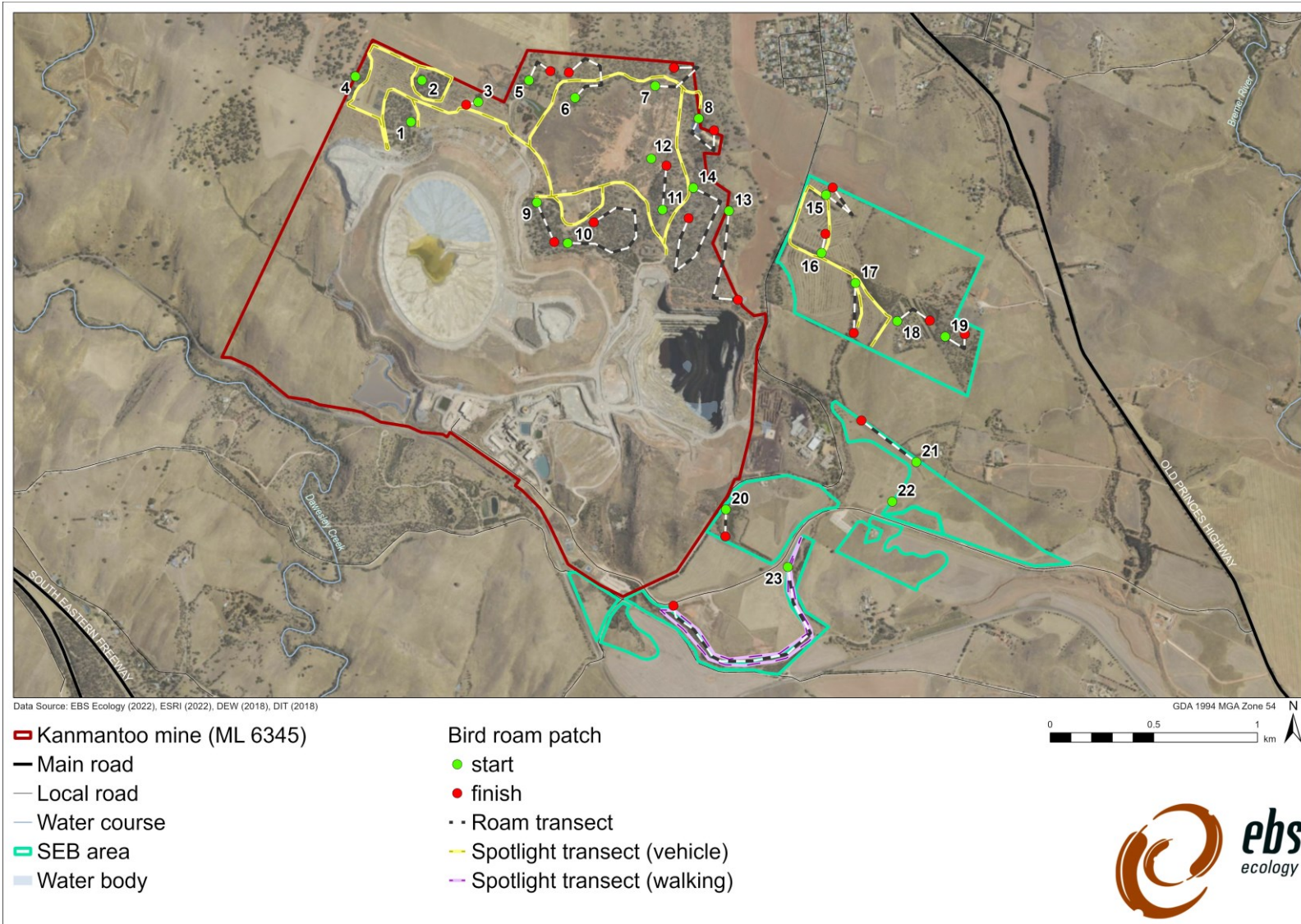


Figure 4. Locations of bird survey transects, and spotlight transects over the Project Area. Spotlight transects as a part of Common Brushtail Possum targeted surveys were conducted by vehicle and on foot.



## 3 RESULTS

### 3.1 Bird Survey 2022

#### 3.1.1 Species richness

A total of 57 bird species were recorded using the Project Area at survey sites (49 species) and opportunistically (8 species) in 2022 ([Appendix 1](#)). An additional two bird species were observed flying over the Project Area and have not been included in the counts as they are unlikely to be utilising the site. The families of birds with the greatest representation were:

- Meliphagidae (Honeyeaters) – six species;
- Acanthizidae (Australian Warblers) - three species;
- Anatidae (Ducks) - three species;
- Pachycephalidae (Whistlers) – three species; and
- Psittaculidae (Parrots) - three species.

Four new species were observed at Kanmantoo for the first time in 2022, which were:

- Black-winged Currawong (*Strepera versicolor melanopectera*);
- Brown Goshawk (*Accipiter fasciatus*);
- Chestnut Teal (*Anas castanea*); and
- Little Pied Cormorant (*Microcarbo melanoleucos*).

#### 3.1.2 Bird abundance

A total of 897 birds from 53 species were recorded using vegetation within the Project Area at survey sites (862 birds) and opportunistically (35 birds) in 2022 ([Appendix 1](#)). The most abundant species over the Project Area in 2022 were:

- Adelaide Rosella (*Platycercus elegans*) (94 individuals);
- White-winged Chough (*Corcorax melanorhamphos*) (93 individuals); and
- Yellow-rumped Thornbill (*Acanthiza chrysorrhoa*) (62 individuals).

#### 3.1.3 Threatened species

Four bird species listed as threatened in South Australia under the *National Parks and Wildlife Act 1972* were observed in 2022. The State Rare White-winged Chough (*Corcorax melanorhamphos*) was abundant, primarily within the ML, but this species was also recorded in the SEB area. The State Rare Elegant Parrot (*Neophema elegans*) was recorded in the ML area but did not occur in the SEB area and the State Vulnerable Diamond Firetail (*Stagonopleura guttata*) was observed in both the ML area and SEB area (Figure 5). Additionally, 23 State Vulnerable Yellow-tailed Black Cockatoo (*Zanda funerea whiteae*) were observed flying over the Project Area near Site 16 in the SEB area (Figure 5).

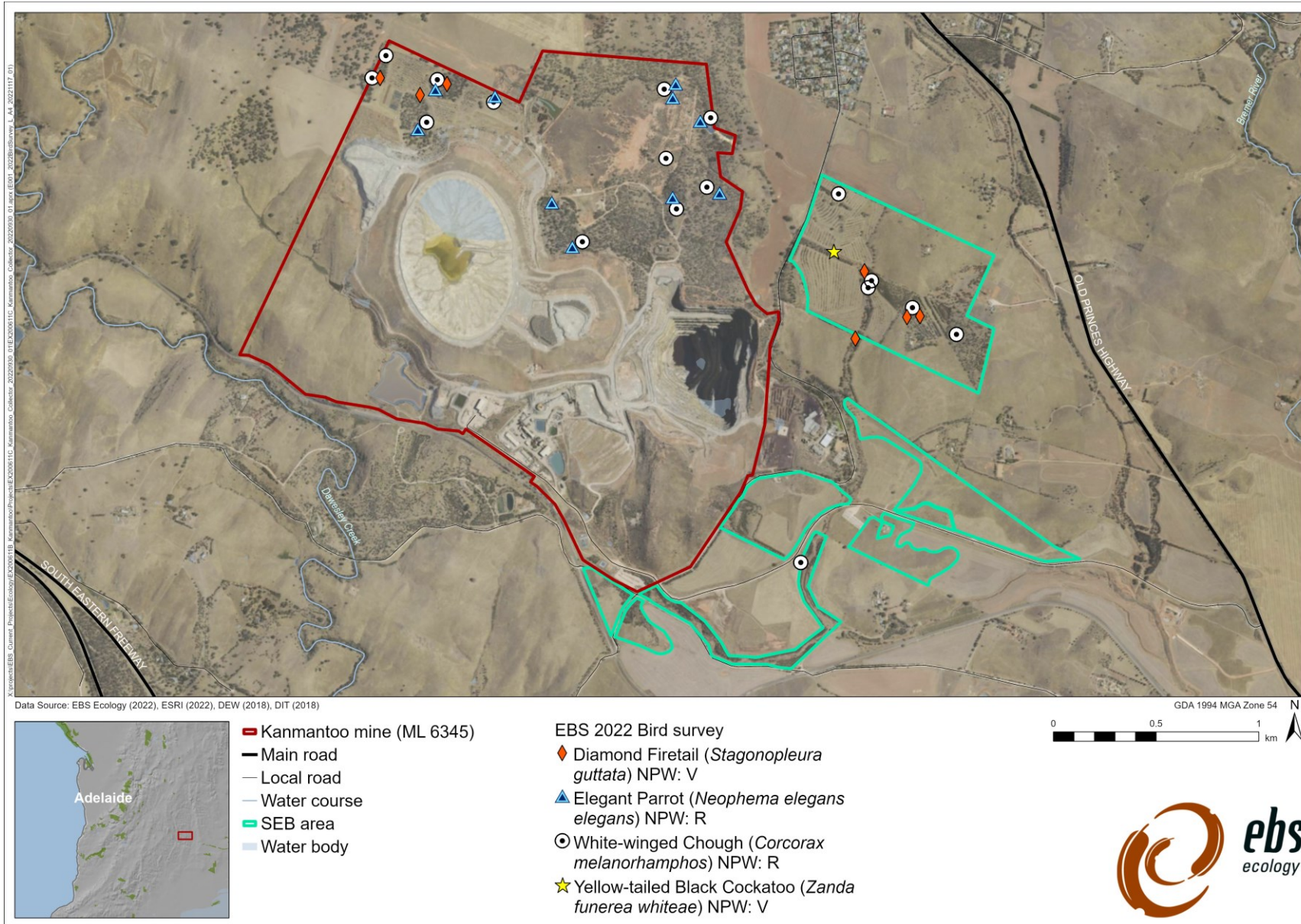


Figure 5. Locations of State threatened bird species observed during the 2022 fauna monitoring program.

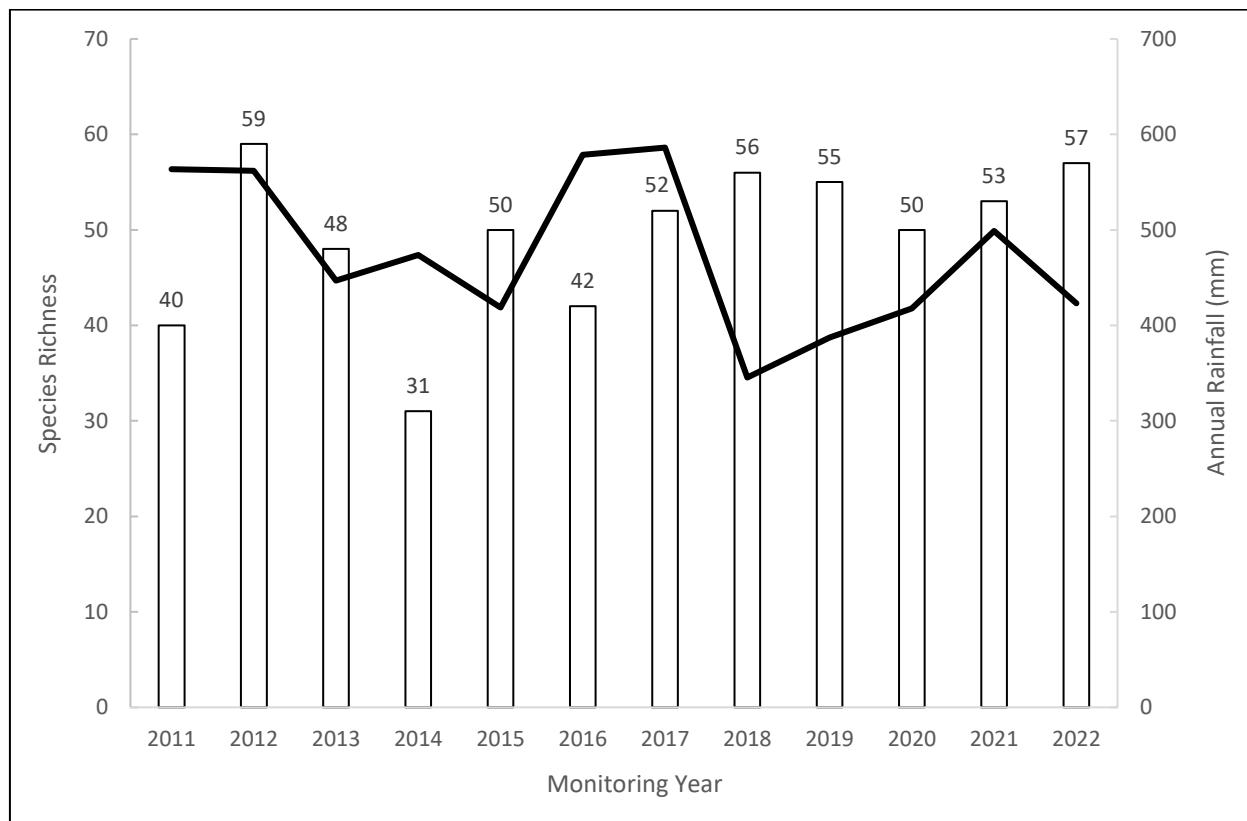
### 3.2 Bird Survey 2011-2022

#### 3.2.1 Species richness

The species richness of birds at Kanmantoo has fluctuated over the lifetime of the fauna monitoring program (range 31 - 59, Figure 6). The mean bird species richness recorded per year over the monitoring program is  $49.4 \mu \pm 2.3$  S.E. (2011-2022). Fewer bird species were recorded from 2011 to 2014 which is likely caused by a lower search effort in those years, with survey sites confined to the ML only (see Section 2.1.2, page 6).

Species richness has increased over the last few years at Kanmantoo with a total of 57 bird species observed. Only one past year of monitoring in 2012 (59 species) recorded a higher species richness than in 2022.

Due to greater consistency in search effort since 2015, species richness is relatively stable between 42 to 56 species after a low species count in 2014 (Figure 6). In particular, the last six years of monitoring has recorded a species richness which fluctuates between 50 and 57 species. Variability in species richness does not appear to be correlated with rainfall (Figure 6).



**Figure 6. Bird species richness recorded over the fauna monitoring program 2011-2022 in relation to annual rainfall. Please note that monitoring was confined to the ML from 2011 to 2014 and expanded to include SEB areas from 2015.**

*Note: Rainfall data for 2022 is limited to the months Oct-Aug, as at the time of the reporting rainfall records for September 2022 were unavailable. Therefore, the total rainfall for 2022 may be higher than the true value (BOM 2022a).*

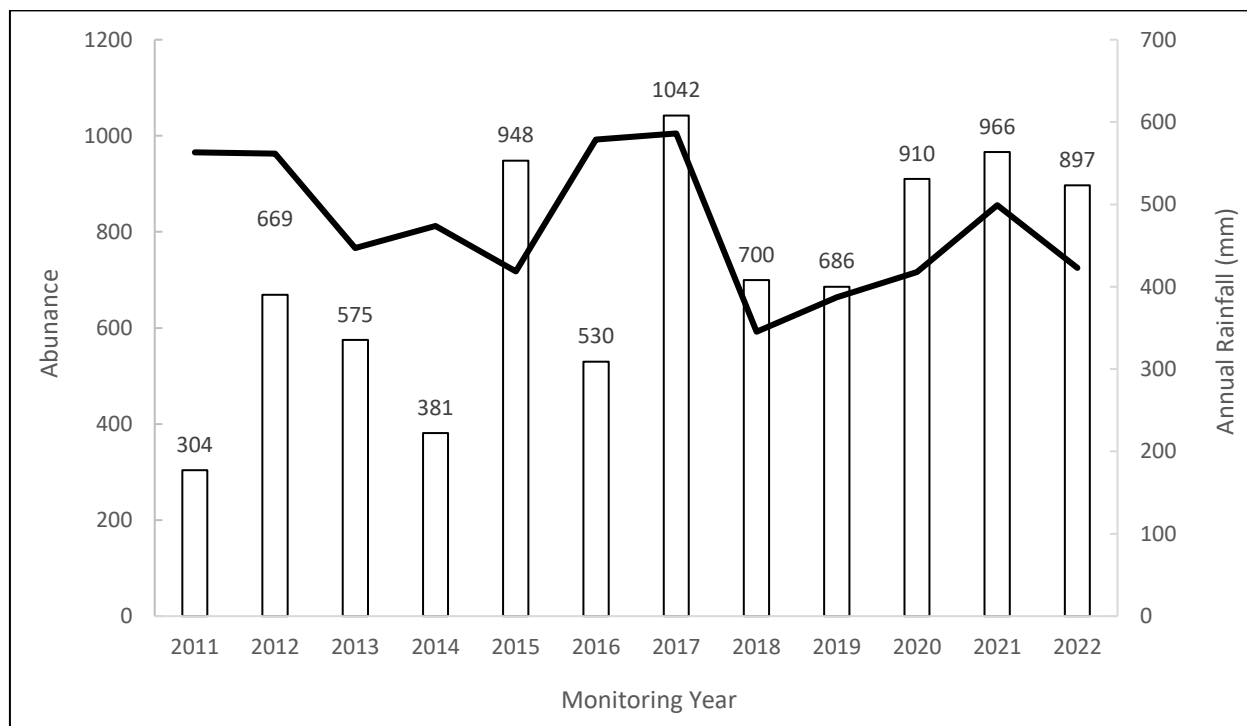
### 3.2.2 Bird abundance

The abundance of birds at Kanmantoo has fluctuated over the lifetime of the fauna monitoring program (Figure 7). The average number of birds recorded per year over the monitoring program is  $717 \mu \pm 69.2$  S.E. (2011-2022). Fewer birds were recorded from 2011 to 2014, which are likely caused by a lower search effort in those years, with survey sites confined to the ML only. The number of birds observed per year are presented per species in [Appendix 1](#).

Bird abundance in 2022 has been relatively stable over the last three years, with a total of 897 individuals observed. This is particularly noticeable after lower abundances in 2018 and 2019 with 700 and 686 individuals observed respectively (Figure 7). Bird abundance recorded in 2022 is also similar to bird abundances recorded in 2015 (948 individuals) and 2017 (1042 individuals).

Consistent and high numbers of birds in 2022 and over the last three years is deemed to be largely driven by the consistently larger numbers of the most abundant birds present. This includes but is not limited to Yellow-rumped Thornbills (62 observed in 2022 compared to the long-term average between 2011-2022 of 54.8), Adelaide Rosellas (94 observed in 2022 compared to the long-term average between 2011-2022 of 64.5) and White-winged Choughs (93 observed in 2022 compared to the long-term average between 2011-2022 of 54.6).

Despite greater consistency in search effort since 2015, bird abundance has remained variable between years. Variability in bird abundance does not appear to be correlated with rainfall (Figure 7).



**Figure 7. Bird abundance recorded over the fauna monitoring program 2011-2022 in relation to annual rainfall. Please note that monitoring was confined to the ML from 2011 to 2014 and expanded to include SEB areas from 2015.**

*Note: Rainfall data for 2022 is limited to the months Oct-Aug, as at the time of the reporting rainfall records for September 2022 were unavailable. Therefore, the total rainfall for 2022 may be higher than the true value (BOM 2022a).*



**3.2.3 Threatened species**

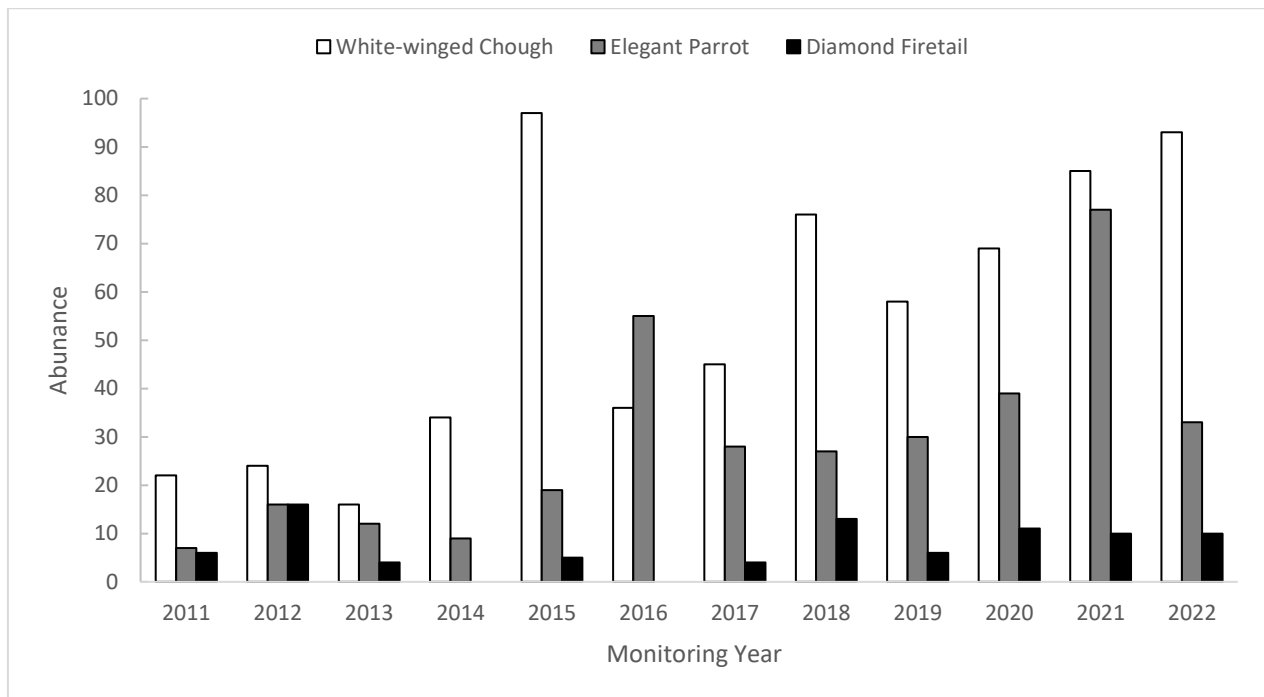
A total of eight State threatened bird species have been observed at Kanmantoo over the lifetime of the fauna monitoring program. In 2022 four of these species were observed (Table 2). No Nationally threatened bird species have been recorded at Kanmantoo.

Three of the eight species of conservation concern have been recorded consistently within the Kanmantoo: The White-winged Chough and Elegant Parrot are the only two State threatened species that have been recorded on each annual survey since 2011, while the Diamond Firetail has been observed in 10 of the 12 survey years. The abundance of White-winged Choughs and Elegant Parrots appears to be stable, if not steadily increasing, while the numbers of Diamond Firetails also appear stable (Figure 8). Yellow-tailed Black Cockatoo were observed flying over the Project Area near Site 16 in the SEB area for the first time since 2017.

**Table 2. The presence and abundance of bird species of conservation significance recorded at Kanmantoo between 2011 and 2022.**

Species name	Common name	EPBC	SA	2011 (yr. 1)	2012 (yr. 2)	2013 (yr. 3)	2014 (yr. 4)	2015 (yr. 5)	2016 (yr. 6)	2017 (yr. 7)	2018 (yr. 8)	2019 (yr. 9)	2020 (yr. 10)	2021 (yr. 11)	2022 (yr. 12)
<i>Corcorax melanorhamphos</i>	White-winged Chough		R	22	24	16	34	97	36	45	76	58	69	85	93
<i>Falco peregrinus</i>	Peregrine Falcon		R	2	2			4	1				1		
<i>Myiagra inquieta</i>	Restless Flycatcher		R								1				
<i>Melanodryas cucullata cucullata</i>	Hooded Robin		R	2											
<i>Microeca fascinans fascinans</i>	Jacky Winter		R			1									
<i>Neophema elegans</i>	Elegant Parrot		R	7	16	12	9	19	55	28	27	30	39	69	33
<i>Stagonopleura guttata</i>	Diamond Firetail		V	6	16	4		5		4	13	6	11	10	10
<i>Zanda funerea whiteae</i>	Yellow-tailed Black Cockatoo		V		7			8		65					23
<b>Number of threatened species observed per year</b>				<b>5</b>	<b>5</b>	<b>4</b>	<b>2</b>	<b>5</b>	<b>3</b>	<b>4</b>	<b>4</b>	<b>3</b>	<b>4</b>	<b>3</b>	<b>4</b>

SA: South Australia (National Parks and Wildlife Act 1972). Conservation Codes: V: Vulnerable. R: Rare. EPBC: Environment Protection and Biodiversity Conservation Act 1999. yr.: year



**Figure 8. Abundance of White-winged Choughs, Elegant Parrots and Diamond Firetails recorded over the Kanmantoo fauna monitoring program 2011-2022.**

The remaining four of the eight species of conservation concern have been recorded inconsistently within Kanmantoo: The Peregrine Falcon (*Falco peregrinus*) has been observed in five survey years, while the Jacky Winter (*Microeca fascinans fascinans*), Hooded Robin (*Melanodryas cucullata cucullata*) and Restless Flycatcher (*Myiagra inquieta*) were observed only once (Table 2). Due to the abundance of these species, trends in the number of individuals that are utilising Kanmantoo cannot be accurately assessed.

### 3.2.4 Indicator species

Given the variable nature of the bird community at Kanmantoo, it is imperative that a suite of indicator species is identified to determine whether the mine has impacted on birds. Indicator species for Kanmantoo were selected as they are woodland-dependent species that are not favoured by impaired tree health nor human mediated landscapes (Read *et al.* 2015). The following species have been selected as indicator species:

- Brown Treecreeper (*Climacteris picumnus*);
- Diamond Firetail (*Stagonopleura guttata*);
- Grey Shrike-thrush (*Colluricincla harmonica*);
- Rufous Whistler (*Pachycephala rufiventris*);
- White-winged Chough (*Corcorax melanorhamphos*); and
- Yellow-rumped Thornbill (*Acanthiza chrysorrhoa*).

Observations of the abundance of each indicator species in the 2022 survey varies in comparison to the 2021 survey. All species were above the long terms average with exception of the Yellow-rumped Thornbill and Brown Treecreeper. Overall, the abundance of indicator species shows variability between years, however, none of the species has been identified to be in decline since the fauna monitoring program commenced in 2011 (Table 3). The mean abundance for these species recorded per year over the monitoring program is also presented in Table 3.

**Table 3. Observations of the abundance of indicator species 2011-2022.**

Species name	Common name	EPBC	SA	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	mean
<i>Acanthiza chrysorrhoa</i>	Yellow-rumped Thornbill			33	43	31	21	90	43	38	54	57	64	121	62	<b>54.8</b>
<i>Climacteris picumnus</i>	Brown Treecreeper			5	12	17	9	8	11	5	10	11	18	20	9	<b>11.3</b>
<i>Colluricincla harmonica</i>	Grey Shrike-thrush			4	1	3	3	14	13	4	8	15	19	21	27	<b>11.0</b>
<i>Corcorax melanorhamphos</i>	White-winged Chough		R	22	24	16	34	97	36	45	76	58	69	85	93	<b>54.6</b>
<i>Pachycephala rufiventris</i>	Rufous Whistler			6	9	6	2	3	6	9	10	2	9	4	6	<b>6.0</b>
<i>Stagonopleura guttata</i>	Diamond Firetail		V	6	16	4		5		4	13	6	11	10	10	<b>8.5</b>

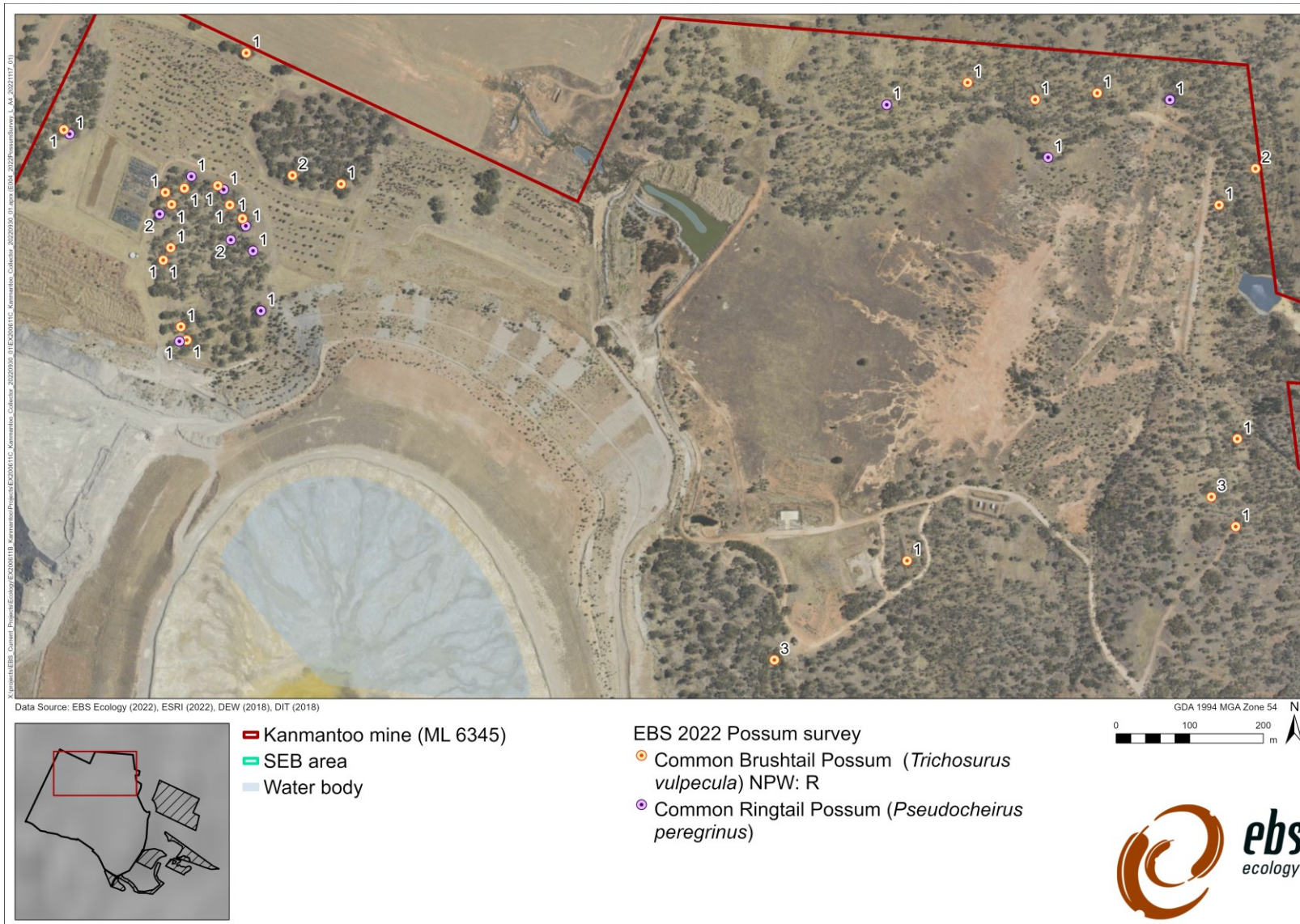
**SA:** South Australia (*National Parks and Wildlife Act 1972*). **Conservation Codes:** V: Vulnerable. R: Rare. **EPBC:** *Environment Protection and Biodiversity Conservation Act 1999*.

### 3.3 Possum survey 2022

In 2022 a total of 30 Common Brushtail Possums and 15 Common Ringtail Possums were observed within the ML in both *Eucalyptus odorata* (Peppermint Box) woodland and *Allocasuarina verticillata* (Drooping Sheoak) woodland. No observations of either species occurred in the SEB area (Table 4; Figure 9).

**Table 4. Observations of Common Brushtail Possums 2011-2022.**

	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Number observed	43	88	53	9	21	14	30	20	22	30	18	30
Number of nights surveyed within ML	3	2	2	1	1	1	1	1	1	1	1	1
Average number of possums observed per night	14.3	44.0	26.5	9.0	21.0	14.0	30.0	20.0	22.0	30.0	18.0	30.0



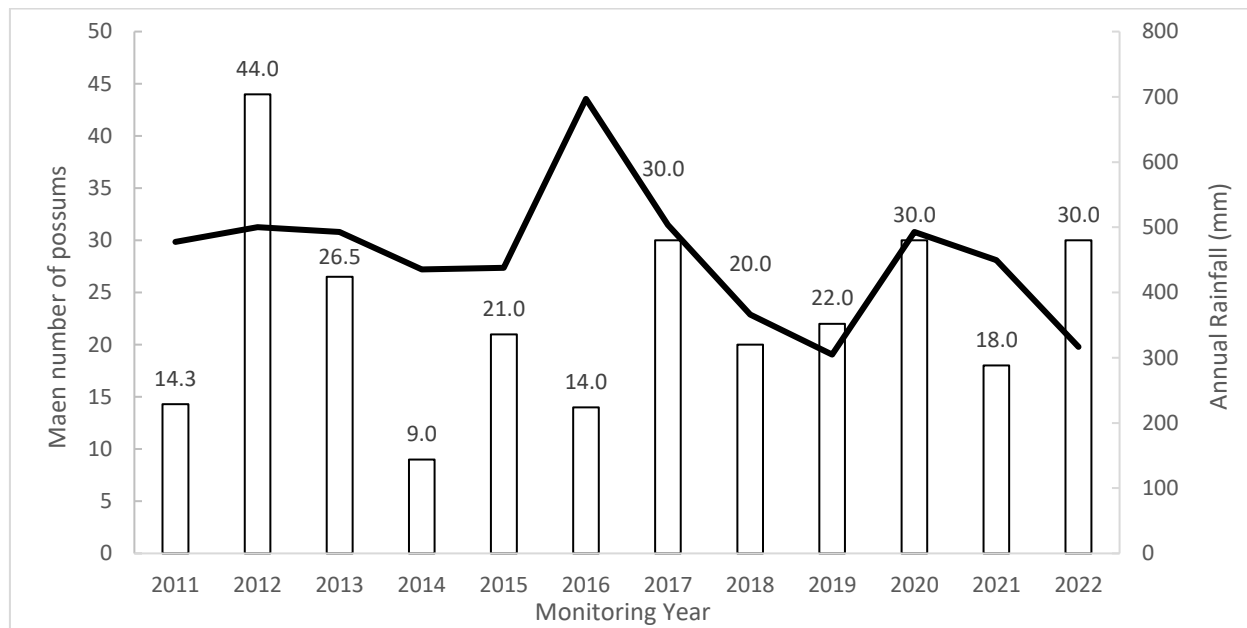
**Figure 9. Locations and number of State Rare Common Brushtail Possums (*Trichosurus vulpecula*) and non-threatened Common Ringtail Possums (*Pseudocheirus peregrinus*) observed during the 2022 fauna survey at Kanmantoo.**



### 3.4 Possum survey 2011-2022

To date there have been no observations of Common Brushtail Possums in the SEB area. In the ML, the number of individuals observed per night has ranged from the lowest of 9 individuals in 2014 to the highest of 44 individuals in 2012.

The average number of possums observed per night is  $23.2 \mu \pm 2.7$  S.E. (2011-2022). Over the lifetime of the fauna monitoring program the number of Common Brushtail Possums observed has fluctuated annually (Table 4, page 16). Since 2015 numbers of Common Brushtail Possums have been relatively stable ranging from 14 to 30 individuals. The correlation between Common Brushtail Possum abundance and rainfall is shown in Figure 10.



**Figure 10. Mean possum abundance recorded over the fauna monitoring program 2011-2022 in relation to annual rainfall. Please note that monitoring was confined to the ML from 2011 to 2014 and expanded to include SEB areas from 2015.**

*Note: Rainfall data for 2022 is limited to the months Oct-Aug, as at the time of the reporting rainfall records for September 2022 were unavailable. Therefore, the total rainfall for 2022 may be higher than the true value (BOM 2022a).*

### 3.5 Opportunistic observation 2022

#### 3.5.1 Frogs

One species of frog *Limnodynastes dumerilii* (Eastern Banjo Frog), was heard during the 2022 survey within the ML. This species was heard in the dam adjacent Bird survey transect 5 and is likely to utilise the vegetated margins of this water source when enough water is present.

#### 3.5.2 Mammals

The Western Grey Kangaroo (*Macropus fuliginosus*) was the most abundant mammal species recorded in the Project Area, with 85 individuals sighted. In 2022, this species was sighted predominantly within the ML, but seven individuals were also observed in the SEB area. Two introduced mammal species were recorded in small numbers in 2022; the Rabbit (*Oryctolagus cuniculus*), with three individuals sighted, and the Red Fox (*Vulpes vulpes*), with one individual sighted. A total of 15 Common Ringtail Possums (*Pseudocheirus peregrinus*) were observed during the spotlight surveys in both *Eucalyptus odorata* (Peppermint Box) woodland and *Allocasuarina verticillata* (Drooping Sheoak) woodland within the ML area (see Figure 9, page 17).

#### 3.5.3 Reptiles

Two Eastern Brown Snakes (*Pseudonaja textilis*) and four Sleepy Lizards (*Tiliqua rugosa*) were observed within the ML during the 2022 survey.

## 4 DISCUSSION

### 4.1 Birds

The bird diversity of the 2022 survey compares with diversity recorded in previous surveys, suggesting the habitat present remains suitable to a high proportion of regularly observed species. A total of 57 bird species were observed in 2022 with only one past year of monitoring in 2012 (59 species) recording a higher diversity of species. The bird abundance was high again in 2022 with 897 individuals observed. This is particularly noticeable after low abundances in 2018 and 2019 due to very low rainfall with 700 and 686 individuals observed respectively.

The abundance of the threatened White-winged Chough (*Corcorax melanorhamphos*), Elegant Parrot (*Neophema elegans*) and Diamond firetail (*Stagonopleura guttata*) were comparable to previous survey years. Variations in the numbers of other threatened species is expected, due to changing seasonal conditions, movements and resource availability across the site particularly given the avian survey period is considered short, and such conditions at the time of the survey represent a snapshot in time. One example of this variation is the observation of 23 Yellow-tailed Black Cockatoo flying over the Project Area near Site 16 in the SEB area for the first time since 2017.

Fluctuations in the number of birds observed at Kanmantoo appear to be in part influenced by the presence of nomadic and flocking species and variations in the numbers of ground foraging species as well as nectivorous species. Large numbers of flocking and nomadic species were recorded in 2021 and 2017, the years with the highest and second highest number of birds recorded. However, the abundance of common bird species was similar to or lower than the 2021 survey, particularly for Yellow-rumped thornbill (*Acanthiza chrysorrhoa*), Adelaide rosella (*Platycercus elegans*) and Little Raven (*Corvus mellori*). The 2022 survey was conducted at a similar time to the 2021 survey, which is up to two weeks later than previous survey years. the presence of common species and nomadic species such as cuckoos is comparable to previous years, suggesting that the survey period did not impact on avian richness and abundance.

As indicated in previous reports, annual rainfall data does not appear to be correlated with bird abundance or species richness (see Figure 6, page 12 and Figure 7, page 13). However, if rainfall data were treated with greater sensitivity, such as looking at the quantity and timing of rainfall within a given year and linking this to the flowering requirements for dominant tree and shrub species, such as *Eucalyptus odorata* (Peppermint Box), then the variability in the number and species richness of nectivorous species may be further explained. Likewise, determining how the rainfall influences soil moisture and the growth of understorey weeds may help explain the variability in the numbers of ground-foraging bird species.

Abundance of the indicator species showed variability between years, however, none of the species has been identified to be in decline since the fauna monitoring program at Kanmantoo commenced in 2011 (see Table 3, page 16).

Some other notable trends and observations from the avian dataset more generally include:

- A greater diversity of raptor species in 2022, such as the observation of Black-shouldered Kite (*Elanus axillaris*) and Brown Goshawk (*Accipiter fasciatus fasciatus*) for the first time in a number of years or for the first time in the Project Area;
- High numbers of honeyeaters observed in 2022 (such as Singing Honeyeaters and New Holland Honeyeaters);
- Varied *Sitella* have not been recorded at the site since 2016;
- Observation of White-winged Trillers (*Lalage tricolor*) in 2022 for the first time since 2019.
- No observations of Common Bronzewing or Musk Lorikeets, even though both of these species were consistently observed in the past six survey years;
- No observations of Australasian Pipits (a grassland species), after consistent sightings in the past three survey years; and
- Stability of avian species diversity at the site.

Each year that the survey runs, new species continue to be added to the cumulative species list for the Project Area (four new species in 2022). This can be attributed, in part to natural cycles such as seasonal variation and bird migration. However, the changes can also reflect local-scale changes in the vegetation structure and composition of the vegetation communities at the Project Area. In particular, it is expected that as the areas of remnant and restored habitat within and outside the ML area mature and improve, this will provide habitat for an increased number and potentially greater diversity of birds.

## 4.2 Common Brushtail Possum

Common Brushtail Possums were observed in both remnant *Eucalyptus odorata* (Peppermint Box) woodland and *Allocasuarina verticillata* (Drooping Sheoak) woodland, with no individuals observed in the SEB area. The occurrence of Common Brushtail Possums within the ML is associated with the availability of den sites in the form of hollows within Peppermint Box. Individuals observed within Drooping Sheoak woodland are presumed to be transiting between areas of remnant Peppermint Box. Common Brushtail Possums prefer large hollows that are deeper than 1 metre (Inions *et al.* 1989; Lindenmayer *et al.* 2008). Such hollows take approximately 200 to 400 years to develop in other eucalypt species (Inions *et al.* 1989), and therefore, the habitat within the SEB area may only become suitable after centuries without intervention. The 40+ year old eucalypts that occur around the fence lines of the SEB area are still too young to have developed any hollows. Even with the installation of possum boxes, Common Brushtail Possums may not colonise the SEB areas located outside the ML. This is because dispersal is uncommon for adult and juvenile possums and artificial possum boxes are not preferred in some cases (Moseby *et al.* 2020). Furthermore, crossing a fragmented landscape would make them vulnerable to predation by species such as the Red Fox (*Vulpes vulpes*), a species that was observed during the 2022 survey (Byrom *et al.* 2015; Moseby *et al.* 2020). Additionally, food resources within the SEB areas may be insufficient until the planted Peppermint Box trees reach maturity, which could take over 20 years.

### **4.3 Opportunistic observations**

Any frogs and reptiles observed within the ML and SEB areas are unlikely to impact on the quality of remnant vegetation in the ML and success of revegetation in the SEB area. Conversely, grazing pressure from over abundant native and introduced mammals could impact the quality of remnant and revegetated areas. Western Grey Kangaroos were frequently sighted in large numbers throughout both the ML and SEB areas. Introduced mammals such as rabbits, foxes and hares (observed in past survey years) are also present across the Project Area. The control of these native and introduced mammals through shooting and baiting may be warranted to ensure that native fauna species are not adversely impacted by reduced habitat quality.

## 5 CONCLUSION AND RECOMMENDATIONS

The results from the 2022 fauna monitoring program confirm that there is no discernible loss of native fauna abundance or diversity in the Mine Lease area and in adjacent SEB areas as demonstrated by the results of the bird and Common Brushtail Possum surveys. As such, Hillgrove has satisfied condition (13) and outcome (21) required for fauna conservation within the PEPR.

EBS recommends the following measures to improve the management and monitoring of fauna within the Kanmantoo Project Area:

- Continue the fauna monitoring program at the same time each year (early spring) with annual analysis of trajectories for threatened and indicator fauna species;
- Change to biennial spotlighting in the SEB areas due to the low likelihood of Common Brushtail Possums using/colonising these areas in the short-term;
- Ensure aerial and flying over species are not included in total bird counts and diversity for the site;
- Include results and discussion on bird species richness and abundance between the ML and SEB areas; and
- Conduct a control program to reduce the numbers of Western Grey Kangaroos and introduced fauna within the Project Area. These are likely to be adversely affecting remnant and planted native vegetation and associated faunal communities.

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## 7 APPENDICES

### 7.1 Appendix 1. Total bird species observed during the period (2011-2022) spring surveys in both the ML and SEB areas (transect counts and opportunistic).

SPECIES NAME	COMMON NAME	EPBC	SA	Exotic	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
<i>Acanthagenys rufogularis</i>	Spiny-cheeked Honeyeater									2		2	4	3	4	3
<i>Acanthiza chrysorrhoa</i>	Yellow-rumped Thornbill				33	43	31	21	90	43	38	54	57	64	121	62
<i>Acanthiza nana</i>	Yellow Thornbill											19	14	8	15	9
<i>Accipiter cirrocephalus</i>	Collared Sparrowhawk				3							1				
<i>Accipiter fasciatus fasciatus</i>	Brown Goshawk															1
<i>Aegotheles cristatus</i>	Australian Owlet-nightjar							1	1		1					1
<i>Alauda arvensis</i>	Eurasian Skylark			*	1		3		3		1	2				
<i>Anas castanea</i>	Chestnut Teal															2
<i>Anas gracilis</i>	Grey Teal					16				6	10	1		12	6	2
<i>Anas superciliosa</i>	Pacific Black Duck					1				10	9			2	6	
<i>Anthochaera carunculata</i>	Red Wattlebird				1	16	5	1	15	1	27	9	15	35	12	12
<i>Anthus australis</i>	Australian Pipit					5	4				6		2	1	7	
<i>Aphelocephala leucopsis</i>	Southern Whiteface				6	9					3		2		2	
<i>Aquila audax</i>	Wedge-tailed Eagle				3	8				1				1		
<i>Artamus cinereus</i>	Black-faced Woodswallow				2	3					260				4	
<i>Artamus cyanopterus</i>	Dusky Woodswallow						8	2	13	5	3	2	2	FO		
<i>Artamus personatus</i>	Masked Woodswallow						4								FO	

SPECIES NAME	COMMON NAME	EPBC	SA	Exotic	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
<i>Artamus superciliosus</i>	White-browed Woodswallow						2							FO		
<i>Aythya australis</i>	Hardhead					1					4	1				
<i>Cacatua galerita</i>	Sulphur-crested Cockatoo									1	3	14	2	FO	FO	
<i>Cacatua sanguinea</i>	Little Corella				2			1	54	2	9			4	FO	7
<i>Cacatua tenuirostris</i>	Long-billed Corella												7			
<i>Cacomantis pallidus</i>	Pallid Cuckoo					1			1					1	1	
<i>Caligavis chrysops</i>	Yellow-faced Honeyeater											1				
<i>Carduelis carduelis</i>	European Goldfinch			*								8	5	4		
<i>Chalcites basalis</i>	Horsfield's Bronze-Cuckoo				1						2				1	6
<i>Chalcites lucidus</i>	Shining Bronze-Cuckoo														1	
<i>Chalcites osculans</i>	Black-eared Cuckoo					1									1	
<i>Chenonetta jubata</i>	Australian Wood Duck					3			19		2				17	5
<i>Chroicocephalus novaehollandiae</i>	Silver Gull													FO		
<i>Cincloramphus cruralis</i>	Brown Songlark					2	1								8	25
<i>Climacteris picumnus</i>	Brown Treecreeper				5	12	17	9	8	11	5	10	11	18	20	9
<i>Colluricincla harmonica</i>	Grey Shrike-thrush				4	1	3	3	14	13	4	8	15	19	21	27
<i>Columba livia</i>	Feral Pigeon [Rock Dove]			*		20	20				2					
<i>Coracina novaehollandiae</i>	Black-faced Cuckoo-shrike				1	2	4	4	3		6	3	1		2	3
<i>Corcorax melanorhamphos</i>	White-winged Chough		R		22	24	16	34	97	36	45	76	58	69	85	93
<i>Corvus mellori</i>	Little Raven				5	3	15	12	26	11	65	24	17	33	31	30
<i>Coturnix pectoralis</i>	Stubble Quail														1	

SPECIES NAME	COMMON NAME	EPBC	SA	Exotic	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
<i>Dacelo novaeguineae</i>	Laughing Kookaburra								1			1	1			
<i>Daphoenositta chrysoptera</i>	Varied Sittella				7	5	21	4	3	5						
<i>Dicaeum hirundinaceum</i>	Mistletoebird												1			
<i>Egretta novaehollandiae</i>	White-faced Heron					1				1	1					1
<i>Elanus axillaris</i>	Black-shouldered Kite				3	2	1									1
<i>Elseyaornis melanops</i>	Black-fronted Dotterel					3					5					2
<i>Eolophus roseicapilla</i>	Galah				12	17	17	15	60	18	43	30	28	63	30	58
<i>Epthianura albifrons</i>	White-fronted Chat					33	18		2			1				
<i>Falco berigora</i>	Brown Falcon				4	6	1	3	4	2	4	4	2	1	3	6
<i>Falco cenchroides</i>	Nankeen Kestrel				3	2	1	1		3	1	2	1	3	2	1
<i>Falco longipennis</i>	Australian Hobby													FO		
<i>Falco peregrinus</i>	Peregrine Falcon		R		2	2			4	1				FO		
<i>Gallinula tenebrosa</i>	Dusky Moorhen					3										
<i>Gavicalis virescens</i>	Singing Honeyeater				7	8	6	4	14	12	4	28	13	27	30	40
<i>Geopelia placida</i>	Peaceful Dove											1	1			1
<i>Glossopsitta concinna</i>	Musk lorikeet					6				2	18	3	19	10	2	
<i>Glossopsitta porphyrocephala</i>	Purple-crowned Lorikeet					20										
<i>Grallina cyanoleuca</i>	Magpie-lark				2	1	1	2	3	1	2		5	8	4	1
<i>Gymnorhina tibicen</i>	Australian Magpie				32	16	15	34	57	48	65	22	29	54	59	47
<i>Hieraaetus morphnoides</i>	Little Eagle		V						1							
<i>Hirundo neoxena</i>	Welcome Swallow				2	6	17		1	37	32	13	6	8	5	4

SPECIES NAME	COMMON NAME	EPBC	SA	Exotic	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
<i>Lalage tricolor</i>	White-winged Triller					3						1	13			3
<i>Malurus cyaneus</i>	Superb Fairy-wren				4		1		4			4	4	10	8	11
<i>Megalurus mathewsi</i>	Rufous Songlark												6			8
<i>Melanodryas cucullata cucullata</i>	Hooded Robin (Southeast ssp.)		R		2											
<i>Melithreptus brevirostris</i>	Brown-headed Honeyeater					6	18	11	19	3	18	32	29	21	28	14
<i>Melithreptus lunatus</i>	White-naped Honeyeater											2			1	
<i>Merops ornatus</i>	Rainbow Bee-eater				7	7	1	2	3	1	4			4	2	
<i>Microcarbo melanoleucos</i>	Little Pied Cormorant															1
<i>Microeca fascians fascians</i>	Jacky Winter		R				1									
<i>Milvus migrans</i>	Black Kite						1									
<i>Myiagra inquieta</i>	Restless Flycatcher		R									1				
<i>Neochmia temporalis</i>	Red-browed Finch											1	4	3		
<i>Neophema elegans</i>	Elegant Parrot		R		7	16	12	9	19	55	28	27	30	32	69	33
<i>Ninox boobook</i>	Southern Boobook												1			
<i>Ocyphaps lophotes</i>	Crested pigeon					9	4			4	2	5	5	11	2	6
<i>Pachycephala pectoralis</i>	Golden Whistler												1			1
<i>Pachycephala rufiventris</i>	Rufous Whistler				6	9	6	2	3	6	9	10	2	9	4	6
<i>Pardalotus punctatus</i>	Spotted Pardalote					3								3		1
<i>Pardalotus striatus</i>	Striated Pardalote				15	26	32	15	26	9	26	37	38	52	33	28
<i>Parvipsitta porphyrocephala</i>	Purple-crowned Lorikeet													4		
<i>Passer domesticus</i>	House Sparrow			*		10	8	1				4	11	14	1	6

SPECIES NAME	COMMON NAME	EPBC	SA	Exotic	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
<i>Petrochelidon nigricans</i>	Tree Martin				12	38	32	50	68	4	41	28	37	25	30	32
<i>Petroica goodenovii</i>	Red-capped Robin								1			1				
<i>Phaps chalcoptera</i>	Common Bronzewing						1			2	1	2	2	2	2	
<i>Phylidonyris novaehollandiae</i>	New Holland Honeyeater						2		21	12	13	25	25	45	11	38
<i>Platycercus elegans</i>	Adelaide Rosella				33	49	64	42	85	58	65	51	44	67	122	94
<i>Podargus strigoides</i>	Tawny Frogmouth								1		1		1	1		3
<i>Pomatostomus superciliosus</i>	White-browed Babbler								8	1	5	13	17	22	18	14
<i>Psephotus haematonotus</i>	Red-rumped Parrot				10	57	27	56	19	15	25	13	12	23	5	15
<i>Ptilotula penicillata</i>	White-plumed Honeyeater				16	18	30	7	13	8	20	28	18	30	21	35
<i>Rhipidura albiscapa</i>	Grey Fantail											9	6		1	3
<i>Rhipidura leucophrys</i>	Willie Wagtail				10	11	11	8	22	13	11	19	14	13	18	13
<i>Sericornis frontalis</i>	White-browed Scrubwren						1									
<i>Smicromis brevirostris</i>	Weebill				3		61	20	56	15	8	18	14	11	42	19
<i>Stagonopleura guttata</i>	Diamond Firetail		V		6	16	4		5		4	13	6	11	10	10
<i>Strepera versicolor melanoptera</i>	Black-winged Currawong															2
<i>Sturnus vulgaris</i>	Common Starling			*	2	27	11		52	37	11	6	22	36	29	33
<i>Tachybaptus novaehollandiae</i>	Australasian Grebe					8	1				4	2		2	2	2
<i>Tadorna tadornoides</i>	Australian Shelduck									13				2		
<i>Threskiornis spinicollis</i>	Straw-necked Ibis								6					4	FO	FO
<i>Todiramphus sanctus</i>	Sacred Kingfisher					1										
<i>Tribonyx ventralis</i>	Black-tailed Native Hen				6	3										

SPECIES NAME	COMMON NAME	EPBC	SA	Exotic	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
<i>Trichoglossus haematodus</i>	Rainbow Lorikeet				2	8	11	2					3	FO	FO	
<i>Turdus merula</i>	Common Blackbird			*				5				1	1	2	6	4
<i>Tyto delicatula</i>	Eastern Barn Owl										1	1				
<i>Vanellus miles</i>	Masked Lapwing					3			4	2		1	1		3	2
<i>Zanda funerea whiteae</i>	Yellow-tailed Black-Cockatoo		V			7					65					FO
<i>Zosterops lateralis</i>	Silvereye						4					3	1			1
		<b>Total Abundance</b>			<b>304</b>	<b>669</b>	<b>575</b>	<b>381</b>	<b>948</b>	<b>530</b>	<b>1042</b>	<b>700</b>	<b>686</b>	<b>910</b>	<b>966</b>	<b>897</b>
		<b>Total Diversity</b>			<b>40</b>	<b>59</b>	<b>48</b>	<b>31</b>	<b>50</b>	<b>42</b>	<b>52</b>	<b>56</b>	<b>55</b>	<b>50</b>	<b>53</b>	<b>57</b>

**SA:** South Australia (*National Parks and Wildlife Act 1972*). **VU/V:** Conservation Codes: V: Vulnerable. R: Rare.

**EPBC:** *Environment Protection and Biodiversity Conservation Act 1999*.

\*Denotes introduced species; FO = observed flying over the site only (FO species not included in diversity count).



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