

LEADING THE WAY  
IN ENVIRONMENTAL  
MANAGEMENT



**RAVENSWORTH  
BIODIVERSITY OFFSET  
AREA MONITORING 2022**  
GLENCORE - RAVENSWORTH COAL MINE  
**December 2022**

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# Document Control Page

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# 1. Executive Summary

This report details the results of the 2022 monitoring programme of the Ravensworth Biodiversity Offset Areas to fulfil the monitoring requirements detailed in the Offset Area Management Programme (Glencore 2019) and Biodiversity Management Plan (Glencore 2022). The survey and assessment involved the continuation of annual vegetation condition assessments and fauna monitoring at 28 permanent monitoring locations across all Biodiversity Offset Areas (BOAs).

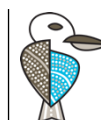
The monitoring surveys indicated a general decrease in floral species richness across the BOAs since the previous monitoring event. As this was the trend across each BOA it is not suspected that detrimental grazing or activities are occurring, rather that the floral diversity is following natural trends and response to local environmental conditions. It is expected that this is indicative of continued higher annual rainfall which has allowed competitive grass species to occupy larger areas and out compete other groundcover species. Species compositions remained similar to previous monitoring surveys with grassland sites continuing to contain a higher richness of exotic species than woodland sites. The highest number exotics were commonly observed in grassland sites, which remains a general trend across all BOAs since monitoring commenced. A number of weeds of significance were recorded during the current monitoring period.

Canopy regeneration assessments revealed further increase in canopy and subcanopy recruitment which was recorded in the previous monitoring round. Despite this, a number of grassland sites across the BOAs show no natural regeneration to date. Although not obvious through monitoring locations, the advancement of regeneration was observed in areas of revegetation works most notably, HOA. The extent of regeneration is expected to become more apparent over time.

Bird census monitoring in 2022 recorded a total of 46 bird species. Grassland sites continued to record fewer bird species than woodland site however this is anticipated to be the case until a developed canopy forms within the grassland areas. A total of three threatened bird species, listed under the *Biodiversity Conservation Act 2016* were recorded during the 2022 monitoring programme. The targeted threatened birds, the Regent Honeyeater and Swift Parrot, were not recorded in 2022.

Fauna monitoring was conducted within all BOA's using both hair tubes as well as terrestrial and arboreal PIR cameras. PIR cameras recorded two fauna species this monitoring round, which is less than in previous years the method has been used although their value is still considered high in detecting nocturnal fauna across the BOA's.

Feral species are evidently still present within this offset area with several species recorded. Records were spread across the BOA's. As surveys did not target feral fauna species specifically a general recommendation of pest control across the BOA's is suggested.



## 2. Abbreviations

Table 1: List of abbreviations used within the report

BAM	<i>Biodiversity Assessment Method</i>
BC Act	<i>Biodiversity Conservation Act 2016</i>
BMP	Biodiversity Management Plan
BOA	Biodiversity Offset Area
Clifton/COA	Clifton Offset Area
DEC	Department of Environment and Conservation
DPI	Department of Primary Industries
EPBC Act	<i>Environment Protection and Biodiversity Conservation Act 1999</i>
GIS	Geographic Information System
GGBF	Green and Golden Bell Frog
Hillcrest/HOA	Hillcrest Offset Area
HTE	High Threat Exotic
mm	Millimetres
NSW	New South Wales
PIR Camera	Passive Infra-red Camera
OAMP	Offset Area Management Programme
OEH	Office of Environment and Heritage
OMP	Offset and Green and Golden Bell Frog Management Plan
PCT	Plant Community Type
Rav. North/RNOA	Ravensthorpe North Offset Area
Stewart/SOA	Stewart Offset Area



## 3. Background Information

### 3.1 Location of the Study Site and Key Definitions

Biodiversity Australia Pty Ltd has been commissioned by Glencore Australia (Ravensthorpe Operations) to conduct monitoring of four Biodiversity Offset Areas (BOAs). These comprise of Clifton Offset Area, Hillcrest Offset Area, Ravensthorpe North Offset Area, and Stewart Offset Area.

In order to address State and Federal approval conditions, a Biodiversity Offset Management Plan (Glencore 2015) and an Offset and Green and Golden Bell Frog Management Plan (Xstrata Coal 2013) were prepared respectively. To address the commitments made in these aforementioned documents, an Offset Area Management Programme was implemented over these BOAs in 2013 (Cumberland Ecology 2013). This detailed implementation programme has since been updated (Glencore 2019) to support the updated Biodiversity Management Plan [BMP] (Glencore 2022). Each of these documents form the framework under which the BOAs are managed.

Biodiversity monitoring of these BOAs commenced in 2012, with the establishment of 28 permanent monitoring sites in 2013 as per the Offset Area Management Programme. Monitoring has continued annually in line with the requirements of this programme. This report addresses the 2022 annual monitoring requirements and provides comparisons to data of previous monitoring years.

### 3.2 Offset Area Locations

The Ravensthorpe Mine Complex is situated approximately 90 kilometres northwest of Newcastle in the Hunter Valley. The offset areas managed under the Biodiversity Management Plan are located as follows:

- Clifton Offset Area (COA) – approximately six kilometres northwest of the Ravensthorpe Complex and covers 106.4 hectares of land.
- Hillcrest Offset Area (HOA) – approximately six kilometres north of the Ravensthorpe Complex and covers 1402.3 hectares of land.
- Ravensthorpe North Offset Area (RNOA) – directly to the north of the Ravensthorpe North Mine and covers 283.7 hectares of land.
- Stewart Offset Area (SOA) - approximately six kilometres northwest of the Ravensthorpe Complex and covers 164.8 hectares of land.

The location of each of these offset areas is provide in Figure 1.

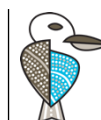
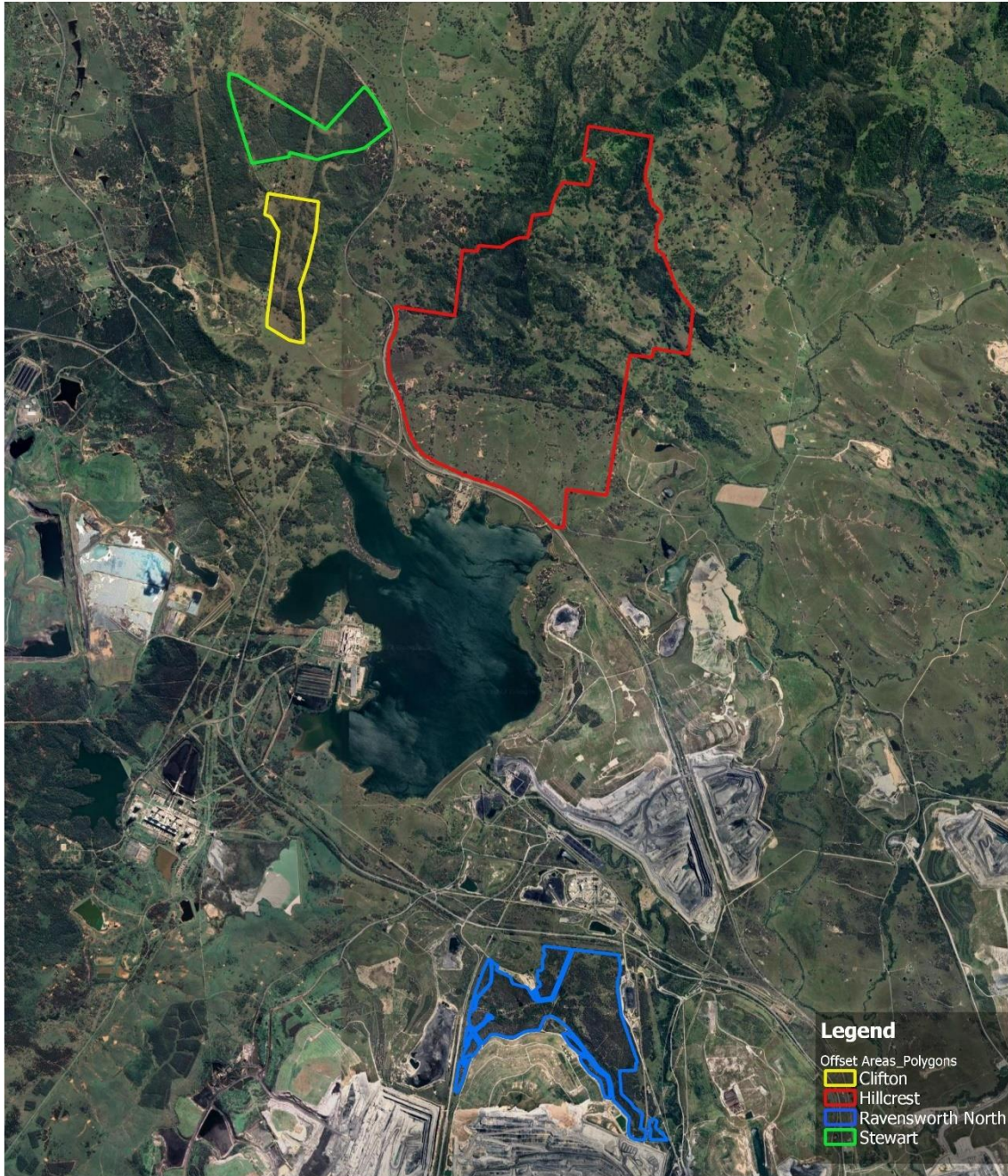



Figure 1: The location of each BOA



<p>This mapping is to be considered indicative only and all derivations (eg of areas of EECs and vegetation communities) are at best approximations and subject to errors including individual interpretation and reliance on information provided to Biodiversity Australia where were not independently verified. All information is intended to be indicative only and no reliance for extrapolation, mapping, ect. should be placed upon this map without independent validation of the information by the user. Biodiversity Australia takes no responsibility for any subsequent errors etc. that may arise from use of this data without independent verification.</p> <p>QGIS</p>	<p>Project Manager: KR</p>	<p>Figure Name: Location of Biodiversity Offset Areas</p>		
	<p>Drawn By: LW</p>	<p>Site: Ravensworth Offset Areas</p>	<p>Job Number: ENS5381</p>	<p>Scale: 1:8,000</p>
	<p>Date: January 2023</p>	<p>Client: Ravensworth Operations Pty Ltd</p>	<p>Spatial Reference: MGA Zone 56/GDA2020</p>	



### 3.3 Monitoring Point Locations

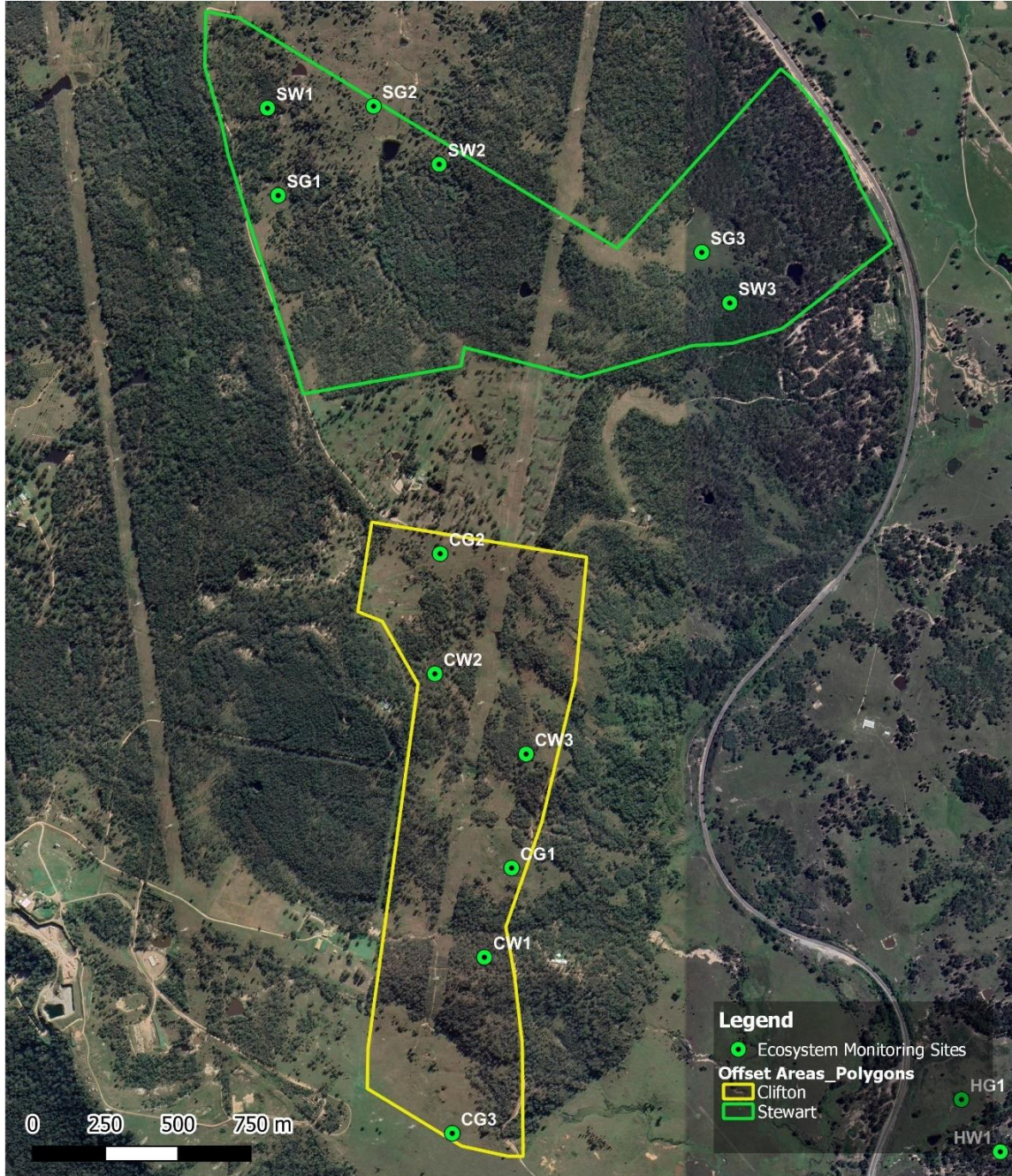
As per the requirements of the Offset Area Management Programme, a total of 28 permanent monitoring locations were established across all BOAs in 2013. These include grassland and woodland sites which are each marked with fixed star-pickets. The following table identifies the location of each of these sites with figures following.

Table 2: Monitoring point locations in each BOA

BOA	Site	Habitat Type	Latitude	Longitude
Clifton	CG1	Grassland	-32.32343	150.97049
	CG2	Grassland	-32.31374	150.96788
	CG3	Grassland	-32.33161	150.96832
	CW1	Woodland	-32.32618	150.96949
	CW2	Woodland	-32.31744	150.96769
	CW3	Woodland	-32.31991	150.97102
Hillcrest	HG1	Grassland	-32.33057	150.98691
	HG2	Grassland	-32.34096	151.00492
	HG3	Grassland	-32.34315	151.01455
	HG4	Grassland	-32.33357	151.01124
	HG5	Grassland	-32.33193	151.01562
	HW1	Woodland	-32.33218	150.98832
	HW2	Woodland	-32.34105	151.00381
	HW3	Woodland	-32.34280	151.01523
	HW4	Woodland	-32.33332	151.01262
	HW5	Woodland	-32.33193	151.01481
RNOA	RG1	Grassland	-32.41321	151.01349
	RG2	Grassland	-32.41633	151.01359
	RG3	Grassland	-32.42298	151.01477
	RW1	Woodland	-32.41917	151.00750
	RW2	Woodland	-32.41689	151.01300
	RW3	Woodland	-32.42889	151.01940
Stewart	SG1	Grassland	-32.30269	150.96197
	SG2	Grassland	-32.29993	150.96545
	SG3	Grassland	-32.30444	150.97743
	SW1	Woodland	-32.29999	150.96158
	SW2	Woodland	-32.30173	150.96784
	SW3	Woodland	-32.30600	150.97845



Figure 2: Monitoring point locations in Stewart and Clifton




<p>This mapping is to be considered indicative only and all derivations (eg of areas of EECs and vegetation communities) are at best approximations and subject to errors including individual interpretation and reliance on information provided to Biodiversity Australia where were not independently verified. All information is intended to be indicative only and no reliance for extrapolation, mapping, ect. should be placed upon this map without independent validation of the information by the user. Biodiversity Australia takes no responsibility for any subsequent error losses etc. that may arise from use of this data without independent verification.</p> <p style="text-align: right;">QGIS</p>	<p><b>Project Manager:</b> KR</p>	<p><b>Figure Name:</b> Monitoring Locations - Stewart &amp; Clifton</p>				
	<p><b>Drawn By:</b> LW</p>	<p><b>Site:</b> Ravensworth Offset Areas</p>	<p><b>Job Number:</b> ENS5381</p>	<p><b>Scale:</b> 1:20,000</p>		
	<p><b>Date:</b> January 2023</p>	<p><b>Client:</b> Ravensworth Operations Pty Ltd</p>	<p><b>Spatial Reference:</b> MGA Zone 56/GDA2020</p>			



Figure 3: Monitoring point locations in Hillcrest



<p>This mapping is to be considered indicative only and all derivations (eg of areas of EECs and vegetation communities) are at best approximations and subject to errors including individual interpretation and reliance on information provided to Biodiversity Australia where were not independently verified. All information is intended to be indicative only and no reliance for extrapolation, mapping, ect. should be placed upon this map without independent validation of the information by the user. Biodiversity Australia takes no responsibility for any subsequent error losses etc. that may arise from use of this data without independent verification.</p> <p>QGIS</p>	<p>Project Manager: KR</p>	<p>Figure Name: Monitoring Locations - Hillcrest</p>			
	<p>Drawn By: LW</p>	<p>Site: Ravensworth Offset Areas</p>	<p>Job Number: ENS5381</p>	<p>Scale: 1:32,000</p>	
	<p>Date: January 2023</p>	<p>Client: Ravensworth Operations Pty Ltd</p>	<p>Spatial Reference: MGA Zone 56/GDA2020</p>		



Figure 4: Monitoring point locations in RNOA



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	<p>Drawn By: LW</p>	<p>Site: Ravensworth Offset Areas</p>	<p>Job Number: ENS5381</p>	<p>Scale: 1:20,000</p>		
	<p>Date: January 2023</p>	<p>Client: Ravensworth Operations Pty Ltd</p>	<p>Spatial Reference: MGA Zone 56/GDA2020</p>			



### 3.4 Information Sources

The following databases, reports, and Geographic Information System (GIS) layers were searched/obtained:

- Department of Agriculture, Water and the Environment Protected Matters Search Tool (DAWE 2022)
- NSW Threatened Biodiversity Data Collection (NSW Government 2022a)
- NSW BioNet Atlas (NSW Government 2022b)
- Ravensworth Open Cut Biodiversity Management Plan (Glencore 2022)
- Ravensworth Open Cut Offset Area Management Programme (Glencore 2019a)
- Offset and Green and Golden Bell Frog Management Plan for Ravensworth Mine Complex EPBC No. 2010/5389 (Xstrata Coal 2013)
- Ravensworth Open Cut Annual Review 2012-2021
- Ravensworth Operations Annual Biodiversity Offset Monitoring Reports 2015-2019 (Cumberland Ecology 2015 & 2017; EcoLogical Australia 2018; Biodiversity Australia 2019-2021).

## 4. Methods

Biodiversity Offset Monitoring surveys were conducted in accordance with those outlined in the Offset Area Management Programme (OAMP). Surveys were carried out by two suitably qualified and experienced ecologists under Biodiversity Australia’s Scientific Licence and Animal Ethics approval.

### 4.1 Survey Timing

The dates of the 2022 surveys and associated survey types conducted are presented in Table 3.

Table 3: Survey timing in 2022

Season	Dates	Required conditions	Survey Type
Winter	29 Aug – 31 Aug 2022	When preferred eucalypt species are in flower	Targeted bird surveys
Spring	1 Sept - 2 Sept 2021	No requirements	Flora Survey, bird census monitoring
Summer	4 Dec – 9 Dec 2022	Warm still nights within one week of rainfall >50 mm	Green and Golden Bell Frog Survey, Spotlighting, Hair tube survey

#### 4.1.1 Weather Conditions

In 2022, monthly rainfall was above the average for the area for 8 of the 11 recorded months, available from the Bureau of Meteorology (rainfall data obtained from Ravensworth Operations; with data obtained from BOM (2022), nearest monitoring station Bowmans Creek (Station no. 61270) [Grenell]). The highest monthly rainfall occurred in March, with 300mm recorded. Above average rainfall for the most part of 2022 likely contributed to increased vegetation growth throughout the year. Figure 5 displays monthly rainfall at Ravensworth from 2019 to the end of 2022 Rainfall during 2022 exceeded 2021, particularly during autumn, winter and in early spring. Below average rainfall was recorded sporadically, in January,



April and June, where rainfall was lowest. Surveying in 2022 occurred outside the substantial rainfall events (Figure 6).

For surveying purposes, as further described in Section 4.4.2, the summer survey period is required to be conducted immediately following a rainfall event that exceeds 50mm. The most recent heavy rainfall event occurred on 14<sup>th</sup> November 2022, where a total of 54 mm of rain fell. A total of 113.4mm of rain fell across the month of November.

Wind speeds during the survey periods were generally low, below 25km/h for all days of surveying. Maximum temperature ranges during each monitoring period were as follows: August/September (16.9°- 22.1°) & December (22.1°- 33.0°)



Figure 5: Recent years' rainfall compared to monthly averages.

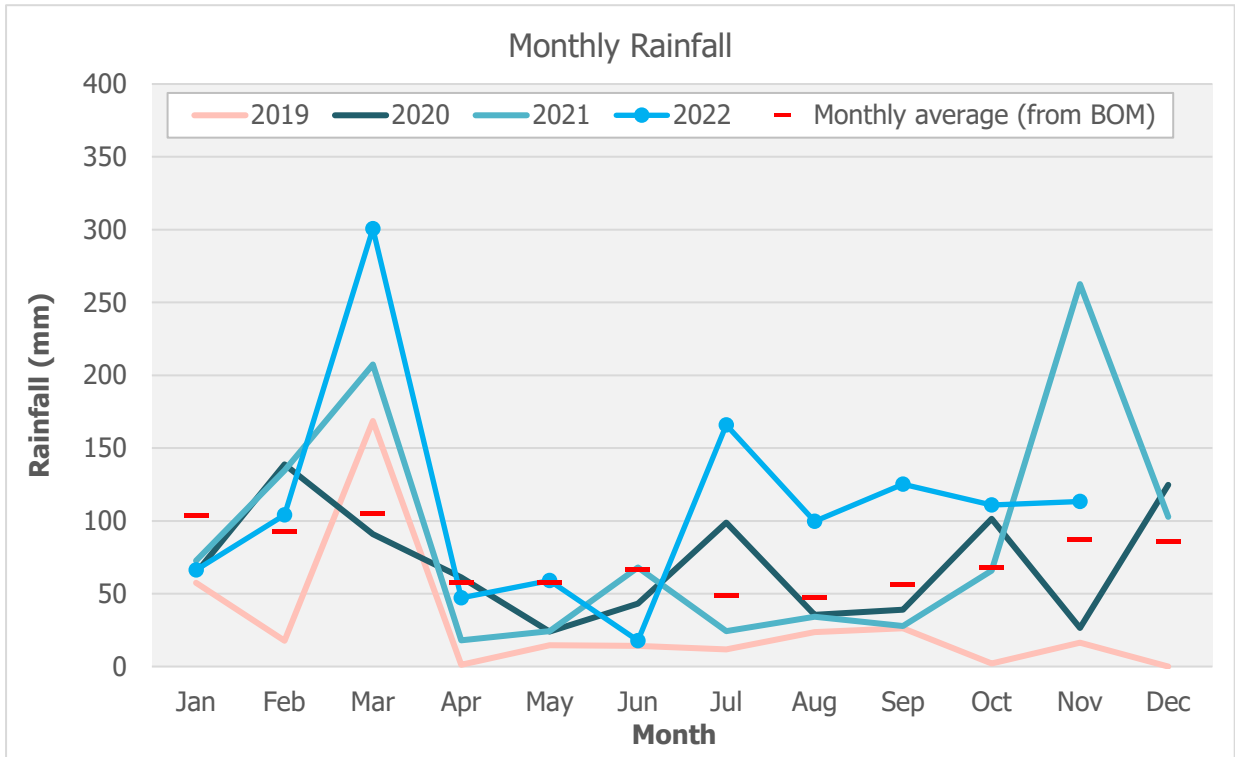
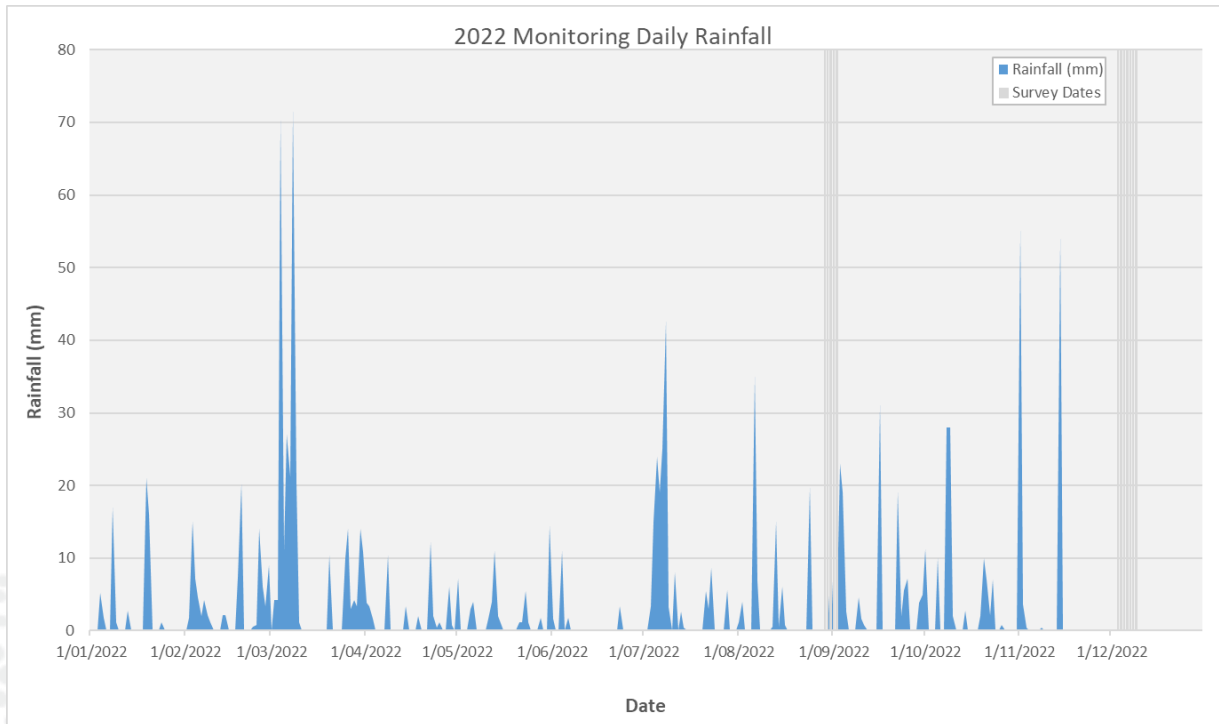


Figure 6: Daily rainfall during the 2022 monitoring period



## 4.2 Flora Survey

### 4.2.1 Vegetation Condition Assessment

A vegetation condition assessment was undertaken at each of the 28 permanent monitoring sites.

At the request of Glencore Group, vegetation condition assessments conducted for the 2022 monitoring survey were undertaken in line with the Biodiversity Assessment Method (BAM) methodology. The BAM was introduced in 2017 as a means of providing assessment methodology in line with the *Biodiversity Conservation Act 2016*.

Vegetation quadrats consist of a 20x20 metre plot at each monitoring location in which floristic composition and structural attributes are collected, and a 20x50 metre plot at each monitoring location which collects ecosystem function attributes.

The following information was collected within the vegetation plot:

- Observer, location, and date
- Plot dimensions and orientation
- Photographic record of vegetation
- Vegetation Class and Plant Community Type (PCT)
- Physical features and disturbance history
- Full flora list
- Growth form, cover and abundance of each species
- Exotic and High Threat Exotic (HTE) plant cover
- Number of large trees
- Recruitment
- Presence of hollow-bearing trees
- Proportion of canopy species regenerating
- Length of logs
- Litter cover

Vegetation quadrat monitoring conducted during previous monitoring years were not collected in line with the BAM methodology, instead these were collected in line with survey requirements outlined in the OAMP. The data obtained via the BAM methodology was almost entirely comparable to data of previous methodology with the required addition of comments in relation to the regeneration of canopy species.

These surveys were conducted by a two suitably qualified and experienced ecologists during spring as per the requirements of the OAMP. The results of the assessment are provided in Section 5.

## 4.3 Fauna Survey

### 4.3.1 Bird Census Monitoring

A bird census targeting all species was undertaken at each of the 28 permanent monitoring sites concurrently with the vegetation condition assessment. This consisted of fixed point and walking transect searches at each monitoring site for a period of 30 minutes by two ecologists.

Due to the requirement for comparison between woodland and grassland sites, and the close proximity of some monitoring sites, only bird species observed or heard calling from within grassland sites were recorded during bird census monitoring of grassland sites. Bird species heard calling within nearby woodlands were recorded as opportunistic observations.



### 4.3.2 Targeted Threatened Bird Survey

An avifauna survey targeting the Regent Honeyeater (*Anthochaera phrygia*) and Swift Parrot (*Lathamus discolor*) was undertaken at two locations within each Biodiversity Offset Area (Figure 7). These surveys were undertaken in the last week of August. The survey aims to coincide with flowering of the preferred winter flowering Eucalypt and Corymbia species, however it is noted that flowering was limited across each BOA. Each survey comprised a combination of a fixed point and walking transect survey with two observers for 30 minutes.

### 4.3.3 Green and Golden Bell Frog Survey

Surveys for the Green and Golden Bell Frog (*Litoria aurea*) were undertaken during the summer survey period. Habitat assessments were conducted at all dams within the BOAs with nocturnal surveys conducted at pre-identified target dams across the BOAs.

A habitat assessment was conducted at each location to determine the suitability for survey. This included visual inspections for presence of water, suitable aquatic plants and *Juncus acutus*; and dip net sampling for the presence of Mosquito Fish (*Gambusia holbrooki*). If habitat was deemed suitable, recorded calls of the Green and Golden Bell Frog were broadcast during a call playback survey and spotlighting was concurrently conducted. Call playback was immediately followed by a period of silence in which the ecologists listened for calls and undertook active searches in suitable habitat.

### 4.3.4 Spotlighting

Spotlighting was conducted concurrently with nocturnal Green and Golden Bell Frog surveys in HOA and RNOA. The procedure involved incidentally shining a handheld 1100 lumen LED spotlight, into the trunks and branches of canopy and understorey trees as well as along the ground, whilst walking or driving slowly through the each BOA.

### 4.3.5 RNOA Fauna Monitoring

Hair tube surveys were carried out at all sites in RNOA in summer. At each site, this consisted of a transect of approximately 100 metres which contained ten hair tubes alternating between arboreal and ground deployed hair tubes. The hair tubes were baited with a standard bait mix of peanut butter, oats, honey and vanilla essence and were set for a total of three nights.

In addition to hair tube surveys, baited PIR cameras, incidental spotlighting and opportunistic herpetological surveys were conducted across RNOA. The data from these surveys were combined with that of the bird census monitoring to assess the continued use of habitat within RNOA by native fauna.

All opportunistic observations of fauna presence within the BOAs were recorded. This is inclusive of, but not limited to, bird sightings and calls, herp searches, and secondary evidence observations such as tracks, scratches, and scats.

## 4.4 Survey Limitations

### 4.4.1 Flora Monitoring

There were no limitations to collection of plot-based data during the 2022 monitoring period. As the entirety of the site is not surveyed during random meanders there may be cryptic species or species outside their flowering period that may not be recorded.



#### 4.4.2 Fauna Monitoring

Fauna detectability is limited by the seasonal, behavioural or lifecycle characteristics of each species, and by external factors including habitat variation (e.g., flowering periods) or climatic conditions (i.e. rainfall) which are at times variable and unpredictable. The surveys conducted in 2022 produced data which is indicative of fauna assemblages at the time of survey but cannot be not considered an exhaustive list of species occupying habitat in each BOA.

In 2022, the targeted threatened bird surveys were conducted were conducted during the prescribed time (i.e. winter) and this is aimed to coincide with flowering of the preferred winter flowering Eucalypt and Corymbia species. However, limited flowering of preferred foraging habitat for both species was noted.

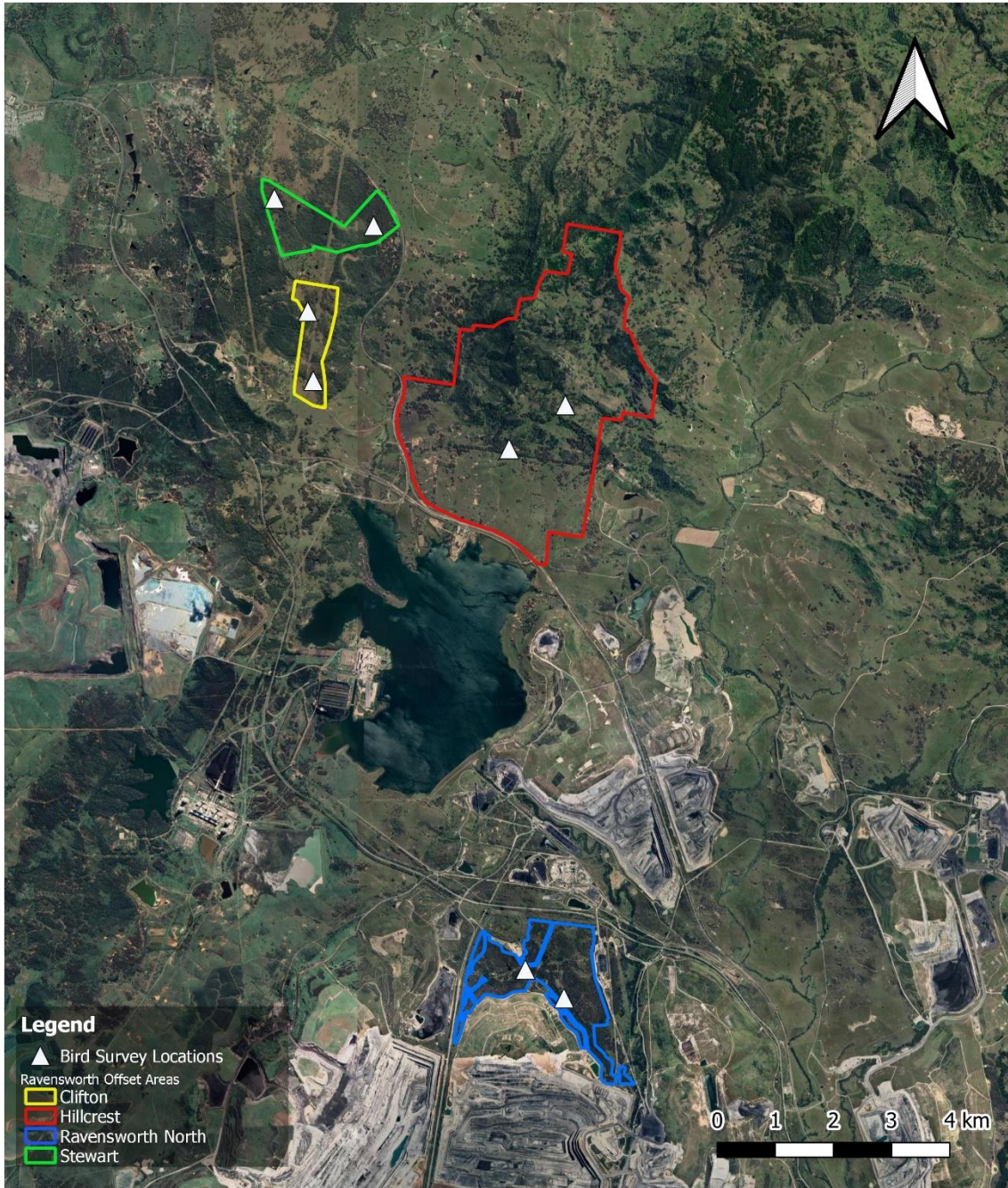
Accessibility issues during this summer survey period also prevented the survey of one dam within the RNOA, RN-New2.

In 2022 hair tube sampling was conducted at all of the BOA's. Although samples were collected, a suitable sub-contractor for the analysis of hair samples was unable engaged by the time this report was submitted. Efforts to engage a sub-contractor for this analysis are ongoing and the report will be updated when results are available.

Despite these limitations, the biodiversity offset monitoring surveys employed in 2022 are considered acceptable in their compliance with the BMP, OAMP and OMP.




Figure 7: Targeted threatened bird survey locations in each BOA



**Legend**

- ▲ Bird Survey Locations
- Ravensworth Offset Areas
- Clifton
- Hillcrest
- Ravensworth North
- Stewart

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Project Manager: KR	Figure Name: Targeted Bird Survey Locations		
Drawn By: LW	Site: Ravensworth Offset Areas	Job Number: ENS5381	Scale: 1:1,000,000
Date: December 2022	Client: Glencore	Spatial Reference: MGA Zone 56/GDA2020	



## 5. Flora Monitoring Results

### 5.1 Vegetation Condition Assessment

Vegetation condition assessment data are provided in Appendix 1.

#### 5.1.1 Species Compositions

A comprehensive list of flora species recorded during the vegetation condition assessment is provided in Appendix A-2.

Assessments of Vegetation Condition have indicated some key trends which have remained consistent since monitoring began in 2012. The overall species richness increased progressively once monitoring commenced, however this reached a peak in 2016 where floral species richness has since, steadily declined. Through all monitoring years, grassland sites have recorded a higher abundance of exotic species than woodland sites. This trend has continued, with the results of the 2022 monitoring also recording a marginally higher abundance of exotic species in grassland sites. It is noted that in current monitoring round has seen a considerable reduction in species diversity across all BOAs with the exception of COA which is comparable to previous years.

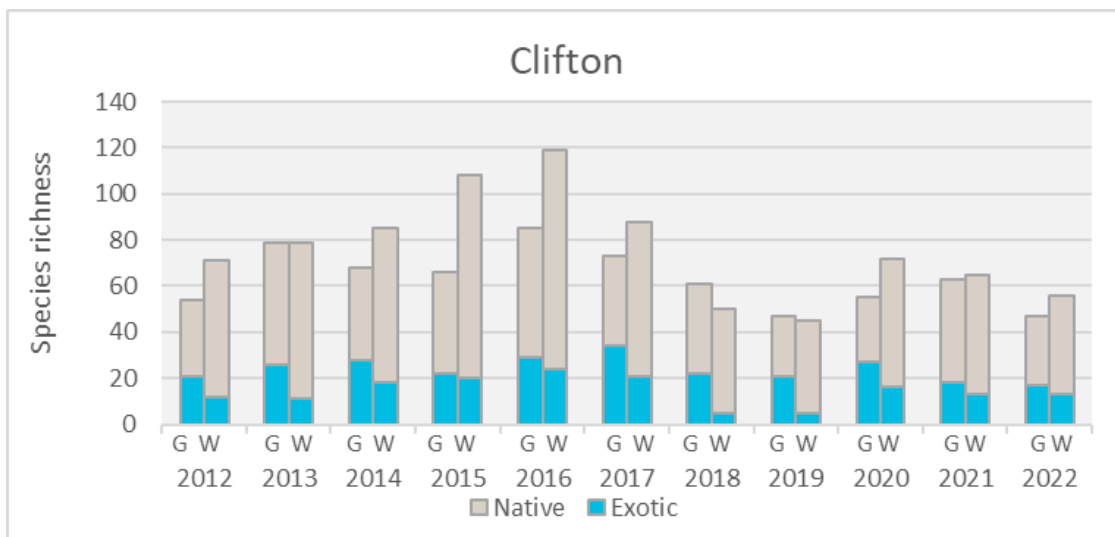
##### 5.1.1.1 Clifton Offset Area

A total of 75 flora species were recorded within Clifton during the 2022 vegetation condition assessment. Of these, 54 species were natives and 21 were exotics. A total of 30 native species were recorded at grassland sites, a slight decrease from the previous year's monitoring, however, still above the lowest diversity during the drought (26 species, 2019) (Figure 8). Similar to monitoring conducted in 2021, a slight decline in woodland native species richness was observed again in 2022, with 43 natives recorded. Historic records are also shown in Figure 8.

Clifton has consistently shown higher native richness in woodland sites than grasslands, with the difference in diversity varying over years. This disparity over the last three monitoring events has been relatively consistent with woodland sites recording more species than that of grassland sites. This may be attributed to a number of years of above average rainfall increasing germination of species within woodland sites and an increase in growth and occupancy of dominant species in grassland sites.

Figure 8: Native and exotic flora species richness by monitoring year at Clifton

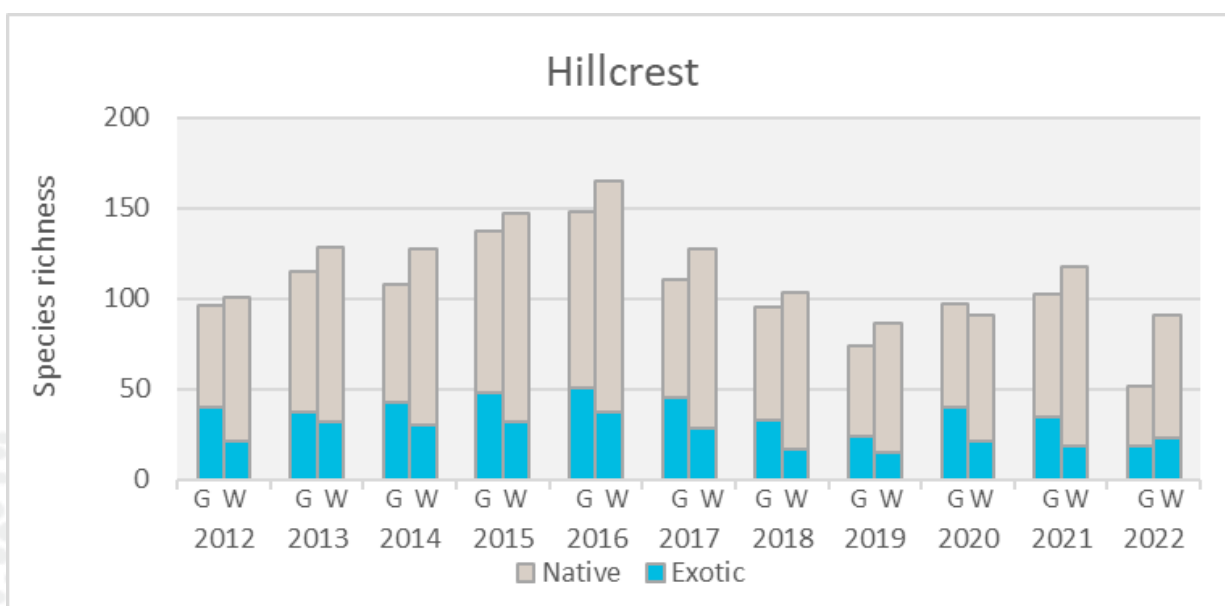




### 5.1.1.2 Hillcrest Offset Area

Figure 9 displays the floral species compositions of grassland and woodland sites recorded in Hillcrest during the 2022 vegetation condition assessment survey. Historically HOA has recorded considerably more species than the other BOAs. These differences in species richness may be accounted for by the larger number of survey sites. For the 2022 monitoring event a total of 108 flora species were recorded, with 80 natives and 28 exotic species. Woodland sites showed higher richness of natives (68 species) and exotics (23 species) when compared with grassland sites (33 natives, 19 exotics). There was an overall decrease in native richness at both grassland and woodland sites between 2021 and 2022. Exotic species richness also declined marginally between 2021 & 2022. Richness of native species is considerably lower than the peak in 2016, however woodland sites show greater diversity than its lowest in 2019 following drought conditions. This may be explained by improved conditions following several seasons of above average rainfall.

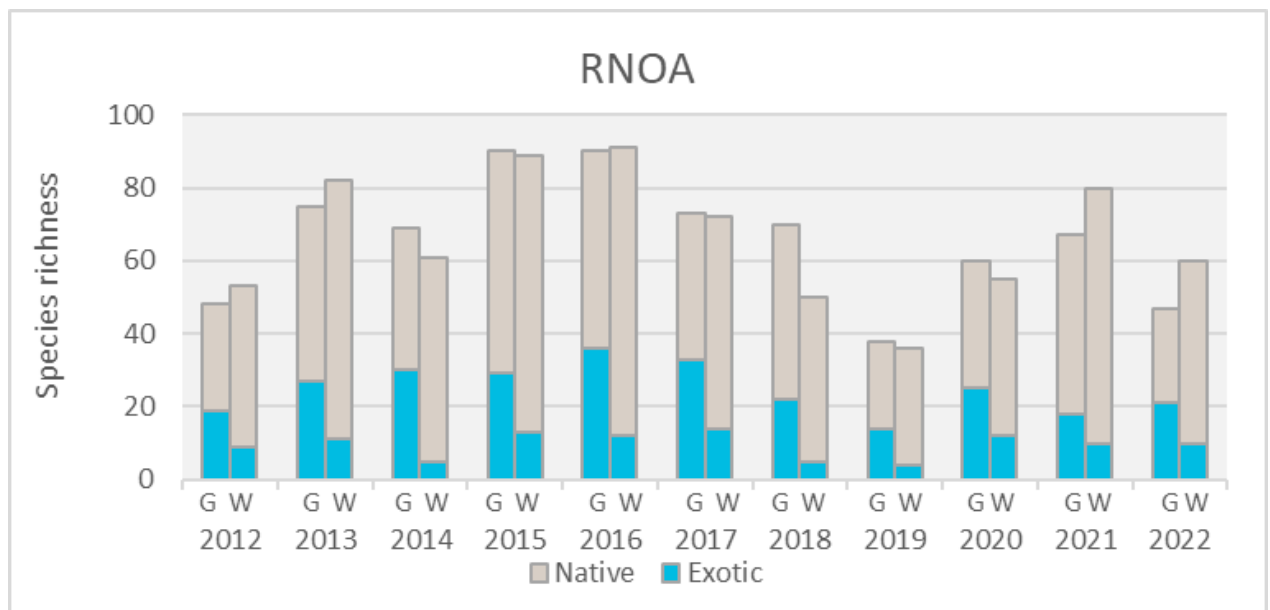
Figure 9: Native and exotic flora species richness by monitoring year at Hillcrest



### 5.1.1.3 Ravensworth Offset Area

2022 showed a decrease in species richness of natives at both woodland and grassland sites in comparison to 2021 (Figure 10). However, is similar to that of diversity recorded in 2020 and higher than recorded at the end of drought conditions in 2019. A total of 74 species, 47 natives and 27 exotics were recorded. Of these, 42 natives occurred at woodland sites and 26 natives at grassland sites. Exotic richness across woodland and grassland sites remained relatively similar to records from 2020 & 2021. Woodland sites continue to show lower exotic species richness than grassland sites.

Figure 10: Native and exotic flora species richness by monitoring year at RNOA

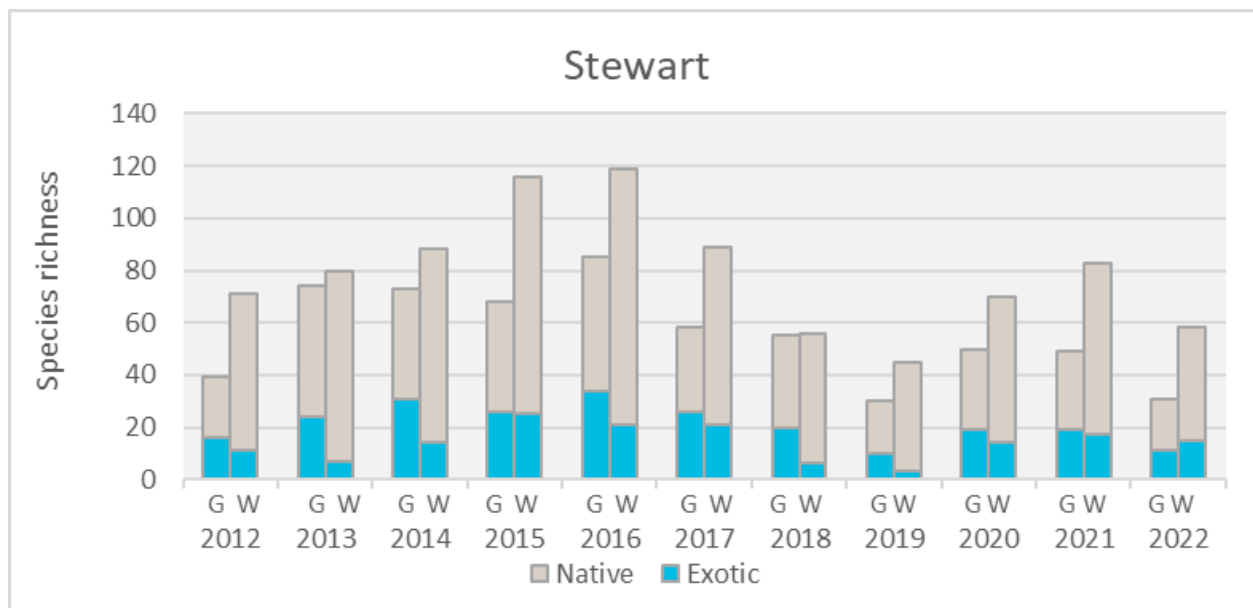


### 5.1.1.4 Stewart Offset Area

A total of 61 flora species were recorded within Stewart in 2022, comprising of 44 native species and 17 exotic (Figure 11). As in previous years, woodlands had considerably higher richness of native species than grasslands (43 and 20 respectively). Exotic richness was marginally higher at woodland sites. Native plant richness at woodland sites has decreased since 2021, however still exceeds that of 2019. Grassland diversity is comparable to that which was recorded at the end of the drought in 2019. Species richness at both woodland and grassland sites is still far below the peaks recorded in 2016, however an overall increase in diversity since the end of the drought appears to be occurring.

Figure 11: Native and exotic flora species richness by monitoring year at Stewart





### 5.1.1.5 Species Composition Summary

Across all BOAs a decline in species richness is evident since 2016 monitoring. The timing of this decline is in line with drought conditions experienced in the region from mid-2017 to 2019. This was an indication of the strong relationship between the state of drought and the decline in floral species richness. However, an increase in species diversity across the BOA’s has been evident since monitoring in 2020. This likely coincides with improved conditions due to above average rainfall over several seasons as described previously in this report. There was a marked increase in species diversity during 2020 & 2021 monitoring events. Across all the BOA’s however, there was a slight decrease in diversity in the current monitoring year. Generally, woodland and grassland sites are higher than recorded in 2019, at the end of the drought.

Exotic richness is comparable to that which was recorded in 2021 across the BOAs. Exotic richness is also considerably lower than its highest in 2016. Management interventions may be contributing to this, as well as the success of natural regeneration that has been occurring across select areas of the BOAs.

Similar to previous years differences between woodland and grassland species richness is still notable at all BOAs, except for Clifton which has very similar native richness between woodlands and grassland sites. However, Clifton also has the lowest number of flora species recorded of all BOAs. In 2021, the woodland sites of all BOAs had higher species richness than the grassland sites.

Richness is still lower at all BOAs than the peak observed in 2016. Despite the slight decrease in richness of the current monitoring year there appears to be an overall trend of increasing richness since the peak of the drought in 2019. This shows grassland and woodland sites are recovering during conditions of above average rainfall. Higher species richness in woodland communities is anticipated as the additional vegetative structural layers found in woodland communities encourages a broader range of potential floral species.

### 5.1.2 Exotic Species

During the 2022 vegetation condition assessments, exotic species comprised 25% of all floral species recorded across all BOAs. This is consistent with the proportion of exotic species recorded during 2021. A total of 42 exotic species were recorded throughout the surveys. The number of exotic species recorded in grassland and woodland sites within each BOA is presented in Table 4. The average number of exotic species has been presented to allow comparisons between BOAs with a different number of survey sites.



Table 4: Number of exotic species in each BOA

	COA		HOA		RNOA		SOA	
	Mean	Total	Mean	Total	Mean	Total	Mean	Total
Grassland sites	4.0	16	4.4	19	5.8	21	3.3	11
Woodland sites	3.0	13	4.4	22	5.5	18	3.5	15
Total	3.5	20	4.4	27	5.7	27	3.4	17

As with previous years, exotic species richness was higher in grassland sites than in woodland sites except for Hillcrest. Across all BOAs, the mean number of exotic species recorded in woodland and grass land sites was comparable or lower than that of the 2021 survey. The exception to this was RNOA which had a higher mean number of exotic species across woodland and grassland sites.

Exotic species cover remains high in some areas across the BOAs, and management of weeds should remain a priority to ensure spread is kept to a minimum, and natural regeneration can be further encouraged. Although exotic richness is not as high at some BOAs as has been in the past, the improved field conditions may see increases in cover and density in areas prone to high weed cover (i.e. with a high seed bank of weed species).

#### 5.1.2.1 Target Weed Species

The OAMP lists out 130 weed species which are identified as target species and includes priority weeds listed under the NSW *Biosecurity Act 2015*. Some of these species have been previously detected on Ravensworth properties. Of the weeds encountered on site, 12 are listed as target weeds according to the OAMP. These species are listed in Table 5.

Fireweed (*Senecio madagascariensis*) was recorded in both woodland and grassland sites across all BOAs with the exception of woodland sites within RNOA. Common prickly pear (*Opuntia stricta*) and Galenia (*Galenia pubescens*) were the next most frequently recorded. The remaining target weeds were recorded infrequently throughout the BOA's but on occasion were dominant.

Thistles have previously been of note within this report. For the current monitoring year, thistle species were present but did not dominate. Hillcrest has previously been of note in regard to the abundance of thistles. The in 2022 there were only two thistle species recorded on HOA and were typically of negligible coverage.

The OAMP also lists several priority weeds for the Hunter Region which are to be subject to weed management techniques. Table 5 & Table 6 detail which of these species were identified in the BOAs during the 2022 monitoring and their priority in the Hunter Region. One of these species fall within the State Priority Weed Objective (fireweed).



Table 5: Target weed species recorded across grassland and woodland sites

Common Name	Scientific Name	COA		HOA		RNOA		SOA	
		G	W	G	W	G	W	G	W
Scotch Broom	<i>Cytisus scoparius</i>				x	x			
Green Cestrum	<i>Cestrum parqui</i>						X		
Galenia	<i>Galenia pubescens</i>	x	x				x		
Coolatai Grass	<i>Hyparrhenia hirta</i>				x	X			
Common Olive	<i>Olea europaea</i>				x				
Common Prickly Pear	<i>Opuntia stricta</i>	X			X	X	X		
Fireweed	<i>Senecio madagascariensis</i>	X	X	X	X	X		X	X

Table 6: Weed species recorded in 2022 which are listed as priority weeds in the Hunter Region

Common Name	Scientific Name	COA		HOA		RNOA		SOA		Document listed
		G	W	G	W	G	W	G	W	
Galenia	<i>Galenia pubescens</i>	x	x				x			Additional Species of Concern
Green Cestrum	<i>Cestrum parqui</i>						x			Regional Priority Weed Objective - ASSET PROTECTION
Coolatai Grass	<i>Hyarrhenia hirta</i>				x	x				Regional Priority Weed Objective - ASSET PROTECTION
Common Prickly Pear	<i>Opuntia stricta</i>	x			x	x	x			Additional Species of Concern
Fireweed	<i>Senecio madagascariensis</i>	x	x	x	x	x		x	x	State Priority Weed Objective – ASSET PROTECTION, Additional Species of Concern

### 5.1.3 Canopy Regeneration Assessment

One key objective outlined in the OAMP, is the establishment of native vegetation to increase canopy cover. An assessment of the current canopy species compared to the juvenile canopy species growing at each site was undertaken to determine the success of natural regeneration within each BOA. Table 7 details the findings of this assessment in 2022.

The increase in canopy regeneration across the BOAs observed in 2021 continued in the current monitoring event. This is likely due to the improved climatic conditions and high rainfall that has occurred over the last two years. In addition, the exclusion of cattle in areas including COA and SOA has also greatly contributed to regeneration success. In areas showing regeneration, the maturity of many of these plants are likely sufficiently mature to continue growth whilst resisting the late summer heats and winter frosts. Despite the success recorded in some areas there are sites that have no canopy regeneration. There is one site on Stewart and Hillcrest and two sites in Clifton. In these cases, active/assisted regeneration would likely be necessary to see plants establish.

The images Photo 1 to Photo 3 show examples of ideal and poor regeneration occurring at sites throughout the BOAs.



Table 7: Regeneration of canopy species at each 20 x 50 metre plot

Site	Species in canopy	Species regenerating
<b>Clifton</b>		
CG1	No canopy species recorded.	No regeneration recorded.
CG2	No canopy species recorded.	<i>Eucalyptus crebra</i>
CG3	No canopy species recorded.	No regeneration recorded.
CW1	<i>Allocasuarina luehmannii</i> , <i>Eucalyptus tereticornis</i> , <i>Eucalyptus crebra</i> , <i>Corymbia maculata</i>	<i>Allocasuarina luehmannii</i> , <i>Eucalyptus crebra</i>
CW2	<i>Eucalyptus crebra</i>	<i>Eucalyptus crebra</i>
CW3	<i>Allocasuarina littoralis</i> , <i>Eucalyptus tereticornis</i>	<i>Allocasuarina luehmannii</i> , <i>Eucalyptus tereticornis</i> , <i>Eucalyptus moluccana</i> , <i>Eucalyptus crebra</i>
<b>Hillcrest</b>		
HG1	No canopy species recorded.	No regeneration recorded.
HG2	No canopy species recorded.	<i>Eucalyptus crebra</i>
HG3	No canopy species recorded.	<i>Corymbia maculata</i> , <i>Eucalyptus crebra</i>
HG4	No canopy species recorded.	<i>Corymbia maculata</i>
HG5	<i>Corymbia maculata</i>	<i>Corymbia maculata</i> , <i>Eucalyptus crebra</i>
HW1	<i>Allocasuarina luehmannii</i> , <i>Corymbia maculata</i> , <i>Eucalyptus crebra</i>	<i>Allocasuarina luehmannii</i> , <i>Corymbia maculata</i> , <i>Eucalyptus crebra</i>
HW2	<i>Corymbia maculata</i> , <i>Eucalyptus crebra</i>	<i>Corymbia maculata</i> , <i>Eucalyptus crebra</i>
HW3	<i>Corymbia maculata</i> , <i>Eucalyptus crebra</i>	<i>Eucalyptus crebra</i>
HW4	<i>Angophora floribunda</i> , <i>Corymbia maculata</i> , <i>Eucalyptus tereticornis</i>	<i>Angophora floribunda</i> , <i>Corymbia maculata</i> , <i>Eucalyptus tereticornis</i>
HW5	<i>Corymbia maculata</i> , <i>Eucalyptus crebra</i> , <i>Eucalyptus tereticornis</i>	<i>Corymbia maculata</i> , <i>Eucalyptus crebra</i> , <i>Eucalyptus tereticornis</i>
<b>RNOA</b>		
RG1	<i>Allocasuarina luehmannii</i>	<i>Eucalyptus crebra</i>
RG2	<i>Allocasuarina luehmannii</i>	<i>Eucalyptus crebra</i>
RG3	<i>Allocasuarina luehmannii</i> , <i>Eucalyptus tereticornis</i> , <i>Eucalyptus moluccana</i>	<i>Allocasuarina luehmannii</i> , <i>Eucalyptus tereticornis</i> , <i>Eucalyptus moluccana</i>
RW1	<i>Allocasuarina luehmannii</i> , <i>Eucalyptus tereticornis</i> , <i>Eucalyptus crebra</i>	<i>Allocasuarina luehmannii</i> , <i>Eucalyptus tereticornis</i> , <i>Eucalyptus crebra</i>
RW2	<i>Allocasuarina luehmannii</i> , <i>Eucalyptus crebra</i>	<i>Allocasuarina luehmannii</i> , <i>Eucalyptus crebra</i>
RW3	<i>Allocasuarina luehmannii</i> , <i>Eucalyptus crebra</i> , <i>Eucalyptus moluccana</i>	<i>Allocasuarina luehmannii</i> , <i>Eucalyptus crebra</i> , <i>Eucalyptus moluccana</i>
<b>Stewart</b>		
SG1	No canopy species recorded.	<i>Corymbia maculata</i> , <i>Eucalyptus crebra</i> , <i>Eucalyptus moluccana</i>
SG2	No canopy species recorded.	<i>Eucalyptus crebra</i> , <i>Eucalyptus moluccana</i>
SG3	No canopy species recorded.	No regeneration recorded.
SW1	<i>Corymbia maculata</i> , <i>Eucalyptus moluccana</i>	<i>Corymbia maculata</i> , <i>Eucalyptus crebra</i> , <i>Eucalyptus moluccana</i> , <i>Allocasuarina luehmannii</i>
SW2	<i>Eucalyptus moluccana</i> , <i>Eucalyptus crebra</i>	<i>Eucalyptus moluccana</i> , <i>Eucalyptus crebra</i>



SW3	<i>Eucalyptus crebra</i>	<i>Eucalyptus crebra</i>
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Photo 1: High grass cover but very little to no regeneration at Clifton.



Photo 2: Regeneration at Stewart grassland site SG2

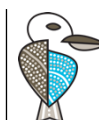
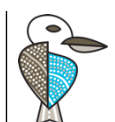


Photo 3: The limited eucalyptus regeneration at RG3



## 6. Fauna Monitoring Results

The following sections outline the results of the fauna surveys in 2022. A full list of fauna species recorded in each BOA during the 2022 monitoring surveys is provided in Appendix A-3.

### 6.1 Bird Census Monitoring

#### 6.1.1 General Bird Census

##### 6.1.1.1 Clifton Offset Area

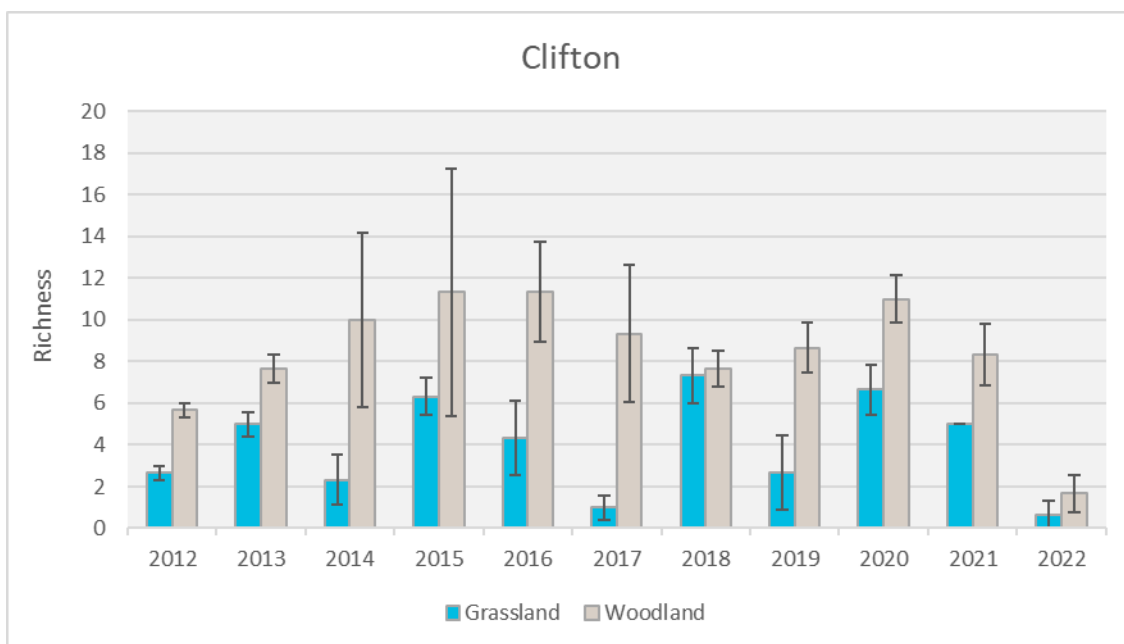
At the COA, a total of 7 species of birds were encountered across the grassland and woodland sites during the 2022 bird census monitoring. Four of these species were only observed at COA, yellow thornbill (*Acanthiza nana*), little wattlebird (*Anthochaera chrysoptera*) and brown songlark (*Cinchoramphus cruralis*) and brown gerygone (*Gerygone mouki*). No threatened birds were observed during the bird census at COA in 2022.

The number of species observed between grassland and woodland species was only marginally lower with, an average of three more species being observed at woodland sites. During 2022 surveys there was a considerable decline in the number of species recorded across COA in comparison to previous years monitoring.

The average species richness recorded during COA bird census monitoring is displayed in Figure 12. Average species richness in both woodland and grassland sites has declined since 2020. The values from the current year are considerably lower than in previous years. This may be explained by extended above average rainfall improving habitat quality across much of the state. Whilst woodland averages tend to follow a smoother trend of rising and falling every few years, grassland bird averages appear more sporadic with apparent annual changes. The lack of habitat diversity and food reliability in grasslands likely explains these patterns. Woodland sites likely provide more reliable foraging opportunities for a greater variety of bird species and feeding guilds, which may explain the consistently higher richness over grasslands.



Figure 12: Average bird species richness over each monitoring year in Clifton, with standard error



### 6.1.1.2 Hillcrest Offset Area

At Hillcrest, 24 bird species were recorded across the woodland and grassland sites during the 2022 bird census. Of these, six species were recorded in this BOA only. There was one threatened species recorded on the BOA opportunistically during the summer surveys, the white-throated needletail (*Hirundapus caudacutus*).

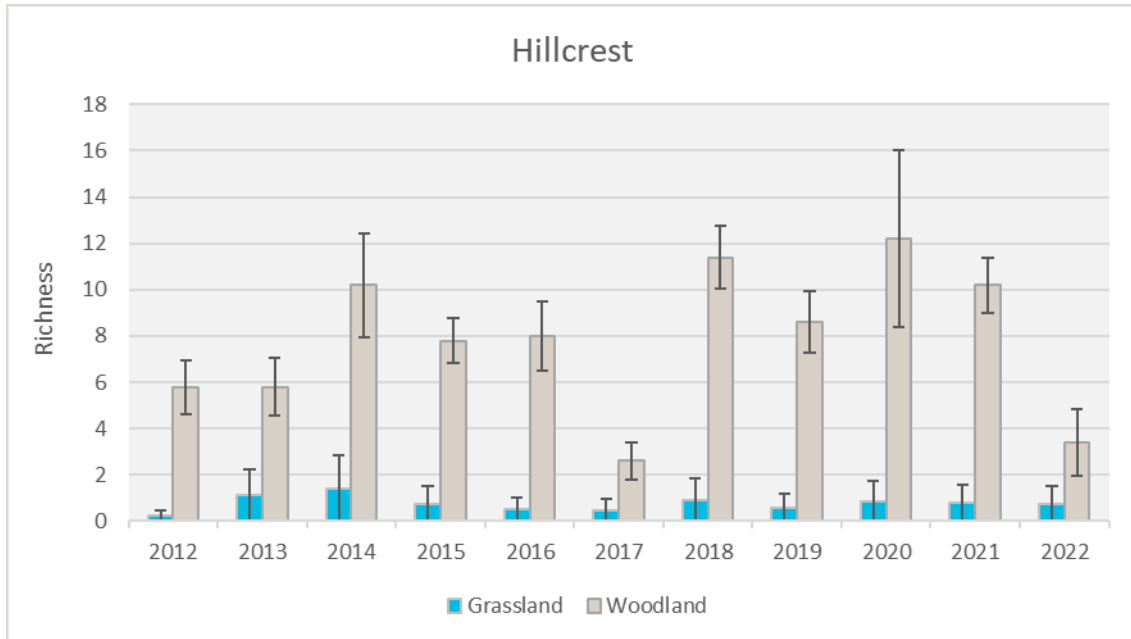
Woodland sites supported 17 different bird species, and grasslands seven. There was a considerable decline in species richness in both woodland and grassland sites in the current monitoring year. This again may be explained by above average rainfall over several seasons improving habitat quality across the state making individuals and groups more widely dispersed across the landscape. Although there has been a considerable decline in comparison to 2020 and 2021 monitoring the numbers recorded are comparable with early rounds of monitoring i.e. 2012-2016.

As with other sites, the higher species richness in woodland sites is likely due to the diversity and reliability of food sources available for birds.

The average number of bird species recorded at grassland sites was comparable to previous years monitoring which continues to be low (<1 species recorded, Figure 13). The average bird species richness at woodland sites decreased considerably from 10.2 in 2021 to 3.4 in 2022.



Figure 13: Average bird species richness over each monitoring year in Hillcrest, with standard error



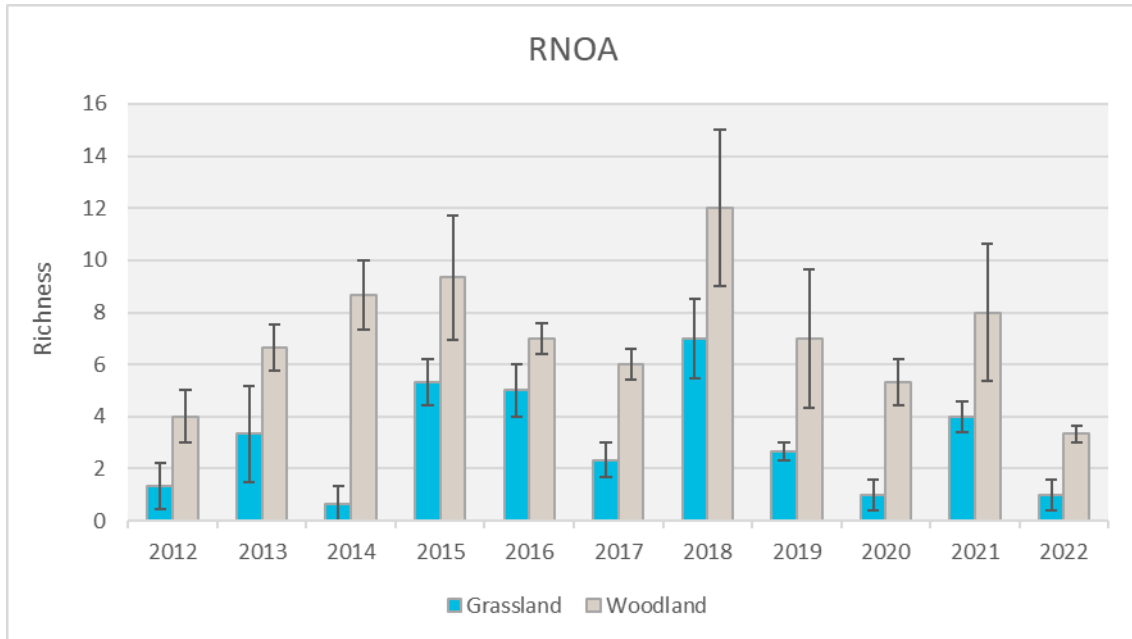
### 6.1.1.3 Ravensworth North Offset Area

The 2022 bird census observed 13 bird species across the grassland and woodland sites in the Ravensworth North Offset Area. Two of these species were only observed at RNOA during the monitoring period and included the pallid cuckoo (*Cacomantis pallidus*) and Lewin’s honeyeater (*Meliphaga lewinii*). Woodland sites accounted for 10 species, and grassland sites accounted for 3. There were no threatened bird species encountered at RNOA during the 2022 bird census, however the grey crowned babbler was opportunistically observed during the summer surveys outside the offset area in habitat between Lemington Road and Ravensworth Operations Office.

As has been the trend with the other BOA’s this monitoring round the average number of birds observed in 2022 has decreased considerably in comparison to 2021 monitoring. Average species richness of woodland sites was again greater than that of grassland sites which is consistent with previous years (Figure 14). Although average species richness decreased at both woodland and grassland sites during 2022, results are comparable to that in 2020 and 2012 and are likely an artefact of natural fluctuations in the native bird population.



Figure 14: Average bird species richness over each monitoring year in RNOA, with standard error



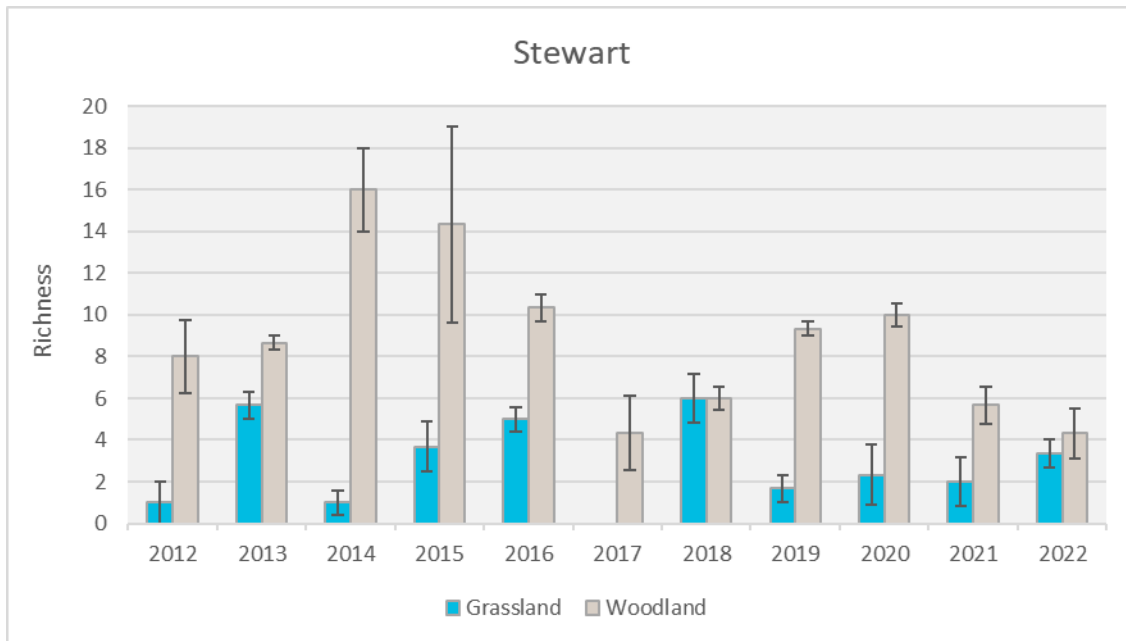
#### 6.1.1.4 Stewart Offset Area

At SOA, 18 bird species were recorded across the grassland and woodland sites during 2022 census monitoring which was a decrease from 2021 monitoring (23 species). Six species were observed in grasslands, and 12 species were observed in woodlands. As has been observed in previous years, and all other BOAs, grasslands accounted for fewer bird species than woodlands. Species richness decreased only at woodland sites in 2022.

The average bird species richness across SOA is shown in Figure 15. Average grassland bird species increased in 2022, whilst woodland sites declined slightly. Average bird species richness has been variable across all BOA's since monitoring began and results from the current round of monitoring likely reflect natural variations in these populations and their response to varying environmental conditions as has been discussed previously.



Figure 15: Average bird species richness over each monitoring year in Stewart, with standard error



### 6.1.2 Targeted Threatened Birds

As discussed in previous years the 2022 monitoring program provided little opportunity to observe the targeted threatened bird species at the BOAs, primarily due to the current methodology. Threatened birds frequently require higher survey effort for detection, which is not supported with the current census methods. An alternative method may be more reliable, and this is discussed further in the recommendations.

The regent honeyeater (*Anthochaera phrygia*) or swift parrot (*Lathamus discolor*) were not detected during the 2022 bird census. These species are listed as threatened under both the *BC Act* and *EPBC Act*. The Swift Parrot is classified as Endangered under the *BC Act* with the Regent Honeyeater listed as Critically Endangered. Both species are listed as Critically Endangered under the *EPBC Act*. Both species are winter migrants to the Upper Hunter. They are known to occur in areas where eucalypts are flowering profusely or where there is an abundance of lerp infestations. Although potentially suitable habitat occurs within the BOAs, at the time of survey, minimal eucalypts were in flower. Limited flowering noted in all BOA's makes the occurrence of both threatened species unlikely.

One occurrence of the Swift Parrot was recorded in the Stewart offset area in 2012. This species was observed foraging on heavily flowering *Corymbia* species' and feeding on lerps in eucalypts (Glencore 2017). The Swift Parrot has not been observed utilising the area since.

The Regent Honeyeater has not previously been recorded during target threatened bird surveys of the BOAs. The nearest record of a Regent Honeyeater is approximately 18 kilometres south of the Ravensworth Mine Complex, where it was recorded foraging in 2002.

### 6.1.3 Other Threatened Birds

The following table displays the threatened bird species which have been recorded in each BOA since the commencement of biodiversity offset monitoring surveys. This table is inclusive of birds recorded



opportunistically as well as those recorded during bird census monitoring and during targeted threatened bird surveys.

Table 8: Threatened bird species recorded by monitoring year at each BOA

Common Name	Scientific Name	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
<b>Clifton</b>												
Speckled Warbler	<i>Chthonicola sagittata</i>					X			X	X		
Varied Sittella	<i>Daphoenositta chrysoptera</i>	X					X					
Little Lorikeet	<i>Glossopsitta pusilla</i>	X										
Grey-crowned Babbler	<i>Pomatostomus temporalis</i>			X	X	X	X	X	X	X	X	
<b>Hillcrest</b>												
Speckled Warbler	<i>Chthonicola sagittata</i>	X										
Spotted Harrier	<i>Circus assimilis</i>		X									
Varied Sittella	<i>Daphoenositta chrysoptera</i>		X							X		
White-throated Needletail	<i>Hirundapus caudacutus</i>											X
Little Lorikeet	<i>Glossopsitta pusilla</i>						X	X				
Scarlet Robin	<i>Petroica boodang</i>				X							
<b>RNOA</b>												
Speckled Warbler	<i>Chthonicola sagittata</i>		X	X	X	X	X	X	X			
Varied Sittella	<i>Daphoenositta chrysoptera</i>					X		X				
Black Falcon	<i>Falco subniger</i>							X				
Blue-billed Duck	<i>Oxyura australis</i>			X								
Grey-crowned Babbler	<i>Pomatostomus temporalis</i>	X	X	X	X	X	X	X		X	X	
<b>Stewart</b>												
Speckled Warbler	<i>Chthonicola sagittata</i>					X	X		X			
Varied Sittella	<i>Daphoenositta chrysoptera</i>								X			X
Little Lorikeet	<i>Glossopsitta pusilla</i>	X										
Swift Parrot	<i>Lathamus discolor</i>	X										
Scarlet Robin	<i>Petroica boodang</i>								X			
Grey-crowned Babbler	<i>Pomatostomus temporalis</i>	X	X			X		X	X	X		X

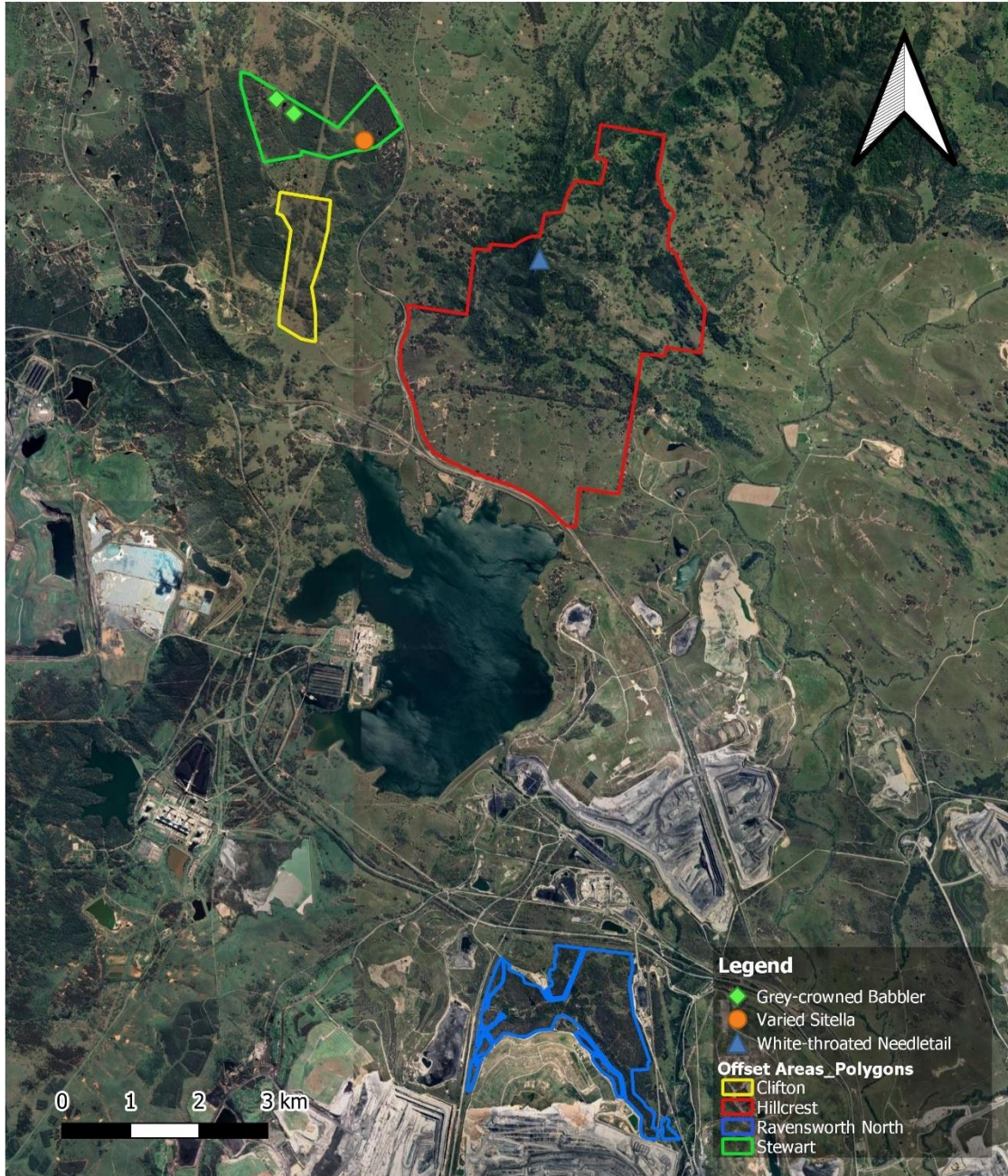


As seen above, there were three threatened bird species recorded across the BOA's this monitoring year. These included the grey-crowned babbler (*Pomatostomus temporalis*), varied sitella (*Daphoenositta chrysoptera*) and white-throated needletail (*Hirundapus caudacutus*). These species were recorded on Stewart and Hillcrest offset areas. The grey-crowned babbler is regularly recorded; however it is the first year that the white throated needletail has been recorded across the BOA's.

The presence of three threatened species across the BOA's is an improvement on monitoring carried out in 2021. This may represent an improvement in habitat quality across the BOA's, although it is more likely that it shows the natural variation in bird populations and their natural movements across the landscape. Ongoing monitoring will be useful in identifying whether threatened species presence is an annually fluctuating phenomenon, or part of a larger event that may involve declines of certain species within their range and habitat.



Figure 16: Location of threatened birds recorded during the survey period



<p>This mapping is to be considered indicative only and all derivations (eg of areas of EECs and vegetation communities) are at best approximations and subject to errors including individual interpretation and reliance on information provided to Biodiversity Australia where were not independently verified. All information is intended to be indicative only and no reliance for extrapolation, mapping, ect. should be placed upon this map without independent validation of the information by the user. Biodiversity Australia takes no responsibility for any subsequent error losses etc. that may arise from use of this data without independent verification.</p> <p>QGIS</p>	<p><b>Project Manager:</b> KR</p>	<p><b>Figure Name:</b> Location of Threatened Fauna</p>				
	<p><b>Drawn By:</b> LW</p>	<p><b>Site:</b> Ravensworth Offset Areas</p>	<p><b>Job Number:</b> ENS5381</p>	<p><b>Scale:</b> 1:85,000</p>		
	<p><b>Date:</b> January 2023</p>	<p><b>Client:</b> Ravensworth Operations Pty Ltd</p>	<p><b>Spatial Reference:</b> MGA Zone 56/GDA2020</p>			



## 6.2 Green and Golden Bell Frog

During the 2022 monitoring period, habitat assessments were conducted at the target dams within all BOAs. These assessments identified a general consistency in the availability of habitat for the green and golden bell frog (GGBF) in all BOAs over the previous year. This is likely attributed to continue above average rainfall.

Within RNOA, eight of the 13 dams surveyed were considered moderately suitable to suitable to support the GGBF. This is largely attributed to the increase in aquatic vegetation at most dams which was planted by Ravensworth Pty Ltd during 2022.

A total of four dams were considered moderately suitable to suitable to support the GGBF in Hillcrest. This is an increase from the three recorded in 2020 however with a total of 20 dams surveyed in this offset, overall suitability is low due to the lack of emergent vegetation present. Three dams within Stewart contained a suitable habitat for the GGBF however of the three dams present in Clifton, none were considered to have appropriate habitat for the species.

The following table provides the results of the habitat assessments of surveyed dams within each BOA.

Table 9: Suitability of dams in each BOA for the GGBF

Dam Name	Wet/ Dry	Vegetation suitability	Presence of <i>J. acutus</i> / <i>G.</i> <i>holbrooki</i>	Suitability for GGBF	Surveyed nocturnally?
<b>Ravensworth Offset Area</b>					
RN-New1	Wet	Contains patches of aquatic vegetation around dam perimeter	No	Suitable	<b>Yes</b>
RN-New2	Not surveyed due to accessibility issues				No
RN-New3	Wet	Contains suitable aquatic vegetation	No	Suitable	<b>Yes</b>
RN-New4	Wet	Contains suitable aquatic vegetation	No	Suitable	<b>Yes</b>
RN-New5	Wet	Contains suitable aquatic vegetation	No	Suitable	<b>Yes</b>
RN-New6	Wet	Contains some areas of dense aquatic vegetation	No	Suitable	<b>Yes</b>
RN-New7	Wet	Contains suitable aquatic vegetation	No	Suitable	<b>Yes</b>
RN-New8	Wet	Extensive <i>Typha orientalis</i> present.	No	Suitable	<b>Yes</b>
RN-New9	Dry	Contains suitable aquatic vegetation	No	Not Suitable	<b>No</b>
RN-New10	Wet	Contains suitable aquatic vegetation	No	Suitable	<b>Yes</b>
RN-Extra 1	Wet	Contains suitable aquatic vegetation	No	Limited suitability	No
RN-Extra 2	Wet	Contains limited patch of suitable aquatic vegetation	No	Not suitable	<b>Yes</b>
RN-Extra 3	Wet	No aquatic vegetation	No	Limited suitability	No
RN-Extra 4	Wet	No aquatic vegetation	No	Not suitable	No
<b>Hillcrest Offset Area</b>					
HC Dam 1	Wet	Contains very sparse aquatic vegetation around dam perimeter	No	Limited suitability	No



HC Dam 2	Wet	Contains very sparse aquatic vegetation	No	Limited suitability	No
HC Dam 3	Wet	Suitable aquatic vegetation – <i>Typha orientalis</i> and <i>Eleocharis dulcis</i>	No	Suitable	Yes
HC Dam 4	Wet	Lack of emergent vegetation. Sparse <i>Juncus sp.</i> Present.	No	Not suitable	No
HC Dam 5	Wet	Contains sparse aquatic vegetation around dam perimeter	No	Not suitable	No
HC Dam 6	Wet	Contains sparse aquatic vegetation around dam perimeter	No	Not suitable	No
HC Dam 7	Wet	Contains sparse aquatic vegetation around dam perimeter	No	Not suitable	No
HC Dam 8	Wet	Contains sparse aquatic vegetation around dam perimeter	No	Not suitable	No
HC Dam 9	Wet	No aquatic vegetation	No	Not suitable	No
HC Dam 10	Wet	No aquatic vegetation	No	Not suitable	No
HC Dam 11	Wet	Contains sparse aquatic vegetation	No	Not suitable	No
HC Dam 12	Wet	No aquatic vegetation	No	Not suitable	No
HC Dam 13	Wet	Contains limited aquatic vegetation around dam perimeter	No	Not suitable	No
HC Dam 14	Wet	Contains limited aquatic vegetation around dam perimeter	No	Not suitable	No
HC Dam 15	Wet	Contains a small extent of suitable aquatic vegetation, not likely to be dense enough to support the GGPF	No	Not suitable	No
HC Dam 16	Wet	No aquatic vegetation	No	Not suitable	No
HC Dam 17	Wet	Contains limited aquatic vegetation around dam perimeter	No	Not suitable	No
HC Dam 18	Dry	No aquatic vegetation	No	Not suitable	No
HC Dam 19	Wet	Contains some aquatic vegetation	No	Suitable	Yes
HC Dam 20	Wet	Contains suitable aquatic vegetation	No	Suitable	Yes
<b>Clifton Offset Area</b>					
CL Dam 1	Wet	Contains sparse aquatic vegetation around dam perimeter	No	Not suitable	No
CL Dam 2	Wet	Contains limited aquatic vegetation around dam perimeter	No	Not suitable	No
CL Dam 3	Wet	Contains suitable aquatic vegetation	No	Suitable	Yes
<b>Stewart Offset Area</b>					
ST Dam 1	Wet	Contains limited aquatic vegetation around dam perimeter	No	Limited suitability	No
ST Dam 2	Wet	Areas of <i>Philydrum</i> and <i>Eleocharis sphacelata</i>	No	Suitable	<b>Yes</b>
ST Dam 3	Wet	Contains limited aquatic vegetation around dam perimeter	No	Limited suitability	No



ST Dam 4	Wet	Dense <i>Eleocharis</i> an <i>Philydrum</i> present.	No	Suitable	Yes
ST Dam 5	Wet	Dense <i>Eleocharis dulcis</i> on fringes of waterbody. Limited open water.	No	Suitable	Yes



Photo 4: Dam containing suitable habitat for the for the GGBF within SOA (ST Dam 4)





Photo 5: Dam containing no aquatic vegetation in RNOA (RN-Extra4)



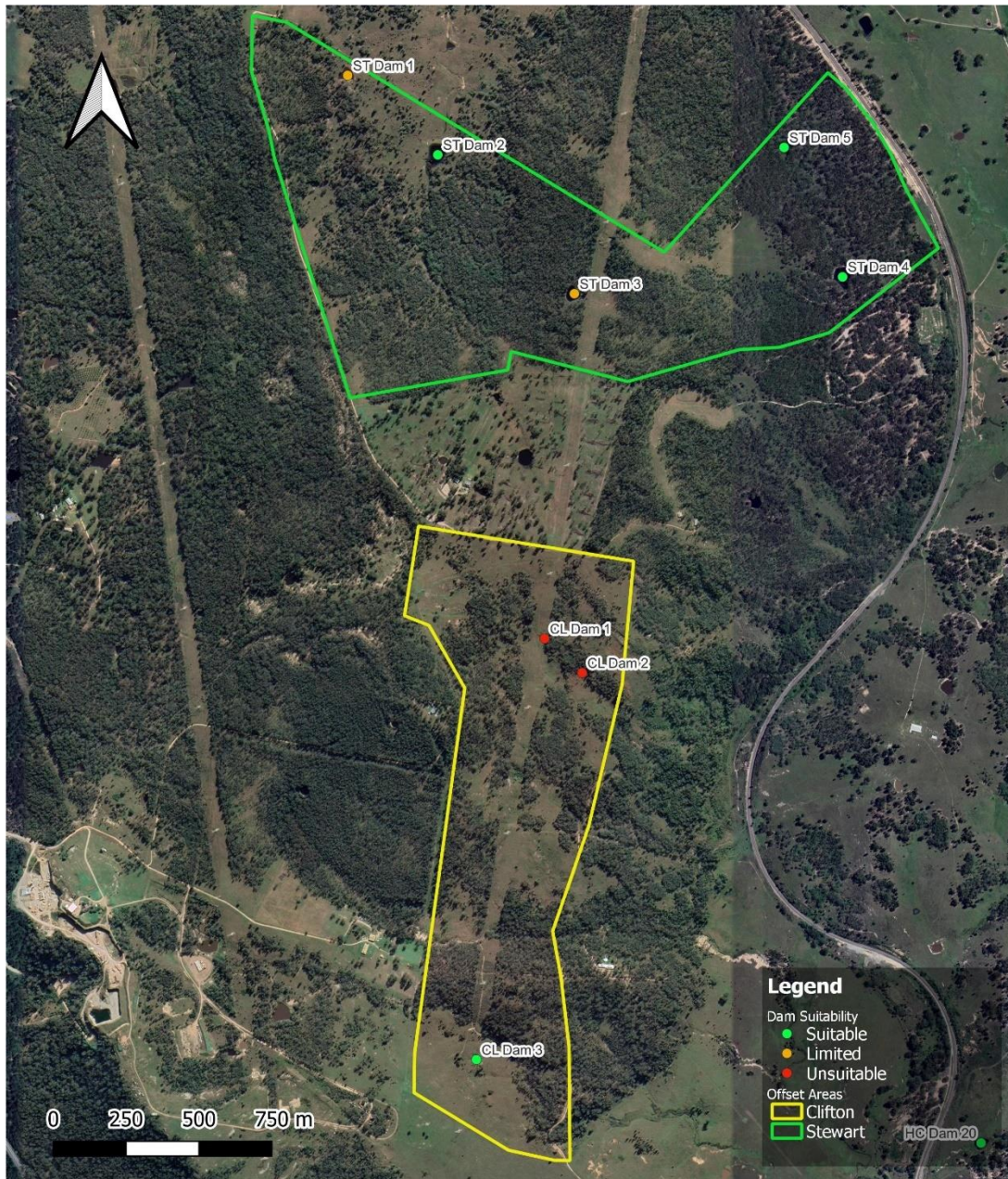


Photo 6: *Litoria fallax* at ST Dam 3

All dams within the BOA's that were identified as containing suitable GGBF habitat were subsequently surveyed nocturnally via call playback and spotlighting surveys. The location of these dams and their suitability classification is mapped in Figure 17 to Figure 19.

Nocturnal surveys did not identify the GGBF within the BOAs. Six non-threatened amphibians were identified using these dams with. Five of which were recorded within dams across the Ravensworth North offset area four heard calling in the in the Stewart Offset Area, three in the Hillcrest Offset Area and two in the Clifton Offset Area. A full list of frog species recorded is provided in Appendix A-3.






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	<p><b>Drawn By:</b> LW</p>	<p><b>Site:</b> Ravensworth Offset Areas</p>	<p><b>Job Number:</b> ENS5381</p>	
	<p><b>Date:</b> January 2023</p>	<p><b>Client:</b> Ravensworth Operations Pty Ltd</p>	<p><b>Spatial Reference:</b> MGA Zone 56/GDA2020</p>	

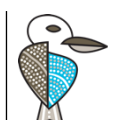
Figure 17: Clifton and Stewart Dams assessed for Green and Golden Bell Frog habitat suitability.





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	<p>Drawn By: LW</p>	<p>Site: Ravensworth Offset Areas</p>	<p>Job Number: ENS5381</p>	<p>Scale: 1:20,000</p>	
	<p>Date: January 2023</p>	<p>Client: Ravensworth Operations Pty Ltd</p>	<p>Spatial Reference: MGA Zone 56/GDA2020</p>		

Figure 18: Hillcrest Dams assessed for Green and Golden Bell Frog habitat suitability.





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	<p>Drawn By: LW</p>	<p>Site: Ravensworth Offset Areas</p>	<p>Job Number: ENS5381</p>	<p>Scale: 1:10,000</p>		
	<p>Date: January 2023</p>	<p>Client: Ravensworth Operations Pty Ltd</p>	<p>Spatial Reference: MGA Zone 56/GDA2020</p>			

Figure 19: RNOA Dams assessed for Green and Golden Bell Frog habitat suitability



### 6.3 RNOA Fauna Monitoring

Appendix A-4 provides a comprehensive list of fauna species recorded in RNOA since the commencement of the monitoring programme (Cumberland Ecology 2017, Biodiversity Australia 2019-2021).

Monitoring in 2022 recorded did not record any new faunal species previously unrecorded within this offset area. However the total number of faunal species recorded has increased considerably since the previous round of monitoring.

The number of fauna species recorded at RNOA during 2022 was 72. An overall increase in faunal species recorded across the BOA's is likely explained by natural fluctuation in faunal populations. It may also be described by improved conditions after prolonged above average rainfall and continued improving vegetation condition across all BOA's. Variation in data collection methodologies may also explain some of this variation. In the recommendations section we discuss the need for consistent methodologies to improve annual comparisons.

Table 10 below shows the total number of fauna species recorded in each monitoring year at all BOA's.

Table 10: Number of fauna species recorded at BOA's during monitoring surveys

Pre-2016	2016	2018	2019	2020	2021	2022
89	67	57	53	59	51	72

The apparent decline of mammals detected pre 2016 was likely due to the use of PIR cameras more extensively for fauna monitoring and improved conditions after the millennium drought. The decline there after (2016-2021) may be explained by the biannual use of the PIR cameras as well as poor environmental conditions associated with the 2016-2019 drought. The fauna population across the BOA's appears to be increasing with the improved conditions after prolonged above average rainfall in the region.

### 6.4 Spotlighting/Oppportunistic Fauna Observations

A range of fauna species were detected opportunistically in each BOA during 2022. These have been incorporated into the comprehensive fauna list provided in Appendix A-3.

Six species of frog were opportunistically heard calling during the summer monitoring period, the majority of which occurred at Hillcrest and RNOA. Scats and visual observations of several macropod species also occurred across Hillcrest and RNOA. Two lace monitor (*Varanus varius*) was observed at one at SOA the other at HOA. A northern brown bandicoot was flushed from dense vegetation while conducting vegetation plot on HOA and a common brush-tailed possum (*Trichosurus vulpecula*) were identified via spotlighting during GGBF surveys at SOA. Analysis of anabat data found 10 species of *Microchiroptera* across the BOA's during 2022. Two of these species are listed as vulnerable and included *Miniopterus orianae oceanensis* (large bent-wing bat) and *Scoteanax rueppellii* (greater broad-nosed bat). *M. orianae oceanensis* was recorded utilising Clifton and Ravensworth North Offset Areas whilst *S. rueppellii* was recorded within the Clifton offset area only. The greater board-nosed bat has not previously been recorded during the offset area monitoring programme.

### 6.5 Feral Species

Feral species were recorded in Ravensworth, Hillcrest and Stewart Offset Areas during the 2022 monitoring programme. These included:

- Dog (*Canis lupus familiaris*) – Stewart
- European rabbit (*Oryctolagus cuniculus*) – Hillcrest



- Wild pig (*Sus scrofa*) - RNOA.

Targeted survey for these species was not undertaken and hence densities are not able to be measured. No evidence was collected that suggests that influences from these pests are having a significant impact on the restoration of the BOA's.

European rabbits were observed on Hillcrest in just a single location during the period. A wild dog was observed near ST Dam 4 during the dam inspection. Several areas where wild pigs (*Sus scrofa*) were observed on Ravensworth North and Clifton Offset Areas.

Domestic cattle have previous been observed grazing in offset areas. During the 2022 monitoring programme there were no cattle observed grazing on offset areas.





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	<p>Drawn By: LW</p>	<p>Site: Ravensthworth Offset Areas</p>	<p>Job Number: ENS5381</p>	<p>Scale: 1:10,000</p>
	<p>Date: January 2023</p>	<p>Client: Ravensthworth Operations Pty Ltd</p>	<p>Spatial Reference: MGA Zone 56/GDA2020</p>	

Figure 20: Location of feral species recorded within Hillcrest during the survey period

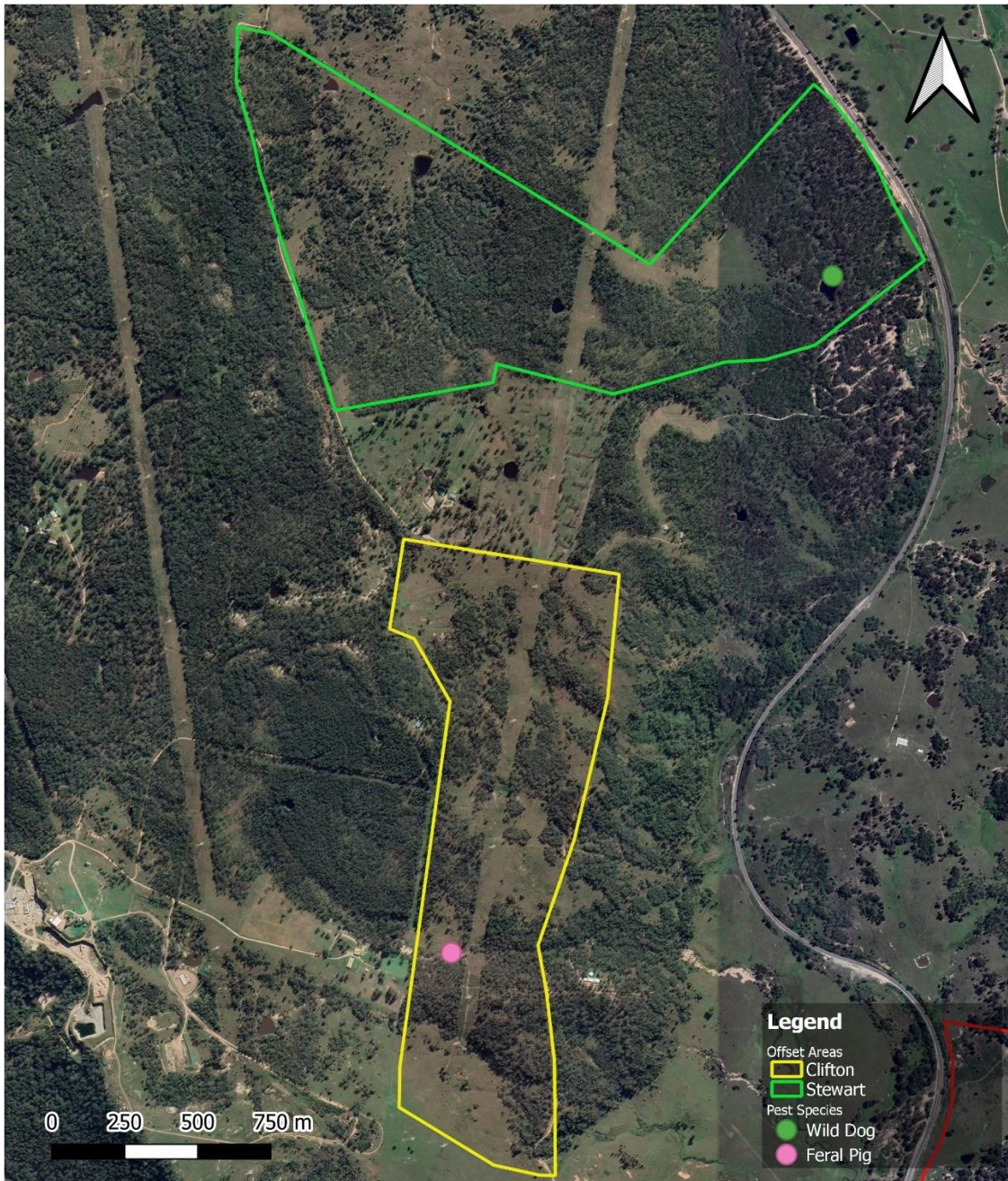




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	<p>Drawn By: LW</p>	<p>Site: Ravensworth Offset Areas</p>	<p>Job Number: ENS5381</p>	<p>Scale: 1:20,000</p>
	<p>Date: January 2023</p>	<p>Client: Ravensworth Operations Pty Ltd</p>	<p>Spatial Reference: MGA Zone 56/GDA2020</p>	

Figure 21: Location of feral species recorded within RNOA during the survey period





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	<p><b>Drawn By:</b> LW</p>	<p><b>Site:</b> Ravensworth Offset Areas</p>	<p><b>Job Number:</b> ENS5381</p>	<p><b>Scale:</b> 1:20,000</p>		
	<p><b>Date:</b> January 2023</p>	<p><b>Client:</b> Ravensworth Operations Pty Ltd</p>	<p><b>Spatial Reference:</b> MGA Zone 56/GDA2020</p>			

Figure 22: Location of feral species recorded within Clifton and Stewart during the survey period



## 6.6 Threatened Species

During the 2022 monitoring period three threatened species was recorded, the grey-crowned babbler, varied sittella and white-throated needletail. These species were all recorded visually within the BOA's. This is an increase on 2021 monitoring records, however, still below that of the six threatened species recorded during 2020. The same survey methods were used in 2022 survey as 2020. The lower number of threatened species recorded is likely explained by natural fluctuation in fauna populations across landscapes in response to habitat conditions.

The three threatened species identified during 2022 had all been recorded on at least one of the BOA's previously.

For reference to the type and location of threatened species recorded during the 2020 monitoring program, refer to the following list. In 2020, the six threatened species were recorded:

- Speckled warbler – COA – (HC, vis) \*
- Varied sittella – HOA – (HC, vis)
- Grey-crowned babbler – COA, RNOA, SOA – (HC)
- Eastern coastal free-tailed bat – HOA – (Anabat)
- Brush-tailed phascogale – RNOA – (PIR camera)
- Grey-headed flying fox – RNOA, HOA – (vis)

\*Note; HC= heard call, vis=visual observation.

## 7. Recommendations

The following recommendations pertain to the methods used for annual monitoring.

- Regarding fauna monitoring at RNOA, the current methods suggest alternating each year between PIR camera surveys and hair tubes for targeting fauna. We have found that this produces less useful data that is a) difficult to compare between years and b) unnecessary field effort that could be managed another way. We recommend rather than performing fauna surveys annually and alternating between PIR cameras and hair tubes, it might be beneficial to undertake the RNOA fauna monitoring every second year. Fauna monitoring could then incorporate both PIR cameras and hair tubes, as the combination would yield greater results than just individually (this is particularly relevant to hair tubes). This would also produce more comparable data for each year the fauna monitoring occurs, and surveys could occur at the same as the microbat surveys, which would further improve efficiency. Fauna monitoring at RNOA every second year is the requirement under the OAMP.
- The previous offset area monitoring report recommended changes to fauna monitoring methods. These recommendations are as detailed below and are still valid in the current round of monitoring. The fauna survey methodologies may require adjustment to allow more appropriate targeting of green and golden bell frogs and threatened wintering birds. These species are yet to be recorded during the survey periods, possibly due to the design of the monitoring programme (rather than purely their absence). The current methods only allow for surveying during a snapshot of time within the year. To target these species, which are threatened and require monitoring as per the OAMP/OMP, we propose deploying song meters as part of the monitoring programme. Firstly, deploying at dams in November and December will target GGBFs, as this time of year tends to be optimal with frequent rainfall events. Secondly, deploying song meters across the BOAs in areas of dense, heavily flowering eucalypts during winter (especially late winter) will target birds such as the



regent honeyeater and swift parrot. By incorporating song meters, a greater range and scale of data can be collected, outside the current monitoring periods. This may improve the overall efficacy of the program and will provide a much higher chance of detection.

- As suggested in previous years given the large amount of baseline data for the vegetation points, it would be advisable to cease monitoring at some select sites. This would be to improve field efficiency, and to incorporate additional field points that facilitate ongoing management of the BOAs. Ideally, points that are showing effective regeneration, are at suitable maturity, and no longer require active management could be 'retired'. These points could then be replaced with new grassland points not yet monitored. This would help identify other areas that may require assisted regeneration.
- We recommend in the Conservation Agreement 2021 monitoring report [EC4475-BEC-REP-RavenSworthOffset-CAMonitoring\_2021-rev1.0] that some monitoring points across the annual offset monitoring and CA monitoring could be merged. This is because many points being monitored across the BOAs are within very close proximity. These points could be consolidated, so one monitoring event for vegetation surveys can occur in spring, for both the annual offset monitoring and the CA monitoring. This is discussed in the aforementioned document, as well as recommendations for the points that could be consolidated.

The following discussed recommendations for improving site condition.

- Revegetation works are recommended to continue as a priority. At present only a small portion of the BOAs have had active regeneration works, an area in Hillcrest and dams in RNOA. It appears the regeneration within HOA has shown little success, perhaps due to weather conditions at the time of planting or the methods used. In comparison, a different area actively planted some years ago shows much higher success rates, so perhaps following the methods adopted at that site may prove useful. We recommend that if the current increased rainfall conditions are predicted to continue, active planting of trees and shrubs should be undertaken across many of the plots. By investing in increased planting effort at this time, greater success of recruitment is likely given the suitability of environmental conditions. In order to manage and established a suitable planting regime, recommendations from the revegetation plan (Bio. Aust. 2022) should be undertaken to ensure success and identify areas best suited to revegetation across the BOA's.
- Eastern grey kangaroos were again recorded in large numbers within HOA. These are likely hampering recruitment and regeneration efforts. It will be important to ensure appropriate tree guards are established around plantings to restrict macropod grazing. A macropod management program may also be beneficial, by providing a framework by which high density macropod populations can be controlled. Within a macropod management program only eastern grey kangaroos (*Macropus giganteus*) should be targeted, and other locally present species including wallabies should not be controlled.
- Tracks through the BOAs require more maintenance work to allow safe and efficient passage throughout the offset areas. This is particularly necessary after the period of heavy rainfall. This is a general observation from all BOA's. After the significant rainfall events there are several tracks that have considerable erosion and washouts. The rain has also allowed grasses to become over grown on a number of tracks that are less used within HOA. Locations of these tracks can be provided on request.
- Following the period of improved weather conditions and regular rainfall, ongoing weed management is recommended. Weed cover in grassland areas across the BOAs is extensive in places.
- European rabbits and wild pigs were again recorded at COA, RNOA and Hillcrest are recommended. Although no feral cats or red foxes were observed in 2021, their presence within the BOAs is likely and thus should continue to be controlled when necessary.



## 7.1 Recommended revegetation methods

The continued use of amelioration methods such as direct seeding, brush-matting, planting of fast-growing pioneer species and soil amelioration are recommended (where possible) to speed up the recovery of vegetation communities within the BOAs and enhance regeneration success of grassland areas. Recommendations from the Ravensworth Offset Area Revegetation Management Plan (Bio. Aust. 2022) should be considered.

- Generally, areas that show a lack of natural regeneration and aren't suitable for assisted regeneration i.e. grassland areas
- Brush-matting is a regenerative technique in which seed-laden branches of trees and vegetation with woody fruits are placed within open areas. This technique aids seed dispersal as well as provides a level of soil protection, as the seed-laden brush can slow overland water flow, allowing it to infiltrate the soil, therefore generating ideal germination conditions (OEH 2011). The execution of this however, does require the seed to be ripe and the ground surface to be suitable (i.e., not weedy or compacted). This technique would aid grassland areas that show little natural regeneration to date that do not receive seed naturally from surrounding vegetation.
- Fast-growing pioneer species, such as peas and wattles (Fabaceae family), establish quicker than other natives and are nitrogen-fixing, in which they add nitrogen to the soil which is required by most plants to establish. By establishing these species in grassland areas, the soil conditions will improve and increase the success rate of seed establishment. Consideration should be given to these species when undertaking planting activities.

## 8. Objectives, Target Criteria and Corrective Actions

The OAMP recommends objectives and target criteria for assessing the progress and effectiveness of management actions of the BOAs. Table 10 outlines the compliance of the 2022 monitoring results with the biodiversity objectives and target criteria outlined within the OAMP. Additional corrective actions are recommended for any targets not yet achieved.



Table 11: Compliance with Objectives and Target Criteria

OAMP Reference	Objective	Target Criteria to be Achieved	2022 Monitoring Results	Corrective Actions
Table 6.4	Augment existing vegetation communities in areas zoned natural regeneration.	Evidence of natural regeneration (tree seedlings), decrease in target weeds or target weeds <10% (see weed management plan), no evidence that feral animals are significantly affecting regeneration (visual assessment).	Regeneration recorded across all BOAs. Limited regeneration in Clifton grassland sites. Richness of weed species is largely unchanged. Density of weed species has decreased since previous years monitoring. Several target weed species recorded at both grassland and woodland sites in these BOAs. Some impacts to vegetation from feral animals observed, particularly feral pigs in grassland areas	Additional assisted regeneration in open grassland areas. Continue to implement management actions outlined in OAMP. Undertake brush-matting (where resources permit) in grassland areas (as per Recommendations). Continue feral animal management within all BOAs.
	Re-establish regionally significant vegetation communities consistent with remnant vegetation in areas zoned assisted regeneration and remediation.	Assisted regeneration and remediation areas within the Offset Areas contain flora species assemblage characteristic of the vegetation communities that are being created.	Data was collected from established monitoring sites to allow for timeline comparisons. Grassland areas, particularly those in Ravensworth and Clifton lack canopy regeneration. Further regeneration assistance may be required.	Focus assisted regeneration efforts in grassland areas. Continue to undertake scheduled seeding/planting works. Undertake brush-matting and soil amelioration measures in grassland areas (as per Recommendations).
	Re-establish or augment fauna habitats for native and threatened fauna (woodland/forest).	Regeneration and remediation areas contain flora species that provide food, shelter, and refuge opportunities for native and threatened fauna.	Data was collected from established monitoring sites to allow for timeline comparisons. Habitat still provided for a range of species. Several threatened fauna species detected historically and in current monitoring year. Differences in floristics between woodland and grassland sites remain. Regeneration of flora species that provide habitat to fauna species is advancing in HOA and SOAs. Assistance in RNOA and COA is likely needed.	Assistance in grassland regeneration and shrub regeneration may be beneficial. Continue to implement management and monitoring actions as per the OAMP.
		Evidence of a range of vegetation structural habitats exists (e.g., canopy species, shrubs, ground cover, developing litter layer etc.) that are commensurate with native and threatened fauna that occur within the area. Native/threatened woodland fauna are utilising offset areas.		
Re-establish and augment habitat for the Green and Golden Bell Frog (wetland and open grassland areas).	Green and Golden Bell Frog habitat reestablishment and augmentation areas contain flora species that are commensurate with those known to provide habitat for this species.	Structural habitat elements present. Water now present in most dams during the GGBF survey period.	Continue to implement management actions as per the OAMP. HOA has the highest number of dams however the vast majority still lack suitable habitat.	



			<p>Nine dams in RNOA, three in HOA, one in COA and three in SOA had moderately sufficient to suitable habitat features to support the GGBF</p> <p>Evidence of flora plantings near dams at HOA.</p> <p>No GGBFs were recorded during surveys.</p>	<p>Augmentation at these dams likely beneficial.</p> <p>Consider alternate monitoring methods (as per Recommendations).</p> <p>More robust survey for <i>Gambusia holbrooki</i> necessary.</p>
Table 7.3	Targeted weed removal across all offset properties to remove noxious and perennial weed species.	Decrease in abundance of all target weed species in first ten years.	<p>Target weed species recorded across all BOAs. Target weed species recorded at both grassland and woodland sites in these BOAs. Target weed coverage over the BOA monitoring sites overall is lower in the current monitoring round.</p>	<p>Continue weed mapping and focus on management plan priorities.</p> <p>Continue to implement management actions as per the OAMP with focus on areas described in this report.</p>
		Weed infestations considered negligible across all four offset properties within 15 years.	<p>Data was collected from established monitoring sites to allow for timeline comparisons and future analysis.</p> <p>Exotic species richness/density overall is lower across the BOA's however, some grassland sties carry large areas of exotic species.</p>	
	Primary, secondary and maintenance weeding within areas zoned assisted regeneration and remediation, to prepare the sites for planting and maintain them so that weed infestation does not compromise the survival of planted seedlings.	Assisted regeneration and remediation areas within the Offset Areas are dominated by native species in all strata (trees, shrubs, groundcover).	<p>Monitoring did not cover any areas with assisted regeneration.</p> <p>The continued success of one area of assisted regeneration was noted in Hillcrest.</p>	Continue to implement management actions as per the OAMP.
Table 8.1	To minimise browsing/disturbance of regeneration areas.	Minimal level of browsing observed (<10% of plants showing evidence of rabbit browsing in permanent plots).	Rabbits and Eastern Grey Kangaroos observed within the Hillcrest during the 2022 monitoring programme.	<p>Continue feral rabbit management at RNOA and Hillcrest.</p> <p>Continue to implement management actions as per the OAMP.</p>
		Disturbance by feral pigs (i.e. digging) is minimal (visual assessment).	Feral pigs were recorded within RNOA grassland areas during the 2022 monitoring programme.	Continue to implement management actions as per the OAMP.
	To minimise predation of, or competition with, native species by feral pest species.	Evidence of foxes/feral cats/wild dogs (including scats, dens, signs of predation) is minimal (Visual assessment).	Dog observed crossing through SOA. No evidence of foxes or cats in 2022.	Continue to implement management actions for feral animals as per the OAMP.



		Regular monitoring by PIR cameras show only occasional use of the site by feral predators.	Cameras were deployed in 2022 but did not target feral pests, so unable to comment. Feral pests likely still active in some areas.	Ensure monitoring of feral animals is conducted.
Table 11.1	Increase habitat linkages between Davis and Bayswater Creeks in RNOA through augmenting /creating a series of dams.	A series of 10 dams with habitat specific to the Green and Golden Bell Frog have been created /augmented between Davis and Bayswater Creeks.	15 dams exist that support habitat specific to the Green and Golden Bell Frog across all BOA's	Continue to implement management actions as per the OAMP and OMP.
	Removal of Mosquito Fish from dams on all four properties.	Dams and waterways are free of Mosquito Fish.	No evidence of Mosquito Fish in dams surveyed.	Continue monitoring for Mosquito Fish as per the OAMP. More detailed survey may be necessary to determine.
	Maintain/augment Green and Golden Bell Frog habitat on RNOA and HOA.	All dams to include native emergent and fringing plant species, surrounding shelter sites and unshaded areas within three years.	There was no increase in available habitat for GGBF during the current monitoring period. However there were numerous dams that supported appropriate habitat for the species.	Focus assisted plantings of suitable aquatic vegetation at dams identified as limited or not suitable habitat for the GGBF. Assisted plantings should aim to create dense patches of vegetation rather than sparse plantings. Continue to implement management actions as per the OAMP.
	Conduct ongoing annual Green and Golden Bell Frog surveys on RNOA and HOA to provide a better understanding of the local population.	Increased understanding of the Hunter Catchment Green and Golden Bell Frog population.	No records of the GGBF during the 2022 monitoring programme.	Continue to implement management and monitoring actions as described in the OAMP. Implement other survey methods as discussed in Recommendations.



## 9. Conclusion

The 2022 monitoring programme has completed all monitoring actions required under the BMP, OMP and OAMP for the Biodiversity Offset Areas. The results from this monitoring programme form the ninth consecutive year of flora and fauna surveys after the 2012 baseline surveys.

Vegetation condition assessments conducted in 2022 indicate an overall reduction in species diversity across the BOAs. For the most part, the diversity of exotic species remained very similar to 2020 and 2021 records. Species richness for all BOAs still remains substantially lower than the peak records of 2016. The decrease in species richness in the current monitoring programme may be explained by the climactic conditions of the past two years. The above average rainfall may have encouraged continue growth of competitive ground layer species, reducing the number of ground lay species present. The rainfall has also allowed the regeneration of native species in select areas across the BOAs, however grassland sites continue to show low regeneration across some BOAs. Grassland and woodland sites have shown relatively similar exotic species diversity with the exception of RNOA where grassland sites supported considerably more exotic species. This suggest a generally decrease in the extent of exotic species across the BOA's. Natural regeneration will likely need to be supplemented with a more active approach in order to see improvements in vegetation cover at the BOAs within a realistic timeframe.

Bird census monitoring yielded considerably lower results across all BOAs. As in previous years, woodland sites supported a higher diversity of bird species than grasslands. This is expected as the extent of foraging habitat and shelter is significantly greater within the woodland sites. As vegetation cover increases in grasslands, it is anticipated a greater diversity of birds will be recorded over time. Three threatened bird was observed in 2022, the grey-crowned babbler, white-throated needletail and varied sitella. These species have all previously been recorded during monitoring. As in previous years, targeted surveys were unsuccessful for the regent honeyeater and swift parrot. It was noted that there was limited flowering of eucalypts at the time monitoring was conducted. As this is an important factor in determining the likelihood of the species presence recommendations have been made on survey timing and use of song meters to increase the likelihood of detection. Suitable habitat for these species remains present in all BOAs.

Two threatened mammals were detected during the survey period in 2022, both were species of microchiropteran bats *Miniopterus orianae oceanensis* and *Scoteanax rueppellii*. These species were both listed as vulnerable under the NSW *BC act*. *S. rueppellii* has not previously been recorded within any of the BOA's.

There was no increase in the number of dams with suitable habitat for the GGBF across the BOAs in 2022, there was however suitable habitat present at all previously recorded dams. Despite suitable habitat existing for the species, it was not detected on during 2022. Further improvements could be made to many dams across the BOAs, particularly those on HOA. Changes to surveying methodology may also improve the detection probability of the GGBF, discussed in the Recommendations.



## 10. References

- Biodiversity Australia (2021). Biodiversity Offset Ecological Monitoring Report - Ravensworth Biodiversity Offset Area Monitoring 2020. Report prepared for Ravensworth Operations Pty Ltd. Australia.
- Biodiversity Australia (2020). Biodiversity Offset Ecological Monitoring Report - Ravensworth Biodiversity Offset Area Monitoring 2019. Report prepared for Ravensworth Operations Pty Ltd. Australia.
- Biodiversity Australia (2019). Biodiversity Offset Ecological Monitoring Report - Ravensworth Biodiversity Offset Area Monitoring 2018. Report prepared for Ravensworth Operations Pty Ltd. Australia.
- Biodiversity Australia (2022). Conservation Agreement Annual Monitoring Report 2021. Report prepared for Ravensworth Operations Pty Ltd. Australia.
- Biodiversity Australia (2022). Ravensworth Offsetting Area – Revegetation Management Plan. Report prepared for Ravensworth Operations Pty Ltd. Australia.
- Biodiversity Conservation Act* (2016). New South Wales Government. Website <<https://www.legislation.nsw.gov.au/~/view/act/2016/63>>.
- Biosecurity Act* (2015). NSW Government. Website <<https://www.legislation.nsw.gov.au/#/view/act/2015/24>>.
- Bureau of Meteorology (2021). Climate Statistics for Australian Locations - Bowmans Creek (Grenell). Australian Government. <[http://www.bom.gov.au/jsp/ncc/cdio/weatherData/av?p\\_nccObsCode=136&p\\_display\\_type=dailyDataFile&p\\_startYear=&p\\_c=&p\\_stn\\_num=061270](http://www.bom.gov.au/jsp/ncc/cdio/weatherData/av?p_nccObsCode=136&p_display_type=dailyDataFile&p_startYear=&p_c=&p_stn_num=061270)>.
- Cumberland Ecology (2013). Ravensworth Mine Complex Offset Area Management Programme. Report prepared for Xstrata Coal, Carlingford Coal.
- Cumberland Ecology (2015). Ravensworth Open Cut Biodiversity Offset Areas 2015 Monitoring Report. Report prepared for Glencore. Australia.
- Cumberland Ecology (2017). Ravensworth Surface Operations: Biodiversity Offset Areas - Monitoring Report. Report Prepared for Glencore. Australia.
- Department of Environment and Conservation (DEC 2004). Threatened Biodiversity Survey and Assessment: Guidelines for Development and Activities. Working Draft. NSW DEC, Hurstville.
- Department of Agriculture, Water and the Environment (2022). Protected Matters Search Tool. Australian Government. Website <<http://www.environment.gov.au/epbc/pmst/>>.
- DPI (2020a). Drought in NSW. NSW Government. Website <<https://www.dpi.nsw.gov.au/climate-and-emergencies/droughthub/drought-in-nsw>>.
- DPI (2021). Combined Drought Indicator. NSW Government. Website <<https://edis.dpi.nsw.gov.au/>>.
- EcoLogical Australia (2018). Annual Biodiversity Offset Monitoring Report 2017. Report prepared for Ravensworth Operations Pty Ltd. Australia.



- Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act)*. Australian Government. Website < <https://www.legislation.gov.au/Details/C2014C00506>>.
- Glencore (2013). The Ravensworth Complex Annual Review. Report prepared for Xtrata Coal. Australia.
- Glencore (2014). The Ravensworth Complex Annual Review. Australia
- Glencore (2015). Ravensworth Open Cut Plan for Biodiversity Management. RAV SD PLN 0079 version 1.0.
- Glencore (2015a). The Ravensworth Complex Annual Review. Australia.
- Glencore (2016). The Ravensworth Complex Annual Review. Resubmission version. Australia.
- Glencore (2017). Ravensworth Open Cut Annual Review 2016. Draft version 0.1. Australia.
- Glencore (2018a). Biodiversity Management Plan.
- Glencore (2018b). Ravensworth Open Cut Annual Review 2017. Draft version 0.1. Australia.
- Glencore (2019a). Ravensworth Open Cut Offset Area Management Programme. Version 1.0. Australia.
- Glencore (2019b). Ravensworth Open Cut Annual Review 2018. Draft version 0.1. Australia.
- Glencore (2020). Ravensworth Open Cut Annual Review 2019. Version 1.0. Australia.
- Glencore (2021). Ravensworth Open Cut Annual Review 2020. Version 1.0. Australia.
- Menkhorst, P., Rogers, D., Clarke, R., Davies, J., Marsack, P. and Franklin, K. (2017). The Australian Bird Guide. CSIRO Publishing. Clayton South, Victoria.
- NSW Government (2022a). BioNet Vegetation Classification. Website <<https://www.environment.nsw.gov.au/research/Visclassification.htm>>.
- NSW Government (2022b) BioNet Atlas Species Sightings Search. Website <[https://www.environment.nsw.gov.au/atlaspublicapp/UI\\_Modules/ATLAS\\_/AtlasSearch.aspx](https://www.environment.nsw.gov.au/atlaspublicapp/UI_Modules/ATLAS_/AtlasSearch.aspx)>.
- Office of Environment and Heritage (2011). Conservation Management Notes - Revegetation. NSW Government. Sydney.
- OEH (2021) Threatened biodiversity profile search. Website <<http://www.environment.nsw.gov.au/threatenedSpeciesApp/>>.
- ParkWatch (2019). Melbourne's Flying Night Gardeners. Victorian National Parks Association. Edition December 2019. No. 279. Victoria.
- Port Macquarie-Hastings Council. 2017. Flying Fox. Website <<https://www.pmhc.nsw.gov.au/Services/Environment/Urban-wildlife/Flying-Fox>>.
- Royal Botanical Gardens. Plantnet website. <[www.plantnet.rbgsyd.nsw.gov.au/search](http://www.plantnet.rbgsyd.nsw.gov.au/search)>.
- Xtrata Coal (2013) Offset and Green and Golden Bell Frog Management Plan for Ravensworth Mine Complex EPBC No. 2010/5389.





















## A-2 Flora Species List

Table 12: Full flora list derived from vegetation condition assessments conducted in 2022

Common Name	Scientific Name	COA		HOA		RNOA		SOA	
		Grass	Wood	Grass	Wood	Grass	Wood	Grass	Wood
<b>Apiales</b>									
<b>Apiaceae</b>									
Native Carrot	<i>Daucus glochidiatus</i>								
<b>Araliaceae</b>									
Stinking Pennywort	<i>Hydrocotyle laxiflora</i>	x							x
Pennywort	<i>Hydrocotyle Pedicellosa</i>					x			
<b>Pittosporaceae</b>									
Blackthorn	<i>Bursaria spinosa</i>		x	x	x		x		
Native Daphne	<i>Pittosporum undulatum</i>				x				
<b>Asparagales</b>									
<b>Asparagaceae</b>									
Wombat Berry	<i>Eustrephus latifolius</i>				x				
Spiny-headed Mat-rush	<i>Lomandra longifolia</i>				x		x		x
Many-flowered Mat-rush	<i>Lomandra multiflora</i>	x	x	x	x	x	x	x	x
Onion Grass	<i>Romulea rosea</i>	x		x		x	x		x
<b>Asphodelaceae</b>									
Bulbine Lily	<i>Bulbine bulbosa</i>				x				
Blueberry Lily	<i>Dianella longifolia</i>	x	x		x			x	x
Native Flax	<i>Dianella prunina</i>				x				
<b>Asterales</b>									
<b>Asteraceae</b>									
Saltmarsh Aster	<i>Aster subulatus</i>					x	x		
Cobblers Pegs*	<i>Bidens pilosa*</i>			x	x	x	x		
Spreading Sneezeweed	<i>Centipeda minima</i>						x		
Cough Bush	<i>Cassinia laevis</i>				x		x		x
Purple Burr-daisy	<i>Calotis cuneifolia</i>				x		x		
Yellow Burr-daisy	<i>Calotis lappulacea</i>				x				
Spear Thistle	<i>Cirsium vulgare*</i>			x	x	x	x		
Common Everlasting	<i>Chrysocephalum apiculatum</i>			x	x		x	x	x
Chilean Fleabane	<i>Conyza primulifolia</i>					x	x		
Erigeron bonariensis	<i>Conyza bonariensis</i>	x	x	x	x	x	x	x	x



Common Name	Scientific Name	COA		HOA		RNOA		SOA	
		Grass	Wood	Grass	Wood	Grass	Wood	Grass	Wood
White Paper Daisy	<i>Coronidium elatum</i>			x					
Purple Fleabane	<i>Cyanthillium cinereum</i>		x				x		
Cudweed	<i>Euchiton sphaericus</i>		x	x		x		x	x
.*	<i>Gamochaeta coarctata</i>	x		x	x	x	x	x	
Catsear*	<i>Hypochaeris radicata*</i>	x		x	x	x	x	x	x
-	<i>Pterocaulon redolens</i>				x				
Fireweed*	<i>Senecio madagascariensis*</i>	x	x	x	x	x	x	x	x
Common St Paul's Wort	<i>Sigesbeckia orientalis</i>				x				
Common Sowthistle	<i>Sonchus apogan</i>								x
Prickly Sowthistle	<i>Sonchus asper*</i>								x
Common Sowthistle	<i>Sonchus oleraceus*</i>			x	x	x	x		x
<b>Campanulaceae</b>									
Whiteroot	<i>Lobelia purpurascens</i>		x		x				x
Tufted Bluebell	<i>Wahlenbergia communis</i>		x						
<b>Goodeniaceae</b>									
Forest Goodenia	<i>Goodenia hederacea</i>	x			x			x	x
<b>Carophyllales</b>									
<b>Aizoaceae</b>									
Galenia	<i>Galenia pubescens*</i>	x	x		x		x		
<b>Amaranthaceae</b>									
Barbwire Weed	<i>Nyssanthes diffusa</i>				x				
<b>Cactaceae</b>									
Common Prickly Pear	<i>Opuntia stricta*</i>	x			x	x	x		
<b>Caryophyllaceae</b>									
Chickweed	<i>Stellaria media</i>				x	x	x		
<b>Chenopodiaceae</b>									
Berry Saltbush	<i>Einadia hastata</i>				x		x		
<b>Droseraceae</b>									
Tall Sundew	<i>Drosera auriculata</i>					x			
<b>Polygonaceae</b>									
Swamp Dock	<i>Rumex brownii</i>			x	x				
<b>Commelinales</b>									
<b>Commelinaceae</b>									
-	<i>Commelina cyanea</i>				x				
<b>Dilleniales</b>									
Dilleniaceae									



Common Name	Scientific Name	COA		HOA		RNOA		SOA	
		Grass	Wood	Grass	Wood	Grass	Wood	Grass	Wood
Hoary Guinea Flower	<i>Hibbertia obtusifolia</i>	x	x		x				x
-	<i>Hibbertia linearis</i>			x					
<b>Ericales</b>									
Ericaceae									
Prickly Beard-heath	<i>Leucopogon juniperinus</i>	x						x	x
Urn-heath	<i>Melichrus urceolatus</i>	x							
<b>Primulaceae</b>									
Scarlet Pimpernel*	<i>Anagallis arvensis*</i>	x	x	x	x	x	x	x	x
<b>Fabales</b>									
<b>Fabaceae</b>									
Fan Wattle	<i>Acacia amblygona</i>						x		
Hickory Wattle	<i>Acacia falcata</i>	x	x		x			x	x
Maiden's wattle	<i>Acacia maidenii</i>		x	x					
Kangaroo Thorn	<i>Acacia paradoxa</i>	x	x	x					
Native Willow	<i>Acacia salicina</i>					x	x		
Variable Bossiaea	<i>Bossiaea heterophylla</i>					x			
Scotch Broom*	<i>Cytisus scoparius*</i>				x	x			
Gorse Bitter Pea	<i>Daviesia ulicifolia</i>	x			x				x
-	<i>Desmodium gunnii</i>						x		
-	<i>Glycine clandestina</i>		x	x	x	x	x		x
Australian Indigo	<i>Indigofera australis</i>				x				
Prickly Mirbelia	<i>Mirbelia pungens</i>		x						
Blunt Bush-pea	<i>Pultenaea retusa</i>				x			x	x
Hairy Bush-pea	<i>Pultenaea villosa</i>								x
White Clover*	<i>Trifolium repens*</i>				x				
<b>Fagales</b>									
<b>Casuarinaceae</b>									
Bulloak	<i>Allocasuarina luehmannii</i>		x		x	x	x		x
Belah	<i>Casuarina cristata</i>					x			
<b>Gentianales</b>									
<b>Rubiaceae</b>									
Common Woodruff	<i>Asperula conferta</i>			x					x
Rough Bedstraw	<i>Galium gaudichaudii</i>				x				
-	<i>Opercularia diphylla*</i>			x	x	x	x		x
Pomax	<i>Pomax umbelatta</i>						x		
<b>Apocynaceae</b>									



Common Name	Scientific Name	COA		HOA		RNOA		SOA	
		Grass	Wood	Grass	Wood	Grass	Wood	Grass	Wood
Mexican Butterfly Weed*	<i>Asclepias curassavica</i> *		x						x
Balloon Cotton Bush*	<i>Gomphocarpus physocarpus</i> *			x	x	x			
Narrow-leaved Cotton Bush*	<i>Gomphocarpus fruticosus</i> *			x	x		x		
<b>Geraniales</b>									
<b>Geraniaceae</b>									
Redstem Filaree	<i>Erodium cicutarium</i>			x					
Native Geranium	<i>Geranium solanderi</i>			x	x	x	x		
-	<i>Pelargonium inodorum</i>						x		
<b>Lamiales</b>									
<b>Acanthaceae</b>									
Blue Trumpet	<i>Brunoniella australis</i>						x		
<b>Lamiaceae</b>									
Hairy Clerodendrum	<i>Clerodendrum tomentosum</i>				x				
Little Spurflower	<i>Plectranthus parviflorus</i>				x				
<b>Oleaceae</b>									
Forest Jasmine	<i>Jasminum suavissimum</i>								x
Small-leaved Privet	<i>Ligustrum sinense</i>				x				
-	<i>Notelaea linearis</i>		x		x				x
Large Mock-olive	<i>Notelaea longifolia</i>				x				
Common Olive*	<i>Olea europaea</i> *				x				
<b>Plantaginaceae</b>									
-	<i>Plantago linearis</i>				x			x	x
Lamb's Tongues	<i>Plantago lanceolata</i> *			x	x	x		x	
Trailing Speedwell	<i>Veronica plebeia</i>	x	x				x		x
<b>Scrophulariaceae</b>									
Boobialla	<i>Myoporum debile</i>		x			x	x		
Western Boobialla	<i>Myoporum montanum</i>				x				
<b>Verbenaceae</b>									
Purpletop	<i>Verbena bonariensis</i> *			x	x	x	x	x	x
<b>Liliales</b>									
<b>Liliaceae</b>									
Taiwanese Lily	<i>Lilium formosanum</i>				x				
<b>Colchicaceae</b>									
Early Nancy	<i>Wurmbea dioica</i>								x
<b>Malpighiales</b>									
<b>Hypericaceae</b>									



Common Name	Scientific Name	COA		HOA		RNOA		SOA	
		Grass	Wood	Grass	Wood	Grass	Wood	Grass	Wood
St Johns Wart	<i>Hypericum gramineum</i>					x			x
<b>Passifloraceae</b>									
Blunt-leaved Passionfruit	<i>Passiflora aurantia</i>				x				
<b>Phyllanthaceae</b>									
Coffee Bush	<i>Breynia oblongifolia</i>		x	x	x				
-	<i>Phyllanthus virgatus</i>				x				x
-	<i>Poranthera microphylla</i>			x	x	x	x		x
<b>Malvales</b>									
<b>Malvaceae</b>									
Kurrajong	<i>Brachychiton populneus</i>				x				
Modiola	<i>Modiola caroliniana</i>			x	x				
Paddy's Lucerne	<i>Sida rhombifolia*</i>			x	x	x			
<b>Thymelaeaceae</b>									
Slender Rice Flower	<i>Pimelea linifolia</i>			x					
<b>Myrtales</b>									
<b>Mrytaceae</b>									
Rough-barked Apple	<i>Angophora floribunda</i>				x				
Lemon-scented gum	<i>Corymbia citriodora</i>							x	x
Spotted Gum	<i>Corymbia maculata</i>			x	x				
Narrow-leaved Ironbark	<i>Eucalyptus crebra</i>		x	x	x	x	x	x	x
Grey Box	<i>Eucalyptus moluccana</i>					x	x	x	x
Forest Red Gum	<i>Eucalyptus tereticornis</i>		x		x	x	x		
<b>Oxalidales</b>									
<b>Oxalidaceae</b>									
-	<i>Oxalis corniculata*</i>		x			x			
-	<i>Oxalis s.p</i>			x					
<b>Poales</b>									
<b>Cyperaceae</b>									
-	<i>Baumea teretifolia</i>							x	
knob Sedge	<i>Carex inversa</i>			x	x	x			
Tall Sedge	<i>Carex appressa</i>				x				
Common Fringe-Sedge	<i>Fimbristylis dichotoma</i>				x				
Spiny Rush	<i>Juncus acutus</i>						x		
Common Bog-rush	<i>Schoenus apogon</i>	x						x	x
-	<i>Scleria mackaviensis</i>						x		



Common Name	Scientific Name	COA		HOA		RNOA		SOA	
		Grass	Wood	Grass	Wood	Grass	Wood	Grass	Wood
<b>Poaceae</b>									
Black Seed Grass	<i>Alloteropsis semialata</i>								x
Oat Speargrass	<i>Anisopogon avenaceus</i>			x	x	x	x		
-	<i>Aristida calycina</i>	x	x	x		x	x	x	x
Purple Wiregrass	<i>Aristida ramosa</i>			x	x				
Threeawn Speargrass	<i>Aristida vagans</i>					x	x		
Stout Bamboo Grass	<i>Austrostipa ramosissima</i>						x		
Slender Bamboo Grass	<i>Austrostipa verticillata</i>			x	x				
Broad-leafed Carpet Grass*	<i>Axonopus compressus*</i>	x						x	x
Shivery Grass*	<i>Briza minor*</i>			x				x	
Rhodes Grass*	<i>Chloris gayana*</i>	x							
-	<i>Chloris ventricosa</i>		x	x	x	x	x		
Barbed Wire Grass	<i>Cymbopogon refractus</i>	x	x		x			x	x
Couch	<i>Cynodon dactylon</i>				x		x		x
Umbrella Grass	<i>Digitaria divaricatissima</i>							x	x
Small-flowered Finger Grass	<i>Digitaria parviflora</i>				x				
Wiry Panic	<i>Entolasia stricta</i>						x		
Brown's Lovegrass	<i>Eragrostis brownii</i>	x	x	x	x	x	x	x	x
Poverty Grass	<i>Eremochloa bimaculata</i>				x		x		
Shorthair Plumegrass	<i>Dichelanthe micrantha</i>					x	x		
Coolatai Grass*	<i>Hyparrhenia hirta*</i>				x	x			
Blady Grass	<i>Imperata cylindrica</i>				x				
Red Natal Grass*	<i>Melinis repens*</i>		x	x	x				
Weeping Grass	<i>Microlaena stipoides</i>		x	x					
Australian Basket Grass	<i>Oplismenus aemulus</i>				x				
Hairy Panic	<i>Panicum effusum</i>	x		x	x	x	x	x	
-	<i>Paspalidium distans</i>						x		
	<i>Paspalum urvillei</i>			x					
Tussock	<i>Poa labillardierei</i>			x					
Red-anther Wallaby Grass	<i>Rytidosperma pallidus</i>	x	x	x	x			x	x
Pale Pigeon Grass	<i>Setaria pumila</i>		x	x	x			x	x
South African Pigeon Grass*	<i>Setaria sphacelata*</i>					x	x		
Western Rat-tail Grass	<i>Sporobolus creber</i>			x	x	x		x	
Kangaroo Grass	<i>Themeda triandra</i>							x	
<b>Polypodiales</b>									
<b>Lindsaeaceae</b>									



Common Name	Scientific Name	COA		HOA		RNOA		SOA	
		Grass	Wood	Grass	Wood	Grass	Wood	Grass	Wood
Lacy Wedge Fern	<i>Lindsaea microphylla</i>				x				
<b>Pteridaceae</b>									
Common Maidenhair	<i>Adiantum aethiopicum</i>				x				
Bristly Cloak Fern	<i>Cheilanthes distans</i>	x	x		x	x	x	x	x
-	<i>Cheilanthes sieberi</i>				x				
<b>Ranunculales</b>									
<b>Ranunculaceae</b>									
Headache Vine	<i>Clematis glycinoides</i>				x				
<b>Rosales</b>									
<b>Cannabaceae</b>									
Native Peach	<i>Trema tomentosa</i>		x		x				
<b>Rosaceae</b>									
Native Raspberry	<i>Rubus parvifolius</i>				x		x		
<b>Sanatales</b>									
<b>Olacaceae</b>									
-	<i>Olax stricta</i>			x					
<b>Santalaceae</b>									
Native Cherry	<i>Exocarpos cupressiformis</i>						x		
<b>Saxifragales</b>									
<b>Haloragaceae</b>									
Raspwort	<i>Gonocarpus tetragynus</i>								x
Rough Raspwort	<i>Haloragis heterophylla</i>	x	x	x	x	x	x	x	x
<b>Solanales</b>									
<b>Convolvulaceae</b>									
Kidney Weed	<i>Dichondra repens</i>		x	x	x	x	x		x
Slender Bindweed	<i>Polymeria calycina</i>				x				
<b>Solanaceae</b>									
Green Cestrum	<i>Cestrum parqui*</i>						x		
Narrawa Burr	<i>Solanum cinereum</i>		x	x	x		x		x
Black-berry Nightshade*	<i>Solanum nigrum*</i>			x	x		x		x
Devil's Needles	<i>Solanum stelligerum</i>			x	x				x
Key: * denotes exotic species.									





### A-3 Fauna Species List

Table 13: Full faunal list derived from all biodiversity monitoring surveys conducted in 2022

Class	Common Name	Scientific Name	COA	HOA	RNOA	SOA
Amphibia	Eastern Sign-bearing Froglet	<i>Crinia parinsignifera</i>	HC	HC		
	Common Eastern Froglet	<i>Crinia signifera</i>		HC		
	Eastern Dwarf Tree Frog	<i>Litoria fallax</i>			HC	HC/Vis
	Broad-palmed Rocket Frog	<i>Litoria latopalmata</i>			HC	HC
	Peron's Tree Frog	<i>Litoria peronii</i>			HC	HC
	Eastern Banjo Frog	<i>Limnodynastes dumerilii</i>		HC		
	Spotted Marsh Frog	<i>Limnodynastes tasmaniensis</i>				HC
	Striped Marsh Frog	<i>Limnodynastes peronii</i>			HC	
Aves	Striated Thornbill	<i>Acanthiza lineata</i>		Vis		
	Yellow Thornbill	<i>Acanthiza nana</i>	Vis			
	Buff-rumped Thornbill	<i>Acanthiza reguloides</i>				Vis
	King Parrot	<i>Alistreus scapularis</i>		Vis		
	pacific Black Duck	<i>Anas superciliosa</i>		Vis		x
	Red Wattlebird	<i>Anthochaera carunculata</i>	Vis		x	
	Little Wattlebird	<i>Anthochaera chrysoptera</i>				
	Australasian Pipit	<i>Anthus australis</i>	Vis	Vis		
	Wedge-tailed Eagle	<i>Aquila audx</i>		Vis		Vis
	Australian Wood Duck	<i>Chenonetta jubata</i>				Vis
	Brown Songlark	<i>Cincloramphus cruralis</i>	Vis			
	Golden-headed Cisticola	<i>Cisticola exilis</i>			Vis	
	Grey Shrike-thrush	<i>Colluricincla harmonica</i>			Vis	
	Black-faced Cuckoo-shrike	<i>Coracina novaehollandiae</i>	Vis		Vis	
	White-winged Chough	<i>Corcorax melanorhamphos</i>		Vis	Vis	Vis
	Australian Raven	<i>Corvus coronoides</i>	Vis	Vis		
	Pied Butcherbird	<i>Cracticus nigrogularis</i>		Vis		Vis
	Laughing Kookaburra	<i>Dacelo novaeguineae</i>		Vis	Vis	
	<b>Varied Sittella</b>	<b><i>Daphoenositta chrysoptera</i></b>				Vis
	Eastern Koel	<i>Eudynamis orientalis</i>		Vis		
	White-throated Gerygone	<i>Gerygone albogularis</i>				Vis
	Brown Gerygone	<i>Gerygone mouki</i>	Vis			
	Australian Magpie	<i>Gymnohina tibicen</i>	Vis	Vis		Vis
	<b>White-throated Needletail</b>	<b><i>Hirundapus caudacutus</i></b>		Vis		
	Yellow-faced Honeyeater	<i>Lichenostomus chrysops</i>	Vis	Vis		Vis
	Superb Fairywren	<i>Malurus cyaneus</i>	Vis	Vis	Vis	Vis



Class	Common Name	Scientific Name	COA	HOA	RNOA	SOA
	Noisy Miner	<i>Manorina melanocephala</i>	Vis	Vis		Vis
	Brown-headed Honeyeater	<i>Melithreptus brevirostris</i>			Vis	
	-	<i>Melithreptus sp.</i>	Vis			
	Red-browed finch	<i>Neochmia temporalis</i>		Vis		
	White-eared Honeyeater	<i>Nesoptilotis leucotis</i>	Vis			
	Olive-backed Oriole	<i>Oriolus sagittatus</i>			Vis	
	Striated Pardalote	<i>Pardalotus striatus</i>	Vis	Vis	Vis	Vis
	Noisy Friarbird	<i>Philemon corniculatus</i>	Vis	Vis	Vis	Vis
	Crimson Rosella	<i>Platycercus elegans</i>		Vis		
	Eastern Rosella	<i>Platycercus eximius</i>		Vis		Vis
	<b>Grey-crowed Babbler</b>	<b><i>Pomatostomus temporalis</i></b>				Vis
	Satin Bowerbird	<i>Ptilonorhynchus violaceus</i>		Vis		
	Grey Fantail	<i>Rhipidura albiscapa</i>	Vis	Vis	Vis	Vis
	Willie Wagtail	<i>Rhipidura leucophrys</i>			Vis	Vis
	Channel-billed Cuckoo	<i>Scythrops novaehollandiae</i>	Vis	Vis		
	White-browed Scrubwren	<i>Sericornis frontalis</i>		Vis		
	Weebill	<i>Smicromnis brevirostris</i>	Vis		Vis	
	Pied Currawong	<i>Strepera graculina</i>		Vis	Vis	
	Australasian Grebe	<i>Tachybaptus novahollandiae</i>		Vis		Vis
	Silvereye	<i>Zosterops lateralis</i>		Vis		
Mammalia	White-striped Freetail Bat	<i>Austronomus australis</i>	Anabat		Anabat	
	Dog*	<i>Canis lupus familiaris*</i>				Vis
	Gould's Wattled Bat	<i>Chalinolobus gouldii</i>	Anabat		Anabat	Anabat
	Chocolate Wattled Bat	<i>Chalinolobus morio</i>				
	Northern Brown Bandicoot	<i>Isodon macrourus</i>		Vis		
	Eastern Grey Kangaroo	<i>Macropus giganteus</i>		Vis		Vis
	Common Wallaroo	<i>Macropus robustus</i>		Vis	Vis	
	<b>Large bent-wing Bat</b>	<b><i>Miniopterus orianae oceanensis</i></b>	<b>Anabat</b>			<b>Anabat</b>
	Red-necked Wallaby	<i>Macropus rufogriseus</i>		Vis	Vis	
	European Rabbit*	<i>Oryctolagus cuniculus*</i>				
	South-eastern Freetail Bat	<i>Ozimops planiceps</i>	Anabat		Anabat	Anabat
	Ride's Freetail Bat	<i>Ozimops ridei</i>	Anabat		Anabat	Anabat
	<b>Greater Broad-nosed bat</b>	<b><i>Scoteanax rueppellii</i></b>	<b>Anabat</b>			
	Inland Broad-nosed Bat	<i>Scotorepens balstoni</i>	Anabat			Anabat
	South-eastern Broad-nosed Bat	<i>Scotorepens orion</i>	Anabat			
Wild Pig*	<i>Sus scrofa*</i>	Track		Track		



<i>Class</i>	<i>Common Name</i>	<i>Scientific Name</i>	<i>COA</i>	<i>HOA</i>	<i>RNOA</i>	<i>SOA</i>
	Common Brushtail Possum	<i>Trichosurus vulpecula</i>				Vis/Cam
	Southern Forest Bat	<i>Vespadelus regulus</i>	Anabat			Anabat
Reptilia	Lace Monitor	<i>Varanus varius</i>		Vis		Vis

Key: invasive species (\*); species listed as threatened under the BC Act and/or EPBC Act (bold); Heard call (HC), hair tube (HT), visually observed (Vis).



## A-4 Flora List – Incidental Observations

Table 14: Flora List – Incidental Observations

Common Name	Scientific Name	COA	HOA	RNOA	SOA
<b>Alismatales</b>					
<b>Hydrocharitaceae</b>					
Swamp Lily	<i>Ottelia ovalifolia</i>			x	x
<b>Juncaginaceae</b>					
Water Ribbons	<i>Cychnogeton procerum</i>				
<b>Commelinales</b>					
<b>Philydraceae</b>					
Frogmouth	<i>Philydrum lanuginosum</i>			x	x
<b>Myrtales</b>					
<b>Onagraceae</b>					
Water Primrose	<i>Ludwigia peploides</i>			x	x
<b>Poales</b>					
<b>Cyperaceae</b>					
Asian Water Chestnut	<i>Eleocharis dulcis</i>	x	x	x	x
Tall Spike-rush	<i>Eleocharis sphacelata</i>	x			
-	<i>Schoenoplectiella mucronata</i>			x	
<b>Juncaceae</b>					
Sharp Rush	<i>Juncus acutus</i>			x	x
<b>Typhaceae</b>					
Broadleaf Cumbungi	<i>Typha orientalis</i>	x	x	x	x



## A-5 RNOA Cumulative Fauna Species List

Table 15: Full faunal list derived from all monitoring surveys in RNOA

Common Name	Scientific Name	Pre 2016	2016	2018	2019	2020	2021	2022
<b>Amphibia</b>								
Common Eastern Froglet	<i>Crinia signifera</i>	VIS	VIS	VIS		VIS	VIS	
Eastern Banjo Frog	<i>Limnodynastes dumerillii</i>	VIS						
Long-thumbed Frog	<i>Limnodynastes fletcheri</i>	VIS						
Brown-striped Frog	<i>Limnodynastes peronii</i>	VIS						
Spotted Marsh Frog	<i>Limnodynastes tasmaniensis</i>	VIS	VIS	VIS		VIS		
Green and Golden Bell Frog	<i>Litoria aurea</i>	VIS						
Eastern Dwarf Tree Frog	<i>Litoria fallax</i>	VIS	VIS	VIS		VIS	VIS	VIS
Broad-palmed Rocket Frog	<i>Litoria latopalmata</i>	VIS	VIS		VIS	VIS	VIS	VIS
Striped Rocket Frog	<i>Litoria nasuta</i>			VIS		VIS		
Peron's Tree Frog	<i>Litoria peronii</i>	VIS	VIS	VIS		VIS	VIS	VIS
Whistling Tree Frog	<i>Litoria verreauxii</i>		VIS					
Brown Broodfrog	<i>Pseudophryne bibronii</i>						VIS	
Dusky Toadlet	<i>Uperoleia fusca</i>			VIS			VIS	
Eastern Toadlet	<i>Uperoleia laevigata</i>		VIS			VIS		
<b>Aves</b>								
Yellow-rumped Thornbill	<i>Acanthiza chrysorrhoa</i>	VIS	VIS	VIS	VIS			
Yellow Thornbill	<i>Acanthiza nana</i>	VIS	VIS	VIS	VIS		VIS	
Brown Thornbill	<i>Acanthiza pusilla</i>					VIS	VIS	
Buff-rumped Thornbill	<i>Acanthiza reguloides</i>	VIS	VIS	VIS		VIS		
Collared Sparrowhawk	<i>Accipiter cirrocephalus</i>			VIS				
Australian Reed-warbler	<i>Acrocephalus australis</i>					VIS		
King Parrot	<i>Alisterus scapularis</i>							
Pacific Black Duck	<i>Anas superciliosa</i>			VIS	VIS			
Red Wattlebird	<i>Anthochaera carunculata</i>	VIS						
Little Wattlebird	<i>Anthochaera chrysoptera</i>							
Australasian Pipit	<i>Anthus australis</i>						VIS	
Wedge-tailed Eagle	<i>Aquila auda</i>		VIS	VIS	VIS		VIS	
Hardhead	<i>Aythya australis</i>			VIS				
Little Corella	<i>Cacatua sanguinea</i>			VIS				
Pallid Cuckoo	<i>Cacomantis pallidus</i>			VIS	VIS		VIS	VIS
Yellow-faced Honeyeater	<i>Caligavis chrysops</i>	VIS	VIS					VIS
Horsfield's Bronze-Cuckoo	<i>Chalcites basalis</i>						VIS	



Common Name	Scientific Name	Pre 2016	2016	2018	2019	2020	2021	2022
Australian Wood Duck	<i>Chenonetta jubata</i>		VIS		VIS	VIS		VIS
Speckled Warbler	<i>Chthonicola sagittata</i>	VIS	VIS	VIS	VIS			
Brown Songlark	<i>Cincloramphus cruralis</i>						VIS	
Golden-headed Cisticola	<i>Cisticola exilis</i>							Vis
Brown Treecreeper	<i>Climacteris picumnus victoriae</i>	VIS						
Grey Shrike-thrush	<i>Colluricincla harmonica</i>	VIS		VIS	VIS			VIS
Black-faced Cuckoo-shrike	<i>Coracina novaehollandiae</i>	VIS	VIS	VIS	VIS	VIS	VIS	VIS
White-winged Cough	<i>Corcorax melanorhamphos</i>	VIS	VIS	VIS	VIS	VIS	VIS	VIS
White-throated Treecreeper	<i>Cormobates leucophaea</i>	VIS						VIS
Australian Raven	<i>Corvus coronoides</i>	VIS	VIS	VIS	VIS	VIS	VIS	VIS
Little Raven	<i>Corvus mellori</i>	VIS						
Torresian Crow	<i>Corvus orru</i>			VIS			VIS	
Quail sp.	<i>Coturnix sp.</i>					VIS		
Stubble quail	<i>Coturnix pectoralis</i>							
Pied Butcherbird	<i>Cracticus nigrogularis</i>	VIS	VIS		VIS	VIS	VIS	
Australian Magpie	<i>Cracticus tibicen</i>	VIS	VIS	VIS	VIS	VIS	VIS	VIS
Grey Butcherbird	<i>Cracticus torquatus</i>	VIS	VIS		VIS	VIS	VIS	
Laughing Kookaburra	<i>Dacelo novaeguineae</i>			VIS	VIS	VIS	VIS	VIS
<b>Varied Sittella</b>	<b><i>Daphoenositta chrysoptera</i></b>		<b>VIS</b>	<b>VIS</b>				<b>Vis</b>
Mistletoebird	<i>Dicaeum hirundinaceum</i>	VIS	VIS					
White-faced Heron	<i>Egretta novaehollandiae</i>		VIS					
Galah	<i>Eolophus roseicapilla</i>					VIS		
Dollarbird	<i>Eurystomus orientalis</i>	VIS						
Black Falcon	<i>Falco subniger</i>			VIS				
Bar-shouldered Dove	<i>Geopelia humeralis</i>			VIS	VIS	VIS		
White-throated Gerygone	<i>Gerygone albogularis</i>			VIS	VIS			
Musk Lorikeet	<i>Glossopsitta concinna</i>		VIS					
Magpie Lark	<i>Grallina cyanoleuca</i>			VIS		VIS	VIS	
<b>White-throated Needle-tail</b>	<b><i>Hirundapus caudacutus</i></b>							<b>VIS</b>
Welcome Swallow	<i>Hirundo neoxena</i>	VIS		VIS	VIS	VIS	VIS	
Yellow-faced Honeyeater	<i>Lichenostomus chrysops</i>				VIS			VIS
Superb Fairy-wren	<i>Malurus cyaneus</i>	VIS	VIS	VIS	VIS	VIS	VIS	VIS
Variegated Fairy-wren	<i>Malurus lamberti</i>	VIS					VIS	
Noisy Miner	<i>Manorina melanocephala</i>	VIS	VIS	VIS	VIS	VIS	VIS	VIS
Tawny Grassbird	<i>Megalurus timoriensis</i>					VIS		
Lewin's Honeyeater	<i>Meliphaga lewinii</i>						VIS	
Brown-headed Honeyeater	<i>Melithreptus brevirostris</i>			VIS		VIS		VIS



Common Name	Scientific Name	Pre 2016	2016	2018	2019	2020	2021	2022
Rainbow Bee-eater	<i>Merops ornatus</i>	VIS						
Little Pied Cormorant	<i>Microcarbo melanoleucos</i>		VIS					
Jacky Winter	<i>Microeca fascians</i>	VIS			VIS		VIS	
Satin Flycatcher	<i>Myiagra cyanoleuca</i>	VIS						
Scarlet Honeyeater	<i>Myzomela sanguinolenta</i>					VIS		
Southern Boobook	<i>NinoVis novaeseelandiae</i>		VIS					
Crested Pigeon	<i>Ocyphaps lophotes</i>					VIS	VIS	
Olive-backed Oriole	<i>Oriolus sagittatus</i>	VIS				VIS	VIS	VIS
Golden Whistler	<i>Pachycephala pectoralis</i>		VIS	VIS	VIS	VIS		
Rufous Whistler	<i>Pachycephala rufiventris</i>	VIS	VIS	VIS	VIS	VIS		
Spotted Pardalote	<i>Pardalotus punctatus</i>	VIS	VIS	VIS	VIS			
Striated Pardalote	<i>Pardalotus striatus</i>	VIS	VIS		VIS	VIS	VIS	VIS
Fairy Martin	<i>Petrochelidon ariel</i>					VIS		
Pied Cormorant	<i>Phalacrocorax varius</i>						VIS	
Scarlet Robin	<i>Petroica boodang</i>	VIS						
Red-capped Robin	<i>Petroica goodenovii</i>	VIS	VIS	VIS		VIS		
Common Bronzewing	<i>Phaps chalcoptera</i>		VIS		VIS	VIS	VIS	
Noisy Friarbird	<i>Philemon corniculatus</i>		VIS	VIS	VIS	VIS	VIS	VIS
Eastern Rosella	<i>Platycercus evisimius</i>		VIS	VIS				
Striped Honeyeater	<i>Plectorhyncha lanceolata</i>	VIS						
<b>Grey-crowned Babbler</b>	<b><i>Pomatostomus temporalis</i></b>	<b>VIS</b>	<b>VIS</b>	<b>VIS</b>		<b>VIS</b>	<b>VIS</b>	<b>VIS</b>
Satin Bowerbird	<i>Ptilonorhynchus violaceus</i>		VIS				VIS	VIS
White-plumed Honeyeater	<i>Ptilotula penicillata</i>	VIS		VIS				
Grey Fantail	<i>Rhipidura albiscapa</i>	VIS	VIS	VIS	VIS	VIS	VIS	VIS
Willie Wagtail	<i>Rhipidura leucophrys</i>	VIS	VIS	VIS	VIS		VIS	VIS
Rufous Fantail	<i>Rhipidura rufifrons</i>			VIS			VIS	
Channel-billed Cuckoo	<i>Scythrops novaehollandiae</i>	VIS		VIS		VIS		VIS
White-browed Scrubwren	<i>Sericornis frontalis</i>		VIS					
Weebill	<i>Smicornis brevirostris</i>	VIS	VIS		VIS	VIS	VIS	VIS
Pied Currawong	<i>Strepera graculina</i>	VIS	VIS	VIS	VIS	VIS	VIS	VIS
Australasian Grebe	<i>Tachybaptus novaehollandiae</i>		VIS			VIS		VIS
Double-barred Finch	<i>Taeniopygia bichenovii</i>	VIS	VIS		VIS	VIS		
Forest Kingfisher	<i>Todiramphus macleayii</i>	VIS						
Sacred Kingfisher	<i>Todiramphus sanctus</i>	VIS		VIS				
Rainbow Lorikeet	<i>Trichoglossus haematodus</i>						VIS	
Masked Lapwing	<i>Vanellus miles</i>			VIS	VIS		VIS	
Silvereye	<i>Zosterops lateralis</i>						VIS	



Common Name	Scientific Name	Pre 2016	2016	2018	2019	2020	2021	2022
<b>Mammalia</b>								
Yellow-footed Antechinus	<i>Antechinus flavipes</i>	VIS						
Brown Antechinus	<i>Antechinus stuartii</i>	VIS						
White-striped Free-tailed Bat	<i>Austronomus australis</i>	VIS	VIS	VIS	VIS	VIS		Ana
Wild Dog*	<i>Canis lupus familiaris*</i>	VIS	VIS	VIS	VIS			
Wild Goat*	<i>Capra hircus*</i>				VIS			
Gould's Wattled Bat	<i>Chalinolobus gouldii</i>	VIS	VIS	VIS	VIS			Ana
Chocolate Wattled Bat	<i>Chalinolobus morio</i>	VIS			VIS	VIS		Ana
Feral Cat*	<i>Felis catus*</i>	VIS	VIS			VIS		
Northern Brown Bandicoot	<i>Isodon macrourus</i>						VIS	
Brown Hare*	<i>Lepus capensis*</i>	VIS	VIS	VIS	VIS	VIS		
Eastern Grey Kangaroo	<i>Macropus giganteus</i>	VIS	VIS	VIS	VIS	VIS	VIS	
Common Wallaroo	<i>Macropus robustus</i>	VIS						VIS
Red-necked Wallaby	<i>Macropus rufogriseus</i>	VIS	VIS		VIS	VIS	VIS	VIS
<b>Little Bent-wing Bat</b>	<b><i>Miniopterus australis</i></b>	<b>VIS</b>						
<b>Large Bent-winged Bat</b>	<b><i>Miniopterus orianae oceanensis</i></b>	<b>VIS</b>	<b>VIS</b>	<b>VIS</b>	<b>VIS</b>			Ana
Eastern Free-tail Bat	<i>Mormopterus norfolkensis</i>	VIS	VIS					
House Mouse	<i>Mus musculus</i>	VIS						
Lesser Long-eared Bat	<i>Nyctophilus geoffroyi</i>	VIS						
European Rabbit*	<i>Oryctolagus cuniculus*</i>	VIS	VIS	VIS	VIS	VIS	VIS	
Southern Free-tailed Bat	<i>Ozimops planiceps</i>	VIS	VIS	VIS	VIS			Ana
Eastern Free-tailed Bat	<i>Ozimops ridei</i>				VIS			Ana
Long-nosed Bandicoot	<i>Perameles nasuta</i>					VIS		
<b>Brush-tailed Phascogale</b>	<b><i>Phascogale tapoatafa</i></b>					<b>VIS</b>		
Grey-headed Flying-fox	<i>Pteropus poliocephalus</i>	VIS				VIS		
Little Red Flying Fox	<i>Pteropus scapulatus</i>					VIS		
Black Rat	<i>Rattus rattus</i>	VIS						
<b>Yellow-bellied Sheath-tail-bat</b>	<b><i>Saccolaimus flaviventris</i></b>		<b>VIS</b>					
<b>Greater Broad-nosed Bat</b>	<b><i>Scoteanax rueppellii</i></b>							<b>Ana</b>
Inland Broad-nosed Bat	<i>Scotorepens balstoni</i>	VIS	VIS					Ana
Eastern Broad-nosed Bat	<i>Scotorepens orion</i>	VIS						Ana
Common Dunnart	<i>Sminthopsis murina</i>	VIS						
Wild Pig*	<i>Sus scrofa*</i>						VIS	Track
Short-beaked Echidna	<i>Tachyglossus aculeatus</i>	VIS	VIS			VIS		
Common Brushtail Possum	<i>Trichosurus vulpecula</i>		VIS	VIS	VIS	VIS	VIS	
Southern Forest Bat	<i>Vespadelus regulus</i>	VIS						



Common Name	Scientific Name	Pre 2016	2016	2018	2019	2020	2021	2022
Little Forest Bat	<i>Vespadelus vulturnus</i>	VIS			VIS			Ana
Common Wombat	<i>Vombatus ursinus</i>	VIS						
Red Fox*	<i>Vulpes vulpes*</i>	VIS	VIS		VIS	VIS		
Swamp Wallaby	<i>Wallabia bicolor</i>	VIS						
<b>Reptilia</b>								
Southern Rainbow-skink	<i>Carlia tetradactyla</i>	VIS						
Eastern Long-necked Turtle	<i>Chelodina longicollis</i>				VIS			
Robust Ctenotus	<i>Ctenotus robustus</i>	VIS	VIS					
Copper-tailed Skink	<i>Ctenotus taeniolatus</i>	VIS						
Wood Gecko	<i>Diplodactylus vittatus</i>	VIS						
Tree Skink	<i>Egernia striolata</i>	VIS	VIS					
Eastern Water Dragon	<i>Intellagama lesueurii</i>		VIS	VIS	VIS			
Dark-flecked Garden Sunskink	<i>Lampropholis delicata</i>	VIS	VIS					
Pale-flecked Garden Sunskink	<i>Lampropholis guichenoti</i>	VIS	VIS					
Bearded Dragon	<i>Pogona barbata</i>	VIS						VIS
Lace Monitor	<i>Varanus varius</i>	VIS	VIS		VIS	VIS	VIS	VIS
Key: invasive species (*); species listed as threatened under the BC Act and/or EPBC Act (bold).								



## A-6 BCD Comment register

BCD Recommendation	Response	Incorporated
1. BCD recommends that future biodiversity offset area monitoring reports include details of affected plant species and conditions that have not become established in revegetation and rehabilitation areas, as this will lead to the identification of solutions.	There has been no planting undertaken during the current monitoring year within the BOA's. Some preparatory work was noted on HOA. Any successful or failed revegetation attempts will be recorded, and detailed notes taken around the environmental conditions and species etc to allow for further direction in future plantings.	Yes. Note: no planting conducted in 2022
2. BCD recommends the boundary of the Ravensworth North Offset Area is clarified in relation to the adjacent waste dump, and either Figure 4 is redrawn or the area of the offset is modified to meet consent requirements.	An updated boundary layer for RNOA was received from Ravensworth Operations and as been replaced in all relevant figures, including but not limited to Figure 4.	Yes
3. BCD recommends the list of plant species recorded at each monitoring site is provided in future monitoring reports.	Vegetation plot lists have been provided in the Appendices of this report.	Yes
4. BCD recommends the provision is made for the use of 'random meanders' or other incidental observations to record plant species that occur outside of vegetation management plots. Such additional species may have management implications for the offset areas.	Random meanders were undertaken during 2023 monitoring. A list of species derived is included in the appendices of this report. Note that random meanders focused largely around farm dams and water ways during habitat assessment for GGBF.	Yes
5. BCD recommends that the flora species list for the biodiversity offset areas, given in Table 12, is rearranged so that plants are arranged alphabetically first by Order, then by Family and then by species	The flora list within Table 12 has been arranged by Order then Family then Species.	Yes
6. BCD recommends that a new table is added to the Appendices, after Table 12 'Full flora list derived from vegetation condition assessments conducted in, in which to list plant species observed during random meanders that were not present in BAM plots. Add details of which vegetation zone(s) the additional plant species occurred in.	As above in recommendation 4. Table 14 has been added in appendices with records of additional flora species recorded outside vegetation plots.	Yes

