

APPENDIX B. REMEDIATION PROGRESS PHOTOGRAPHS



April 2021



December 2021



February 2023



April 2021



December 2021



February 2023



April 2021



December 2021



February 2023



April 2021



December 2021



February 2023



April 2021



December 2021



February 2023



April 2021



December 2021

Missing

February 2023



April 2021



December 2021



February 2023

APPENDIX C. REMOTE CAMERA: FAUNA SPECIES INVENTORY

Species	Pest monitoring - Wattle Grove						Connectivity - Wattle Grove				Connectivity - Georges River			
	C5	C1-2	C1-5	C1-12	C1-13	C1-26	C1-4	C1-7	C2	C7	C1-14	C1-15	C1-17	C1-20
Australasian Swamphen (<i>Porphyrio melanotus</i>)	x							x						
Australian Magpie (<i>Gymnorhina tibicen</i>)			x	x										
Australian Raven (<i>Corvus coronoides</i>)	x	x	x	x		x								x
Australian White Ibis (<i>Threskiornis moluccus</i>)				x	x			x						
Black Rat* (<i>Rattus rattus</i>)							x	x				x		
Brown Hare* (<i>Lepus europaeus</i>)	x		x		x	x								
Chestnut Teal (<i>Anas castanea</i>)								x						
Common Wallaroo (<i>Macropus robustus</i>)		x	x			x	x	x		x				
Common Wombat (<i>Vombatus ursinus</i>)	x													
Domestic Cat* (<i>Felis catus</i>)	x		x			x	x	x				x		
Eastern Grey Kangaroo (<i>Macropus giganteus</i>)	x		x	x		x								
Grey Fantail (<i>Rhipidura albiscapa</i>)							x							
Koala (<i>Phascolarctos cinereus</i>)		x	x			x								
Noisy Miner (<i>Manorina melanocephala</i>)					x									
Pacific Black Duck (<i>Anas superciliosa</i>)								x						

MPE Operational Facility AMR 2022/2023

Species	Pest monitoring - Wattle Grove						Connectivity - Wattle Grove				Connectivity - Georges River			
	C5	C1-2	C1-5	C1-12	C1-13	C1-26	C1-4	C1-7	C2	C7	C1-14	C1-15	C1-17	C1-20
Red Fox* (<i>Vulpes vulpes</i>)	x	x	x	x	x	x	x	x	x	x		x		x
Sacred Kingfisher (<i>Todiramphus sanctus</i>)												x		
Swamp Wallaby (<i>Wallabia bicolor</i>)		x								x		x		x
Unidentified Macropod (<i>Macropus spp.</i>)				x		x								
White-faced Heron (<i>Egretta novaehollandiae</i>)					x	x		x						

APPENDIX D. EPBC OFFSET SITES - ANNUAL MONITORING REPORT

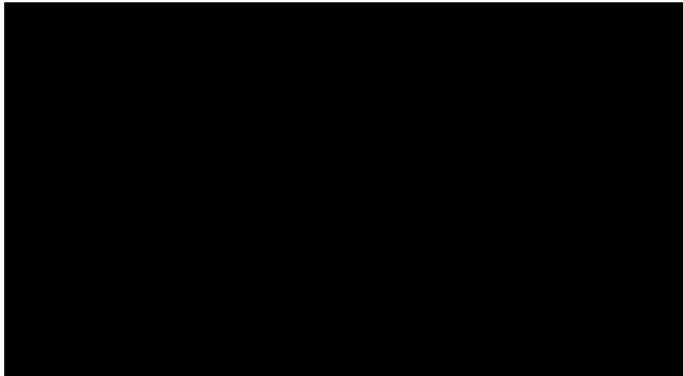
MOOREBANK PRECINCT EAST - EPBC OFFSET SITE

EPBC Threatened Flora Monitoring Report

11 AUGUST 2023



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EPBC Threatened Flora Monitoring Report

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Revision Text B

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REVISIONS

Revision	Date	Description	Prepared by	Approved by
A	15/06/2023	Draft report	Thea Kane	Nathan Banks
B	11/08/2023	Final report	Nathan Banks	Nathan Banks

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1 INTRODUCTION

Arcadis has been commissioned to monitor two threatened plant species listed under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) – *Grevillea parviflora* subsp. *parviflora* (Small-flower Grevillea) and *Persoonia nutans* (Nodding Geebung) – within designated offset sites in the Wattle Grove offset area, adjacent to the Moorebank Logistics Precinct East operational facility (herein referred to as MPE). Monitoring of offset sites is being conducted annually to satisfy the requirements of the Commonwealth Conditions of Approval (CoA) for the MPE project (EPBC 2011/6229). Monitoring commenced in spring 2019 and is set to continue for the life of the offset site, which has been anticipated at 20 years.

Objectives of monitoring, survey methodologies, timings and guidelines have been described in the Threatened Flora Offset Management Plan (TFOMP) prepared by Arcadis in 2017 and updated in 2020. This monitoring report addresses the conditional requirements to monitor Small-flower Grevillea and Nodding Geebung and presents the results of 2022 monitoring surveys for populations of these plants within the designated EPBC offset sites (Figure 1).



1.1 Project background

The MPE project received Commonwealth approval under the EPBC Act for the construction and operation on 6 March 2014 (EPBC 2011/6229).

Construction of the MPE project commenced in mid-2016, with operations being launched in a staged manner from Q2-2020. The MPE project includes an intermodal terminal and warehouse/distribution facility, offering container storage and warehousing solutions with direct rail access to Port Botany.

The MPE project directly impacted two threatened flora species listed under the EPBC Act:

- *Persoonia nutans* (Nodding Geebung), a shrub listed as Endangered under the EPBC Act and *Biodiversity Conservation Act 2016* (BC Act). The MPE project removed 17 Nodding Geebung.
- *Grevillea parviflora* subsp. *parviflora* (Small-flower Grevillea), a shrub listed as Vulnerable under the EPBC Act and BC Act. The MPE project removed 20 Small-flower Grevillea stems.

Impacts to these EPBC Act-listed threatened flora species occurred at the following two locations within the MPE project footprint:

- A portion of Stage 1, Package 1: the Rail Link; and
- The MPE Stage 2 Modification 2 project area – onsite stormwater detention basin (OSD) 2 (which includes a section of the MPL East Stage 2 project footprint).

A total of 11 Nodding Geebung and 20 Small-flower Grevillea were removed to make way for the MPE Rail Link construction. An additional six Nodding Geebung were removed during the construction of the OSD basin at the southern extent of the MPE Stage 2 project site.

1.2 Requirement to monitor

Arcadis prepared a Threatened Species Offset Management Plan (TFOMP) in 2017, updated in 2020, specifying how SIMTA would achieve the EPBC Act Environmental Offset Policy requirements for impacts to Small-flower Grevillea and Nodding Geebung. The TFOMP is a conditional requirement (Condition 6) of the MPE CoA (EPBC 2011/6229) (Table 1).

Table 1. CoA (EPBC 2011/6229): Condition 6

CoA	Requirement
6	For the better protection of Nodding Geebung, Small-flower Grevillea (and potentially, <i>Hibbertia</i> sp. Bankstown and Bynoe's Wattle pending the outcome of conditions 3 and 4), the person taking the action must engage a suitably qualified expert to prepare a Threatened Flora Offset Management Plan (TFOMP) (or plans) for the approval of the Minister. The TFOMP must include (but need not be limited to): (a) Details of a direct offset that satisfies the requirement of the Department's offset policy, in accordance with the offset user guide (including timeframes for the delivery or acquisition of the direct offset); (b) Maps (s) and shapefile that identify the location and boundaries of the direct offset; (c) Details of the management action and performance objectives which will maintain and enhance the Nodding Geebung and Small-flower Grevillea habitat and/or population covered by the TFOMP (including duration, intensity, and timing of management actions); (d) An assessment of the baseline population and distribution for Nodding Geebung and Small-flower Grevillea within the direct offset, including: • The number of plants protected and their location; and

CoA	Requirement
	- Plant and habitat protection (e) Measures for regular monitoring of the status of individuals of Nodding Geebung and Small-flower Grevillea and their habitat as measured against the baseline population and distribution, including: - Fluctuations in population size and distribution; and - Response to disturbance and/or management actions (f) Provisions to revise the approved TFOMP in response to monitoring associated with condition 6 (e) - Native vegetation clearance must not occur until the TFOMP has been approved. The TFOMP must be implemented once approved. - Should the action result in, or be likely to result in, residual impacts to <i>Hibbertia</i> sp. Bankstown or Bynoe's Wattle (as determined by the Minister), the TFOMP must also demonstrate how it meets the standards described in (a) and (f), for these two species.

This report has been prepared to specifically address CoA 6(e):

Measures for regular monitoring of the status of individuals of Nodding Geebung and Small-flower Grevillea and their habitat as measured against the baseline population and distribution, including:

- fluctuations in population size and distribution; and*
- response to disturbance and/or management actions*

1.3 Project documents

The following project documents were reviewed prior to establishing offset sites and referenced during the inaugural monitoring surveys to ensure adherence to the EPBC offsetting requirements and to maximise the chance of success in achieving the monitoring objectives:

- BioBanking Agreement (BA341) for Moorebank Intermodal Terminal Biobank Site (OEH 2017)
- Biodiversity Assessment Report: Biobanking Agreement – Wattle Grove Offset Area, Casula Offset Area and Moorebank Conservation Area (WSP & Parsons Brinckerhoff 2017)
- Biodiversity Management Implementation Plan (Arcadis 2019)
- Conditions attached to the approval: SIMTA Moorebank Intermodal Terminal Facility, Sydney, NSW (EPBC 2011/6229) (DoE 2014)
- Threatened Flora Offset Management Plan (Arcadis 2020a).

1.4 Establishment of offset sites

Five designated offset sites were established to deliver the required offset for impacts to EPBC listed threatened plants. Offset sites were situated within the Wattle Grove offset area, which is a part of the BA341 Moorebank biobank site. Including these offset sites within the biobank site affords better protection to these plants, being secured under a conservation agreement which provides in-perpetuity funding for management actions tied to a strong regulatory framework of monitoring and auditing.

In accordance with the revised TFOMP (Arcadis 2020a), four offset sites are designated for conserving Nodding Geebung and one for Small-flower Grevillea. It is anticipated that the conservation and management of EPBC offset sites will maintain the initial number of plants/stems of these species and will result in a population increase across a 20-year management period. It is

anticipated that the protection and management of the offset sites over a 20-year period will increase Nodding Geebung and Small-flower Grevillea by 16 and 17 individuals, respectively.

In order to achieve this population growth within the offset sites, a total of 155 Nodding Geebung and 142 Small-flower Grevillea were included across the five offset sites (see Table 2).

Offset calculations were prepared for Nodding Geebung and Small-flower Grevillea based on guidance provided in the EPBC Offset Assessments Guide (DOEE 2012). Offset calculations and associated species information (temporal scale, risk scales, future habitat quality, result confidence) have been included within the approved TFOMP (Arcadis 2020a). These calculations assessed and supported the suitability of the proposed offset sites to achieve 100 percent of the required EPBC offset for the MPE project over a period of 20 years.

Table 2. Details of EPBC offset sites: Nodding Geebung

EPBC Offset Site	Area	Number of individual plants to be conserved within the offset site per the EPBC Act offset requirement	Offset requirement objective
P1	0.25 ha	31 plants of Nodding Geebung	Increase Nodding Geebung population within EPBC Offset Sites by 16 plants over 20 years
P2	0.2 ha	46 plants of Nodding Geebung	
P3	0.26 ha	35 plants of Nodding Geebung	
P4	2.17 ha	43 plants of Nodding Geebung	
Total	2.88 ha	155 plants of Nodding Geebung	

Table 3. Details of EPBC offset sites: Small-flower Grevillea

EPBC Offset Site	Area	Number of stems to be conserved within the offset site per the EPBC Act offset requirement	Offset requirement objective
G1	0.24 ha	142 stems of Small-flower Grevillea	Increase Small-flower Grevillea population within EPBC Offset Sites by 17 plants over 20 years

1.5 Monitoring history

The inaugural monitoring survey occurred in spring 2019 when four EPBC offset sites were established in accordance with the Threatened Flora Offset Management Plan (TFOMP) (Arcadis 2017). These four offset sites were established as direct offset sites to compensate for impacts to 11 Nodding Geebung and 20 Small-flower Grevillea from the MPE project.

In 2020, an additional 6 Nodding Geebung plants were impacted by the MPE Stage 2 development and subsequently required offsetting in accordance with the EPBC Offsetting Guide. The TFOMP was updated (Arcadis 2020a) to include the additional impacts and document how the additional offsets would be delivered. During the second year of monitoring, an additional Nodding Geebung offset site (P4) was established at the northern extent of the Wattle Grove offset area. This additional offset site (P4) was monitored along with the existing Nodding Geebung offset sites (P1, P2, P3 and P4), and Small-flower Grevillea offset site (G1) during 2021 and currently in 2022.

Monitoring of EPBC offset sites commenced approximately 18 months following a wildfire that burnt through the southern portion of Wattle Grove offset area. The locations of offset sites P1, P2, P3 and G1 were all burnt by the fire, which destroyed the majority of the individuals of Nodding Geebung and

Small-flower Grevillea previously recorded. Offset site P4 was unaffected. A summary of the results of the last years of monitoring is included in Section 1.5.1.

The 2022 monitoring event marks the fourth year of monitoring for the EPBC offset sites, and the findings of these surveys are the subject of this report.

1.5.1 Summary of 2021 monitoring results

In spring 2021, monitoring was conducted for the four Nodding Geebung (P1, P2, P3 and P4) offset sites and the single Small-flower Grevillea offset site (G1). The population census recorded 92 individuals of Nodding Geebung and 50 individuals of Small-flower Grevillea.

Of the 92 Nodding Geebung individuals identified, 51 were identified across offset sites P1 and P3 and 41 individuals at offset site P4. No individuals were recorded in offset site P2 for the second consecutive year. A thorough search was conducted throughout offset sites P1, P2, P3 and P4 to re-locate Nodding Geebung individuals previously tagged during the previous monitoring surveys (2019, 2020) and to record any new plants which may have recruited. Searches re-located 84 tagged Nodding Geebung individuals and identified eight new plants. A total of 49 Nodding Geebung were not re-located from the previous survey. It is assumed that the 49 previously marked Nodding Geebung individuals died at some time in year following the fire.

Generally, Nodding Geebung within offset sites were observed to be in good condition. No evidence of impacts from mammals (trampling or grazing) was observed. However, there was some evidence of damage from insects on juvenile plants in offset site P3. A diversity of native plant species was recorded across all offset sites, and exotic species occurrence was restricted to the edges of bushland, specifically on the interface between access tracks and bushland. *Eragrostis curvula* (African Love Grass) was the most encountered weed species.

Small-flower Grevillea stems were more prevalent towards the east and west of the offset site (G1), with 50 plants distributed throughout the site. Small-flower Grevillea stems were observed to be flowering at the time of survey. Plants tended to be found in clusters, with close groupings of five or more plants often being observed. Individuals appeared to have a healthy condition and displaying new growth. Small-flower Grevillea displayed a habitat preference for exposed areas with reduced vegetation and litter cover. The condition of vegetation across the Small-flower Grevillea offset sites was observed to be in good condition.

2 METHODOLOGY

Arcadis ecologists undertook annual monitoring of EPBC offset sites over six days between 7 September 2022 and 14 November 2022.

Generally, the weather on the survey dates was sunny, and the temperature was mild to warm. Weather records from the nearest weather station, Holsworthy Aerodrome AWS (station 066161), for the surveyed dates, are presented in Table 4.

Threatened flora searches were undertaken during sunny, dry weather conditions and during the recommended survey season for Nodding Geebung and Small-flower Grevillea (DPIE 2019a, 2019b) to maximise the chance of detection.

Table 4. Surveying ecologists and climatic conditions during EPBC offset site monitoring

Date	Surveying ecologists	Temperature		Rain
		Min (°C)	Max (°C)	(mm)
7/09/2022	Thea Kane, Jed Brown, Kate Mauger	5.8	19.6	0
16/09/2022	Thea Kane, Jed Brown, Kate Mauger	9.8	23.6	17.2
26/09/2022	Thea Kane, Taylor Bliss-Henaghan, Kate Mauger	8.3	19.8	0
27/09/2022	Thea Kane, Jed Brown, Kate Mauger	11.4	22.7	1.2
28/09/2022	Thea Kane, Jed Brown, Kate Mauger	12.4	22.0	9.6
6/10/2022	Thea Kane, Taylor Bliss-Henaghan, Kate Mauger	12.9	17.4	36.0

2.1 Population census

Targeted searches for Nodding Geebung and Small-flower Grevillea were conducted within the EPBC offset sites. Transects were walked at three-metre spacings, covering the entire offset site. The location of plants was recorded on an Arc-GIS-enabled iPad.

Counts were made for Small-flower Grevillea and Nodding Geebung within designated offset sites. Additional information was recorded for Nodding Geebung individuals:

- Size (height and spread)
- General health (i.e. evidence of insect damage)
- Reproductive status (i.e. evidence of flowering and fruiting)

Individual Nodding Geebung were marked with numbered metal tags to allow individual tracking across monitoring periods.

Juvenile plants were classified as small individuals lacking any reproductive features, including flowers and seeds. Adult plants were generally larger shrubs and displayed reproductive features. Most adult Nodding Geebung identified during surveys were observed to be seeding (Plate 1).

2.1.1 Limitations

In offset sites burned by the bushfire (P1, P2, P3 and G1), Nodding Geebung and Small-flower Grevillea transects were difficult to conduct due to large stands of fallen *Petrophile pulchella* (Conesticks) trees blocking access. Transects were recorded on GPS devices to keep track of approximate lines. In some small areas where walking in straight lines was not possible, ecologists sought to prioritise areas of high-quality habitat.

Due to the density of bushland in some offset sites and the inconspicuous nature of seedling Nodding Geebung and Small-flower Grevillea, transects may have failed to locate/re-locate all of the plants present.

2.2 Habitat Assessment

Offset sites were evaluated for habitat suitability for Nodding Geebung and Small-flower Grevillea. An assessment of the habitat value of each offset site was determined by quantitatively measuring the condition of native vegetation, noting significant changes to site characteristics (i.e. vegetation growth, weed occurrence, erosion) and identifying potential impacts.

The condition of native vegetation within each offset site was measured using vegetation quadrats in accordance with Section 5.3 of the Biodiversity Assessment Method (BAM) (DPIE, 2020). Results of BAM quadrats were used to inform upon the following vegetation attributes:

- Percent foliage cover of canopy species
- Percent foliage cover of shrub species
- Percent foliage cover of ground cover species
- Percent foliage cover of exotic species

A Vegetation Integrity (VI) score was calculated using the results of vegetation quadrats conducted at each offset site. VI scores will be compared between monitoring periods to measure changes to vegetation conditions. It is anticipated that the VI score continually improves and the contributing attributes (composition, function etc.) move towards the benchmark scores for the present Plant Community Type (PCT), being PCT 883 *Hard-leaved Scribbly Gum - Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin Bioregion*.

Notes were made for observations of native vegetation dieback within or surrounding the EPBC offset sites.

2.3 Photo points

Four photo points were established on the perimeter of each EPBC offset site, and a single photo point was established centrally within each offset site. Photo points on the boundary were captured in a single cardinal direction. In the middle of the plot, four photographs were captured from the central photo point in the four cardinal directions.

Photo points are located at metal boundary stakes and a stake in the middle of the offset site. The metal stakes were demarcated with a numbered metal tag identifying the relevant photo point. The locations of photo points and the orientation of photographs are presented in Appendix D.

3 RESULTS

The results of the 2022 monitoring events are summarised in the following sections.

3.1 Population census for EPBC threatened flora

The population census results for Nodding Geebung and Small-flower Grevillea are presented below.

3.1.1 Nodding Geebung

A total of 74 Nodding Geebung were identified across Nodding Geebung offset sites during the 2022 survey. Of the 74 plants located, eight individuals were identified in offset site P1, 28 at P3, 37 at P4, and one at P2.

A thorough search was conducted throughout offset sites P1, P2, P3 and P4 to re-locate Nodding Geebung individuals previously tagged during 2019, 2020, 2021 and 2022 surveys and any new plants which may have recruited. Searches re-located 66 tagged Nodding Geebung individuals and identified eight new plants. A total of 26 individuals located during the previous year's survey (2021 monitoring event) were not re-located and are presumed to have died between the 2021 and current surveys.

Generally, Nodding Geebung within offset sites were observed to be in healthy condition, with about 70 percent of all individuals observed to be healthy. No evidence of impacts from mammals (trampling or grazing) was observed. However, there was some evidence of damage from insects on juvenile plants in offset site P3. Insect damage was also observed during the 2022 surveys.

Offset sites P1, P2, and P3 mainly supported juvenile Nodding Geebung. In contrast, offset site P4, which was not impacted by the 2018 wildfire, has a Nodding Geebung population consisting of adult plants greater than one metre in height and width. The population dynamics of Nodding Geebung within each offset site are discussed below. In offset sites P1, P2 and P3 juvenile Nodding Geebung were mostly observed within seven meters of a road or access track.

Across all sites, except for P2, there has been a general downward trend in the number of individuals of Nodding Geebung within the offset sites. The most prominent population decline has been observed in site P3 (Figure 2).

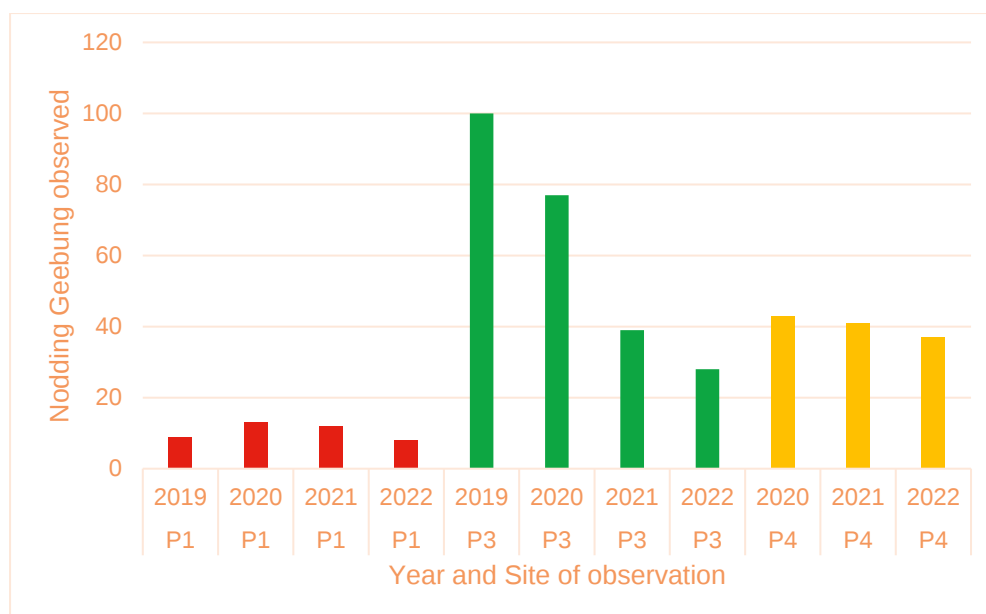


Figure 2. Nodding Geebung counts at each offset site since monitoring commenced. Site P2 has been omitted due to a small number (<3 individuals) of Nodding Geebung observed since 2019.



Plate 1. Adult Nodding Geebung bearing fruit observed during the population census

Offset site P1

A total of eight Nodding Geebung were found in offset site P1 during the 2022 survey. All individuals were juvenile plants showing no signs of seeding or flowering. All of the eight plants identified had been previously recorded and were marked with numbered metal tags. Four individuals identified during the 2021 survey were not re-found and are presumed to have died between the 2021 and the current survey. A summary of changes to the Nodding Geebung population within offset site P1 has been presented in Table 5.

Table 5. Summary of changes to Nodding Geebung population in offset site P1

Offset site P1	Count
Count of individuals from 2021 survey	12
Existing individuals	8
New individuals	0
Total	8
Individuals not re-located (presumed dead)	4

Nodding Geebung within offset site P1 were located towards the northern boundary of the offset site in disturbed areas near an access track (Figure 3). Nodding Geebung were observed growing as individuals and in small groupings on a sandy soil profile interspersed amongst tussocks of African Love Grass and beneath burnt Conesticks. Nodding Geebung were more prevalent in exposed areas with reduced leaf litter and vegetation cover.

Six Nodding Geebung were found to be in a healthy condition, one in moderate condition and one in poor condition. The Six Nodding Geebung found in healthy condition did not exhibit insect damage. Low to moderate levels of insect damage were observed on two of the individuals observed, with the Nodding Geebung found in poor condition exhibiting a moderate level of insect damage.

Offset site P2

During the recent monitoring event, one Nodding Geebung was identified within offset site P2. Except for the Nodding Geebung observed in the most recent survey, no individuals have been recorded since the 2019 monitoring.. The Nodding Geebung was found in healthy condition with no insect damage.

Table 6. Summary of changes to Nodding Geebung population in offset site P2

Offset site P2	Count
Count of individuals from 2021 survey	0
Existing individuals	0
New individuals	1
Total	1
Individuals not re-located (presumed dead)	0

Offset site P3

A total of 28 Nodding Geebung were identified in offset site P3 during the 2022 survey, consisting of six adult plants and 22 juvenile plants. Of the 28 individuals identified, 23 had been recorded and marked with numbered metal tags during previous surveys. The additional five plants are considered to have germinated since the 2021 surveys. A total of 16 Nodding Geebung recorded during the 2021 surveys were not able to be re-located and are presumed to have died. A summary of changes to the Nodding Geebung population within offset site P3 has been presented in Table 7.

Table 7. Summary of changes to Nodding Geebung population in offset site P3

Offset site P3	Count
Count of individuals from 2021 survey	39

Offset site P3	Count
Existing individuals	23
New individuals	5
Total	28
Individuals not re-located (presumed dead)	16

The majority of individuals were observed growing in dense groupings along the northern boundary of the offset site interspersed amongst tussocks of African Love Grass beneath stands of *Kunzea ambigua* (Tickbush). Individuals were observed to prefer the bushland's disturbed edge adjacent to an access track. One plant was found centrally within the offset site in bushland (Figure 6).

Of the Nodding Geebung found, 61 percent were in healthy condition, 32 percent in moderate condition and 7% percent found to be in poor condition.

Offset Site P4

A total of 37 Nodding Geebung were identified in offset site P4 during the 2022 survey. Of the 37 individuals identified, 35 had been previously recorded and marked with numbered metal tags during the 2021 survey. Two additional plant not previously recorded were found and six Nodding Geebung were found to have died since the 2021 survey. A summary of changes to the Nodding Geebung population within offset site P4 has been presented in Table 9.

Table 8. Summary of changes to Nodding Geebung population in offset site P4

Offset site P4	Count
Count of individuals from 2021 survey	41
Existing individuals	35
New individuals	2
Total	37
Individuals not re-located (presumed dead)	6

Nodding Geebung within offset site P4 were distributed throughout Hard-leaved Scribbly Gum Woodland. Individuals were identified in areas of open woodland with a sparse shrub layer as well as areas densely vegetated with mid-storey species and shrubs. Of the Nodding Geebung found, 76 percent were in healthy condition, 5 percent in moderate condition and 5 percent in poor condition.

Annual EPBC Offset Site Monitoring (2022)

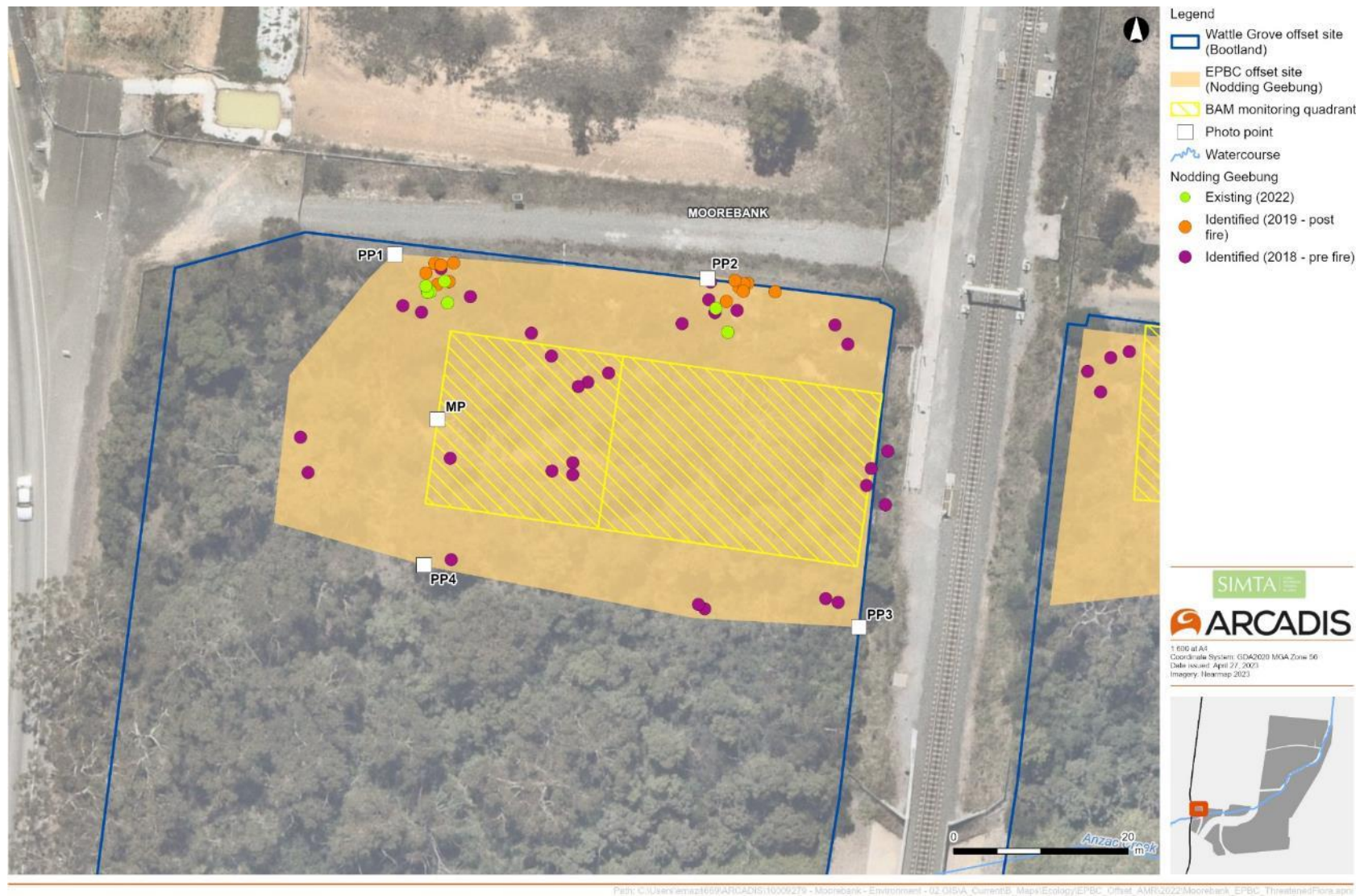


Figure 3. Offset site 1: Nodding Geebung records

Annual EPBC Offset Site Monitoring (2022)

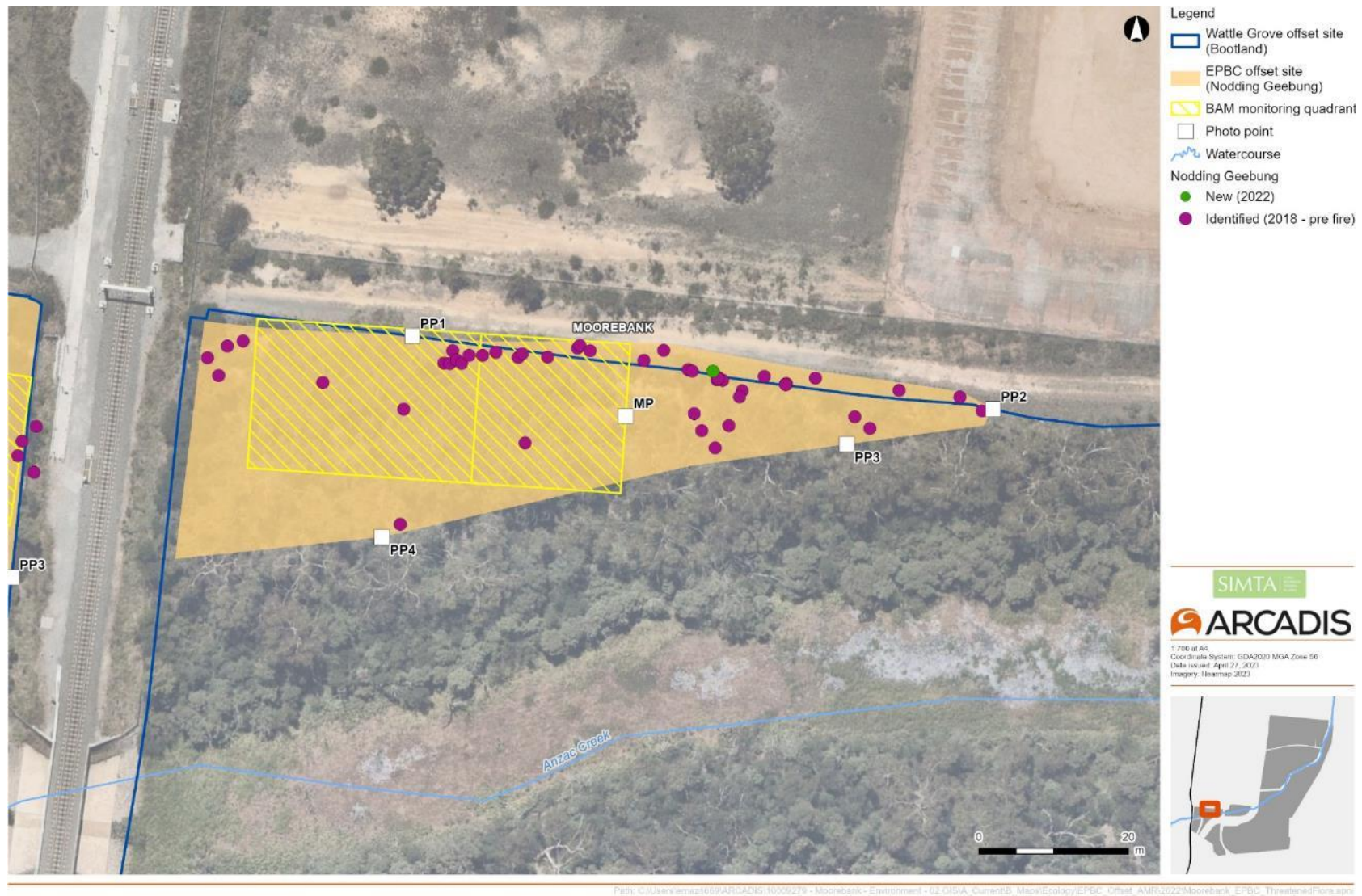


Figure 4. Offset site 2: Nodding Geebung records

Annual EPBC Offset Site Monitoring (2022)

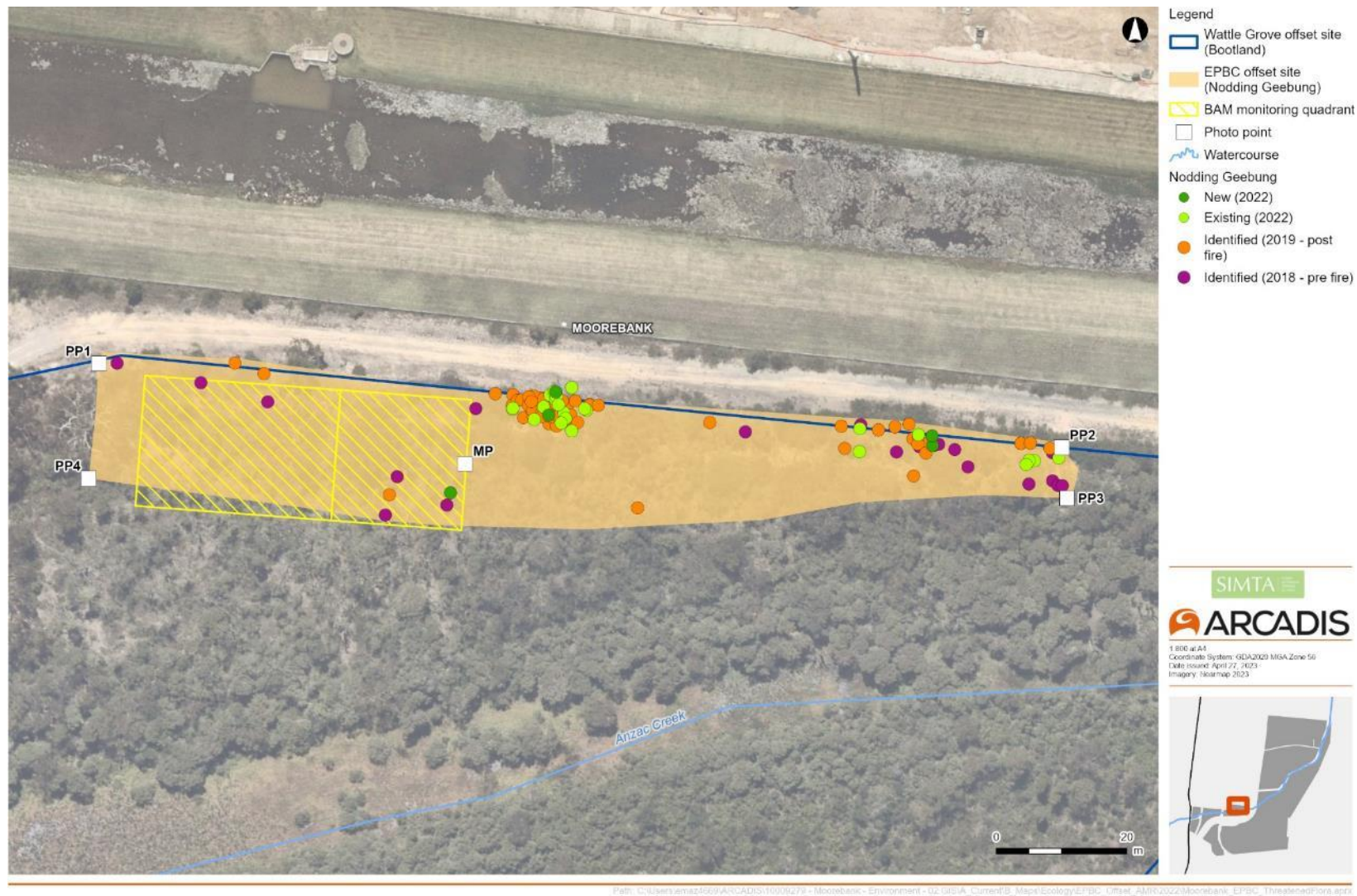


Figure 5. Offset site 3: Nodding Geebung records

Annual EPBC Offset Site Monitoring (2022)



Figure 6. Offset site 4: Nodding Geebung records

3.1.2 Small-flower Grevillea

Offset site G1

A total of 112 Small-flower Grevillea stems were identified within offset site G1 during the 2022 survey. Unlike Nodding Geebung, the TFOMP (Arcadis 2020) did not include a requirement to mark Small-flower Grevillea individuals during the 2019 survey, therefore, recruitment and death rates within the population can't be accurately determined.

The 2022 survey has seen an increase in Small-flower Grevillea compared to the 2020 and 2021 surveys, with the 2022 survey recording 62 more Small-flower Grevillea than the 2021 survey. A summary of changes to the Small-flower Grevillea population within offset site G1 across the annual monitoring events has been presented in Table 10.

Table 9. Summary of changes to Small-flower Grevillea population in offset site G1

Offset site G1	Count
Count of stems from 2019 survey	143
Count of stems from 2020 survey	60
Count of stems from 2021 survey	50
Count of stems from current (2022) survey	112

Small-flower Grevillea stems were found throughout the site, with greater densities observed towards the north east and south west of the offset site, and lower densities of plants distributed centrally. Some Small-flower Grevillea stems were observed to be flowering at the time of the survey but did not appear to have seed present. Plants were generally sparsely scattered. However, close groupings of up to five plants were occasionally observed, generally in areas where leaf litter and ground cover species were absent.

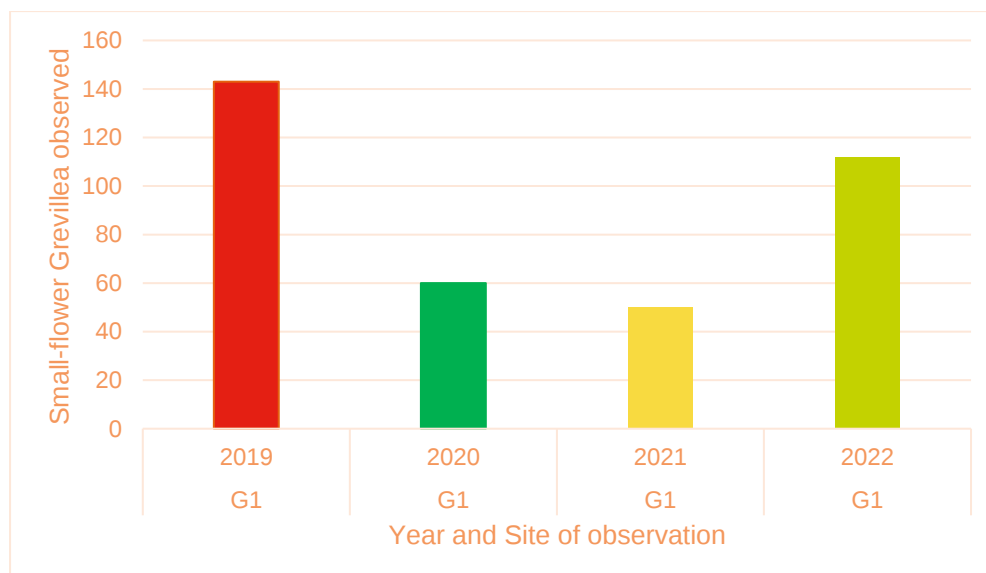


Figure 7. Total number of Small-flower Grevillea observed at each site since observation began in 2020

Generally, Small-flower Grevillea within the offset site was observed to be in healthy or moderate condition, with 55 percent of all individuals observed to be healthy and 38 percent observed to be in moderate condition. No evidence of impacts from mammals (trampling or grazing) was observed.

However, there was some evidence of insect damage, with 50 Small-flower Grevillea observed to have low insect damage.



Plate 2. Small-flower Grevillea observed to be in flower within the offset site

Annual EPBC Offset Site Monitoring (2022)

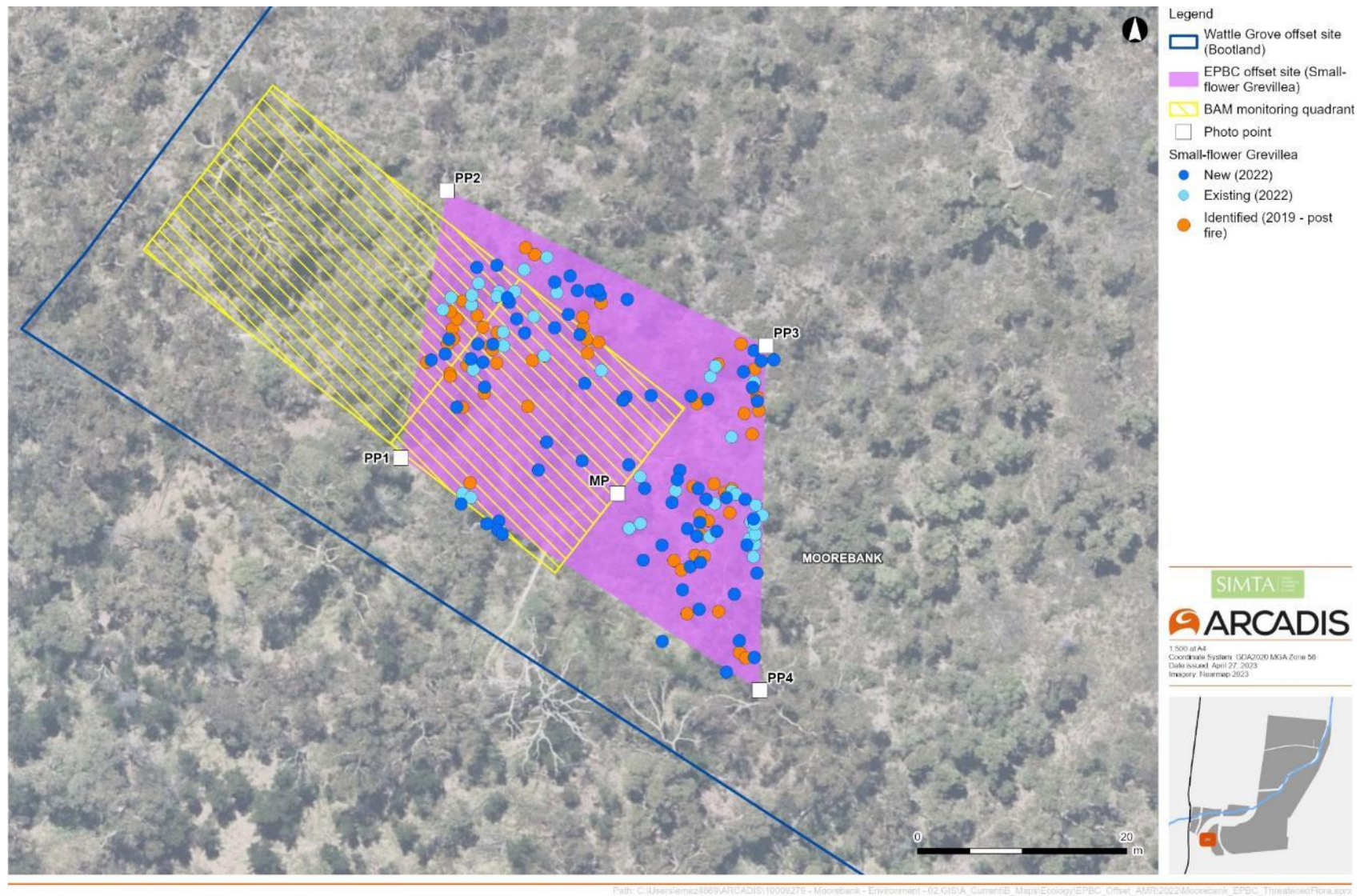


Figure 8. Offset site 4: Small-flower Grevillea records

3.2 Habitat assessment

All five EPBC offset sites are situated within PCT 883 *Hard-leaved Scribbly Gum – Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin Bioregion*.

This community is one of several unique dry shrub woodland communities found on poorly consolidated sand deposits on hinterland plains and valleys of the Sydney region. This community occurs on old stream deposits at Holsworthy (Tozer et al. 2010).

This vegetation has a woodland formation comprising an open, low-growing eucalypt cover dominated by *Eucalyptus racemosa* (Hard-leaved Scribbly Gum), *Angophora bakeri* (Narrow-leaved Apple) and *Eucalyptus parramattensis* subsp. *parramattensis* (Parramatta Red Gum). A sparse cover of *Melaleuca decora* (Tall Paperbark) is often present. *Banksia* spp., *Hakea* spp., *Acacia* spp., *Leptospermum* spp. And *Melaleuca* spp. Provide a well-developed shrub layer. The ground layer typically supports a diverse mix of species, including a high cover of grasses and sedges (Tozer et al. 2010).

3.2.1 Nodding Geebung

3.2.1.1 General habitat preference (OEH, 2019)

The ecology of Nodding Geebung is poorly known, and this species has a disjunct distribution. The southern population of Nodding Geebung, which includes this population, is isolated and consists of relatively small populations in the Liverpool, Campbelltown, Bankstown and Blacktown local government areas. The southern population occupies tertiary alluvium extending onto shale sandstone transition communities into Cooks River/Castlereagh Ironbark Forest.

Habitat preference is not well understood; however, abundance at sites appears to be related to disturbance history, as sites with higher abundance appear to be more disturbed. The frequency of disturbance, particularly fire, is of vital importance for the management and conservation of Nodding Geebung.

The species prefers low woodland communities dominated by Hard-leaved Scribbly Gum and Narrow-leaved Apple with a diverse understorey of sclerophyllous shrub species. Nodding Geebung is an obligate seeder and, therefore, may be difficult to detect during targeted surveys even if it is present, as it can be stored in the seed bank, and the number of above-ground individuals will fluctuate in space and time (DEC, 2006).

3.2.1.2 Offset Site P1 (Nodding Geebung)



Plate 3. Vegetation within EPBC Offset Site P1

The patch of Hard-leaved Scribbly Gum – Parramatta Red Gum heathy woodland within offset site P1 recorded a VI score of 70. This patch of vegetation had a complete structure including native species from each vegetation stratum; canopy, shrub and ground layer. Weed cover across the offset site was low, with only scattered occurrences of three exotic species being present.

The upper stratum comprised four tree species; Parramatta Wattle, Narrow-leaved Apple, Parramatta Red Gum and Hard-leaved Scribbly Gum. Canopy cover was 20 percent across the quadrat.

Native shrub cover was 43.7 percent across the quadrat, with 13 different species identified in this stratum. The dominant shrub species included *Melaleuca nodosa* (Prickly-leaved Paperbark), *Hakea sericea* (Bushy Needlewood), *Leptospermum trinervium* (Slender Tea-tree), *Callistemon rigidus* (Stiff Bottlebrush), *Melaleuca linariifolia* (Flax-leaved Paperbark) and *Pimelea linifolia* (Slender Rice Flower).

Twenty two ground layer species were recorded within the BAM vegetation quadrat, having a combined cover of 10.1 percent. The dominant ground cover species included *Microlaena stipoides* (Weeping Grass), *Lomandra longifolia* (Spiny-headed Mat Rush), and *Dianella caerulea* (Blue Flax-lily).

Three exotic species were identified within the quadrat, *Conyza bonariensis* (Hairy Fleabane), African Love Grass and *Paspalum urvillei* (Vaseygrass). This species was sparse within the bushland but became more prominent on the northern edge of the offset site nearest the access road. Exotic species cover was 0.3 percent across the quadrat.

Table 10. Habitat assessment summary: EPBC Offset Site P1

Attributes	PCT Benchmark	Survey results	Dominant species
Tree cover	28	20	<i>Angophora bakeri</i> (8%) <i>Eucalyptus parramattensis</i> (4%) <i>Eucalyptus racemosa</i> (5%)
Shrub cover	82	43.7	<i>Melaleuca nodosa</i> (30%)

Attributes	PCT Benchmark	Survey results	Dominant species
			<i>Leptospermum trinervium</i> (2%) <i>Hakea sericea</i> (2%)
Ground cover	66	10.1	<i>Microlaena stipoides</i> (4%) <i>Lomandra longifolia</i> (2%) <i>Dianella caerulea</i> (1%)
Exotic cover	NA	0.3	<i>Conyza bonariensis</i> (0.1%) <i>Paspalum urvillei</i> (0.1%) <i>Eragrostis curvula</i> (0.1%)
Vegetation Integrity Score	100	70	

3.2.1.3 Offset Site P2 (Nodding Geebung)



Plate 4. Vegetation within EPBC Offset Site P2

The patch of Hard-leaved Scribbly Gum – Parramatta Red Gum heathy woodland within offset site P2 recorded a VI score of 41.8. The vegetation assemblage is fully structured with an established canopy, shrub layer and developing ground layer. There is little to no weed occurrence within the core of the offset site. Invasive grasses are present on the northern boundary of the offset site, on the peripheries of natural bushland next to a vehicle access track.

Three species were present within the canopy stratum: Hard-leaved Scribbly Gum, Parramatta Wattle and Narrow-leaved Apple. The canopy recorded a cover of 30.2 percent across the quadrat.

A total of 11 shrub species were identified in the vegetation quadrat. The dominant shrubs species present include *Exocarpos cupressiformis* (Native Cherry), *Hibbertia aspera* (Rough Guinea Flower), Prickly-leaved Paperbark, Flax-leaved Paperbark and *Persoonia pinifolia* (Pine-leaved Geebung). The total shrub cover recorded for the quadrat was 10.4 percent.

The ground stratum covered 6.5 percent, including 14 different flora species. The dominant ground covers species included Spiny-headed Mat-rush, *Lomandra multiflora* (Many-flower Mat Rush), *Dianella revoluta* (Blueberry Lily) and Weeping Grass.

Weeds cover was generally low across the offset site, with two exotic flora species being identified. Weed cover was recorded as 0.5 percent, comprising of *Senecio madagascariensis* (Fireweed) and African Love Grass. Patches of African Love Grass are present along the northern boundary of the offset site on the periphery of bushland next to an access track.

Table 11. Habitat assessment summary: EPBC Offset Site P2

Attribute	PCT Benchmark	Survey results	Dominant species
Tree cover	28	30.2	<i>Eucalyptus racemosa</i> (51%) <i>Acacia parramattensis</i> (10.3%) <i>Angophora bakeri</i> (0.4%)
Shrub cover	82	10.4	<i>Melaleuca nadosa</i> (10.3%) <i>Exocarpos cupressiformis</i> (8.2%) <i>Melaleuca linariifolia</i> (0.2%)
Ground cover	66	6.5	<i>Lomandra longifolia</i> (10.3%) <i>Microlaena stipoides</i> (1%)
Exotic cover	NA	0.5	<i>Eragrostis curvula</i> (0.8%) <i>Senecio madagascariensis</i> (0.2%)
Vegetation Integrity Score	100	41.8	

3.2.1.4 Offset Site P3 (Nodding Geebung)

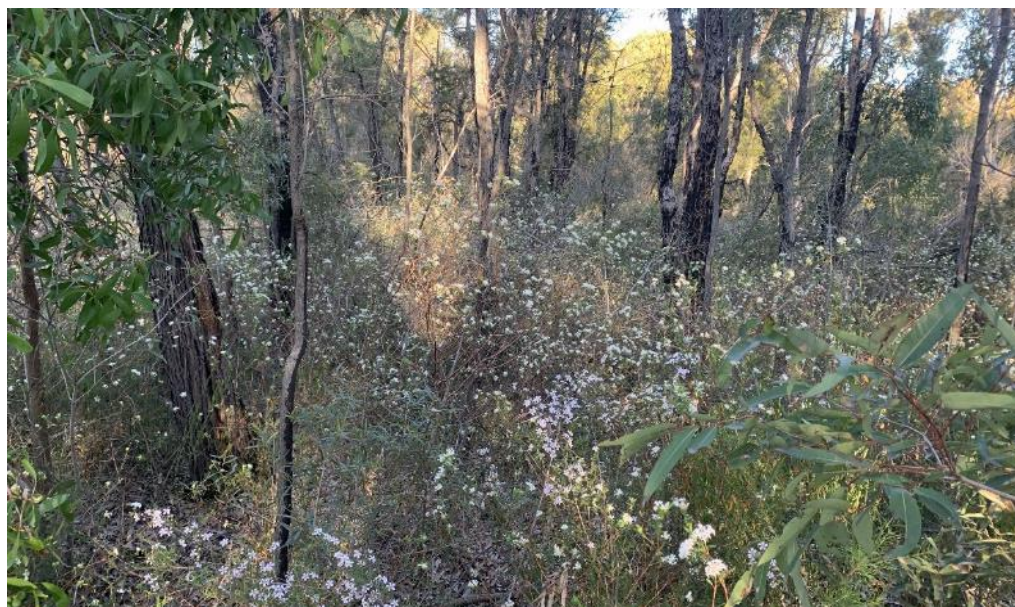


Plate 5. Vegetation within EPBC Offset Site P3

The patch of Hard-leaved Scribbly Gum – Parramatta Red Gum heathy woodland within offset site P3 recorded a VI score of 55.8. The assemblage has recovered significantly since the wildfire and contains a diverse shrub and ground cover stratum. Within the natural bushland, weed occurrence is sparse. Weed occurrence was only observed on the northern boundary, on the peripheries of bushland adjacent to a vehicle access track.

Four canopy species were identified within the vegetation quadrat: *Acacia binervia* (Coast Myall), Hard-leaved Scribbly Gum and Narrow-leaved Apple. Canopy cover accounted for 37 percent across the quadrat.

Shrubs accounted for 9.7 percent cover across the quadrat. A total of 26 native shrubs species were identified, including Prickly-leaved Paperbark, Slender Rice-flower, Conesticks, *Leptospermum parvifolium* (Lemon-scented Tea Tree), Bushy Needlewood and *Persoonia linearis* (Narrow-leaved Geebung).

A total of 24 ground cover species was recorded within the vegetation quadrat, accounting for a cover of 17.6 percent. Groundcover species identified included *Cyathochaeta diandra* (Sheath Rush), Weeping Grass, *Laxmannia gracilis* (Slender Wire-lily), *Calochilus campestris* (Copper Beard Orchid), and *Entolasia stricta* (Wiry Panic).

African Love Grass was the only exotic species recorded within the vegetation quadrant. This invasive species recorded a percentage cover of 0.2 percent. Similarly to other Nodding Geebung offset sites, weed occurrence was mainly restricted to the peripheries of intact bushland adjacent to a vehicle access track.

Table 12. Habitat assessment summary: EPBC Offset Site P3

Attributes	PCT Benchmark	Survey results	Dominant species
Tree cover	28	37	<i>Angophora bakeri</i> (46%) <i>Eucalyptus racemosa</i> (8%) <i>Acacia binervia</i> (1.5%)
Shrub cover	82	12.6	<i>Pimelea linifolia</i> (3%) <i>Melaleuca nodosa</i> (3%) <i>Leptospermum parvifolium</i> (1.5%)
Ground cover	66	26	<i>Microlaena stipoides</i> (15%) <i>Cyathochaeta diandra</i> (8%) <i>Patersonia sericea</i> (0.5%)
Exotic cover	NA	0.2	<i>Eragrostis curvula</i> (0.2%)
Vegetation Integrity Score	100	55.8	

3.2.1.5 Offset site P4 (Nodding Geebung)



Plate 6. Vegetation within EPBC Offset Site P4

The patch of Hard-leaved Scribbly Gum – Parramatta Red Gum heathy woodland within offset site P4 recorded an average VI score of 48.35 across the two vegetation quadrats. Due to the large size of the offset site, two vegetation quadrats were conducted to give a representative condition score for vegetation. The results of each quadrat area are summarised in Table 13. The 2018 wildfire did not impact this patch of bushland. This assemblage has an established canopy and a well-developed tall shrub layer, transitioning from a densely shrubby woodland to open woodland. Where shrubs density was less, ground covers were more prominent.

The dominant canopy species at offset site P4 is Hard-leaved Scribbly Gum; however, a number of other tree species are present, albeit at lower abundances, including *Allocasuarina* sp., *Casuarina glauca* (Swamp Oak), Narrow-leaved Apple and Parramatta Red Gum. Canopy cover was recorded at 12.1 percent and 8.1 percent at two locations within the offset site. Both canopy cover scores were lower than the benchmark tree cover scores for the Hard-leaved Scribbly Gum – Parramatta Red Gum heathy woodland community.

Shrub cover differs through the offset site, with some areas having a more open shrubby structure and others a dense thicket of shrubs. Shrub cover at two locations recorded 15 percent and 40.1 percent. A suite of tall shrub species are common across the site, including Prickly-leaved Paperbark, Needlebush, *Persoonia laurina* (Laurel Geebung), Narrow-leaved Geebung and Conesticks. A total of 26 shrubs species was recorded across vegetation quadrats conducted within the offset site.

A total of 24 ground cover species were recorded across the two vegetation quadrats conducted within offset site P4. The ground covers differed across the sites measuring 4.3 percent at one location and 7.4 percent at another. Forbs and twining plants were common within the ground stratum. Ground species present included Spiny-head Mat-rush, *Trachymene incisa* (Wild Parsnip), Sheath Rush, *Billardiera scandens* (Hairy Apple Berry), *Hardenbergia violacea* (False Sarsaparilla) and *Cassytha glabella* (Slender Devil's Twine).

Exotic species occurrence across the offset site was generally low. A moderately sized patch (approximately 100 metres square) of the woody weed *Cinnamomum camphora* (Camphor Laurel) was observed inside the eastern boundary of the site, and the Priority weed species *Rubus fruticosus* sp. agg (Blackberry) was observed encroaching at the southernmost section of the site. One of the plots recorded a small occurrence of African Love Grass (Figure 6).

Table 13. Habitat assessment summary: EPBC Offset Site P4(A)

Attributes	PCT Benchmark	Survey result	Dominant species
Tree cover	28	8.1	<i>Eucalyptus racemosa</i> (16%) <i>Angophora bakeri</i> (10%)
Shrub cover	82	15	<i>Melaleuca nodosa</i> (16%) <i>Hakea sericea</i> (13%) <i>Petrophile pulchella</i> (10%)
Ground cover	66	7.4	<i>Xanthorrhoea</i> spp. (13%) <i>Lomandra longifolia</i> (7%)
Exotic cover	NA	0	None
Vegetation Integrity Score	100	37	

Table 14. Habitat assessment summary: EPBC Offset Site P4(B)

Attributes	PCT Benchmark	Survey results	Dominant species
Tree cover	28	12.1	<i>Eucalyptus racemosa</i> (9%) <i>Angophora bakeri</i> (9%) <i>Eucalyptus parramattensis</i> (2%)
Shrub cover	82	40.1	<i>Melaleuca nodosa</i> (53%) <i>Leptospermum trinervium</i> (4%) <i>Hakea sericea</i> (4%)
Ground cover	66	4.3	<i>Gahnia aspera</i> (5%) <i>Xanthorrhoea</i> spp. (1%)
Exotic cover	NA	0.1	<i>Eragrostis curvula</i> (0.1%)
Vegetation Integrity Score	100	59.7	

3.2.2 Small-flower Grevillea

3.2.2.1 General habitat preference (OEH, 2019)

Small-flower Grevillea has a habitat preference for sandy or light clay soils, usually over thin shales, often with lateritic ironstone gravels and nodules. Populations of Small-flower Grevillea in the Sydney region usually occur on Tertiary sands and alluvium and soils derived from the Mittagong Formation.

This species occurs in a range of vegetation types, from heath and shrubby woodland to open forest. Found over a range of altitudes from flat, low-lying areas to upper slopes and ridge crests. Southern Sydney occurrences are typically at 100-300m ASL. Often occurs in open, slightly disturbed sites such as along tracks.

Habitat preference of this species also includes open, slightly disturbed sites such as along tracks.

3.2.2.2 Offset Site G1 (Small-flower Grevillea)



Plate 7. Vegetation within EPBC Offset Site G1

The Hard-leaved Scribbly Gum – Parramatta Red Gum heathy woodland patch within offset site G1 recorded a VI score of 49.3.

The assemblage has a sparse canopy cover and a well-developed shrub and ground stratum. A diversity of native flora species are present, and the occurrence of weeds is low. A patch of African Love Grass immediately to the west of the offset site was observed encroaching on the offset site.

The canopy stratum comprises five different tree species and recorded a cover of 21 percent within the vegetation quadrat. Trees species within the offset site include Parramatta Red Gum, Narrow-leaved Apple and Hard-leaved Scribbly Gum.

Shrub cover was relatively uniform across the offset site and continues to regenerate following the wild fire in 2018, recording a cover of 28.5 percent. A total of 12 different shrubs species were identified, including Prickly-leaved Paperbark, Bushy Needlewood and *Leptospermum trinervium* (Flaky-barked Tea-tree).

Ground cover species, including grasses, forbs, herbs and scrambling plants, recorded a cover of 15.4 percent across the vegetation quadrat. Nineteen different species were identified, including Weeping Grass and *Xanthorrhoea* spp.

The herbaceous weed *Senecio madagascariensis* (Fireweed) was rarely encountered within the offset site and had a cover of 0.1 percent within the vegetation quadrat.

Table 15. Habitat assessment summary: EPBC offset site G1

Attributes	PCT Benchmark	Survey results	Dominant species
Tree cover	28	21	<i>Eucalyptus parramattensis</i> (20%) <i>Eucalyptus racemosa</i> (8%) <i>Angophora bakeri</i> (3%)

Attributes	PCT Benchmark	Survey results	Dominant species
Shrub cover	82	28.5	<i>Melaleuca nodosa</i> (31%) <i>Leptospermum trinervium</i> (8%) <i>Hakea sericea</i> (2%)
Ground cover	66	15.4	<i>Xanthorrhoea</i> sp. (8%) <i>Microlaena stipoides</i> (5%) <i>Entolasia stricta</i> (3%)
Exotic cover	NA	0.1	<i>Senecio madagascariensis</i> (0.1)
Vegetation Integrity Score	100	49.3	

3.3 Photo point monitoring

Annual monitoring photographs are presented in Appendix C.

4 REVIEW OF CURRENT MANAGEMENT ACTIONS

The offset sites were established within high-condition patches of native vegetation within the BA341 biobank site. This has minimised the need for management actions to protect the extant populations of Small-flower Grevillea and Nodding Geebung since 2019. Despite the 2018 wildfire (a stochastic event) which killed a large proportion of the adult plants in the southern offset sites (P1, P2, P3 and G1), other threats including weeds, feral animal grazing, inappropriate access from public leading to trampling or habitat degradation (i.e. dumping) which can be managed, are not apparent or jeopardising the remaining individuals.

Being a biobank site, native vegetation and biodiversity values are subject to improvement through a combination of management activities including weed removal, bush regeneration, soil stabilisation and habitat enhancement. In the first half of last year (2022) EcoLogical was engaged by National Internodal (owner of the BA341 biobank site) to commence active management of the site. Prior to this the biobank site was being passively managed, which was restricted to maintenance of infrastructure (i.e. fencing, gates), erosion and sediment control works and annual monitoring.

Over the past year EcoLogical have conducted a suite of bush regeneration activities (weed removal, revegetation and brush matting) across the broader biobank site, however have not undertaken these activities in the locations of the offset sites. As discussed above, management to improve the quality of these high-condition patches of native vegetation is less pertinent than other areas of the biobank site which have high covers of aggressive weed species and ongoing issues with erosion. Nevertheless, some targeted weed control have occurred along the access and firetails which are located near to the offset sites including brush cutting and careful spot spraying with herbicide targeting the following aggressive weed species: *Eragrostis curvula* (African Love Grass), *Senecio madagascariensis* (Fireweed), *Conyza* sp. (Fleabane), *Cortaderia selloana* (Pampass Grass), *Paspalum* sp. (Paspalum), *Setaria* sp. (Pigeon Grass) and *Andropogon virginicus* (Whiskey Grass). Treatment of these weeds in nearby areas will reduce the potential for encroachment/colonisation in the future which would likely lead to habitat degradation.

An evaluation of the management and performance of offset sites against the recovery strategies of Small-flowered Grevillea (DEWHA 2008) and Nodding Geebung (DEC 2006) has been included Table 16.

Annual EPBC Offset Site Monitoring (2022)

Table 16. Assessment of the offset sites and implemented management action against the recovery strategies of Small-flowered Grevillea (DEWHA 2008) and Nodding Geebung (DEC 2006)

Threatened species	Recovery strategies	Timing and duration	Performance criteria		Comments
			Objective	Status (2020)	
Small-flower Grevillea	Restrict access to sites	Year 1: 20 years	Fencing installed and maintained to remain functional	Achieved	An existing cyclone fence follows the external boundary of the Wattle Grove offset site. All EPBC offset sites are within the Wattle Grove offset site boundary fence. EPBC offset sites have been demarcated with metal pickets. Exclusion fencing for individual offset sites has not been erected. All areas within the boundary fence are secure and can only be accessed by relevant personnel with a regulated key managed by Knight Frank. Additional fencing has been installed along the MPE operational Rail Link passing through the western corner of the Wattle Grove offset site, delineating the bushland environment from the rail corridor.
	Create and maintain weed-free bushland areas	Primary weed control: Year 1-5	<5% weed cover	Achieved	No weed control works have been conducted within the Small-flower Grevillea offset site during the 2020/2021 monitoring year. However, weed levels within the offset site remain low and don't threaten Small-flower Grevillea at this stage. The BAM vegetation quadrat conducted within offset site G1 recorded a weed cover of 0.1 percent across 400 square metres. Weed cover within offset site G1 is estimated at less than 5 percent cover. Site inspection did not identify any notable weed infestations. One exotic species was identified within the BAM vegetation quadrat; <i>Senecio madagascariensis</i> (Fireweed) was recorded with a cover of 0.1%. The aggressive invasive grass species African Love Grass is located immediately west of the offset site and was observed encroaching on the offset site.

Annual EPBC Offset Site Monitoring (2022)

Threatened species	Recovery strategies	Timing and duration	Performance criteria		Comments
			Objective	Status (2020)	
	Ensure appropriate fire regimes for species (minimum fire-free period of 8 - 15 years)	Conduct ecological burns every 6-20 years in winter: 20 years	Monitoring of burn site is to be undertaken every six months. The net gain in the number of stems over the duration of management to meet the offset obligation	Achieved	A wildfire directly impacted the EPBC offset site in April 2018. No ecological burns will be conducted within the EPBC offset site until 2026. At this time, the appropriateness of an ecological burn will be assessed to determine whether it will positively impact the populations of Small-flower Grevillea.
	Avoid spraying herbicide within the vicinity of the species	At all times (monitored annually in spring): 20 years	No damage to threatened species through inappropriate herbicide use. Evidence would trigger corrective actions	Achieved	During the monitoring year, no herbicide spraying has been conducted within the offset site.
	Monitor species for grazing or damage, this may indicate large macropod overabundance to inform control frequency	Monitored annually in spring: 20 years	Evidence of excessive grazing would trigger corrective actions under the overabundant herbivore management action plan	Achieved	No evidence was observed to suggest that Small-flower Grevillea have been impacted through grazing or trampling by large macropods.
	Protect individuals from pedestrian traffic along formal tracks, use fencing if required	Year 1: 20 years	Fencing installed and maintained to remain functional	Achieved	The location of EPBC offset sites have been demarcated using metal star pickets with secured yellow caps. The delineation of boundaries will act to remind personnel working within the Wattle Grove offset area of a sensitive area. All personnel working with the Wattle Grove offset area should be aware of sensitive areas during the initial biobank site induction.
	Ensure that this species is considered in all works and future planning matters	At all times: 20 years	Net gain in the number of stems over the duration of management to meet the offset obligation	Achieved	The Moorebank Avenue Realignment Works (MARW) project is currently in detailed design phase. The project dissects the southern position of the Wattle Grove Offset Area, following an easement through the BA341 biobanks site, and passes approximately 30 metres to the north-west of the G1

Annual EPBC Offset Site Monitoring (2022)

Threatened species	Recovery strategies	Timing and duration	Performance criteria		Comments
			Objective	Status (2020)	
					offset site. The project will not directly impact the offset site, however it is possible that indirect impacts could occur through construction and operation of the project like introduction of novel weeds and weed encroachment which could lead to habitat degradation. It is anticipated that mitigation measures have been considered and adopted by the MARW during detailed design that will minimise impact to native vegetation beyond the construction limits of the project. Regardless, being a biobank site increased focus will likely be shifted to locations (i.e. new edges) which are adjacent to the new road corridor. The bush regeneration contractor will likely have an increased focus on minimising/preventing indirect impacts including introduction of novel weeds and weed encroachment into the biobank site.
Nodding Geebung	Restrict access to sites	Year 1 - 20 years	Fencing installed and maintained to remain functional	Achieved	An existing cyclone fence follows the external boundary of the Wattle Grove offset site. All EPBC offset sites are within the Wattle Grove offset site boundary fence. EPBC offset sites have been demarcated with metal pickets. Exclusion fencing for individual offset sites has not been erected. All areas within the boundary fence are secure and can only be accessed by relevant personnel with a regulated key managed by Knight Frank. Additional fencing has been installed along the MPE operational Rail Link passing through the western corner of the Wattle Grove offset site, delineating the bushland environment from the rail corridor.
	Create and maintain weed-free bushland areas	Primary weed control: Year 1-5	<5% weed cover	Achieved	Weed levels across Nodding Geebung offset sites are low. BAM vegetation quadrat conducted within offset sites P1, P2, P3 and P4 recorded weed

Annual EPBC Offset Site Monitoring (2022)

Threatened species	Recovery strategies	Timing and duration	Performance criteria		Comments
			Objective	Status (2020)	
					covers of less than five percent; 0.2, 0.5, 0.2 and 0.1, respectively. Weed covers at each Nodding Geebung offset site are estimated at less than 5 percent cover. Weed presence is sparse, consisting mainly of scattered individuals on the peripheries of natural bushland. The invasive grass species African Love Grass was observed at three of the offset areas, P2, P3 and P4. The majority of occurrences of this species were restricted to the disturbed edges of bushland parallel to existing access tracks. There is no evidence to suggest that weeds identified within the offset sites negatively impact Nodding Geebung individuals.
	Ensure appropriate fire regimes for species (minimum fire-free period of 10 years)	Annually in spring: 20 years	Monitoring of burn site is to be undertaken every six months. Net gain in the number of plants over the duration of management to meet the offset obligation	Not achieved	A wildfire directly impacted the EPBC offset sites in April 2018. This wildfire did not coincide with timings or suitable conditions for ecological burning with respect to Nodding Geebung. No ecological burns will be conducted within the EPBC offset site until 2026. At this time, the appropriateness of an ecological burn will be assessed to determine whether it will positively impact the populations of Nodding Geebung.
	Monitor site for <i>Acacia baileyana</i> , which may outcompete species	Annually in spring: 20 years	Evidence of encroachment by this species would trigger corrective actions (see section)	Achieved	<i>Acacia baileyana</i> was not identified within the BAM monitoring quadrants undertaken to assess habitat quality, nor was it identified in other areas of the offset sites.
	Monitor species for grazing or damage, this may indicate large macropod overabundance to inform control frequency	Monitored annually in spring: 20 years	Evidence of excessive grazing would trigger corrective actions under the overabundant herbivore management action plan (see Section 7.2)	Achieved	No evidence was observed to suggest that Nodding Geebung have been impacted through grazing or trampling by large macropods.

Annual EPBC Offset Site Monitoring (2022)

Threatened species	Recovery strategies	Timing and duration	Performance criteria		Comments
			Objective	Status (2020)	
	Protect individuals from pedestrian traffic along formal tracks, use fencing if required	Year 1: 20 years	Fencing installed and maintained to remain functional	Achieved	The location of EPBC offset sites have been demarcated using metal star pickets with secured yellow caps. The delineation of boundaries will act to remind personnel working within the Wattle Grove offset site of a sensitive area. All personnel working with the Wattle Grove offset area should be aware of sensitive areas during the initial biobank site induction.
	Ensure that this species is considered in all works and future planning matters	At all times: 20 years	Net gain of 16 plants over the duration of management to meet the offset obligation	Achieved	The Moorebank Avenue Realignment Works (MARW) project is currently in detailed design phase. The project dissects the southern position of the Wattle Grove Offset Area, following an easement through the BA341 biobanks site. The project will not directly impact the offset sites of Nodding Geebung and is unlikely to indirectly impact habitat or the present populations due being separated from the project footprint by Anzac Creek. It is possible that removal and remediation of a section of disused rail spur (DURS) at the southern extent of the Wattle Grove offset area may be initiated as part of the MARW project of works. The remediation footprint of DURS does not intersect EPBC offset sites. It is anticipated that works would not interfere or jeopardise the offset sites as access to the DURS could completely occur through the MARW footprint and no access would be required along the existing trail which runs along the northern boundary of Nodding Geebung offset site P3. If a route is identified which passes near to an EPBC offset site, an impact assessment should be undertaken which identifies the potential impacts of the access track and any necessary mitigation measures that should be adopted.

5 DISCUSSION & RECOMMENDATIONS

The 2022 survey marked the fourth monitoring event for offset sites P1, P2, P3 and G1 and the third monitoring event for offset site P4. Comparisons can be made between this year's data and the results of previous monitoring events to analyse population dynamics of Nodding Geebung and Small-flower Grevillea within EPBC offset sites, specifically:

- Fluctuations in population size and distribution; and
- Response to disturbance and/or management actions.

The condition of vegetation has been scored, and a habitat assessment has been conducted for offset sites across monitoring periods to provide more context to changes in Nodding Geebung and Small-flower Grevillea populations.

Changes to Nodding Geebung and Small-flower Grevillea populations across offset sites P1, P2, P3, P4 and G1 are discussed below.

5.1.1 Nodding Geebung

A comparison of results for Nodding Geebung between the 2019, 2020, 2021 and 2022 monitoring events are discussed below.

Population assessment

A total of 37 individuals of Nodding Geebung were identified across offset sites P1, P2 and P3 during the 2022 monitoring event in comparison to 51 individuals recorded in 2021, 90 individuals recorded in 2020, and 112 individuals recorded in 2019. A total of 37 individuals were recorded in P4, which is a slight decrease from 41 individuals recorded during the establishment of the site in 2020. Across all sites, the number of Nodding Geebung individuals has decreased from 92 (2021) to 74 individuals recorded during the 2022 surveys.

The number of Nodding Geebung individuals in all offset site P1, P3 and P4 has decreased since the 2020 population. One Nodding Geebung was identified within P2 for the first time in two years. A comparison of population counts at each offset site across survey years is presented in Table 17.

Table 17. Comparison of Nodding Geebung population census across monitoring years

Offset site	Census year	Life stage	Sub-count	Count
P1	2019	Adult	0	9
		Juvenile	9	
	2020	Adult	0	13
		Juvenile	13	
	2021	Adult	0	12
		Juvenile	12	
P2	2022	Adult	0	8
		Juvenile	8	
	2019	Adult	0	3
		Juvenile	3	
	2020	Adult	0	0

Offset site	Census year	Life stage	Sub-count	Count
	2021	Juvenile	0	0
		Adult	0	
		Juvenile	0	
	2022	Adult	1	1
		Juvenile	0	
P3	2019	Adult	2	100
		Juvenile	98	
	2020	Adult	2	77
		Juvenile	75	
	2021	Adult	2	39
		Juvenile	37	
	2022	Adult	6	28
		Juvenile	22	
P4	2019	Adult	N/A	N/A
		Juvenile		
	2020	Adult	43	43
		Juvenile	0	
	2021	Adult	41	41
		Juvenile	0	
	2022	Adult	37	37
		Juvenile	0	

Of the 92 individuals recorded during the 2021 surveys, 49 were juvenile plants considered to be sensitive to environmental variables and at reasonable risk of perishing. During the current surveys, 66 of the 92 Nodding Geebung marked during the 2021 survey were re-located. Of these 43 were adult individuals. Therefore, 19 juveniles have persisted since 2021, which equates to about 40 percent survival rates of the juvenile recorded in 2021.

This may result from the 2018 fires that burnt sites P1, P2 and P3. Following the fires, habitat space may have been made available to Nodding Geebung, allowing them to access limiting resources of soil moisture, light, and nutrients. As other plants in the fire-affected sites recover, they may have shaded out the juvenile Nodding Geebung plants, resulting in plant mortality. However, too frequent fire is thought to be detrimental to Nodding Geebung populations, although the critical fire frequency for Nodding Geebung has not yet been determined.

The recent heavy rains do not appear to have had any noticeable impact on the mortality or fecundity of Nodding Geebung outside of a possible increase in biomass of the surrounding vegetation leading to increased competition and contributing to the general decrease in Nodding Geebung populations.

The persistence of less than 50 percent of Nodding Geebung individuals is not considered an ideal outcome. However, there is insufficient data to determine whether this persistence rate is significant. Nodding Geebung populations are known to be dynamic throughout the landscape and fluctuations in space and time of above ground individuals is considered to be a natural occurrence (DEC, 2005). These fluctuations make the number of individuals and populations difficult to estimate (DEC, 2005).

It was anticipated that a proportion of the juvenile Nodding Geebung observed during monitoring events would not survive the following year due to several environmental and ecological factors. The majority of juvenile plants recorded are in dense clusters containing many individuals. It is possible that the death of the juvenile plants represents a natural dieback whereby the strongest plants in the cluster survive and utilise the available resources. In other locations of the Wattle Grove offset area, which were unaffected by the 2018 wildfire, large numbers of adult Nodding Geebung are present though are rarely observed in close proximity to each other. It is expected that only a small number of individuals within clusters of Nodding Geebung juveniles will persist to become adult plants.

The current surveys recorded 18 fewer individuals across the four Nodding Geebung offset sites compared to the previous (2021) survey period. The largest decline was identified at P3, where a decline of 11 individuals between the 2021 and 2022 survey periods was observed. A similar decline was also recorded at this site between the 2020 and 2021 surveys, with a decline of 41 individuals between those survey periods. However, new recruitment was observed at offset sites P1 and P3, which is a positive sign that Nodding Geebung is continuing to germinate and replace individuals that perish. New individuals were generally recorded within or in close proximity to existing clusters of juveniles. At P3, juvenile individuals were also re-located in areas away from dense clusters, whereas many juveniles recorded in clusters during the 2021 surveys were not. This could indicate that an increase in the distribution of Nodding Geebung across the site will reduce interspecies competition and may provide a greater chance of individuals persisting to maturity.

Using the EPBC offsetting policy, it was calculated that 155 Nodding Geebung require conservation and management within offset sites to achieve a net gain of 16 Nodding Geebung individuals over a 20-year period. Unforeseen impacts from the 2018 wildfire saw the majority of the Nodding Geebung population within offset sites burnt. Regeneration of the species over the past three years has seen a fluctuation in the recovery of the population, with 133 individuals recorded in 2020 survey, 92 in the 2021 survey and 74 individuals recorded in the 2022 survey. It is considered that some level of intervention will be required in order to achieve a net gain of 16 Nodding Geebung individuals across the offset sites. Over the coming year, the establishment of experimental disturbance plots will be investigated for offset sites P1, P2 and P3 to promote the germination of Nodding Geebung (discussed in more detail below). It is anticipated that with adaptive management and ongoing monitoring, the population of Nodding Geebung within offset sites will increase to 171 individuals within the 20-year time frame.

Habitat assessment and potential impacts

Current surveys found that patches of Hard-leaved Scribbly Gum - Parramatta Red Gum heathy woodland within offset site P1 have achieved a greater or VI score than was recorded in 2021, with lower VI scores at all other offset sites (Table 18). Exotic species cover was recorded to be low across all offset sites over the 2022 monitoring period. An increasing or decreasing vegetation condition does not necessarily reflect an increase in habitat value for Nodding Geebung, as the abundance of this species can often be related to disturbance history. Sites with higher abundance appear to be more disturbed (DPIE 2019).

Table 18. A summary of changes to vegetation condition at offset sites P1, P2 and P3 across monitoring periods

Offset site	Monitoring year	Cover across BAM quadrat				VI score
		Tree	Shrub	Groundcover	Exotic	
P1	2019	11.5	47.7	4.2	0.2	52.5
	2020	16	46	6.8	0.1	64.8

Offset site	Monitoring year	Cover across BAM quadrat				VI score
		Tree	Shrub	Groundcover	Exotic	
	2021	20	41.1	14.1	0.2	64.4
	2022	20	43.7	9.6	0.3	70.0
P2	2019	52.5	4.7	19.4	0.6	51.8
	2020	47.3	15.5	22.1	0	56.5
	2021	47	21.5	41.9	0.2	67.2
	2022	30.2	10.4	6.5	0.5	41.8
P3	2019	22.5	8	17.3	0.1	51.5
	2020	36	5.7	22.9	0.2	59.6
	2021	37.2	12.6	26	0.2	63.5
	2022	37	9.7	17.6	0.2	55.8
P4a	2020	45	43.9	25.4	0	73.4
	2021	40.5	49.8	26.2	0	72.4
	2022	8.1	15	7.4	0	37
P4b	2020	32.4	18	8.2	50	50
	2021	32.2	46.4	19.7	0.1	70.6
	2022	12.1	40.1	4.3	0.1	59.7

No obvious signs of impact on Nodding Geebung were observed within the offset sites. Some minor insect damage was observed on a few individuals; however, it appears that this damage may be existing from previous years. Plants observed to have insect damage were also observed as having fresh new green shoots and foliage. There were no signs of foraging or trampling upon this species by mammals.

Adult Nodding Geebung is at less risk of being outcompeted by other plant species compared to juveniles of its species. Populations of Nodding Geebung at offset sites P1 and P3 consist mainly of juvenile plants, which are more susceptible to being outcompeted by native and exotic plants than mature plants. Currently, there is significant competition in the shrub and understorey layers as there is an overabundance of post-fire recruiters like *Acacia decurrens* (Black Wattle), *Imperata cylindrica* (Blady Grass), Slender Rice Flower, *Platysace ericoides*, *Pultenaea villosa* (Hairy Bush-pea) and Wild Parsnip. An increase in native shrub and ground stratum vegetation cover within offset sites P1, P2 and P3 may be reducing the availability of space and resources (light, water etc.) for Nodding Geebung to regenerate. Juvenile Nodding Geebung were observed being smothered by the native vine Devils Twine in offset site P3. However, it is not considered likely that this would result in the death of plants. Increased competition by native species provides reasoning for why the majority of Nodding Geebung individuals in offset sites P1 and P3 are located on the peripheries of intact

bushland in disturbed, more open areas, amongst the exotic species African Love Grass where there is less competition from other plants.

The cover of African Love Grass is increasing on the edges of native bushland, which may reduce the availability of habitat for Nodding Geebung or compete with juvenile plants in the future. Increases in the cover of African Love Grass should be monitored over the following years to determine if it is having an impact on Nodding Geebung.

It is likely that too frequent disturbance, and potentially a long-term absence of disturbance, may be detrimental to the persistence of Nodding Geebung in local populations. In this instance, the presence of a seed bank is essential for persistence after a fire event. If fires occur at an interval too small to allow the re-establishment of a soil-stored seed bank following a previous fire event, then local extinction will occur. A long-term absence of fire may also be detrimental to the persistence of the species, as recruitment is likely to be largely dependent upon disturbance. This critical fire frequency rate has not yet been determined. However the NSW National Parks and Wildlife Service (NPWS) suggests greater than 7-year intervals, and the Threatened Species Hazard Reduction List for the Bushfire Environmental Assessment Code states that fire should not occur more frequently than once every ten years in the habitat of Nodding Geebung (DEC, 2006).

Corrective actions

It is evident that Nodding Geebung populations within offset sites that burned in 2018 are fluctuating, with new individuals germinating and other juvenile plants perishing. This fluctuation is due to the opportunistic nature of post-bushfire vegetation recovery and the high levels of competition amongst post-fire recruitment specialist species. Although a moderate proportion of juvenile Nodding Geebung identified during the 2019 monitoring period have perished, each proceeding monitoring event has recorded recruitment suggesting that population recovery is ongoing.

The localised nature of recruitment/regeneration of Nodding Geebung on the disturbed edge of offset sites due to increasing competition by native species has initiated a management response to support the germination of individuals within bushland areas of the offset sites, specifically for P1, P2 and P3. Experimental disturbance plots will be positioned in areas of the offset sites where individuals do not currently occur but have been recorded as occurring prior to the 2018 wildfire. In each of the experimental plots, the following actions will be implemented:

- Disturbance stimulus - a disturbance stimulus, including raking of leaf litter back to bare earth, will be trialled to promote germination in areas where viable seed may be present
- Competition control - selective pruning or removal of ground layer and shrubs to reduce competition to Nodding Geebung and encourage recruitment/survival of juvenile plants

A conservative methodology will be developed for each offset site considering all present biodiversity values prior to implementation. As per the requirements of the TFOMP, NSW DPIE (EES) and the Commonwealth Department of Climate Change, Environment and Water (DCCEW) will be consulted prior to the implementation of the proposed adaptive management measure. Further, approvals and endorsement from the Biodiversity Conservation Trust and National Intermodal (owner of the BA341 biobank site) will also need to be sought prior to implementing. The methodology and results of experimental disturbance plots will be presented in the 2023 -2024 annual monitoring report for the EPBC offset sites.

Additional bush regeneration activities will be implemented over the coming year to support existing Nodding Geebung, including weed control works and native vegetation pruning where smothering cover is occurring.

If Nodding Geebung populations across offset sites continue to show a decline in future surveys, a translocation project could be initiated whereby seeds collected from adult individuals in offset sites P3 and P4 are propagated at an offsite location and re-introduced at a later stage as young plants.

Table 19. Recommended corrective actions

Identified issues	Offset site	Recommended action
Patch of the woody weed Camphor Laurel with offset site P4	P4	Bush regenerators to remove the occurrence of Camphor laurel.
Encroaching Blackberry at offset site P4	P4	Blackberry infestation should be monitored and controlled as necessary to prevent encroachment into the offset site.
Increased cover of African Love Grass along the edges of offset sites and nearest access roads	P1, P2, P3	Monitoring of African Love Grass adjacent to access roads within EPBC offset sites. If this invasive grass species is thought to be having a negative impact on Nodding Geebung, weed control works may be implemented. Manual control methodologies should be prioritised unless a targeted herbicide treatment that has no risk of over spray or off-target poisoning can be used. An example of a selective herbicide that may be suitable for the control of African Lovegrass within offset areas is Flupropanate granular herbicide.
Native plant species outcompeting Nodding Geebung (i.e. smothering, occupying open areas)	All offset site	Juvenile Nodding Geebung in plots P1, P2 and P3 should be monitored for smothering from native plant species. On a quarterly basis, inspection should be made of juvenile Nodding Geebung with offset sites P1, P2 and P3. Any native plants observed to be crushing or smothering individuals should be cut back. i.e. Slender Devils Twine observed on juvenile Nodding Geebung should be removed.
Lack of recruitment of Nodding Geebung in bushland areas at offset sites P1, P2 and P3	P1, P2, P3	Establishment of experimental disturbance plots in offset sites to: • encourage the germination of Nodding Geebung individuals within bushland • increase distribution of Nodding Geebung across sites • reduce competition from native and exotic vegetation • increase overall population numbers of Nodding Geebung

5.1.2 Small-flower Grevillea offset sites

A comparison of results for Small-flower Grevillea between the 2020, 2021 and 2022 monitoring events have been discussed below.

Population assessment

The 2022 monitoring survey saw an increase in the number of stems of Small-flower Grevillea within offset site G1. The population has increased from 50 to 112 stems, marking an increase of 45 percent. An overall increase in Small-flower Grevillea was observed across the site, with greater densities observed in the north west and south east.

Fire impacted the G1 site in 2018, removing all above-ground biomass of Small-flower Grevillea. The findings from the 2022 survey reveals that the population of Small-flower Grevillea is resilient to wildfire and has the capacity to recover well due to either root stock or soil seed banks

Small-flower Grevillea is capable of suckering from rootstock and demonstrates a degree of vegetative spread, particularly after disturbances such as fire (DPIE 2019a). During 2022 an overall decrease in shrub cover and ground cover was observed compared to 2021, which may partially explain the increase in Small-flower Grevillea observed in 2022. The observed decreased shrub and ground cover would allow increased light and to reach the ground layer allowing Small-flower Grevillea to access this resource. This observation acts as evidence that Small-flower Grevillea does not effectively compete in areas of high biomass.

It was calculated using the EPBC offsetting policy that 142 Small-flower Grevillea require conservation and management within offset sites to achieve a net gain of at least 17 individuals over a 20-year period. Due to unforeseen impacts from the 2018 wildfire, all Small-flower Grevillea within the offset site perished. The 2022 survey is promising as the recorded Small-flower Grevillea population has more than doubled from 2021 and is on track to meet the EPBC offsetting policy conservation and management requirements. However, fluctuating biomass, disturbance and climatic variability may impact this trajectory.

Table 20. Comparison of Small-flower Grevillea population census across monitoring years

Offset site	Census year	Count
G1	2019	142
G1	2020	60
G1	2021	50
G1	2022	112

Habitat assessment and potential impacts

The condition of Hard-leaved Scribbly Gum - Parramatta Red Gum heathy woodland within the offset site has increased in condition as demonstrated by an increasing VI score from 37.7 in 2019 to 47 in 2020, increasing again to 55.7 in 2021 and now decreasing to 49.3 in 2022 (Table 21). The patch has seen a large decrease in the groundcover and shrub vegetation which may have allowed for available habitat for Small-flower Grevillea. Weed cover has remained similar across all monitoring periods.

Table 21. Changes in vegetation cover at offset site G1 across monitoring periods (2019 - 2022)

	Tree	Shrub	Groundcover	Exotic	VI score
2019	9.1	22.6	9.2	0.1	37.7
2020	24	21.2	17	0.1	47
2021	27.3	41.2	41.9	0.1	55.7
2022	21	28.5	15.4	0.5	49.3

No obvious signs of impact on this species were observed. Individuals were not observed to have been foraged by animals or showing signs of damage from insects. Most individuals were recorded to be in a healthy condition, with only three individuals recorded in poor health. Weed occurrence within the offset area is low and is not impacting the occurrence or persistence of this species.

Areas of open woodland with a sparser shrub and ground layer vegetation have healthy populations of Small-flower Grevillea with many individuals. It is evident that the numbers of Small-flower Grevillea are greatest in open woodland areas with reduced competing shrub and ground covers.

Corrective actions

It is recommended that the population be monitored for another year prior to implementing any management actions to increase the population of Small-flower Grevillea. It is not suggested that individuals be tracked for monitoring as has been done for Nodding Geebung. Small-flower Grevillea is capable of suckering from a rootstock, and most populations demonstrate a degree of vegetative spread, particularly after disturbances such as fire. Therefore, it would be futile trying to track individuals via stems to monitor recruitment and death rates.

Table 22. Recommended corrective actions

Identified issues	Recommended action
Moderate infestation of African Love Grass is beginning to encroach on the offset site	Infestations of African Love Grass should be monitored and controlled as necessary to prevent encroachment into the offset site.
Native plant species outcompeting Small-flower Grevillea (i.e. smothering, occupying open areas)	Monitoring of the Small-flower Grevillea population over the following year to determine whether individuals are reducing in areas that are becoming increasingly vegetated by other native plant species.

6 REFERENCES

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7 APPENDICES

Appendix A. BAM monitoring quadrat data set

Appendix B. BAM quadrats vegetation score summary

Appendix C. Annual monitoring photographs

Appendix D. Photo point detail

APPENDIX A BAM MONITORING QUADRAT DATA SET

Annual EPBC Offset Site Monitoring (2022)

Scientific name	Common name	Exotic	G1		P1		P2		P3		P4(A)		P4(B)	
			Cover	Abundance	Cover	Abundance	Cover	Abundance	Cover	Abundance	Cover	Abundance	Cover	Abundance
<i>Acacia brownii</i>	Heath Wattle			-							0.2	40		
<i>Acacia binervata</i>	Two-veined Hickory			-					1	10				
<i>Acacia browniana</i>				-	0.1	20			0.2	30				
<i>Acacia falciformis</i>	Broad-leaved Hickory			-										
<i>Acacia longifolia</i>				-	2	60					0.1	5		
<i>Acacia parramattensis</i>	Parramatta Wattle		0	-	3	15	5	60	1	20				
<i>Acacia ulicifolia</i>	Prickly Moses		0.5	-			0	0						
<i>Allocasuarina littoralis</i>	Black She-Oak			-							0.1	1		
<i>Allocasuarina spp.</i>				-									0.1	1
<i>Angophora bakeri</i>	Narrow-leaved Apple		2	-	8	20	0.2	3	30	6	3	7	5	15
<i>Aristida ramosa</i>	Purple Wiregrass			-					0.1	30				
<i>Aristida spp.</i>				-							0.1	20		
<i>Aristida vagans</i>	Threeawn Speargrass			-					0.2	40				
<i>Arthropodium milleflorum</i>	Pale Vanilla-lily		0.1	-										
<i>Astroloma humifusum</i>	Native Cranberry			-							0.1	20		
<i>Banksia integrifolia</i>	Coast Banksia		1	-										
<i>Banksia oblongifolia</i>	Fern-leaved Banksia			-					0.2	5	0.1	20	0.5	10
<i>Banksia spinulosa</i>	Hairpin Banksia		0.1	-	2	10					1	30	2	20
<i>Billardiera scandens</i>	Hairy Apple Berry			-	0.1	20	0	0	0.1	50	0	0	0.1	10
<i>bossiaea heterophylla</i>	Variable Bossiaea			-					0.5	100	0	0		
<i>Burchardia Umbellata</i>	Milkmaids			-							0	0	0	0
<i>Bursaria spinosa</i>	Native Blackthorn			-					0.1	5				
<i>Caladenia spp.</i>				-	0	3								
<i>Callistemon linearifolius</i>	Netted Bottle Brush			-					0.1	3				

Annual EPBC Offset Site Monitoring (2022)

Scientific name	Common name	Exotic	G1		P1		P2		P3		P4(A)		P4(B)	
			Cover	Abundance	Cover	Abundance	Cover	Abundance	Cover	Abundance	Cover	Abundance	Cover	Abundance
<i>Callistemon pinifolius</i>	Pine-leaved Bottlebrush			-									1	20
<i>Callistemon rigidus</i>	Stiff Bottlebrush			-	1	20								
<i>Calochilus campestris</i>	Copper Beard Orchid			-					0.1	2				
<i>Cassytha glabella</i>			2	-	0.5	100	0.1	100	0.1	50	0.1	50	0.1	1000
<i>Casuarina glauca</i>	Swamp Oak			-									1	2
<i>Cheilanthes sieberi</i>	Rock Fern			-	0.1	150								
<i>Clematis aristata</i>	Old Man's Beard			-	0.1	5								
<i>Conyza bonariensis</i>	Flaxleaf Fleabane	*		-	0.1	6								
<i>Coronidium scorpioides</i>	Button Everlasting			-	0.1	30			0.1	5				
<i>Cyathochaeta diandra</i>			0.5	-	0.1	2			5	500	0.2	200	0	0
<i>Cynodon dactylon</i>	Common Couch			-	0.1	15								
<i>Daviesia genistifolia</i>	Broom Bitter Pea			-					0	0				
<i>Daviesia ulicifolia</i>	Gorse Bitter Pea			-			0.2	25						
<i>Dianella caerulea</i>	Blue Flax-lily			-	0.5	30			0.2	50				
<i>Dianella revoluta</i>	Blueberry Lily			-			0.2	15					0.1	5
<i>Dianella spp.</i>			0.5	-										
<i>Drosera peltata</i>				-	0.1	50								
<i>Empodisma minus</i>				-							0	0		
<i>Entolasia marginata</i>	Bordered Panic			-							0.1	40		
<i>Entolasia stricta</i>	Wiry Panic		2	-	0.3	100	0.1	100	0.1	300	0.1	60	0.1	50
<i>Eragrostis brownii</i>	Brown's Lovegrass			-					0.1	20				
<i>Eragrostis curvula</i>	African Lovegrass	*		-	0.1	2	0.4	200	0.2	10			0.1	5
<i>Eucalyptus parramattensis</i>	Parramatta Red Gum		13	-	4	4	1	2					1	3
<i>Eucalyptus racemosa</i>	Narrow-leaved Scribbly Gum		5	-	5	2	25	5	5	10	5	2	5	5

Annual EPBC Offset Site Monitoring (2022)

Scientific name	Common name	Exotic	G1		P1		P2		P3		P4(A)		P4(B)	
			Cover	Abundance	Cover	Abundance	Cover	Abundance	Cover	Abundance	Cover	Abundance	Cover	Abundance
<i>Exocarpos cupressiformis</i>	Cherry Ballart			-			4	30						
<i>Gahnia aspera</i>	Rough Saw-sedge			-	0.1	10	0.2	60	0.1	2			3	200
<i>Gahnia spp.</i>			0.2	-										
<i>Glycine clandestina</i>	Twining glycine			-	0.1	100	0	0						
<i>Gompholobium glabratum</i>	Dainty Wedge Pea		0	-										
<i>Gompholobium minus</i>	Dwarf Wedge Pea			-					0.1	40				
<i>Gonocarpus teucrioides</i>	Germander Raspswort			-							0.1	20		
<i>Grevillea parviflora</i>			0.2	-										
<i>Hakea dactyloides</i>	Finger Hakea			-							0.1	5	0.2	10
<i>Hakea sericea</i>	Needlebush		1	-	2	50	0.4	100	1	150	4	700	2	50
<i>Hardenbergia violacea</i>	False Sarsaparilla			-	0.5	40	0.2	3	0.2	15			0.1	10
<i>Hibbertia aspera</i>	Rough Guinea Flower			-			0.3	40	0.1	1				
<i>Hibbertia fumana</i>				-	0.1	1								
<i>hibbertia puberula</i>				-							0	0		
<i>Hibbertia riparia</i>				-					0.1	1				
<i>Hypericum gramineum</i>	Small St John's Wort		0.2	-										
<i>Imperata cylindrica</i>	Blady Grass			-	0.1	25								
<i>Isopogon Anemonifolius</i>	Broad-leaf Drumsticks			-							0	0		
<i>Juncus spp.</i>			0.1	-										
<i>Kunzea ambigua</i>	Tick Bush			-					0.2	10				
<i>Kunzea capitata</i>			0	-					0.1	35				
<i>Laxmannia gracilis</i>	Slender Wire Lily			-	0	0			0.1	10				
<i>Leptocarpus tenax</i>				-					0.1	500			0	0
<i>Leptospermum parvifolium</i>			0.5	-	0.1	50			1	50	0	0		

Annual EPBC Offset Site Monitoring (2022)

Scientific name	Common name	Exotic	G1		P1		P2		P3		P4(A)		P4(B)	
			Cover	Abundance	Cover	Abundance	Cover	Abundance	Cover	Abundance	Cover	Abundance	Cover	Abundance
<i>Leptospermum polyanthum</i>				-	0.2	1	0.1	1	0.2	10				
<i>Leptospermum polygalifolium</i>	Tantoon			-										
<i>Leptospermum trinervium</i>	Slender Tea-tree		5	-	2	20					1	30	2	30
<i>Leucobryum spp.</i>				-					0.1	50				
<i>Leucopogon spp.</i>				-					0.2	50				
<i>Lissanthe strigosa</i>	Peach Heath			-							0.1	10		
<i>Lobelia purpurascens</i>	whiteroot			-	0.1	10								
<i>Lomandra filiformis</i>	Wattle Matt-rush			-					0.1	100	0.1	10		
<i>Lomandra gracilis</i>				-							0	0		
<i>Lomandra longifolia</i>	Spiny-headed Mat-rush			-	2	50	5	250			2	100	0.2	50
<i>Lomandra multiflora</i>	Many-flowered Mat-rush			-			0	0			0.2	20		
<i>Melaleuca decora</i>				-					0.5	1			1	2
<i>Melaleuca erubescens</i>	Pink Honeymyrtle			-									0	0
<i>Melaleuca linariifolia</i>	Flax-leaved Paperbark			-	1	20	0.1	1	0.2	200				
<i>Melaleuca nodosa</i>			20	-	30	100	5	300	2	10	5	900	30	1000
<i>Melaleuca thymifolia</i>	Thyme Honey-myrtle		0.1	-					0.1	10				
<i>Microlaena stipoides</i>	Weeping Grass		3	-	4	1000	0.5	3000	10	1000	0.1	100	0.1	40
<i>Mitrasacme polymorpha</i>				-							0.1	4		
<i>Mitrasacme spp.</i>			0.1	-										
<i>Notodanthonia longifolia</i>	Long-leaved Wallaby Grass			-					0.1	50				
<i>Olea spp.</i>				-							0	0		
<i>Olearia microphylla</i>				-							0.1	0		
<i>Opercularia diphylla</i>	Stinkweed		0	-										
<i>Opercularia varia</i>	Variable Stinkweed			-	0	0			0.1	30				

Annual EPBC Offset Site Monitoring (2022)

Scientific name	Common name	Exotic	G1		P1		P2		P3		P4(A)		P4(B)	
			Cover	Abundance	Cover	Abundance	Cover	Abundance	Cover	Abundance	Cover	Abundance	Cover	Abundance
<i>Paspalum urvillei</i>	Vasey Grass	*		-	0.1	5								
<i>Patersonia sericea</i>	Silky Purple-Flag		0.2	-					0.3	10				
<i>Persoonia laurina</i>	Laurel Geebung			-									0.1	1
<i>Persoonia linearis</i>	Narrow-leaved Geebung			-	0.1	2	0	0	0.2	5			0.1	1
<i>Persoonia nutans</i>	Nodding Geebung			-					0.1	10	0.2	1	0.1	1
<i>Petrophile pulchella</i>	Conesticks			-	0.2	10			0.1	100	3	800	1	20
<i>Pimelea linifolia</i>	Slender Rice Flower		1	-	3	100	0.2	100	2	300	0	0	0.1	5
<i>Platysace ericoides</i>			0.1	-									0	0
<i>Pomax umbellata</i>	Pomax			-			0	0	0.1	50	0	0		
<i>Pratia purpurascens</i>	Whiteroot			-					0.1	30	0.1	40		
<i>Ptilothrix deusta</i>			0.5	-										
<i>Pultenaea villosa</i>	Hairy Bush-pea			-					0.1	5				
<i>Ricinocarpos pinifolius</i>	Wedding Bush			-					0.2	20				
<i>Schizaea bifida</i>	Forked Comb Fern			-					0.1	10				
<i>Schoenus imberbis</i>			0	-										
<i>Senecio madagascariensis</i>	Fireweed	*	0.5	-			0.1	1						
<i>Stackhousia spp.</i>			0.1	-										
<i>Stylidium graminifolium</i>	Grass Triggerplant			-					0.1	1				
<i>Stylidium spp.</i>			0.5	-										
<i>Themeda australis</i>	Kangaroo Grass			-									0	0
<i>Themeda triandra</i>				-	0.5	20	0	0						
<i>Trachymene incisa</i>	Trachymene		0.1	-	0.1	30	0.1	50	0.1	50	0.1	0	0	0
<i>Tricoryne elatior</i>	Yellow Autumn-lily		0.3	-										
<i>Xanthorrhoea spp.</i>			5	-	0.2	50	0.1	1			4	300	0.5	15

APPENDIX B BAM QUADRATS VEGETATION SCORE SUMMARY

Annual EPBC Offset Site Monitoring (2022)

Vegetation attributes	P1				P2				P3				P4A			P4B			G1			
	"19	"20	"21	"22	"19	"20	"21	"22	"19	"20	"21	"22	"20	"21	"22	"20	"21	"22	"19	"20	"21	"22
Total Count Tree (TG)	3	4	4	4	3	4	3	3	3	3	4	4	2	3	4	5	5	5	3	5	5	5
Total Count Shrub (SG)	11	11	12	13	11	13	11	11	19	20	22	25	17	16	18	14	15	15	12	11	11	12
Total Count Grass & grasslike (GG)	7	7	7	7	8	5	6	6	7	8	9	10	4	10	10	6	7	7	10	9	5	7
Total Count Forb (FG)	6	5	6	8	4	3	3	3	4	8	10	10	7	6	6	2	3	3	9	11	7	10
Total Count Fern (EG)	1	1	1	1	0	0	0	0	0	1	1	1	1	0	0	0	0	0	0	0	0	0
Total Count Other (OG)	6	6	6	6	3	5	5	4	3	3	3	3	3	3	3	5	4	4	2	2	2	2
Total Cover Tree (TG)	11.5	16	20.00	20	52.5	47.3	47.0	30.2	22.5	36	37.2	37	45	40.5	8.1	32.4	32.2	12.1	9.1	24	27.3	21
Total Cover Shrub (SG)	47.7	46	41.10	43.7	4.7	15.7	21.5	10.4	8	5.7	12.6	9.6	43.9	49.8	15	18	46.4	40.1	22.6	21.2	41.2	28.5

Annual EPBC Offset Site Monitoring (2022)

Vegetation attributes	P1				P2				P3				P4A			P4B			G1			
	"19	"20	"21	"22	"19	"20	"21	"22	"19	"20	"21	"22	"20	"21	"22	"20	"21	"22	"19	"20	"21	"22
Total Cover Grass & grasslike (GG)	1.2	4.5	8.30	7.1	18.7	20.7	40.2	5.8	16.6	21.5	24.5	15.9	24.2	24.4	2.9	7	17.6	3.4	7.5	13.5	14.7	6.3
Total Cover Forb (FG)	1	1	1.20	0.9	0.4	0.8	1.2	0.3	0.4	0.9	1.1	1.3	0.7	0.9	0.4	0.2	0.4	0.1	1.4	2.2	9.9	2.1
Total Cover Fern (EG)	0.1	0.1	0.20	0.1	0	0	0.0	0	0	0.1	0.0	0	0.1	0	0	0	0.0	0	0	0	0.0	0
Total Cover Other (OG)	1.9	1.2	4.40	1.5	0.3	0.6	0.5	0.3	0.3	0.4	0.4	0.4	0.4	0.9	4.1	1	1.7	0.8	0.3	1.2	16.0	7
Total Cover Exotics	0.2	0.1	0.2	0.3	0.6	0	0.2	0.5	0.1	0.2	0.2	0.2	0	0	0	0	0.1	0.1	0.1	0.1	0.1	0.5
Total Cover High Threat Weeds	0.2	0.1		0.1	0.5	0	0.2	0.5	0.1	0.2	0.2	0.2	0	0	0	0	0.1	0.1	0.1	0.1	0.1	0.5
Vegetation Integrity Score	52.5	64.8	64.4	68.6	51.8	56.5	67.2	41.8	51.5	59.6	63.5	55.8	73.4	72.4	49.3	50	70.6	37	37.7	47	55.7	59.7

APPENDIX C ANNUAL MONITORING PHOTOGRAPHS

Monitoring Photographs – *Persoonia nutans* Offset site P1



PP_MP(North) - 2019



PP_MP(North) - 2020



PP_MP(North) - 2021



PP_MP(North) - 2022



PP_MP(East) - 2019



PP_MP(East) - 2020



PP_MP(East) - 2021



PP_MP(East) - 2022



PP_MP(South) - 2019



PP_MP(South) - 2020



PP_MP(South) - 2021



PP_MP(South) - 2022

Monitoring Photographs – *Persoonia nutans* Offset site P1



PP_MP(West) - 2019



PP_MP(West) - 2020



PP_MP(West) - 2021



PP_MP(West) - 2022



PP1 – 2019



PP2 – 2020



PP1 - 2021



PP1 - 2022



PP2 – 2019



PP2 – 2020



PP2 - 2021



PP2 - 2022

Monitoring Photographs – *Persoonia nutans* Offset site P1



PP3 – 2019



PP3 – 2020



PP3 - 2021



PP3 - 2022



PP4 – 2019



PP4 – 2020



PP4 - 2021



PP4 - 2022

Monitoring Photographs – *Persoonia nutans* Offset site P2

			Not captured
PP_MP(North) - 2019	PP_MP(North) - 2020	PP_MP(North) - 2021	PP_MP(North) - 2022
			Not captured
PP_MP(East) - 2019	PP_MP(East) - 2020	PP_MP(East) - 2021	PP_MP(East) - 2022
			Not captured
PP_MP(South) - 2019	PP_MP(South) - 2020	PP_MP(South) - 2021	PP_MP(South) - 2022

Monitoring Photographs – *Persoonia nutans* Offset site P2



PP_MP(West) - 2019



PP_MP(West) - 2020



PP_MP(West) - 2021

Not captured

PP_MP(West) - 2022



PP1 – 2019



PP2 – 2020



PP1 - 2021



PP1 - 2022



PP2 – 2019



PP2 – 2020



PP2 - 2021



PP2 - 2022

Monitoring Photographs – *Persoonia nutans* Offset site P2



PP3 – 2019



PP3 – 2020



PP3 - 2021



PP3 - 2022



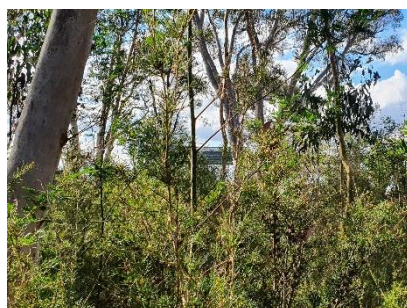
PP4 – 2019



PP4 – 2020



PP4 - 2021



PP4 - 2022

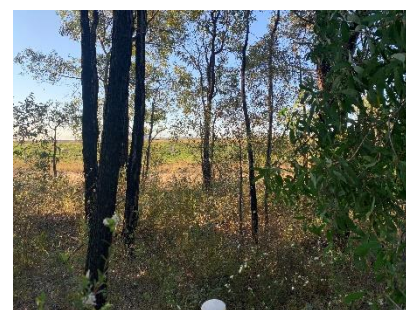
Monitoring Photographs – *Persoonia nutans* Offset site P3



PP_MP(North) - 2019



PP_MP(North) - 2020



PP_MP(North) - 2021



PP_MP(North) - 2022



PP_MP(East) - 2019



PP_MP(East) - 2020



PP_MP(East) - 2021



PP_MP(East) - 2022



PP_MP(South) - 2019



PP_MP(South) - 2020



PP_MP(South) - 2021



PP_MP(South) - 2022

Monitoring Photographs – *Persoonia nutans* Offset site P3



PP_MP(West) - 2019



PP_MP(West) - 2020



PP_MP(West) - 2021



PP_MP(West) - 2022



PP1 – 2019



PP2 – 2020



PP1 - 2021



PP1 - 2022



PP2 – 2019



PP2 – 2020



PP2 - 2021



PP2 - 2022

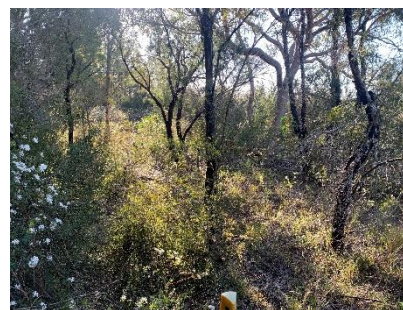
Monitoring Photographs – *Persoonia nutans* Offset site P3



PP3 – 2019



PP3 – 2020



PP3 - 2021

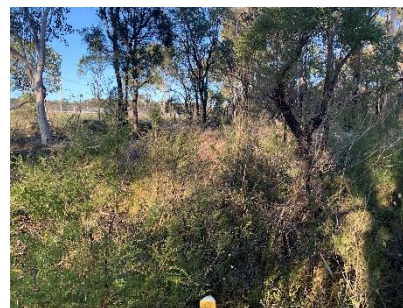
Not captured



PP4 – 2019



PP4 – 2020



PP4 - 2021



PP4 - 2022

Monitoring Photographs – *Persoonia nutans* Offset site P4



PP_MP(A)_(North) - 2021



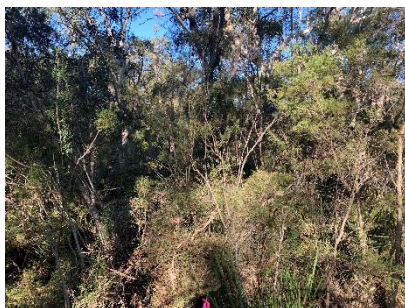
PP_MP(A)_(North) - 2022



PP_MP(A)_(East) - 2021



PP_MP(A)_(East) - 2022



PP_MP(A)_(South) - 2021



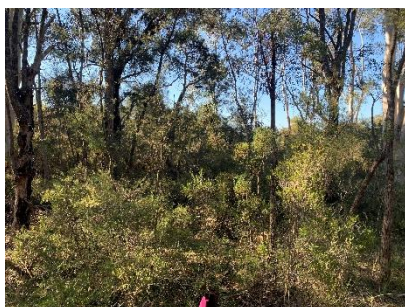
PP_MP(A)_(South) - 2022



PP_MP(A)_(West) - 2021



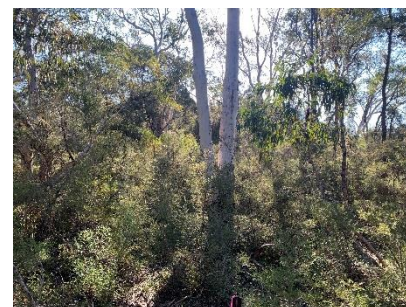
PP_MP(A)_(West) - 2022



PP_MP(B)_(North) - 2021



PP_MP(B)_(North) - 2022



PP_MP(B)_(East) - 2021



PP_MP(B)_(East) - 2022

Monitoring Photographs – *Persoonia nutans* Offset site P4



PP_MP(B)_South) - 2021



PP_MP(B)_South) - 2022



PP_MP(B)_West) - 2021



PP_MP(B)_West) - 2022



PP1 – 2021



PP1 – 2022



PP2 - 2021



PP2 - 2022



PP3 – 2021



PP3 – 2022



PP4 - 2021

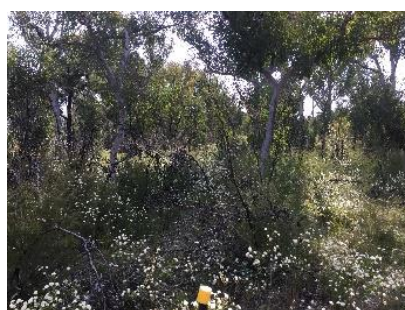


PP4 - 2022

Monitoring Photographs – *Persoonia nutans* Offset site P4



PP_MP(North) - 2019



PP_MP(North) - 2020



PP_MP(North) - 2021



PP_MP(East) - 2019



PP_MP(East) - 2020



PP_MP(East) - 2021



PP_MP(South) - 2019



PP_MP(South) - 2020



PP_MP(South) - 2021

Monitoring Photographs – *Persoonia nutans* Offset site P4



PP_MP(West) - 2019



PP_MP(West) - 2020



PP_MP(West) - 2021



PP1 – 2019



PP2 – 2020



PP1 - 2021



PP2 – 2019



PP2 – 2020



PP2 - 2021

Monitoring Photographs – *Persoonia nutans* Offset site P4



PP3 – 2019



PP3 – 2020



PP3 - 2021



PP4 – 2019



PP4 – 2020



PP4 - 2021

APPENDIX D PHOTO POINT DETAIL

Offset Site	Photo point identifier	Location of Photo Point		Direction of Photograph (degrees)
		Latitude	Longitude	
P1	MP (North)	-33.960619°	150.921811°	0/360
	MP (East)			90
	MP (South)			180
	MP (West)			270
	PP1	-33.960425°	150.921772°	140
	PP2	-33.960478°	150.922122°	200
	PP3	-33.960833°	150.922291°	250
	PP4	-33.960773°	150.921709°	340
P2	MP (North)	-33.960663°	150.923187°	0/360
	MP (East)			90
	MP (South)			180
	MP (West)			270
	PP1	-33.960550°	150.922926°	130
	PP2	-33.960670°	150.923663°	250
	PP3	-33.960702°	150.923512°	270
	PP4	-33.960783°	150.922837°	335
P3	MP (North)	-33.960451°	150.926147°	0/360
	MP (East)			90
	MP (South)			180
	MP (West)			270
	PP1	-33.960278°	150.925545°	65
	PP2	-33.960469°	150.927180°	260
	PP3	-33.960495°	150.927074°	260
	PP4	-33.960421°	150.925524°	35
P4	MP(A) (North)	-33.954026	150.93522	0/360
	MP(A) (East)			90
	MP(A) (South)			180
	MP(A) (West)			270
	MP(B) (North)	-33.953164	150.93527	0/360
	MP(B) (East)			90
	MP(B) (South)			180
	MP(B) (West)			270
	PP1	-33.953362	150.93603	268
	PP2	-33.954238	150.93568	316
	PP3	-33.955183	150.93529	352
	PP4	-33.953414	150.93472	90
G1	MP (North)	-33.963454°	150.923047°	0/360
	MP (East)			90

Annual EPBC Offset Site Monitoring (2022)

Offset Site	Photo point identifier	Location of Photo Point		Direction of Photograph (degrees)
		Latitude	Longitude	
	MP (South)			180
	MP (West)			270
	PP1	-33.963401°	150.922906°	50 degrees
	PP2	-33.963163°	150.922886°	140 degrees
	PP3	-33.963321°	150.923232°	200 degrees
	PP4	-33.963650°	150.923207°	320 degrees

APPENDIX E. KEY PERFORMANCE INDICATORS (KPIS) FOR RVMP WORKS

Key Performance Indicator	Status	Comments
Certification that all plant stock used for revegetation are of local botanical provenance	Not applicable	No revegetation activities have occurred over the 2023 monitoring year.
Gradual improvement of native plant establishment with the aim of achieving 80 percent cover of native vegetation after five years following the initial planting	Not on track – works required	Quadrat monitoring of revegetated areas identified, on average, a native plant coverage of 29.4 percent. It should be noted that this average includes areas that were not subject to revegetation, rather bush regeneration practices to enhance the condition of existing native vegetation. Planting occurred on the eastern side of the Georges River in June 2019 and is therefore required to meet the KPI by June 2024. Currently the percent cover of native species is about 35% which is significantly less than the KPI of 80%. It is unlikely that the KPI will be achieved by June 2024 with the current management routine. Planting occurred on the western side of the Georges River in December 2019 and is therefore required to meet the KPI by December 2024. Currently the percent cover of native species is about 12% which is significantly less than the KPI of 80%. It is unlikely that the KPI will be achieved by June 2024 with the current management routine. Although the entire management site is not on-track to achieve an 80 percent native vegetation cover, several areas of bare earth were observed, which are anticipated to be increasingly colonised by native species over the coming years, with support from bush regenerators. It is recommended that instead of installing additional plants in this area to make up shortfalls in native percent cover, bush regeneration activities should aim to reduce exotic species cover and encourage natural recruitment of bare areas by native species that are already present.
Gradual reduction in weed density to 5 percent of the total area of each management site (eastern bank of Georges River)	Progressing – works required	Baseline monitoring occurred in June 2018 which has been taken to mark the completion of construction. Therefore, reduction of weeds across the management site to less than 5 percent total cover by June 2023 is required to achieve the KPI. An average weed cover of about 19% was recorded for the eastern side of the Georges River management site during surveys completed in April 2023. It is unlikely that the total weed cover across the management site will be reduced to less than 5% by June 2023 with the current management routine. With the presence of native species throughout the management site and the types of weed species present, it is anticipated that if a concerted effort is applied to removing weeds, a reduction to 5% cover could be achieved in two years; being June 2025. Fixed monitoring quadrats conducted within revegetated areas recorded an average weed cover of 24.3 percent. Weed species cover has increased since previous monitoring periods from 8.1 percent in March 2020. Weed control works have not been conducted at the management site since June 2020.

Key Performance Indicator	Status	Comments
		Native plants are showing signs of being outcompeted by exotic species at many of the monitored quadrats. It is recommended that weed control works are commenced immediately within the management site on the eastern bank of the Georges River to support natural regeneration and further colonisation by native species. Weed control works should remove scattered weeds from revegetated areas and remove weeds encroaching from infested areas adjacent to the management site
Reduction in weed density to 5 percent of the total area of management site 5 years after construction (western bank of Georges River only)	Not on track – works required	Baseline monitoring occurred in June 2018 which has been taken to mark the completion of construction. Therefore, reduction of weeds across the management site to less than 5 percent total cover by June 2023 is required to meet the KPI. An average weed cover of about 24% was recorded for the western side of the Georges River management site during surveys completed in April 2023. It is unlikely that the total weed cover across the management site will be reduced to less than 5% by June 2023 with the current management routine. With the presence of native species throughout the management site and the types of weed species present, it is anticipated that if a concerted effort is applied to removing weeds, a reduction to 5% cover could be achieved in two years; being June 2025. It is recommended that weed control works are commenced immediately within the management site on the western bank of Georges River to support recent plantings and encourage natural regeneration and colonisation by native species. Weed control works should remove scattered weeds from revegetated areas and remove weeds encroaching from infested areas adjacent to the management site
Gradual extension of native plant cover in each management site through natural regeneration	Progressing – works required	Evidence of natural regeneration was observed at the eastern side of the Georges River management site. Bare areas between plantings are showing signs of increasing colonisation by native species, including <i>Cassytha glabella</i> (Slender Devil's Twine), <i>Commelina cyanae</i> (Scurvy Weed), <i>Entolasia marginata</i> (Bordered Panic Grass), Kangaroo Grass and <i>Dichelachne micrantha</i> (Short-hair Plume Grass).
Stability of riparian banks, including maintenance or reduction of erosion within management sites	Achieving	Groundcover and shrubs species installed amongst coir mesh on steep slopes on the eastern side of the Georges River management site have established and provide stabilisation to the substrate. Natural regeneration of native species was observed on slopes which will increase the stabilisation of the slope across the monitoring year. Coir mesh has been installed and secured with intermittent planting of groundcover and shrubs species on exposed sections of the river bank at the western side of the Georges River management site. As plantings mature, they will offer increased stabilisation of soils. Several major flooding events were experienced along the Georges River system during the 2021/2022 monitoring year. High floodwaters inundated the lower floodplain on the site, completely submerging revegetated areas. Following the receding of the floodwaters,

Key Performance Indicator	Status	Comments
		revegetation areas were observed to be in good condition and had acted to stabilise soils and previously exposed banks. The vegetation in flood-affected areas remains intact as of the April 2023 survey.
Re-establish and maintain connectivity for fauna habitat, particularly in the Georges River management site.	Progressing – works required and review of adequacy	Habitat connectivity is not consistent with the approved habitat connectivity strategy as documented within the RVMP produced by Hyder (2015) and other project-related documents. Changes to habitat connectivity beneath the Rail Link bridge and the potential impacts this is having on the dispersal of native species are discussed in detail in Sections 4.4.1. Habitat connectivity across the Georges River management site, linking bushland within the MLP site with bushland to the south, currently consists of large logs placed on rock ballast with small piles of thin course wood debris assembled on either side. A total of four fauna species were captured on remote cameras traversing the area beneath the Rail Link bridge, including Red Fox (<i>Vulpes vulpes</i>), Black Rat (<i>Rattus rattus</i>), Domestic/Feral Cat (<i>Felis catus</i>) and Swamp Wallaby (<i>Wallabia bicolor</i>).

APPENDIX F. RIPARIAN VEGETATION MANAGEMENT – NATIVE FLORA INVENTORIES

Scientific name	Common name	RFEFCF EEC	GZ1_ MR09	GZ1_ MR10	GZ1_ MR11	GZ2_ MR12	GZ2_ MR13	GZ4_ MR14	GZ2_ MR15	GZ4_ MR16	GZ2(W)_ MR18	GZ2(W)_ MR19
<i>Acacia binervata</i>	Two-veined Hickory		•	•	•			•			•	•
<i>Acacia decurrens</i>	Black Wattle										•	
<i>Acacia floribunda</i>	White Sally	*									•	
<i>Acacia longifolia</i>											•	
<i>Acacia parramattensis</i>	Parramatta Wattle	*			•			•			•	
<i>Austrostipa ramosissima</i>	Stout Bamboo Grass	*	•		•						•	
<i>Billardiera scandens</i>	Hairy Apple Berry				•							
<i>Breynia oblongifolia</i>	Coffee Bush	*		•	•							
<i>Bursaria spinosa</i>	Native Blackthorn	*									•	
<i>Callistemon salignus</i>	Willow Bottlebrush											•
<i>Cassytha glabella</i>				•							•	
<i>Casuarina glauca</i>	Swamp Oak	*				•			•		•	
<i>Cayratia clematidea</i>	Native Grape	*			•	•						
<i>Chloris truncata</i>	Windmill Grass						•					
<i>Clematis aristata</i>	Old Man's Beard	*	•	•	•							
<i>Clematis glycinoides</i>	Headache Vine	*		•		•	•			•		
<i>Commelina cyanea</i>	Native Wandering Jew	*							•	•		
<i>Cymbopogon refractus</i>	Barbed Wire Grass	*										•
<i>Cynodon dactylon</i>	Common Couch											•
<i>Dichelachne micrantha</i>	Shorthair Plumegrass	*			•							•
<i>Dichondra repens</i>	Kidney Weed	*				•					•	
<i>Dodonaea truncatiales</i>	Angular Hop-bush								•			
<i>Echinopogon ovatus</i>	Forest Hedgehog Grass	*										•
<i>Einadia hastata</i>	Berry Saltbush	*							•	•		
<i>Entolasia marginata</i>	Bordered Panic	*	•	•			•		•		•	
<i>Entolasia stricta</i>	Wiry Panic	*				•						

Scientific name	Common name	RFEFCF EEC	GZ1_ MR09	GZ1_ MR10	GZ1_ MR11	GZ2_ MR12	GZ2_ MR13	GZ4_ MR14	GZ2_ MR15	GZ4_ MR16	GZ2(W)_ MR18	GZ2(W)_ MR19
<i>Eucalyptus botryoides</i>	Bangalay	*	•		•	•	•			•		
<i>Geranium solanderi</i>	Native Geranium	*					•		•	•	•	
<i>Glycine clandestina</i>	Twining glycine	*									•	
<i>Hardenbergia violacea</i>	False Sarsaparilla	*									•	•
<i>Hydrocotyle laxiflora</i>	Stinking Pennywort						•		•			•
<i>Imperata cylindrica</i>	Blady Grass					•	•		•	•		
<i>Juncus usitatus</i>						•	•		•		•	
<i>Kunzea ambigua</i>	Tick Bush			•								
<i>Lobelia purpurascens</i>	whiteroot						•		•			
<i>Lomandra longifolia</i>	Spiny-headed Mat-rush	*				•	•			•	•	•
<i>Melaleuca decora</i>		*							•	•		
<i>Melaleuca linariifolia</i>	Flax-leaved Paperbark	*				•						
<i>Melaleuca styphelioides</i>	Prickly-leaved Tea Tree	*							•	•	•	
<i>Microlaena stipoides</i>	Weeping Grass		•	•	•	•	•	•	•	•		
<i>Oplismenus aemulus</i>		*		•	•	•	•	•	•	•	•	
<i>Oplismenus imbecillis</i>							•					
<i>Parsonsia straminea</i>	Common Silkpod		•									
<i>Persicaria hydropiper</i>	Water Pepper						•	•	•	•		
<i>Pteridium esculentum</i>	Bracken	*						•		•		
<i>Rubus parvifolius</i>	Native Raspberry	*				•			•	•		
<i>Sigesbeckia orientalis</i>							•					
<i>Themeda australis</i>	Kangaroo Grass	*										•
<i>Viola hederacea</i>	Ivy-leaved Violet	*				•					•	

APPENDIX G. RIPARIAN VEGETATION COMPARISON OF EXOTIC AND NATIVE COVER PERCENTAGES FOR EACH VEGETATION QUADRAT ACROSS MONITORING EVENTS (JUNE 2018 - APRIL 2023)

Exotic

Quadrat identifier	Zone	Jun '18	Sep '18	Dec '18	Mar '19	Jun '19	Sep '19	Dec '19	Mar '20	Nov '21	Apr '23
MR09	GZ1	10.1	4.8	3.9	5.8	5.4	3	3.9	19.3	6.25	23.2
MR10	GZ1	23.8	0.3	2.8	1.3	2	2.4	0.3	2.8	4	4.2
MR11	GZ1	43.8	2	13.1	10.5	13.1	18.9	13.9	17.6	39.75	37.5
MR12	GZ2	104.3	8.5	1.8	2	0	0.4	0.2	0.1	2.5	2
MR13	GZ2	82.1	38.5	2	1.1	0	0.9	1.3	2	20	26.7
MR14	GZ4	89.1	49.8	50.5	32.3	2	7.5	10.6	14.1	48.75	44.5
MR15	GZ2	79.6	69.8	12.3	7.9	0.1	4.4	6.2	6.3	14.25	9.8
MR16	GZ4	28.9	20.8	24	14	0.5	2.3	3.1	3.9	27.25	7.4
MR18	GZ2	-	-	-	-	-	47.6	1.2	14	51.75	76.8
MR19	GZ5	-	-	-	-	-	11.3	0.1	0.4	6.43	10.5
Average		-	57.7	24.3	13.8	9.4	8.9	9.9	4.1	22.09	24.3

Native

Quadrat identifier	Zone	Jun '18	Sep '18	Dec '18	Mar '19	Jun '19	Sep '19	Dec '19	Mar '20	Nov '21	Apr '23
MR09	GZ1	15.4	16.8	20.3	18	32.5	21.8	29.8	42.8	44.0	20.6
MR10	GZ1	24.5	21.8	16	23.5	28.5	24.8	26.5	40.5	41.5	48.8
MR11	GZ1	12.5	12.3	18.3	12.5	31.3	26	23.5	37.3	25.9	35
MR12	GZ2	1	0.3	0.3	1.5	6	8.3	4	23	32.3	33.8
MR13	GZ2	3.6	5.5	4.8	4.6	9.5	7.8	7.8	24.8	45.0	25
MR14	GZ4	30.8	38.8	80	63	26.3	13.3	7.8	26	12.9	5
MR15	GZ2	3.8	1.8	0.1	0	8.5	4	6.3	23.2	35.0	27.3
MR16	GZ4	11.3	28.5	16.3	14.5	10.8	9.8	13	39.8	45.8	42.5
MR18	GZ2	-	-	-	-	-	11.5	3.8	22	22.6	32.1
MR19	GZ5	-	-	-	-	-	0	0.5	6.5	2.6	24.1
Average		12.8	15.7	19.5	17.2	17.1	12.7	12.3	28.6	30.8	29.4

APPENDIX H. RIPARIAN VEGETATION MANAGEMENT - PHOTO POINTS



MR09



MR10



MR11



MR12



MR13



MR14



MR15



MR16



MR18



MR19

APPENDIX I. BA341 LANDS ADJOINING RAIL LINK - QUADRAT MONITORING DATA

Scientific name	Common name	Monitoring quadrat on western side of Rail Link (Q1)		Monitoring quadrat on eastern side of Rail Link (Q2)	
		Cover	Abundance	Cover	Abundance
<i>Acacia brownii</i>	Heath Wattle	0.5	10	0.1	20
<i>Acacia longifolia</i>	Sydney Golden Wattle	0.5	5	1	1
<i>Acacia parramattensis</i>	Parramatta Wattle	0.2	10		
<i>Angophora bakeri</i>	Narrow-leaved Apple	8	35	10	39
<i>Anisopogon avenaceus</i>	Oat Speargrass	8	20	3	50
<i>Austrostipa puberula</i>	Fine-hairy Speargrass			0.1	100
<i>Banksia oblongifolia</i>	Fern-leaved Banksia	0.1	2	1	5
<i>Banksia spinulosa</i>	Hairpin Banksia	1	15	2	30
<i>Bossiaea ensata</i>	Sword Bossiaea			0.5	50
<i>Bossiaea heterophylla</i>	Variable Bossiaea	1	75	2	1000
<i>Brachyloma daphnoides</i>	Daphne Heath	0.1	5	0.2	100
<i>Burchardia umbellata</i>	Milkmaids	0.1	30	0.1	50
<i>Cassytha glabella</i>	Slender Devil's Twine	0.5	20	1	50
<i>Conyza sumatrensis</i>	Tall fleabane			0.1	300
<i>Coronidium scorpioides</i>	Button Everlasting	0.5	200	0.2	20
<i>Cyathochaeta diandra</i>	Sheath Rush'	2	50	2	500
<i>Dianella caerulea</i>	Blue Flax-lily	0.2	20	0.2	50
<i>Empodisma minus</i>	Wire Rush	2	300	0.1	50
<i>Entolasia stricta</i>	Wiry Panic	1	200	0.5	1000
<i>Eucalyptus parramattensis</i>	Parramatta Red Gum			2	3
<i>Eucalyptus racemosa</i>	Narrow-leaved Scribbly Gum	5	5	10	4
<i>Gahnia aspera</i>	Rough Saw-sedge	0.2	15	0.1	10
<i>Gompholobium minus</i>	Dwarf Wedge Pea	0.5	150	0.1	100
<i>Goodenia hederacea</i>	Ivy Goodenia	0.1	50	0.2	100

Scientific name	Common name	Monitoring quadrat on western side of Rail Link (Q1)		Monitoring quadrat on eastern side of Rail Link (Q2)	
		Cover	Abundance	Cover	Abundance
<i>Hakea dactyloides</i> (broad leaf form)	Broad leaf Hakea	0.1	2		
<i>Hakea sericea</i>	Needlebush	0.5	15	0.5	200
<i>Hardenbergia violacea</i>	False Sarsaparilla	0.2	50	0.1	50
<i>Hibbertia puberula</i>		0.1	2	0.1	2
<i>Hypericum gramineum</i>	Small St John's Wort	0.1	20	1	200
<i>Hypolaena fastigiata</i>	Tassel Rope-rush			0.5	1000
<i>Imperata cylindrica</i>	Blady Grass	0.1	10		
<i>Kunzea ambigua</i>	Tick Bush	0.5	1		
<i>Leptospermum parvifolium</i>	Lemon-scented Tea Tree	2	20	1	500
<i>Leptospermum trinervium</i>	Slender Tea-tree	2	15	1	3
<i>Lindsaea linearis</i>	Screw Fern	0.2	200	0.1	200
<i>Lomandra filiformis</i>	Wattle Matt-rush	0.1	50	1	100
<i>Lomatia silaifolia</i>	Crinkle Bush	0.1	2		
<i>Melaleuca nodosa</i>	Prickly-leaved Paperbark	5	100	30	2000
<i>Microlaena stipoides</i>	Weeping Grass	0.2	50		
<i>Opercularia varia</i>	Variable Stinkweed	0.1	10		
<i>Persoonia laurina</i>	Laurel Geebung			1	20
<i>Persoonia linearis</i>	Narrow-leaved Geebung	0.1	3		
<i>Petrophile pulchella</i>	Conesticks	0.1	25	1.5	200
<i>Philothea salsolifolia</i>		0.5	15	0.1	30
<i>Pimelea linifolia</i>	Slender Rice Flower	1	150	2	1000
<i>Plantago lanceolata</i>	Lamb's Tongues			0.1	100
<i>Platysace ericoides</i>	Heath Platysace	0.5	250	0.2	100

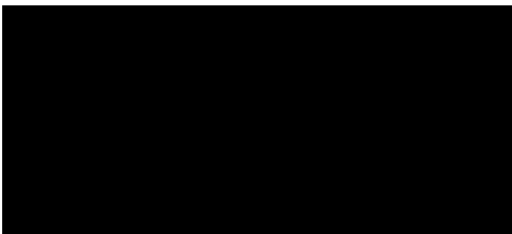
Scientific name	Common name	Monitoring quadrat on western side of Rail Link (Q1)		Monitoring quadrat on eastern side of Rail Link (Q2)	
		Cover	Abundance	Cover	Abundance
<i>Pomax umbellata</i>	Pomax			0.2	30
<i>Ptilanthelium deustum</i>		1	500		
<i>Pultenaea tuberculata</i>	Weath Bush-pea	0.1	5		
<i>Schizaea bifida</i>	Forked Comb Fern	0.1	1		
<i>Secale cereale</i>	Cereal Rye	0.1	50		
<i>Senecio madagascariensis</i>	Fireweed	0.1	10	0.1	5
<i>Stylidium graminifolium</i>	Grass Triggerplant	0.1	15	1	30
<i>Themeda triandra</i>	Kangaroo Grass	3	100	3	100
<i>Trachymene incisa</i>	Trachymene	50	0.1	200	
<i>Tricoryne simplex</i>	Yellow Rush Lily	50	0.1	10	
<i>Trifolium repens</i>	White Clover	20	0.1	500	
<i>Xanthorrhoea spp.</i>	Xanthorrhoea	5			

* Exotic species

APPENDIX J. NEST BOX MONITORING REPORT (SPRING 2022)

DATE

16/01/2023

**SUBJECT**

Moorebank Logistics Park - Spring Nest Box Monitoring 2022

Arcadis were commissioned by Tactical Group on behalf of LOGOS to conduct the 2022 annual spring nest box monitoring survey within the Moorebank Logistics Park (MLP). The 2022 monitoring event marks the fifth year that Arcadis has monitored nest boxes installed within the Bootland and Georges River corridor to offset the removal of hollow-bearing trees for the construction of the MLP development. As a requirement of the State Conditions of Consent and Commonwealth Conditions of Approval and to guide the replacement of hollows removed during construction, a Nest Box Management Strategy (CPB, 2017) was prepared. This project document also included the requirement for monitoring of nest boxes. This memorandum has been prepared to document the findings of the 2022 nest box monitoring survey.

Background

The Sydney Intermodal Terminal Alliance (SIMTA) and Moorebank Intermodal Company entered an agreement to develop the Moorebank Precinct East (MPE) Project and Moorebank Precinct West (MPW) Project into the Moorebank Logistics Park (MLP). MLP is located in the suburb of Moorebank within the Liverpool Local Government Area (LGA).

The MLP development comprises an Import Export (IMEX) terminal on MPE and interstate terminal on MPW including rail links to the Southern Sydney Freight Line (SSFL), warehouse and distribution facilities, freight village, road and intersection upgrades, and ancillary activities such as landscaping and utilities installation and diversion.

Approval for the construction and operation of the MLP is divided into respective east and west precincts as follows:

- Stage 1 (SSD 6766), divided into Package 1 (RALP) and Package 2 (IMEX), and Stage 2 (SSD 7628) of MPE under the MPE Concept Consent (MP10_0193) was provided in March 2018 (as amended through the Land and Environment Court) and January 2018 respectively. Commonwealth approval (EPBC 2011/6299) was received in March 2014.
- MPW Concept and Stage 1 (SSD 5066) received approval in June 2016, with commonwealth approval (EPBC 2011/6086) in September 2016. MPW Stage 2 (SSD 7709) received approval on 11 November 2019.

Prior to construction, vegetation clearing was conducted across the two project sites: MPE and MPW. Vegetation clearing was conducted in a staged approach and included the removal of important habitat features including hollow-bearing trees. To offset impacts to hollow-bearing trees a Nest Box Strategy Report (NBS) (CPB 2017) was prepared. Preparation of an NBS was a requirement of the approval (refer to Table 1) and was initially developed for MPE Stage 1 – RALP and MPW Stage 1. The MPE Stage 1 – RALP NBS was further adapted for implementation on MPE Stage 1 – IMEX and MPE Stage 2.

Table 1: Conditions relevant to installation and monitoring of nest boxes within MLP

Condition	Requirement
MPE Stage 1 (SSD 6766)	
CoC E34(d)(ii)(b)	The identification of areas to be cleared and details of management measures to avoid residual habitat damage or loss and to minimise or eliminate time lags between the removal and subsequent replacement of habitat such as: clearing procedures (including nest box plan)
Final compilation of mitigation measures: 8C	A nest box management strategy will be prepared prior to clearing hollow-bearing trees. The strategy will inform the installation of nest boxes in retained native vegetation in the riparian corridor of the Georges River and the woodland in the Southern Bootland and the ongoing monitoring and maintenance of nest boxes through the construction and operational phases.
MPW Stage 1 (SSD 5066)	
CoC D21(d)(ii)	The identification of areas to be cleared and details of management measures to avoid residual habitat damage or loss and to minimise or eliminate time lags between the removal and subsequent replacement of habitat such as: - clearing procedures (including nest box plan)
MLP EPBC Approval	
Commonwealth mitigation measures: 7.4.1.3 n	Consider the installation of nest boxes in woodland vegetation in the rail corridor that may offer alternative nesting habitats to hollow-dependent species recorded in the study area.

Hollow loss and replacement

Prior to vegetation removal to facilitate construction, pre-clearing surveys were conducted by the construction contractor's ecologist to record an inventory of tree hollows subject to removal. A review of the pre-clearing survey data identified that 108 tree hollows were removed during construction, as follows:

- IMEX: 25 hollows were identified across 13 hollow-bearing trees.
- Rail Access Link Package (RALP): 33 hollows were identified across 30 hollow-bearing trees.
- Precinct East Demolition Remediation (PEDR) Stage 2: 50 hollows across 39 hollow-bearing trees.

Nest boxes of an appropriate size and specification were required to be installed within retained vegetation in MLP at a ratio of 2:1 to offset the loss of hollows as per the Nest Box Strategy (NBS) (CPB, 2017). As such a total of 216 nest boxes were required to be installed to offset the removal of 108 hollows.

Nest boxes were progressively installed within native vegetation at the Bootland and along the Georges River corridor. The majority of the areas where nest boxes were installed were included in the BA341 biobank site when it was established in January 2019. Nest boxes that were not within the biobank site have since been relocated into bushland within the Wattle Grove offset area (Bootland) and Moorebank offset area (Georges River corridor).

As of the 2022 nest box monitoring surveys, there are a total of 225 nest boxes within the BA341 biobank site; 51 in the Wattle Grove offset area (Bootland) and 174 in the Moorebank offset area (Georges River corridor).

Monitoring

The MPE NBS (based on MPE Stage 1 – RALP) recommended that nest boxes installed for the project should be monitored shortly after installation and then on an annual basis in the spring thereafter. There is a requirement for these nest boxes to be monitored and maintained to ensure they offer suitable habitat to locally occurring hollow-dependant fauna.

The first round of nest box monitoring on the Moorebank Precinct was completed by Arcadis in spring 2018. Arcadis was engaged to undertake the proceeding annual nest boxes spring monitoring surveys within the Moorebank Precinct in 2019, 2020, 2021 and 2022 (the subject of this report) per the requirements specified in the MPE NBS.

This memo summarises the results of the fifth round of nest box monitoring undertaken by Arcadis in spring 2022 across the Bootland and Georges River corridor.

Nest box details

The types of nest boxes installed within the Bootland and Georges River corridor and details of installation are summarised in Table 2. Examples of nest boxes installed in these areas are shown in Plate 1. During surveys, it was noted that several nest boxes mounted using the 'Habisure' method were mounted incorrectly, being loosely secured to tree branches or installed above a maximum height of ten metres to enable inspection, a requirement of the NBS.

Table 2: Nest box designs and methods of installation utilised

Types	Installation method	Installation height	Other comments
Possum/Lorikeet Glider Microbat Cockatoo/Owl Kookaburra	'Habisure' method: hung using a wire Screwed directly into the trunk of the tree	3 – 15 metres above the ground	Fixed or hinged lid



Plate 1: Examples of nest box designs and installation methods in the Moorebank Logistics Park. Left to right: Arboreal mammal/lorikeet nest box installed using screws attaching to the tree, glider nest box installed using the habisure method, cockatoo/owl nest box installed using the habisure method.

Previous surveys

Nest box surveys have been conducted annually by Arcadis since 2018. The number of nest boxes located within the Bootland and along the Georges River corridor has been inconsistent across the monitoring years for the following reasons:

- the initial number of nest boxes installed within the Bootland and along the Georges River corridor was unknown due to nest boxes being installed progressively and a lack of installation records.
- nest boxes not being located during annual monitoring events.
- decommissioning of damaged and fallen nest boxes between monitoring years.

The number of nest boxes internally inspected has also varied between survey years, due to constraints such as box condition and access through vegetation (see Survey limitations). A summary of the number of nest boxes found and inspected across the three previous years of monitoring is included in Table 3.

Table 3: Number of nest boxes located and internally inspected during monitoring events

Survey year	Survey area	Number of nest boxes located	Number internally inspected
2018	Bootland	52	50
	Georges River corridor	195	169
	Total	247	219
2019	Bootland	54	51
	Georges River corridor	199	152
	Total	253	200
2020	Bootland	52	52
	Georges River corridor	161	140
	Total	213	192
2021	Bootland	51	51
	Georges River corridor	178	143
	Total	229	194
2022	Bootland	51	51
	Georges River corridor	174	146
	Total	225	197

Summary of findings from last year's (2021) monitoring

The outcomes of the previous years (2021) nest box monitoring survey and nest box maintenance works (2022) are summarised below:

- 229 nest boxes were located: 178 in the Georges River corridor and 51 in the Bootland.
- 194 nest boxes were inspected internally using a pole-mounted camera.
- 35 nest boxes were not internally inspected.
- 68 nest boxes were occupied by native fauna: 54 in the Georges River corridor and 14 in the Bootland.
- Four nest boxes were occupied by invasive fauna (European Honey Bee and Black Rat).
- A deceased Australian Wood Duck was located in box #14 in the Bootland.

Nest box annual monitoring report

- During the 2021 survey period, 53 nest boxes were identified as requiring maintenance, with 43 of these classified as needing urgent action.
- During remediation works in March 2022, 29 nest boxes were assessed for maintenance action. Three nest boxes were decommissioned, four nest boxes were reinstalled at new locations, and twelve boxes were reinstalled on the same tree. Ten boxes were unable to be accessed during the maintenance works due to access constraints or the presence of nesting birds.

Methodology

Nest box monitoring surveys within the Bootland and Georges River corridor were undertaken by Arcadis ecologists Taylor Bliss-Henaghan, William Terry, Kate Carroll and Thea Kane across six days in Spring, 2022. Survey dates and weather conditions on the dates of survey are outlined in Table 4.

Table 4: Survey dates and climate data from the weather station closest to MLP, Holsworthy Aerodrome (066161) (BoM, 2022)

Date	Min (°C)	Max (°C)	Rain (mm)	Max wind gust (direction, km/h)
26 September 2022	8.3	19.8	0	E 24
27 September 2022	11.4	22.7	1.2	ENE 24
28 September 2022	12.4	22.0	9.6	SSE 35
11 October 2022	10.1	19.0	0	E 28
14 November 2022	17.6	26.8	33	WNW 63
15 November 2022	13.0	24.4	0	W 30

Ecologists traversed the Bootland and Georges River corridor on foot, using an Arc-GIS enabled iPad to locate nest boxes. A total of 225 nest boxes were located by Arcadis during the 2022 monitoring period: 51 in the Bootland and 174 in Georges River corridor.

Initial external inspections were made for each nest box, and if no fauna could be observed externally, internal inspections were conducted using a GoPro (Wi-Fi connected) camera attached to an 8-metre telescopic pole. The following information was collected for each nest box, as recommended in Section 5 of the MPE NBS:

- Date and time.
- Nest box number.
- Nest box location (GPS).
- Occupancy status (identification of fauna to a species level where possible).
- Life stage of occupying fauna (eggs, juvenile, adults).
- Condition of occupying fauna (healthy, deceased).
- Evidence of previous occupancy (such as nesting material, feathers, scratch/claw marks).
- General condition of the nest box and mount.
- Any recommendations for maintenance actions, such as:
 - Reinstallation of the nest box to resecure, lower, or increase shade cover.
 - Replacement, repair or re-installation of missing, damaged or fallen nest boxes or mounts.
 - Removal of excess nesting material.
 - Amending or moving nest boxes that aren't functioning correctly.

Survey limitations

Several nest boxes were installed with fixed lids or at a height greater than ten metres. These nest boxes were unable to be inspected using the pole-mounted camera. Three boxes were also unable to be accessed due to the high cover of the invasive plant species, *Lantana camara* (Lantana), blocking ecologists from reaching the nest box for internal inspection. Only nest boxes internally inspected were included in the calculation of occupancy and utilisation rates.

Results

A total of 225 nest boxes were located by Arcadis during the spring 2022 survey period: 51 in the Bootland and 174 in the Georges River corridor. Of the 225 nest boxes located during the 2022 survey period, 197 nest boxes were internally inspected using a pole-mounted camera. The remaining 29 were not inspected internally for the following reasons:

- 13 nest boxes were installed greater than 10 metres above the ground and could not be reached with a pole-mounted camera.
- 8 nest boxes were not fitted with hinged lids and therefore could not be internally inspected with a pole-mounted camera.
- 1 box was not inspected as the lid was damaged and an inspection could have resulted in the lid falling off.
- 3 nest boxes were on the ground or on fallen trees.
- 4 boxes were inaccessible due to the high cover of vegetation, primarily Lantana.

Two nest boxes identified during previous survey periods could not be relocated despite locating the numbered trees (#82 and #110). Twelve of the nest boxes located during the spring 2022 monitoring did not have ID numbers. Eight unnumbered boxes were in the same position last year, indicating they were installed prior to 2020 when the tree-tag numbering system was implemented. Four unnumbered boxes were found to be new to the area. It is possible these were fallen boxes recovered during the March 2022 maintenance works and reinstalled without tree numbers.

A summary of the utilisation and condition of nest boxes from the spring 2022 monitoring period is discussed below and presented in Figure 1.

Nest box occupancy

Nest box 'occupancy' was determined based on the number of nest boxes recorded as being occupied by fauna at the time of survey, including nests containing eggs or hatchlings. Only nest boxes that could be internally inspected or nest boxes with fauna observable from the outside were assessed for occupancy. The following occupancy rates were recorded for nest boxes during the spring 2022 monitoring period:

- 68 nest boxes were occupied by native fauna, 17 nest boxes in the Bootland and 51 nest boxes in the Georges River corridor.
- 7 nest boxes were occupied by invasive fauna, all from the Georges River corridor.
- 6 nest boxes contained eggs or fledgelings from unidentified bird species, 1 in the Bootland and 5 from the Georges River corridor.
- 3 boxes were found to contain deceased fauna. In the Bootland, nest box #28 contained dead Rainbow Lorikeet fledglings, and #247 contained a nest with several large eggs that had been flooded. A deceased Common Ringtail Possum was found in an unnumbered box in the Georges River corridor.

Table 5 provides a list of species recorded occupying or utilising nest boxes during the 2022 monitoring period, and examples of nest boxes occupied by native and invasive fauna are shown in Plate 2 and Plate 3, respectively. A detailed record of nest boxes identified as being occupied by fauna is included in Appendix B.

Table 5: Species observed occupying or utilising nest boxes within the survey area.

Native fauna	Invasive fauna
Australian Owlet-nightjar (<i>Aegotheles cristatus</i>)	Black Rat (<i>Rattus rattus</i>) (Plate 3)
Australian Wood Duck (<i>Chenonetta jubata</i>)	Common Myna (<i>Acridotheres tristis</i>)
Common Brushtail Possum (<i>Trichosurus vulpecula</i>) (Plate 2)	European Honey Bee (<i>Apis mellifera</i>)

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Native fauna	Invasive fauna
Common Ringtail Possum (<i>Pseudocheirus peregrinus</i>) Rainbow Lorikeet (<i>Trichoglossus haematodus</i>) Southern Boobook (<i>Ninox boobook</i>) (Plate 2) Sugar Glider (<i>Petaurus breviceps</i>) Sulphur-crested Cockatoo (<i>Cacatua galerita</i>)	



Plate 2: Native fauna recorded occupying nest boxes within the survey area – Common Brushtail Possum (left), Southern Boobook (right)



Plate 3: Nest boxes occupied by invasive fauna - European Honey Bee hive (left) and Black Rat (right)

Nest box utilisation

Nest box 'utilisation' is measured for nest boxes currently occupied or with evidence of previous occupancies such as nesting material, or eggshells. Utilisation by invasive species was determined by the presence of an invasive species, or evidence of use by an invasive species, such as nesting materials not used by native fauna. Common Myna are known to use non-organic nesting materials including plastics, rubber, and metal (Dhandukia & Patel, 2012). All nest boxes with evidence of utilisation not associated with invasive fauna were considered to be utilised by native fauna. Nesting material indicative of occupation by native fauna included eucalypt leaves, bark shredding and other organic matter. The presence of feathers was also relied upon to

determine whether a nest box was utilised by native or introduced species. Examples of nest boxes with evidence of utilisation by native species are shown in Plate 4.



Plate 4: Nest boxes utilised by native fauna – Sugar glider nesting material (left) and Rainbow Lorikeet fledglings (right)

A summary of nest box utilisation observed during the spring 2022 survey event includes:

- 117 nest boxes are considered to be utilised by native fauna, 31 in the Bootland and 86 in the Georges River corridor, equating to a utilisation rate of 59% for all nest boxes in the 2022 survey period.
- 13 nest boxes are considered to be utilised by invasive species, 1 in the Bootland and 12 in the Georges River corridor, equating to an overall utilisations rate of 7%.

A summary of nest box utilisation by invasive fauna during the spring 2022 survey event includes:

- 4 nest boxes were occupied by Black Rats.
- 4 nest boxes contained active European Honey Bee hives.
- 5 nest boxes showed signs of utilisation by Common Myna, containing nesting material (litter) used by the species.

Nest box condition

Observations on nest box 'condition' assessed the structural condition of boxes as well as box mounts. The condition of each nest box was assessed upon inspection to identify if any maintenance actions are required. The majority of nest boxes located during the spring 2022 survey period showed minor deterioration due to weathering or use by fauna (e.g., plywood separation). Of the 225 nest boxes located, 57 were identified as requiring removal or repair for the following reasons:

- Nest box identified as damaged and in poor condition for use by fauna: A total of 19 nest boxes were identified as damaged, including four nest boxes that had fallen from the tree. The most common types of damage observed to nest boxes during the 2022 survey period were missing or loose lids and flooding of boxes.
- Nest box installed at a height above 10 metres: 15 nest boxes were installed too high and were unable to be internally inspected due to the camera being unable to reach the box. Several of these nest boxes were also identified as being damaged and/or unstable.
- Nest box inaccessible due to weed encroachment: 3 nest boxes were unable to be accessed due to dense *Lantana camara* blocking access.
- Nest box has potential to or has resulted in the fatality of occupying fauna: 4 nest boxes were determined to be hazardous to fauna with the potential to cause fatality. 3 nest boxes were found to contain deceased fauna during the 2022 survey period, and 1 additional box contained no internal ladder.

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- Nest box unstable on the tree due to incorrect mounting: A total of 7 nest boxes were loose on the tree.
- Nest box installed in an inappropriate location (i.e., no shade): A total of 4 nest boxes were found to be fully exposed to the sun, as well as one nest box in the Georges River corridor containing a deceased Common Ringtail Possum which also had little shade cover.
- Nest box installed on a dead or dying tree: 5 nest boxes were found to be installed on stags or dying trees and are considered to have an increased risk of falling.

Many of the nest boxes inspected during the 2022 surveys were found to have several maintenance issues. In these cases, the nest box has been categorised by the issue with the highest risk to fauna (e.g., causing a fatality). Full descriptions of the maintenance actions required for each nest box are described in Appendix A. Examples of nest boxes identified as requiring management action are shown in Plate 5.

According to Section 5 of the MPE NBS, nest boxes must be installed at a height below 10 metres to allow for visual inspection using an inspection camera and extension pole. Many nest boxes in the Georges River corridor are installed at heights close to 10 metres and are difficult to monitor, however, a total of 15 nest boxes (#71, #101, #164, #173, #178, #182, #206, #230, #233, #236, #239, #242, #250, and two unnumbered boxes in Georges River corridor) could not be reached using a pole-mounted camera as they are above this height. Issues with nest boxes that may put fauna at risk cannot be identified if boxes are unable to be inspected. For this reason, the 15 boxes that could not be internally inspected are considered to be in an unsuitable condition.



Plate 5: Examples of nest boxes with management issues – Damaged and unstable nest box installed on stag fully exposed to the sun (left), flooded nest box (right)

Fauna fatalities

Three nest boxes were found to contain deceased fauna during the 2022 survey period, two in the Bootland and one in the Georges River corridor. In the Bootland area, box #28 contained two deceased Rainbow Lorikeet fledglings and was found to not contain an internal ladder. Nest boxes without internal ladders can cause fauna fatalities as the animals are unable to exit the box resulting in starvation and death. Nest box #229 in the Bootland was flooded and contained several large eggs floating in water. Flooding of nest boxes during nesting season can result in the death of young that are unable to leave the nest box. In the Georges River corridor, an unnumbered box contained a deceased Common Ringtail Possum that appeared to have been deceased for a while showing significant decay. This box was facing north with very little shade cover, which may have resulted in heat stress for the animal inside.

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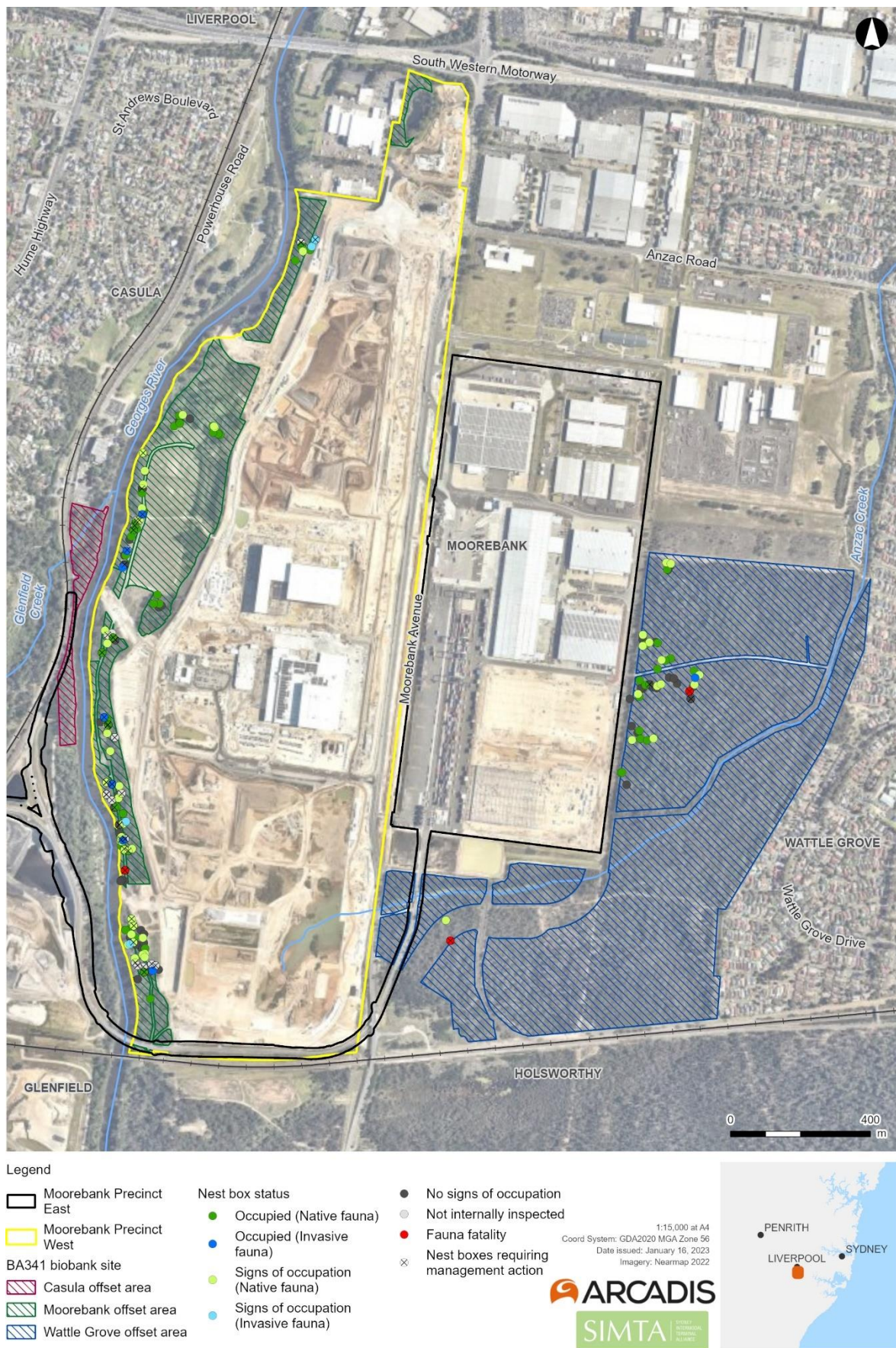


Figure 1: Results of the 2022 nest boxes monitoring survey

Discussion and recommendations

Native fauna

Comparison of nest box occupancy by native fauna can be made between different monitoring periods, given the occurrence of live animals is independent during each monitoring period. A summary of nest box occupation rates for all spring monitoring events conducted to date is included in Table 4.

Table 6: Occupation of nest boxes by fauna for annual survey periods

Survey year	Survey area	Number of nest boxes	Occupied by native fauna
2018	Bootland	52	(4) 7%
	Georges River corridor	195	(23) 12%
	Total	247	(27) 11%
2019	Bootland	54	(5) 9%
	Georges River corridor	199	(31) 16%
	Total	253	(36) 14%
2020	Bootland	52	(16) 31%
	Georges River corridor	161	(31) 19%
	Total	213	(47) 22%
2021	Bootland	51	(14) 27%
	Georges River corridor	178	(54) 30%
	Total	229	(68) 30%
2022	Bootland	51	(17) 33%
	Georges River	174	(51) 35%
	Total	225	(68) 35%

A comparison between annual spring monitoring periods from 2018-2022 indicates a steady increase in the occupation of nest boxes by native fauna (Figure 2). In the 2018 monitoring event, 11 per cent of nest boxes were occupied, which has increased to a 35 per cent rate of occupation in the 2022 survey period.

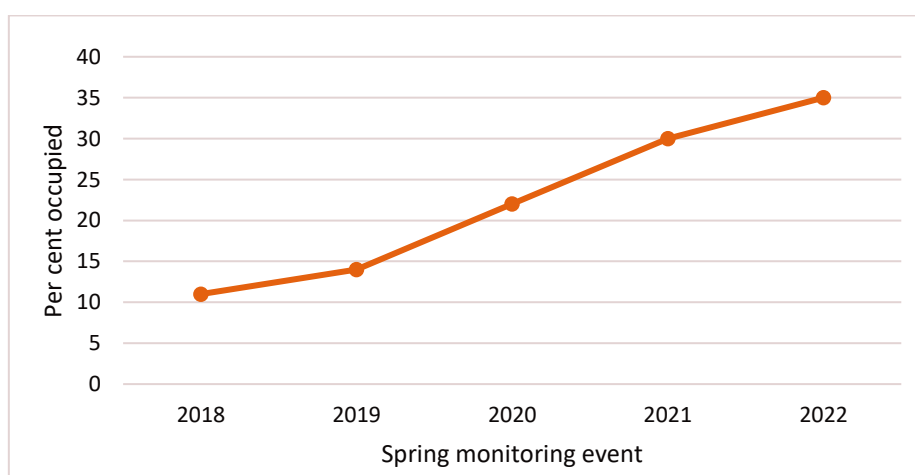


Figure 2: Occupancy rate of nest boxes by native fauna for spring monitoring events between 2018 and 2022

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Comparisons of utilisation between monitoring periods are not reliable, given some evidence of occupation may still be present from previous survey years. Combining occupancy status with evidence of use does provide a cumulative measure of nest box utilisation over time. The rate of utilisation for all nest boxes has increased from 32 per cent in 2018 to 59 per cent in 2022 (Table 7).

Table 7: Utilisation of nest boxes within the survey area across each survey year.

Survey year	Survey area	Number of nest boxes	Utilisation by native fauna	Utilisation by invasive fauna
2018	Bootland	52	(5) 15%	(3) 6%
	Georges River corridor	195	(65) 35%	(5) 3%
	Total	247	(70) 32%	(8) 4%
2019	Bootland	54	(21) 39%	(2) 4%
	Georges River corridor	199	(60) 30%	(6) 3%
	Total	253	(81) 32%	(8) 3%
2020	Bootland	52	(28) 53%	(1) 2%
	Georges River corridor	161	(71) 44%	(7) 4%
	Total	213	(99) 46%	(8) 4%
2021	Bootland	51	(28) 55%	(0) 0%
	Georges River corridor	178	(109) 61%	(10) 6%
	Total	229	(131) 57%	(10) 4%
2022	Bootland	51	(31) 61%	(1) 2%
	Georges River corridor	174	(86) 60%	(7) 8%
	Total	225	(117) 59%	(8) 7%

While nest boxes may show signs of occupation from previous years, there has been almost a double in the total number of nest boxes with signs of use by native fauna since 2018. Monitoring utilisation over time may provide useful insights into nest box preferences of local hollow-dependent fauna. As annual monitoring continues, nest boxes showing no signs of use can be assessed to determine if design modifications or reinstallation into a more appropriate area may be needed to increase the likelihood of utilisation. There are three nest boxes that have not been recorded as previously utilised - #87, #150, and #253. Nest box #87 has been recommended for relocation due to its exposed position, however it is recommended #150 and #253 be considered for relocation or maintenance if they remain unoccupied during the next monitoring period.

Overall, nest box occupancy and utilisation by native fauna are adequate in both the Bootland and the Georges River corridor. This assumes that 10 per cent of nest boxes should be occupied by target (native) fauna (Goldingay et al. 2018, Lindenmayer et al. 2017). The 2022 survey period occupancy of 35 per cent is therefore above the target occupancy.

Invasive fauna

A comparison of the nest boxes utilised by invasive fauna across all monitoring events identified that:

- The 2019 monitoring event had the lowest invasive nest box utilisation rate of 3%.
- The 2022 monitoring event had the highest rate of utilisation by invasive fauna at 7%.

The occupancy of nest boxes by invasive fauna is low and is similar across annual monitoring periods. Nest box utilisation by invasive fauna should continue to be recorded and compared across monitoring periods to

assess competition pressure from invasive fauna on native hollow-dependent species. The current rates of utilisation by invasive fauna are unlikely to negatively impact native species in the area. No new invasive species were identified in the 2022 survey period, with all species observed in previous monitoring years.

Nest box management and maintenance

Currently, 181 nest boxes across the Bootland and Georges River corridor are functional and provide suitable habitat for native hollow-dependant fauna species. To maintain the hollow replacement ratio of 2:1 for hollows removed by the MLP development and increase the number of functional boxes to 216, a minimum of 35 nest boxes require maintenance. In assessing the condition of nest boxes during monitoring, some nest boxes identified as requiring maintenance are still considered to be functional to fauna, dependent on the severity of the issue. Nest boxes with management issues that were still considered functional to fauna were those that have been:

- Identified as being unstable on the tree.
- Unable to be internally inspected during the 2022 surveys due to overgrown vegetation restricting access.
- Installed in a location with low sun protection increasing susceptibility to heat stress.
- Installed on a dead tree, but in otherwise good condition.

A total of 57 nest boxes were identified as requiring maintenance actions during the spring 2022 survey period, 4 from the Bootland and 53 from the Georges River corridor. Of the 57 nest boxes requiring maintenance, 34 were identified as requiring essential maintenance, with 2 boxes from the Bootland and 32 from the Georges River corridor. Essential maintenance has been prioritised for nest boxes that are deemed unsafe for use by fauna, including those that have been:

- Identified as potentially causing fauna fatalities.
- Identified as not having an internal ladder for the safe exit of fauna.
- Damaged and require removal (decommissioning) or repair.
- Installed above 10 metres and are unable to be inspected internally.

The four nest boxes that had fallen to the ground, while not considered functional, pose little risk to fauna and therefore have not been flagged for urgent action. It is still recommended that these boxes are recovered and reinstalled where possible to increase the number of functioning nest boxes in the offset sites.

Many nest boxes in the Georges River corridor are installed at a height difficult to monitor, including 15 that were unable to be internally inspected with the pole-mounted camera. Nest boxes that cannot be internally inspected are considered unsuitable due to the risk of hazards to fauna remaining undetected. Nest boxes above 10 metres have therefore been prioritised for management action. During maintenance works, it is recommended that any nest boxes undergoing maintenance should be reinstalled at a height between 5-7 metres to improve accessibility.

During the 2022 survey period, three nest boxes were found with deceased fauna inside. Nest box #28 contained two deceased Rainbow Lorikeet fledglings, and the box did not have an internal ladder. Nest boxes without internal ladders have caused fatalities in previous monitoring years as animals, particularly juvenile birds, cannot climb out of the box resulting in dehydration and starvation. It is recommended that all nest boxes be assessed for internal ladders during the next monitoring period to identify any nest boxes that may pose a risk to fauna.

Nest box #229 in the Bootland contained a flooded nest with several large eggs. During the 2022 monitoring period, there was an observable increase in the number of nest boxes with water damage. This was likely due to the high rainfall events experienced throughout the year increasing the susceptibility of the nest boxes to drainage issues and flooding. Nest boxes with visible flooding or water damage have been prioritised for management, as they are either unusable by fauna, or are a hazard to juvenile birds due to flooding risk.

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An unnumbered nest box in the Georges River corridor contained a deceased Common Ringtail Possum. Though the possum may have died of natural causes, the nest box was observed to be in a very exposed position on the tree with minimal sun protection. Nest boxes exposed to high levels of solar radiation can reach internal temperatures over 5 °C higher than ambient temperatures (Ellis, 2016), resulting in heat stress to animals inside. During periods of extreme heat, temperatures inside exposed nest boxes can become fatal (Goldingay, 2015). Nest boxes that are exposed to the sun have therefore been identified for maintenance actions.

In March 2022, corrective actions were undertaken across two days to decommission, repair, or reinstall nest boxes identified as faulty during the spring 2021 survey period (Arcadis, 2022). Several nest boxes were unable to be accessed for maintenance works, as they were located on dead trees which are too dangerous to climb. Nest boxes installed on stags will require an elevated working platform (EWP) to access, and these have been identified in Appendix A.

Finally, several nest boxes within the Georges River corridor do not have identification numbers. It is recommended during maintenance works that these nest boxes be issued with tree tags for easy identification during future monitoring. A summary of maintenance issues for nest boxes has been detailed in Table 8 and a full description of recommended actions for each box is detailed in Appendix A. As per the NBS, urgent maintenance should be actioned within 4 weeks from the submission of the annual monitoring report.

Table 8: Summary of issues of nest boxes found within the survey area and maintenance actions required.

Issue	Box ID Number	Action Required	Urgency
Hazardous to fauna	28, 117, 247, No ID (Georges River corridor)	Decommission box or modify to install internal ladder.	Urgent
Damaged box	60, 66, 67, 68, 81, 125, 126, 128, 134, 135, 161, 163, 175, 190, No ID	Decommission box or repair and reinstall below 8 metres	Urgent
Installed above 10 metres in height and unable to be internally inspected	71, 101, 164, 173, 178, 182, 206, 230, 233, 236, 239, 242, 250, No ID, No ID	Reinstall box at appropriate height	Urgent
Box on tree with no shade cover	87, 88, 208, No ID	Reinstall box in tree in shaded position	Non-urgent
Box fallen from tree	29, 145, No ID, No ID	Recover box, assess for condition and reinstall if undamaged	Non-urgent
Unstable on tree	15, 55, 73, 122, 123, 136, 146	Reinstall box securely on tree at appropriate height	Non-urgent
Installed on dead or dying tree	92, 99, 100, 124, 127	Monitor tree health and remove nest box if tree condition declines or box becomes unstable	Non-urgent
Box inaccessible due to overgrown vegetation	77, 224, 225	Remove exotic species blocking tree access	Non-urgent

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APPENDIX A. NEST BOXES REQUIRING MAINTENANCE

Box Location	Box ID	Box Condition	Action Required
Bootland	15	Unstable on tree	Reinstall box to be securely attached to tree.
Bootland	28	Fauna fatality	Remove deceased Lorikeets. Decommission box or retrofit internal ladder before reinstalling.
Bootland	29	Fallen box	Recover fallen box, if suitable reinstall in tree.
Bootland	247	Fauna fatality	Remove abandoned nest. Decommission box or repair drainage and waterproofing prior to reinstalling.
Georges River corridor	55	Unstable on tree	Reinstall box to be securely attached to tree.
Georges River corridor	60	Damaged box	Decommission box or repair drainage and waterproofing before reinstalling.
Georges River corridor	66	Damaged box	Decommission box or repair drainage and waterproofing before reinstalling.
Georges River corridor	67	Damaged box	Decommission box or repair before reinstalling.
Georges River corridor	68	Damaged box	Decommission box or repair before reinstalling.
Georges River corridor	71	Box inaccessible	Reinstall box to be securely attached to tree at a lower height.
Georges River corridor	73	Unstable on tree	Reinstall box to be securely attached to tree.
Georges River corridor	77	Box inaccessible	Weed control - remove Lantana blocking tree access.
Georges River corridor	81	Damaged box	Decommission box or repair prior to reinstallation. EWP required.
Georges River corridor	87	Full sun exposure	Reinstall box in shaded position.
Georges River corridor	88	Full sun exposure	Reinstall box in shaded position.
Georges River corridor	92	Tree health poor	Move box to a live tree. EWP required.
Georges River corridor	99	Tree health poor	Move box to a live tree. EWP required.
Georges River corridor	100	Tree health poor	Move box to a live tree. EWP required.
Georges River corridor	101	Box inaccessible	Reinstall lower on tree. EWP required.
Georges River corridor	117	No internal ladder	Decommission box or retrofit internal ladder and reinstall.
Georges River corridor	122	Unstable on tree	Reinstall box to be securely attached to tree at a lower height.
Georges River corridor	123	Unstable on tree	Reinstall box to be securely attached to tree at a lower height.
Georges River corridor	124	Tree health poor	Move box to a live tree.
Georges River corridor	125	Damaged box	Decommission box or replace lid and reinstall at an appropriate height.
Georges River corridor	126	Damaged box	Decommission box or replace lid and reinstall at an appropriate height.
Georges River corridor	127	Tree health poor	Move box to a live tree. EWP required.

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Box Location	Box ID	Box Condition	Action Required
Georges River corridor	128	Damaged box	Decommission box or replace lid and reinstall at an appropriate height.
Georges River corridor	134	Damaged box	Decommission box or repair drainage and waterproofing prior to reinstalling.
Georges River corridor	135	Damaged box	Decommission box or repair drainage and waterproofing prior to reinstalling.
Georges River corridor	136	Unstable on tree	Repair broken lid and reinstall box securely to tree.
Georges River corridor	145	Fallen box	Recover fallen box and reinstall if functional.
Georges River corridor	146	Unstable on tree	Reinstall lower on tree.
Georges River corridor	161	Damaged box	Reinstall box securely to tree.
Georges River corridor	163	Damaged box	Decommission box, or if possible, repair lid and reinstall.
Georges River corridor	164	Box inaccessible	Reinstall lower on tree.
Georges River corridor	173	Box inaccessible	Reinstall lower on tree.
Georges River corridor	175	Damaged box	Decommission box or repair drainage and waterproofing prior to reinstalling.
Georges River corridor	178	Box inaccessible	Reinstall lower on tree.
Georges River corridor	182	Box inaccessible	Reinstall lower on tree.
Georges River corridor	190	Damaged box	Decommission box, or if possible, repair lid and reinstall.
Georges River corridor	206	Box inaccessible.	Decommission box, or repair prior to reinstallation lower on tree. EWP required.
Georges River corridor	208	Full sun exposure	Reinstall box in shaded position
Georges River corridor	224	Box inaccessible	Weed management - remove Lantana surrounding tree.
Georges River corridor	225	Box inaccessible	Weed management - remove Lantana surrounding tree.
Georges River corridor	230	Box inaccessible	Decommission box, or repair prior to reinstallation lower on tree.
Georges River corridor	233	Box inaccessible	Decommission box.
Georges River corridor	236	Box inaccessible	Reinstall lower on tree.
Georges River corridor	238	Box inaccessible	Modify lid design for inspection and reinstall lower on tree.
Georges River corridor	239	Box inaccessible	Decommission box, or repair prior to reinstallation lower on tree.
Georges River corridor	242	Box inaccessible	Reinstall box in shaded position
Georges River corridor	250	Box inaccessible	Decommission box, or repair prior to reinstallation lower on tree.
Georges River corridor	None	Fallen box	Recover fallen glider box and reinstall if functional.
Georges River corridor	None	Fallen box	Recover fallen medium mammal/small parrot box and reinstall if functional.
Georges River corridor	None	Damaged box	Decommission glider box or repair drainage and waterproofing prior to reinstalling.

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Box Location	Box ID	Box Condition	Action Required
Georges River corridor	None – next to box 242	Fauna fatality	Reinstall medium mammal/small parrot box in a new location with appropriate shade cover. If no internal ladder present retrofit one prior to reinstallation.
Georges River corridor	None	Box inaccessible	Reinstall medium mammal/small parrot box lower on tree.
Georges River corridor	None	Box inaccessible	Reinstall box in shaded position.
Georges River corridor	None	Full sun exposure	Reinstall box in shaded position.

APPENDIX B. FAUNA RECORDED IN NEST BOXES

Location	Box ID	Box Type	Species	Notes
Bootland	2	Medium mammal/small parrot	Rainbow Lorikeet	Two eggs
Bootland	3	Medium mammal/small parrot	Common Ringtail Possum	
Bootland	4	Medium mammal/small parrot	Rainbow Lorikeet	Two juveniles
Bootland	5	Medium mammal/small parrot	Common Ringtail Possum	
Bootland	9	Medium mammal/small parrot	Common Ringtail Possum	
Bootland	13	Glider	Sugar Glider	Two individuals
Bootland	14	Large bird	Owlet Nightjar	Owlet Nightjar observed in entrance. No internal inspection to avoid disturbance
Bootland	23	Glider	Sugar Glider	Three individuals
Bootland	25	Glider	European Bee	
Bootland	28	Large bird	Rainbow Lorikeet	Two deceased fledglings
Bootland	30	Glider	Sugar Glider	Two individuals
Bootland	31	Medium mammal/small parrot	Common Ringtail Possum	
Bootland	33	Medium mammal/small parrot	Rainbow Lorikeet	Adult lorikeet in box. Not internally inspected to avoid disturbance
Bootland	35	Glider	Sugar Glider	Two individuals
Bootland	42	Glider	Sugar Glider	Two individuals
Bootland	45	Medium mammal/small parrot	Australian Wood Duck	Eggs in nest
Bootland	48	Medium mammal/small parrot	Sugar Glider	Three adults
Bootland	247	Medium mammal/small parrot	Unidentified	Large Eggs floating in water
Georges River corridor	56	Glider	Sugar Glider	
Georges River corridor	62	Large bird	Common Ringtail Possum	Adult and young
Georges River corridor	64	Large bird	Common Ringtail Possum	Adult and young
Georges River corridor	65	Medium mammal/small parrot	Unidentified	Two grey hatchlings
Georges River corridor	66	Large bird	Black Rat	Two individuals
Georges River corridor	70	Medium mammal/small parrot	Common Ringtail Possum	Family
Georges River corridor	72	Large bird	Australian Wood Duck	

Nest box annual monitoring report

Location	Box ID	Box Type	Species	Notes
Georges River corridor	73	Glider	Sugar Glider	Several individuals
Georges River corridor	74	Medium mammal/small parrot	Common Ringtail Possum	
Georges River corridor	76	Medium mammal/small parrot	European Bee	Hive
Georges River corridor	79	Medium mammal/small parrot	Common Ringtail Possum	
Georges River corridor	84	Medium mammal/small parrot	European Bee	Hive
Georges River corridor	85	Glider	Sugar Glider	
Georges River corridor	86	Medium mammal/small parrot	Rainbow Lorikeet	One juvenile
Georges River corridor	89	Medium mammal/small parrot	Rainbow Lorikeet	Nesting pair
Georges River corridor	92	Glider	Black Rat	Black rat
Georges River corridor	93	Medium mammal/small parrot	Common Ringtail Possum	Mum and juvenile possum
Georges River corridor	98	Glider	Sugar Glider	Two individuals
Georges River corridor	99	Medium mammal/small parrot	Unidentified	Six large eggs
Georges River corridor	100	Large bird	Rainbow Lorikeet	Two juvenile lorikeets
Georges River corridor	106	Medium mammal/small parrot	Rainbow Lorikeet	Two eggs
Georges River corridor	107	Medium mammal/small parrot	Rainbow Lorikeet	Two eggs
Georges River corridor	108	Large bird	Australian Wood Duck	Nest containing several eggs
Georges River corridor	109	Medium mammal/small parrot	Rainbow Lorikeet	Two eggs
Georges River corridor	112	Glider	Sugar Glider	
Georges River corridor	114	Medium mammal/small parrot	Rainbow Lorikeet	Two eggs
Georges River corridor	117	Medium mammal/small parrot	Australian Wood Duck	Nesting wood duck
Georges River corridor	123	Medium mammal/small parrot	Unidentified	Single egg
Georges River corridor	124	Glider	Black Rat	
Georges River corridor	133	Medium mammal/small parrot	Rainbow Lorikeet	One juvenile
Georges River corridor	139	Medium mammal/small parrot	Common Ringtail Possum	
Georges River corridor	149	Medium mammal/small parrot	Rainbow Lorikeet	Two eggs
Georges River corridor	154	Glider	Sugar Glider	
Georges River corridor	155	Glider	Rainbow Lorikeet	Two juveniles
Georges River corridor	158	Medium mammal/small parrot	Australian Wood Duck	Nesting wood duck
Georges River corridor	161	Medium mammal/small parrot	Rainbow Lorikeet	Three juvenile rainbow lorikeets
Georges River corridor	162	Glider	Black Rat	Two black rats

Nest box annual monitoring report

Location	Box ID	Box Type	Species	Notes
Georges River corridor	166	Medium mammal/small parrot	Common Ringtail Possum	
Georges River corridor	169	Large bird	Rainbow Lorikeet	Two eggs
Georges River corridor	172	Medium mammal/small parrot	Common Ringtail Possum	
Georges River corridor	177	Medium mammal/small parrot	Rainbow Lorikeet	Chick and egg
Georges River corridor	180	Medium mammal/small parrot	Unidentified	One egg looks abandoned
Georges River corridor	191	Medium mammal/small parrot	Rainbow Lorikeet	One juvenile
Georges River corridor	192	Medium mammal/small parrot	Rainbow Lorikeet	One juvenile
Georges River corridor	193	Large bird	Southern Boobook	Southern Boobook breeding pair exited box. Four eggs inside
Georges River corridor	197	Medium mammal/small parrot	Unidentified	Juvenile birds unidentified eucalyptus leaves in box.
Georges River corridor	200	Medium mammal/small parrot	Common Ringtail Possum	
Georges River corridor	202	Medium mammal/small parrot	Common Ringtail Possum	
Georges River corridor	207	Glider	Sugar Glider	
Georges River corridor	212	Medium mammal/small parrot	Common Ringtail Possum	
Georges River corridor	219	Medium mammal/small parrot	Rainbow Lorikeet	One juvenile
Georges River corridor	227	Glider	European Bee	Bees in nest box starting to form hive
Georges River corridor	229	Medium mammal/small parrot	Rainbow Lorikeet	Two juveniles
Georges River corridor	231	Medium mammal/small parrot	Common Brushtail Possum	
Georges River corridor	233	Large bird	Sulphur-crested Cockatoo	Couldn't inspect but cockatoo sitting in box
Georges River corridor	235	Large bird	Rainbow Lorikeet	Hatchlings
Georges River corridor	240	Glider	Rainbow Lorikeet	Adult lorikeet and two eggs
Georges River corridor	-	Medium mammal/small parrot	Common Ringtail Possum	Deceased possum in box