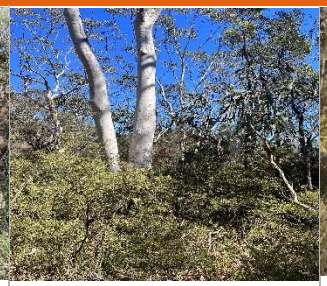
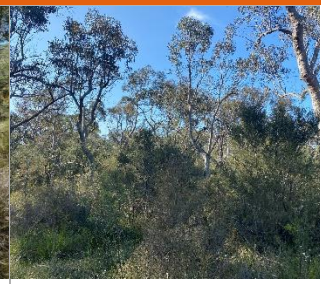
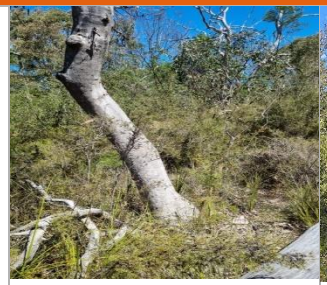
Monitoring Photographs – *Persoonia nutans* Offset site P4					
N/A	N/A				
		PP_MP(B)_(South) - 2021	PP_MP(B)_(South) - 2022	PP_MP(B)_(South) - 2023	PP_MP(B)_(South) - 2024
N/A	N/A				
		PP_MP(B)_(West) - 2021	PP_MP(B)_(West) - 2022	PP_MP(B)_(West) - 2023	PP_MP(B)_(West) - 2024
N/A	N/A				
		PP1 – 2021	PP1 – 2022	PP1 – 2023	PP1 – 2024

Monitoring Photographs – *Persoonia nutans* Offset site P4					
N/A	N/A				
		PP2 - 2021	PP2 - 2022	PP2 - 2023	PP2 - 2024
N/A	N/A				
		PP3 – 2021	PP3 – 2022	PP3 – 2023	PP3 – 2024
N/A	N/A				
		PP4 - 2021	PP4 - 2022	PP4 – 2023	PP4 – 2024

Monitoring Photographs –*Grevillea parviflora subsp. Parviflora* Offset site G1					
			Not captured		
PP_MP(North) - 2019	PP_MP(North) - 2020	PP_MP(North) - 2021	PP_MP(North) - 2022	PP_MP(North) - 2023	PP_MP(North) - 2024
			Not captured		
PP_MP(East) - 2019	PP_MP(East) - 2020	PP_MP(East) - 2021	PP_MP(East) - 2022	PP_MP(East) - 2023	PP_MP(East) - 2024
			Not captured		
PP_MP(South) - 2019	PP_MP(South) - 2020	PP_MP(South) - 2021	PP_MP(South) - 2022	PP_MP(South) - 2023	PP_MP(South) - 2024

Monitoring Photographs –*Grevillea parviflora subsp. Parviflora* Offset site G1					
			Not captured		
PP_MP(West) - 2019	PP_MP(West) - 2020	PP_MP(West) - 2021	PP_MP(West) - 2022	PP_MP(West) - 2023	PP_MP(West) - 2024
			Not captured		
PP1 – 2019	PP2 – 2020	PP1 - 2021	PP1 - 2022	PP1 – 2023	PP1 - 2024
			Not captured		
PP2 – 2019	PP2 – 2020	PP2 - 2021	PP2 - 2022	PP2 - 2023	PP2 - 2024

Monitoring Photographs –*Grevillea parviflora subsp. Parviflora* Offset site G1					
			Not captured		
PP3 – 2019	PP3 – 2020	PP3 - 2021	PP3 - 2022	PP3 – 2023	PP3 - 2024
			Not captured		
PP4 – 2019	PP4 – 2020	PP4 - 2021	PP4 - 2022	PP4 – 2023	PP4 - 2024

APPENDIX D PHOTO POINT DETAILS

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

Offset Site	Photo point identifier	Location of Photo Point		Direction of Photograph (degrees)
		Latitude	Longitude	
G1	MP (North)	-33.963454°	150.923047°	0/360
	MP (East)			90
	MP (South)			180
	MP (West)			270
	PP1	-33.963401°	150.922906°	50
	PP2	-33.963163°	150.922886°	140
	PP3	-33.963321°	150.923232°	200
	PP4	-33.963650°	150.923207°	320

APPENDIX E POPULATION CENSUS

Table 27. Comparison of Persoonia nutans 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	
	2022	Adult	0	7
		Juvenile	7	
	2023	Adult	2	7
		Juvenile	5	
	2024	Adult	7	7
		Juvenile	0	
P2	2019	Adult	0	3
		Juvenile	3	
	2020	Adult	0	0
		Juvenile	0	
	2021	Adult	0	0
		Juvenile	0	
	2022	Adult	1	1
		Juvenile	0	
	2023	Adult	1	1
		Juvenile	0	
	2024	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	
	2023	Adult	17	28
		Juvenile	11	
	2024	Adult	27	38
		Juvenile	11	

Offset site	Census year	Life stage	Sub-count	Count
P4	2019	Adult	N/A	N/A
		Juvenile		
	2020	Adult	43	43
		Juvenile	0	
	2021	Adult	41	41
		Juvenile	0	
	2022	Adult	32	32
		Juvenile	0	
	2023	Adult	31	32
		Juvenile	1	
	2024	Adult	33	34
		Juvenile	1	
Total	2019	Adult	N/A	N/A
		Juvenile		
	2020	Adult	45	**133**
		Juvenile	88	
	2021	Adult	43	**92**
		Juvenile	49	
	2022	Adult	39	**68**
		Juvenile	29	
	2023	Adult	52	**68**
		Juvenile	16	
	2024	Adult	68	**80**
		Juvenile	12	

Table 28. Comparison of Grevillea parviflora subsp. *parviflora population census across monitoring years*

Offset site	Census year	Count
G1	2019	142
G1	2020	60
G1	2021	50
G1	2022	112
G1	2023	146
G1	2024	75

APPENDIX D. 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 2024/5 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 17 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 20% 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 3% 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)	Failed	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 16.6% was recorded for the eastern side of the Georges River management site during surveys completed in January 2024. The total weed cover across the management site has not been 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 achieve in two years: being June 2026. Fixed monitoring quadrats conducted within revegetated areas recorded an average weed cover of 17.6%. Weed species cover has increased since previous monitoring periods from 8.1% in March 2020. Weed control works have not been conducted at the management site since June 2020. Native

Key Performance Indicator	Status	Comments
		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)	Failed	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 21.4% was recorded for the western side of the Georges River management site during surveys completed in January 2024. The total weed cover across the management site has not been 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 achieve in two years: being June 2026. 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 *Cassytha glabella* (Slender Devil's Twine), *Commelina cyanae* (Scurvy Weed), *Entolasia marginata* (Bordered Panic Grass), *Kangaroo Grass* and *Austrostipa ramosissima* (Stout Bamboo 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 riverbank 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 January 2024 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 MIP 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 (*Vulpes vulpes*), Black Rat (*Rattus rattus*), Domestic/Feral Cat (*Felis catus*) and Swamp Wallaby (*Wallabia bicolor*).

APPENDIX E. RIPARIAN VEGETATION MANAGEMENT – NATIVE FLORA INVENTORIES

Scientific name	Common name	RFEFCFEEC	GZ1_MR09	GZ1_MR10	GZ1_MR11	GZ2_MR12	GZ2_MR13	GZ4_MR14	GZ2_MR15	GZ4_MR16	GZ2(W)_MR18	GZ2(W)_MR19
Acacia binervata	Two-veined Hickory		X	X	X			X			X	X
Acacia decurrens	Black Wattle											X
Acacia floribunda	White Sally	*									X	
Acacia longifolia								X			X	
Acacia parramattensis	Parramatta Wattle	*						X				
Austrostipa ramosissima	Stout Bamboo Grass	*	X		X						X	
Billardiera scandens	Hairy Apple Berry				X							
Breynia oblongifolia	Coffee Bush	*		X	X							
Bursaria spinosa	Native Blackthorn	*										
Callistemon salignus	Willow Bottlebrush											X
Cassytha glabella				X	X						X	
Casuarina glauca	Swamp Oak	*							X			
Cayratia clematidea	Native Grape	*			X							
Chloris truncata	Windmill Grass						X					
Clematis aristata	Old Man's Beard	*	X	X	X							
Clematis glycinoides	Headache Vine	*		X			X			X		
Commelina cyanea	Native Wandering Jew	*						X	X	X		
Cymbopogon refractus	Barbed Wire Grass	*										X
Cynodon dactylon	Common Couch											X
Dichelachne micrantha	Shorthair Plumegrass	*										
Dichondra repens	Kidney Weed	*					X		X		X	X
Dodonaea truncatiales	Angular Hop-bush								X			
Echinopogon ovatus	Forest Hedgehog Grass	*										
Einadia hastata	Berry Saltbush	*							X	X		
Entolasia marginata	Bordered Panic	*	X	X			X		X		X	
Entolasia stricta	Wiry Panic	*				X						X
Eucalyptus botryoides	Bangalay	*	X		X	X	X			X		
Geranium solanderi	Native Geranium	*					X		X	X	X	
Glycine clandestina	Twining glycine	*									X	

Hardenbergia violacea	False Sarsaparilla	*									X	
Hydrocotyle laxiflora	Stinking Pennywort						X		X			X
Imperata cylindrica	Blady Grass						X		X	X		
Juncus usitatus							X		X			X
Kunzea ambigua	Tick Bush			X								
Lobelia purpurascens	whiteroot						X		X			
Lomandra longifolia	Spiny-headed Mat-rush	*					X			X	X	X
Melaleuca decora		*							X	X		
Melaleuca linariifolia	Flax-leaved Paperbark	*										
Melaleuca styphelioides	Prickly-leaved Tea Tree	*							X	X	X	
Microlaena stipoides	Weeping Grass		X	X	X		X	X	X	X		
Oplismenus aemulus		*		X	X		X	X	X	X	X	X
Oplismenus imbecillis							X					
Parsonsia straminea	Common Silkpod		X									
Persicaria hydropiper	Water Pepper					X	X		X	X		
Pteridium esculentum	Bracken	*								X		
Rubus parvifolius	Native Raspberry	*							X	X		
Sigesbeckia orientalis							X					X
Themeda australis	Kangaroo Grass	*										
Viola hederacea	Ivy-leaved Violet	*					X				X	
Vittadinia spp.	Fuzzweed						X					

APPENDIX F. RIPARIAN VEGETATION COMPARISON OF EXOTIC AND NATIVE COVER PERCENTAGES FOR EACH VEGETATION QUADRAT ACROSS MONITORING EVENTS (JUNE 2018 – APRIL 2025)

Exotic

Quadrat identifier	Zone	Jun ‘18	Sep ‘18	Dec ‘18	Mar ‘19	Jun ‘19	Sep ‘19	Dec ‘19	Mar ‘20	Nov ‘21	Apr ‘23	Jan ‘24	Apr ‘25
MR09	GZ1	10.1	4.8	3.9	5.8	5.4	3	3.9	19.3	6.25	23.2	21.3	5.25
MR10	GZ1	23.8	0.3	2.8	1.3	2	2.4	0.3	2.8	4	4.2	1.8	4.25
MR11	GZ1	43.8	2	13.1	10.5	13.1	18.9	13.9	17.6	39.75	37.5	23.0	4.5
MR12	GZ2	104.3	8.5	1.8	2	0	0.4	0.2	0.1	2.5	2	21.8	22.5
MR13	GZ2	82.1	38.5	2	1.1	0	0.9	1.3	2	20	26.7	16.3	25
MR14	GZ4	89.1	49.8	50.5	32.3	2	7.5	10.6	14.1	48.75	44.5	11.8	2.75
MR15	GZ2	79.6	69.8	12.3	7.9	0.1	4.4	6.2	6.3	14.25	9.8	24.0	8.75
MR16	GZ4	28.9	20.8	24	14	0.5	2.3	3.1	3.9	27.25	7.4	13.3	11.5
MR18	GZ2	-	-	-	-	-	47.6	1.2	14	51.75	76.8	20.3	14.75
MR19	GZ5	-	-	-	-	-	11.3	0.1	0.4	6.43	10.5	22.5	6.25
Average		-	57.7	24.3	13.8	9.4	8.9	9.9	4.1	22.09	24.3	17.6	10.55

Native

Quadrat identifier	Zone	Jun ‘18	Sep ‘18	Dec ‘18	Mar ‘19	Jun ‘19	Sep ‘19	Dec ‘19	Mar ‘20	Nov ‘21	Apr ‘23	Jan ‘24	Apr ‘25
MR09	GZ1	15.4	16.8	20.3	18	32.5	21.8	29.8	42.8	44.0	20.6	23.0	8.7
MR10	GZ1	24.5	21.8	16	23.5	28.5	24.8	26.5	40.5	41.5	48.8	33.8	25.1
MR11	GZ1	12.5	12.3	18.3	12.5	31.3	26	23.5	37.3	25.9	35	27.1	16.3
MR12	GZ2	1	0.3	0.3	1.5	6	8.3	4	23	32.3	33.8	3.7	3.8
MR13	GZ2	3.6	5.5	4.8	4.6	9.5	7.8	7.8	24.8	45.0	25	15.4	17.1
MR14	GZ4	30.8	38.8	80	63	26.3	13.3	7.8	26	12.9	5	13.3	13.8
MR15	GZ2	3.8	1.8	0.1	0	8.5	4	6.3	23.2	35.0	27.3	2.3	30.8
MR16	GZ4	11.3	28.5	16.3	14.5	10.8	9.8	13	39.8	45.8	42.5	45	12.6
MR18	GZ2	-	-	-	-	-	11.5	3.8	22	22.6	32.1	3.3	6.2
MR19	GZ5	-	-	-	-	-	0	0.5	6.5	2.6	24.1	2.5	2.2
Average		12.8	15.7	19.5	17.2	17.1	12.7	12.3	28.6	30.8	29.4	16.9	13.7

APPENDIX G. RIPARIAN VEGETATION MANAGEMENT – PHOTO POINTS

				
MR09	**MR10**	**MR11**	**MR12**	**MR13**
				
MR14	**MR15**	**MR16**	**MR18**	**MR19**

APPENDIX H. 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
Acacia brownii	Heath Wattle	0.2	20	0.2	40
Acacia decurrens	Silver Wattle	0.5	1	-	-
Acacia longifolia	Sydney Golden Wattle	0.1	1	0.1	1
Acacia obtusifolia	Stiff-leaf Wattle	-	-	0.1	1
Angophora bakeri	Narrow-leaved Apple	15	40	20	15
Anisopogon avenaceus	Oat Speargrass	0.1	3	-	-
Austrostipa scabra	Speargrass	-	-	0.1	1
Banksia oblongifolia	Fern-leaved Banksia	0.1	2	0.2	2
Banksia spinulosa	Hairpin Banksia	1	5	0.2	1
Bossiaea heterophylla	Variable Bossiaea	0.2	30	1	100
Brachyloma daphnoides	Daphne Heath	-	-	0.1	1
Burchardia umbellata	Milkmaids	-	-	0.1	1
Cassinia sp.		0.3	40	1	100
Cassytha glabella	Slender Devil's Twine	0.1	100	0.1	20
Coronidium scorpioides	Button Everlasting	0.1	30	0.1	20
Cyathochaeta diandra	Sheath Rush	1	20	2	50
Dianella longifolia	Smooth Flax-lily	-	-	0.1	4
Dodonaea viscosa	Broadleaf Hopbush	-	-	0.1	1
Drosera peltata	Sundew	0.1	3	0.1	5
Empodisma minus	Wire Rush	15	60	10	200
Entolasia stricta	Wiry Panic	2	60	1	50
Epacris microphylla	Coral Heath	0.1	1	-	-
Eucalyptus parramattensis	Parramatta Red Gum	-	-	2	3
Eucalyptus racemosa	Narrow-leaved Scribbly Gum	1	3	1	1
Gahnia aspera	Rough Saw-sedge	0.1	10	-	-
Gonocarpus teucrioides	Forest Raspwort	0.1	1	-	-
Hakea sericea	Needlebush	2	45	5	30

Hardenbergia violacea	False Sarsaparilla	0.1	30	0.1	3
Hibbertia puberula	-	0.1	2	0.1	3
Hypericum gramineum	Small St John's Wort	-	-	0.1	3
Kunzea ambigua	Tick Bush	-	-	0.1	1
Kunzea capitata	-	0.1	1	-	-
Leptospermum parvifolium	Lemon-scented Tea Tree	5	45	2	30
Leptospermum trinervium	Slender Tea-tree	2	30	3	30
Leucopogon virgatus	Common Beard-heath	0.1	2	-	-
Lindsaea linearis	Screw Fern	0.2	50	0.1	20
Lomandra filiformis	Wattle Matt-rush	0.1	3	0.1	3
Lomandra gracilis	-	-	-	0.1	2
Lomandra longifolia	Spiny-headed Mat Rush	-	-	0.2	10
Medicago polymorpha	Burr Medic	0.1	10	0.1	10
Melaleuca nodosa	Prickly-leaved Paperbark	10	40	5	40
Opercularia diphylla	-	0.1	20	-	-
Persoonia linearis	Narrow-leaved Geebung	-	-	0.1	1
Persoonia nutans	Nodding Geebung	-	-	0.1	1
Petrophile pulchella	Conesticks	0.5	30	0.2	10
Philotheca salsolifolia	-	0.2	30	0.2	10
Pimelea linifolia	Slender Rice Flower	0.2	50	0.1	50
Plantago lanceolata	Lamb's Tongues	0.1	2	-	-
Poranthera microphylla	Small poranthera	0.1	5	-	-
Salvia sp.	-	-	-	0.1	3
*Senecio madagascariensis**	Fireweed	0.1	20	0.1	20
Themeda triandra	Kangaroo Grass	0.1	1	0.1	10
Trachymene incisa	Wild Parsnip	0.1	25	0.1	30
Tricoryne elatior	-	0.1	10	0.1	2
*Verbena bonariensis**	Purpletop	0.1	1	-	-
Xanthorrhoea sp.	-	0.1	1	-	-

APPENDIX I. NEST BOX MONITORING REPORT (SPRING 2024)

Memo

DATE
28/04/2025

[redacted]

SUBJECT
Moorebank Logistics Park - Spring Nest Box Monitoring 2024

Arcadis were commissioned by Tactical Group on behalf of LOGOS to conduct the annual spring nest box monitoring survey within the Moorebank Logistics Park (MLP). The spring 2024 monitoring event marks the seventh 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 2024 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 - Rail Access Land Package (RALP) and Package 2 - Import Export (IMEX) Terminal, 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 associated with the removal of 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 2024 nest box monitoring surveys, there are a total of 213 nest boxes within the BA341 biobank site; 53 in the Wattle Grove offset area (Bootland) and 160 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 – 2023 and 2024 (the subject of this report) per the requirements specified in the MPE NBS.

This memo summarises the results of the seventh round of nest box monitoring undertaken by Arcadis in spring 2024 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.

It is no longer recommended that nest boxes be installed using the ‘Habisure’ method due the damage the wire causes the trees they are installed on. Nest boxes installed in this manner should be eventually changed to the preferred direct screw attachment method. Nest boxes with fixed lids are unable to be inspected during monitoring and thus cannot be used when calculating occupancy rates. It is recommended that fixed nest box lids be phased out in favour of hinged lids. Annual inspection of nest boxes is 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: cockatoo/owl and arboreal mammal/lorikeet nest boxes installed using habisure method, cockatoo/owl nest box installed using the screws attaching to the tree, glider nest box installed using the habisure method.

Previous surveys

Nest box monitoring 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 varied between 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.
- the decommissioning of damaged or fallen nest boxes during management works between monitoring years.

The number of nest boxes internally inspected has also changed 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 all 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**
2023	Bootland	51	51
	Georges River corridor	163	144
	Total	**214**	**195**
2024	Bootland	53	53
	Georges River corridor	160	130
	Total	**213**	**183**

Summary of findings from last year's (2023) monitoring

The outcomes of the previous years (2023) nest box monitoring survey and nest box maintenance works (2024) are summarised below:

- 214 nest boxes were located: 163 in the Georges River corridor and 51 in the Bootland.
- 195 nest boxes were inspected internally using a pole-mounted camera.
- 19 nest boxes were not internally inspected.
- 61 nest boxes were occupied by native fauna: 32 in the Georges River corridor and 29 in the Bootland.
- 102 nest boxes were utilised by native fauna: 72 in the Georges River corridor and 31 in the Bootland.
- Ten boxes were utilised by invasive fauna (European Honeybee (*Apis mellifera*) and Common Myna (*Acridotheres tristis*)).
- During the 2023 survey period, 51 nest boxes were identified as requiring maintenance or removal, with 11 of these classified as needing urgent action.
- During remediation works in June 2024, 13 nest boxes were assessed for maintenance action. The following works were undertaken:
  - Ten nest boxes maintenance actions undertaken and were reinstalled within the offset site
  - Three nest boxes were unable to be accessed due to safety constraints
- One next box was found to be damaging a tree due to the cord used in attachment.

Methodology

Nest box monitoring surveys within the Bootland and Georges River corridor were undertaken by Arcadis ecologists Taylor Bliss-Henaghan, Acacia Jennings, and Emma Teusner across three days in Spring, 2024. 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, 2024)

Date	Min (°C)	Max (°C)	Rain (mm)	Max wind gust	
				Direction	Speed (km/h)
24 September 2024	11.6	26.7	0	SSE	28
25 September 2024	13.9	26.8	0	W	31
27 September 2024	10.2	17.2	12.2	SSE	41

Ecologists traversed the Bootland and Georges River corridor on foot, using an Arc-GIS enabled iPad to locate nest boxes. 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

Some nestboxes were unable to be reached or inspected during the survey event. Only nest boxes internally inspected were included in the calculation of occupancy and utilisation rates.

Results

A total of 213 nest boxes were located by Arcadis during the spring 2024 survey period: 53 in the Bootland and 160 in the Georges River corridor. Of the 213 nest boxes located during the 2024 survey period, 183 nest boxes were internally inspected using a pole-mounted camera. The remaining 30 were not inspected internally for the following reasons:

- 10 nest boxes were installed greater than 10 metres above the ground and could not be reached with a pole-mounted camera.
- 12 nest boxes were not fitted with hinged lids and therefore could not be internally inspected with a pole-mounted camera.
- 6 boxes were inaccessible due to the high cover of vegetation, primarily Lantana.
- 2 nest boxes could not be accessed due to safety concerns.

Twenty of the nest boxes located during the spring 2024 monitoring did not have ID numbers. Eighteen of these unnumbered boxes can be accounted for using 2022 and 2023 data, with some installed prior to 2020 when the tree-tag numbering system was implemented. The remaining two unidentified next boxes were both found fallen and damaged and could not be accounted for using 2023 data. The coordinates of these two nest boxes match the coordinates of next boxes #41 and #46 in 2022 data, however these ID's have already been accounted for during the spring 2024 monitoring event. It is possible that these nest boxes were subject to corrective actions previously and reinstalled in their current position.

A summary of the utilisation and condition of nest boxes from the spring 2024 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 2024 monitoring period:

- 52 nest boxes were occupied by native fauna, 11 nest boxes in the Bootland and 41 nest boxes in the Georges River corridor.
- 3 nest boxes were occupied by invasive fauna, two from the Georges River corridor and one from Bootland.

Table 5 provides a list of species recorded occupying or utilising nest boxes during the 2024 monitoring period, and examples of nest boxes occupied by native fauna are shown in Plate 2. 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
Common Brushtail Possum (*Trichosurus vulpecula*) Common Ringtail Possum (*Pseudocheirus peregrinus*) (Plate 2) Galah (*Eolophus roseicapilla)* Rainbow Lorikeet (*Trichoglossus haematodus*) Sugar Glider (*Petaurus breviceps*)	Black Rat (*Rattus rattus*) Common Myna (*Acridotheres tristis*) European Honeybee (*Apis mellifera*)

Plate 2: Native fauna recorded occupying nest boxes within the survey area – Common Ringtail Possum (left), Galah (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's 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 both native and invasive species are shown in Plate 3.

Plate 3: Examples of nest boxes utilised by fauna – Invasive Indian Myna nesting material (left) and native Sugar glider nesting material (right)

A summary of nest box utilisation observed during the spring 2024 survey event includes:

- 99 nest boxes are considered to be utilised by native fauna, 31 in the Bootland and 68 in the Georges River corridor, equating to a utilisation rate of 47% for all nest boxes in the 2024 survey period.
- 13 nest boxes are considered to be utilised by invasive species, 2 in the Bootland and 11 in the Georges River corridor, equating to an overall utilisations rate of 6%.

A summary of nest box utilisation by invasive fauna during the spring 2024 survey event includes:

- 3 nest boxes contained old or active European Honeybee hives.
- 10 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 2024 survey period showed minor deterioration due to weathering or use by fauna. Nestboxes that were the subject of the 2024 nestbox corrective actions showed that damages were due to the timber not being painted or sealed exposing it to the elements. This damage was then worsened by the chewing of cockatoos and damp nesting material that accelerated the rot in the bottom of the nest boxes.

Of the 213 nest boxes located, 50 were identified as requiring assessment for maintenance actions for the following reasons:

- A total of 26 were nest boxes identified as damaged and in poor condition for use by fauna. Damages included missing bottoms and lids and lack of drainage for pooling water. Three nest boxes were found to have fallen from the tree.
- Nest box installed at a height above 10 metres: Ten nest boxes were installed too high and were unable to be internally inspected due to the camera being unable to reach the box.
- Seven nest boxes were unable to be accessed due to dense *Lantana camara* blocking access.
- Nest box unstable on the tree due to incorrect mounting: A total of two nest boxes were loose on the tree.
- Nest box installed in an inappropriate location (i.e., no shade): One nest box was found to have little shade cover and had potentially resulted in a fauna fatality.

- One nest box was installed too low to the ground (below three metres).
- Three nest boxes have remained unutilised since their installation in 2018, indicating they may be installed in inappropriate locations.

Many of the nest boxes inspected during the 2024 surveys were found to have several maintenance issues, 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 4.

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. A total of 10 next boxes (#56, #99, #146, #163, #164, #165, #169, #235, #243, and one unnumbered box in Georges River corridor) were unable to be reached using a pole-mounted camera as they are above this height. Two damaged nestboxes were also unable to be reached (#125 and one unnumbered box in Georges River corridor).

The following nest boxes were previously listed for corrective action in the 2023 nest box monitoring report: #59, #99, #125 and #163. Nest boxes #125 and #163 were assessed during the corrective actions in 2023 as requiring elevated working platform (EWP) due to being on a dead tree which cannot be climbed with ropes and these actions have still not been addressed as of the corrective actions in 2024 and the 2024 spring next box survey. Nest boxes #99 will also require the use of an EWP for relocation. The nest box 56 contained feral Honeybees preventing safe relocation by tree climbers.

Issues with nest boxes that may put fauna at risk cannot be identified if boxes are unable to be inspected.

Plate 4: Examples of nest boxes with management issues – fallen nest box (left), nest box with full sun exposure (right)

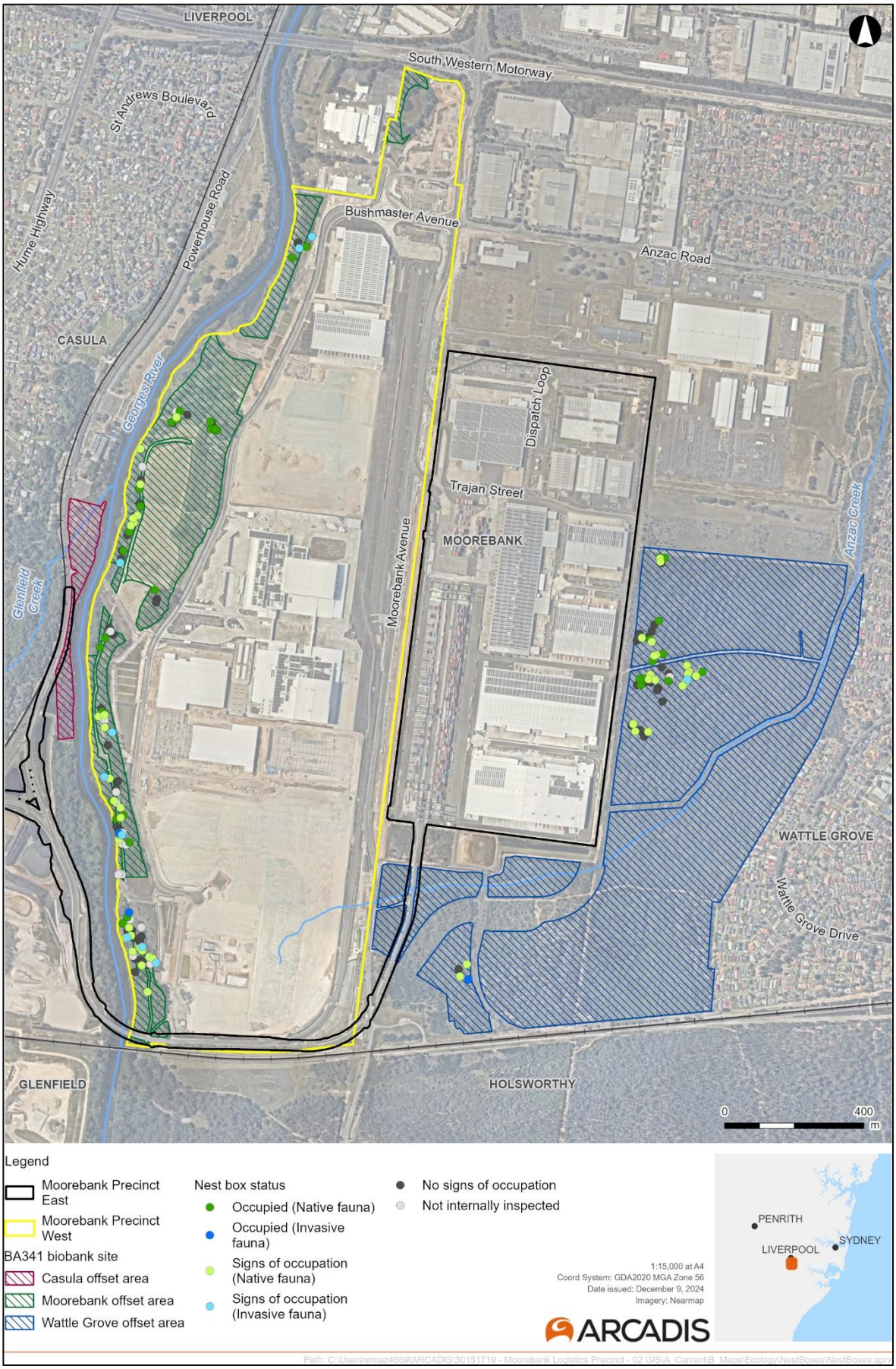


Figure 1: Results of the 2024 nest boxes monitoring survey

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 6.

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%**
2023	Bootland	49	(29) 59%
	Georges River	161	(32) 20%
	Total	**214**	**(61) 29%**
2024	Bootland	53	(11) 21%
	Georges River	160	(41) 26%
	Total	**213**	**(52) 24%**

A comparison between annual spring monitoring periods from 2018-2022 indicates a steady increase in the occupation of nest boxes by native fauna but a decline from 2022-2024 (

Figure 2). In the 2018 monitoring event, 11 per cent of nest boxes were occupied, which had increased to a 35 per cent rate of occupation in 2022 but decreased to 24 per cent in the 2024 survey period. The 2024 result was the fourth highest occupancy rate in the seven years of monitoring.

Overall, there has been a 5 per cent reduction in the occupation of nest boxes by native fauna across both offset sites during the 2024 monitoring period. The Bootland showed a large decrease from 59% to 21% occupation of nest boxes by native fauna between the 2023 and 2024 monitoring periods, while Georges River had a small increase from 20% to 26% occupation by native fauna between the same monitoring periods. It in the 2023 next box monitoring report, it was suggested that the reduction in the 2023 Georges River nest boxes could be attributed to the maintenance actions that occurred in the site.

The variability in the data likely reflects a variety of processes including changes in species composition, seasonal patterns of behaviour and temporal variation of nest box use.

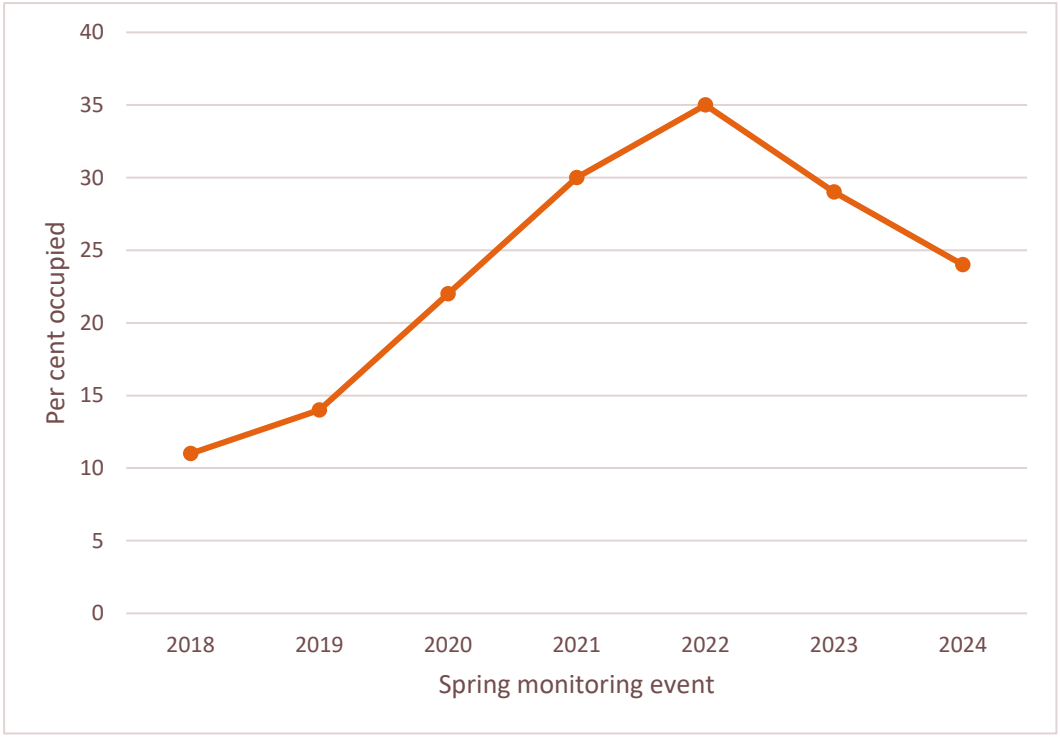


Figure 2: Occupancy rate of nest boxes by native fauna for spring monitoring events between 2018 and 2024

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 by native fauna for all

nest boxes has increased from 33 per cent in 2018 to 52 per cent in 2022 but decreased to 47% in 2024 (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) 9.6%	(3) 6%
	Georges River corridor	195	(65) 33%	(5) 2.5%
	Total	**247**	**(70) 28%**	**(8) 3.2%**
2019	Bootland	54	(21) 39%	(2) 3.7%
	Georges River corridor	199	(60) 30%	(6) 3%
	Total	**253**	**(81) 32%**	**(8) 3%**
2020	Bootland	52	(28) 53.8%	(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) 5.6%
	Total	**229**	**(131) 57%**	**(10) 4.4%**
2022	Bootland	51	(31) 61%	(1) 2%
	Georges River corridor	174	(86) 49.4%	(7) 4%
	Total	**225**	**(117) 52%**	**(8) 3.5%**
2023	Bootland	49	(31) 63%	(0) 0%
	Georges River corridor	161	(72) 45%	(10) 6%
	Total	**214**	**(102) 48%**	**(10) 5%**
2024	Bootland	53	(31) 59%	(2) 6%
	Georges River corridor	160	(68) 43%	(11) 7%
	Total	**213**	**(99) 47%**	**(13) 6%**

While there is still a 19% increase in the total number of nest boxes with signs of use by native fauna since 2018, noting that nest boxes may show signs of occupation from previous years, utilisation by native fauna has been slowly decreasing since 2021, from 57% to 47% in 2024.

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. During the 2023 spring survey, Nest boxes #8, #87, #150 and #253 recorded no utilisation and therefore, were recommended be relocated to more desirable habitat during the next maintenance works. These maintenance actions were not carried out, however, in the 2024 surveys, nest box #87 was recorded as having evidence of use. The remaining three nest boxes #8, #150 and #253 are still recommended for relocation.

Overall, nest box occupancy and utilisation by native fauna are considered adequate if occupancy rates are greater than 10% (Goldingay et al. 2018, Lindenmayer et al. 2017). As the occupancy rates for native fauna in both the Bootland and the Georges River corridor are 21% and 26% respectively, the levels of occupancy and utilisation are considered adequate.

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 2024 monitoring event had the highest rate of utilisation by invasive fauna at 6%.

The overall nest box occupancy by invasive species between installation in 2018 and monitoring in 2024 is considered low and 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 2024 survey period, with all invasive species observed in previous monitoring years.

Nest box management and maintenance

Currently, there are 213 recorded nest boxes across the Bootland and Georges River corridor. Of these, 26 nest boxes are broken or have fallen from the tree and are unable to be used by local fauna, meaning the number of functional boxes providing suitable habitat for native hollow-dependant fauna species is 187. One additional nest box may be considered to be not functional due to low sun protection resulting in fauna mortality.

To maintain the hollow replacement ratio of 2:1 for hollows removed by the MLP development, the number of functional boxes required is 216.

A total of 50 nest boxes were identified as requiring maintenance actions during the spring 2024 survey period, including the 26 nest boxes (and the one additional sun exposed nestbox) that are no longer considered functional. In assessing the condition of nest boxes during monitoring, some nest boxes identified as requiring maintenance are still considered to be functional to fauna. Nest boxes with management issues that were still considered functional to fauna were those that have been:

- Identified as being unstable on the tree, but not at immediate risk of falling.
- Unable to be internally inspected during the 2024 surveys due to overgrown vegetation restricting access.
- Installed on a dead tree, but in otherwise good condition (restricts from access).
- Installed at a height below 3 metres
- Nest box has no evidence of use since 2018 monitoring period.

Table 8 summarises nest boxes identified as requiring maintenance action. Maintenance works have been undertaken in March 2022, May 2023 and June 2024 to repair and reinstall nest boxes across the site, however, the number of failing nest boxes continues to increase annually as the boxes approach the end of their expected lifespan. As per the NBS (CPB 2018), nest boxes that are not functional to fauna are to be classified as requiring urgent repair. The 27 nest boxes identified as not providing habitat to fauna should therefore be repaired and reinstalled as soon as possible.

Due to the increasing number of failing nest boxes, it is recommended that the installation of alternative artificial hollows be considered for future maintenance works, such as chainsaw hollows or mechanically bored hollows inside large eucalypts. Carved hollows built into trees generally require less maintenance than nest boxes and may be preferrable to fauna due to better temperature regulation (Terry et al. 2023). Rather than continually repairing already degraded nest boxes within the offset site, Arcadis recommends the installation of new hollows to meet the hollow replacement ratio. The Moorebank offset sites has an abundance large Eucalypts and stags which would be suitable for the installation of carved hollows.

For the nest boxes identified as requiring maintenance action, it is recommended that the condition of these nest boxes be reassessed in spring 2025 for risk to fauna and changes to functionality. Nest boxes that pose a risk to fauna are to be flagged for urgent maintenance.

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

Issue	Box ID Number	Action Recommended	Urgency
Box fallen from tree	170, No ID, No ID	Recover box, assess for condition and reinstall if undamaged	Urgent
Damaged box	11, 18, 41, 43, 59, 62, 79, 86, 87, 103, 117, 123, 125, 136, 153, 175, 195, 200, 212, 220, 230, No ID, NoID	Decommission box and replace, or repair and reinstall below 8 metres	Urgent
Box on tree with no shade cover	30	Reinstall box in tree in shaded position	Urgent
Installed above 10 metres in height and unable to be internally inspected	56, 99, 146, 163, 164, 165, 169, 235, 243, No ID	Reinstall box at appropriate height	Non-urgent
Unstable on tree	7, 40	Reinstall box securely on tree at appropriate height	Non-urgent
Box inaccessible due to overgrown vegetation	55, 57, 58, 191, 209, 244, 249	Remove exotic species blocking tree access	Non-urgent
Installed below 3 metres in height	52	Reinstall box at appropriate height	Non-urgent
Nest box shows no evidence of use in 5-year period	8, 87, 253	Relocate nest box to higher quality habitat and/or more appropriate position on tree	Non-urgent

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APPENDIX A. **NEST BOXES REQUIRING MAINTENANCE**

Box Location	Box ID	Box Condition	Action Required
Bootland	7	Unstable on tree	Reinstall box to be securely attached to tree
Bootland	8	No evidence of use	Consider relocation to a different area of habitat
Bootland	11	Damaged box	Decommission box or repair and reinstall at an appropriate height
Bootland	18	Damaged box	Decommission box or repair and reinstall at an appropriate height
Bootland	30	Sun exposure	Reinstall box in shaded position
Bootland	40	Unstable on tree	Reinstall box to be securely attached to tree
Bootland	41	Damaged box	Decommission box or repair and reinstall at an appropriate height
Bootland	43	Damaged box	Decommission box or repair and reinstall at an appropriate height
Georges River Corridor	52	Box height	Reinstall higher on tree
Georges River Corridor	55	Box inaccessible	Weed control - remove Lantana blocking tree access
Georges River Corridor	56	Box height	Reinstall lower on tree
Georges River Corridor	57	Box inaccessible	Weed control - remove Lantana blocking tree access
Georges River Corridor	58	Box inaccessible	Weed control - remove Lantana blocking tree access
Georges River Corridor	59	Damaged box	Decommission box or repair and reinstall at an appropriate height
Georges River Corridor	62	Damaged box	Decommission box or repair and reinstall at an appropriate height
Georges River Corridor	79	Damaged box	Decommission box or repair and reinstall at an appropriate height
Georges River Corridor	86	Damaged box	Decommission box or repair and reinstall at an appropriate height
Georges River Corridor	97	Damaged box	Decommission box or repair and reinstall at an appropriate height
Georges River Corridor	99	Box inaccessible	Reinstall lower on tree
Georges River Corridor	103	Damaged box	Decommission box or repair and reinstall at an appropriate height
Georges River Corridor	117	Damaged box	Decommission box or repair and reinstall at an appropriate height
Georges River Corridor	123	Damaged box	Decommission box or repair and reinstall at an appropriate height
Georges River Corridor	125	Damaged box	Decommission box or repair and reinstall at an appropriate height
Georges River Corridor	136	Damaged box	Decommission box or repair and reinstall at an appropriate height
Georges River Corridor	146	Unstable on tree	Reinstall box to be securely attached to tree
Georges River Corridor	153	Damaged box	Decommission box or repair and reinstall at an appropriate height
Georges River Corridor	163	Unstable on tree	Reinstall box to be securely attached to tree
Georges River Corridor	164	Unstable on tree	Reinstall box to be securely attached to tree

Box Location	Box ID	Box Condition	Action Required
Georges River Corridor	165	Box inaccessible	Reinstall lower on tree
Georges River Corridor	169	Box inaccessible	Reinstall lower on tree
Georges River Corridor	170	Fallen Box, damaged box	Decommission box or repair and reinstall at an appropriate height
Georges River Corridor	175	Damaged box	Decommission box or repair and reinstall at an appropriate height
Georges River Corridor	191	Box inaccessible	Weed control - remove Lantana blocking tree access
Georges River Corridor	195	Damaged box	Decommission box or repair and reinstall at an appropriate height
Georges River Corridor	200	Damaged box	Decommission box or repair and reinstall at an appropriate height
Georges River Corridor	209	Box inaccessible	Weed control - remove Lantana blocking tree access
Georges River Corridor	212	Damaged box	Decommission box or repair and reinstall at an appropriate height
Georges River Corridor	220	Damaged box	Decommission box or repair and reinstall at an appropriate height
Georges River Corridor	230	Damaged box	Decommission box or repair and reinstall at an appropriate height
Georges River Corridor	235	Box inaccessible	Reinstall lower on tree
Georges River Corridor	243	Box inaccessible	Weed control - remove Lantana blocking tree access
Georges River Corridor	244	Box inaccessible	Weed control - remove Lantana blocking tree access
Georges River Corridor	249	Box inaccessible	Weed control - remove Lantana blocking tree access
Georges River Corridor	No ID	Box inaccessible	Reinstall lower on tree
Georges River Corridor	No ID	Damaged box	Decommission box or repair and reinstall at an appropriate height
Georges River Corridor	No ID	Damaged box	Decommission box or repair and reinstall at an appropriate height
Bootland	No ID	Fallen Box, damaged box	Decommission box or repair and reinstall at an appropriate height
Bootland	No ID	Fallen Box, damaged box	Decommission box or repair and reinstall at an appropriate height

APPENDIX B. **FAUNA RECORDED IN NEST BOXES**

Location	Box ID	Box Type	Species	Notes
Bootland	10	Medium mammal/small parrot	Unidentified	One egg- possibly Wood duck
Bootland	13	Glider	Sugar Glider	
Bootland	30	Glider	Sugar Glider	Possibly dead
Bootland	33	Medium mammal/small parrot	Rainbow Lorikeet	
Bootland	38	Kookaburra	Common Ringtail Possum	Two or more
Bootland	39	Glider	Sugar Glider	Two
Bootland	42	Glider	Sugar Glider	
Bootland	45	Medium mammal/small parrot	Common Ringtail Possum	
Bootland	48	Medium mammal/small parrot	Unidentified	Four eggs- possibly Wood Duck
Georges River Corridor	51	Medium mammal/small parrot	Sugar Glider	
Georges River Corridor	55	Medium mammal/small parrot	Common Ringtail Possum	
Georges River Corridor	61	Glider	Sugar Glider	Two or more
Georges River Corridor	64	Large bird	Common Ringtail Possum	Three
Georges River Corridor	72	Medium mammal/small parrot	Common Ringtail Possum	Two
Georges River Corridor	74	Medium mammal/small parrot	Common Brushtail Possum	
Georges River Corridor	83	Medium mammal/small parrot	Common Ringtail Possum	Adult and two juveniles
Georges River Corridor	85	Glider	Rainbow Lorikeet	
Georges River Corridor	88	Medium mammal/small parrot	Rainbow Lorikeet	
Georges River Corridor	89	Medium mammal/small parrot	Rainbow Lorikeet	
Georges River Corridor	91	Medium mammal/small parrot	Rainbow Lorikeet	Adult and two eggs
Georges River Corridor	92	Glider	Sugar Glider	
Georges River Corridor	93	Medium mammal/small parrot	Common Ringtail Possum	
Georges River Corridor	106	Medium mammal/small parrot	Rainbow Lorikeet	
Georges River Corridor	107	Medium mammal/small parrot	Rainbow Lorikeet	One egg
Georges River Corridor	108	Large bird	Wood Duck	Three eggs and down
Georges River Corridor	109	Medium mammal/small parrot	Rainbow Lorikeet	
Georges River Corridor	111	Glider	Sugar Glider	
Georges River Corridor	116	Medium mammal/small parrot	Rainbow Lorikeet	Juvenile
Georges River Corridor	134	Medium mammal/small parrot	Rainbow Lorikeet	Two eggs
Georges River Corridor	146	Medium mammal/small parrot	Unidentified	

Nest box annual monitoring report

Location	Box ID	Box Type	Species	Notes
Georges River Corridor	149	Medium mammal/small parrot	Rainbow Lorikeet	
Georges River Corridor	154	Glider	Rainbow Lorikeet	Two juveniles
Georges River Corridor	155	Glider	Rainbow Lorikeet	
Georges River Corridor	158	Medium mammal/small parrot	Common Brushtail Possum	
Georges River Corridor	159	Medium mammal/small parrot	Common Brushtail Possum	
Georges River Corridor	174	Medium mammal/small parrot	Rainbow Lorikeet	Two juveniles
Georges River Corridor	177	Glider	Sugar Glider	
Georges River Corridor	193	Large bird	Rainbow Lorikeet	One egg
Georges River Corridor	197	Medium mammal/small parrot	Galah	
Georges River Corridor	207	Glider	Sugar Glider	Three
Georges River Corridor	214	Medium mammal/small parrot	Unidentified	Possibly Black Rat
Georges River Corridor	216	Medium mammal/small parrot	Unidentified	Two large eggs
Georges River Corridor	219	Medium mammal/small parrot	Common Ringtail Possum	
Georges River Corridor	229	Medium mammal/small parrot	Common Brushtail Possum	
Georges River Corridor	234	Medium mammal/small parrot	Common Ringtail Possum	
Georges River Corridor	236	Medium mammal/small parrot	European Honeybee	Honeycomb
Georges River Corridor	238	Medium mammal/small parrot	Rainbow Lorikeet	Juvenile
Georges River Corridor	241	Medium mammal/small parrot	Common Ringtail Possum	
Bootland	No ID	Microbat	Unidentified	Possibly microbat
Bootland	No ID	Medium mammal/small parrot	Common Ringtail Possum	
Bootland	No ID	Large bird	European Honeybee	Honeycomb and hive
Georges River Corridor	No ID	Medium mammal/small parrot	Rainbow Lorikeet	
Georges River Corridor	No ID	Medium mammal/small parrot	Common Ringtail Possum	
Georges River Corridor	No ID	Medium mammal/small parrot	Indian Myna	
Georges River Corridor	No ID	Medium mammal/small parrot	Common Brushtail Possum	One egg- possibly Wood duck

APPENDIX J. ANNUAL KOALA MONITORING REPORT

Baseline Koala Monitoring Report

Addendum to the Moorebank Annual Flora and Fauna Monitoring Report

May 2025

Version Control

Revision No.	Date Issued	Description	Author	Approver
1	9 May 2025	First draft	[redacted]	

Contents

Acronyms and Abbreviations

Acronym	Definition
MPW	Moorebank Precinct West
MPE	Moorebank Precinct East
MIP	Moorebank Intermodal Precinct
SAT	Spot Assessment Technique
KMA	Koala Management Area
PKFT	Preferred Koalas Feed Tree
DBH	Diameter at Breast Height
VIS	Vegetation Integrity Scores

1 Introduction

As part of the Moorebank Intermodal Precinct (MIP), two Biobank offset areas were created, Wattle Grove to the east (MPE) and Georges River section to the west (MPW). In accordance with the Moorebank Precinct West conditions of approval, a Koala Management Plan (2020) was developed, due to be implemented once the MPW site became operational. Monitoring of Koala populations are to be undertaken as a critical component of the ongoing management of this threatened species at Moorebank. The monitoring will enable actions to be taken if a decline in Koalas is observed across the site or if movement is obstructed. It will also assist in informing revegetation and weed control.

Distinguishing important key habitat involves identifying key Koala feed trees. Koalas will typically avoid or occur in much lower densities where these trees are absent. The NSW Koala Recovery Plan describes seven Koala Management Areas (KMAs) located across NSW, based on landscape characteristics. Particularly, the geographic distribution of primary or secondary feed tree species, and administrative boundaries management of distinct populations. The Koala feed tree species differ between the seven management areas. The Intermodal Precinct and broader Sydney Metropolitan Area lie within the Central Coast KMA. The main Koala food trees in this KMA listed in the recovery plan include:

- Tallowwood (*Eucalyptus microcorys*)
- Swamp Mahogany (*E. robusta*)
- Forest Red Gum (*E. tereticornis*)
- Ribbon Gum (*E. viminalis*)
- Grey gum (*E. punctata*)

Furthermore, a review of Koala tree uses across New South Wales (OEH 2018) also identified several additional species that were considered regionally significant for Koalas. At Moorebank, relevant species are:

- Narrow-leaf Scribbly Gum (*E. racemosa)*
- Parramatta Red Gum *(E. parramattensis)*
- Sydney Blue-gum *(E. saligna)*
- Southern Mahogany *(E. botryoides)*
- Grey Box *(E. moluccana)*
- Narrow-leave Ironbark *(E. crebra)*
- Red Ironbark (*E. fibrosa*)

This report provides the results of baseline survey monitoring as well as providing a detail of the proposed long-term Koala monitoring program at Moorebank biobank sites. The methodology used in this report has been designed to be repeatable for the implementation in future annual assessments. It includes surveys using the Rapid Spot Assessment Technique, spotlighting and opportunistic observations. The report also provides a repeatable habitat assessment which consists of vegetation plots recording foliage cover from canopy, mid-storey and ground cover. Photo point monitoring has also been established as a repeatable measure for monitoring changes to habitat enabling rapid responses to weeds or other potential threats. A list of key recommendations are outlined in this report which complement the existing actions listed in the original Koala Management Plan. These recommendations further bolster the overall aim of conserving the Koala population at Moorebank.

2 Methods

The following sections detail the survey methodology utilised for the baseline Koala monitoring surveys undertaken between December 2024 and May 2025. The survey methodology outlined below is to be adopted for annual monitoring surveys. For all surveys, the presence of preferred feed trees was used to inform suitable monitoring locations. Methodology and effort for these surveys are based on the original recommendations provided in Moorebank Precinct West Stage 2 Koala Management Plan (2020) and the methodology detailed in 'Koala (*Phascolarctos cinereus*) Biodiversity Assessment Method Survey Guide' (DPE, 2022).

2.1 Annual monitoring survey site establishment

During the baseline Koala surveys, permanent survey locations were established across the Moorebank offset areas. Annual monitoring surveys are to be undertaken at these locations to assess changes in habitat quality and use by Koala. Surveys are to include Rapid Spot Assessment Technique (SAT) surveys and habitat assessments at each survey location. Survey locations were determined by overlaying a 250 x 250 metre grid on an aerial of each of the Moorebank offset sites, with permanent monitoring locations to be established where the centre of each grid square intersected suitable Koala habitat. Each grid square was inspected for suitable Koala habitat including suitable feed trees. If there were no suitable trees recorded, the marker was located at the most suitable location closest to the central point.

Each potential monitoring site was assessed for the presence of preferred Koala feed trees (over 10-centrimetre DBH) and therefore suitable habitat. If preferred feed trees were identified at, or near, the grid point location, a permanent monitoring location was established by:

- Demarcating the Rapid-SAT location by installing a star-picket painted blue next to the central tree (Plate 2-1)
- Allocating a location identification number and recording the monitoring location's geographic coordinates using a GIS-enabled iPad.

Following the establishment of the permanent monitoring location using the above methodology, a Rapid-SAT survey and habitat assessment were completed.

Plate 2-1 All SAT sites were marked with a star picket, which was spraypainted with blue paint to ensure easy locating in future years, and to help distinguish them from other monitoring stakes for vegetation within the Biobank.

2.2 Rapid Spot Assessment Technique

Koalas can be difficult to detect due to their ability to remain camouflaged in the tree canopy. Instead, indirect evidence of Koala occurrence such as scats and scratches can be used to detect the occurrence of Koalas in a local area. One such method which has been widely used to determine Koala activity is the Spot Assessment

Technique (SAT) (Phillips and Callahan 2020). The SAT involves selectively searching around the base of known Koala feed trees for the presence of Koala scats.

The Rapid-SAT technique is a modification to the SAT to allow for more time efficient surveys, which allow for larger areas to be assessed in much quicker succession (Phillips et al. 2021). The Rapid SAT differs to the regular method in that it only requires searching of the nearest 5-7 preferred Koala feed trees that have a minimum diameter at breast height (DBH) of 30 centimetres. In contrast, the standard SAT survey methodology requires searching of the closest 29 trees of any species with a DBH of over 10-centimetres, closest to the central tree which is much more labour intensive.

When completing a Rapid SAT at each tree, the undisturbed leaf litter was searched within 100 centimetres from the base of the trunk, followed by a more thorough inspection involving disturbance of leaf litter and ground cover. Where Koala faecal pellets were detected, the location was recorded with tree species, height, and DBH on a GIS-enabled iPad or other mobile device. Where feasible, the scats were collected with an aim to have them genetically assessed (as per the recommendations in the Koala Management Plan) to determine the number of individuals as per the recommendations in the Koala Plan. However, discussions with EcoDNA at Canberra University have determined that it is not possible to identify individuals via scats as the eucalyptus toxins damage the DNA. All Rapid-SAT surveys were undertaken in optimal conditions, avoiding heavy rainfall which may reduce the detectability of pellets.

2.3 Spotlighting

Nocturnal spotlighting surveys were undertaken in both the Wattle Grove and Georges River Corridor offset areas. Surveys focused on Wattle Grove areas due to the large number of suitable feed trees. Transects were undertaken primarily along the internal access tracks of the offset areas to allow for easy repeatability. While Koalas can be surveyed year-round, wet and windy conditions were avoided for nocturnal transects as it could make detection more difficult.

Transects were primarily completed on foot, however vehicle-based transects were also conducted along the Georges River Corridor in areas of low tree density. As Koala calls are more likely to be heard when walking, it is recommended to undertake these surveys on foot where possible. Ecologists used high-powered handheld torches to slowly scan vegetation for eyeshine, walking at an average pace of 10 minutes per 100 metres or <5 kilometres per hour when travelling in a vehicle. Koalas have bright eyeshine but can still be difficult to detect requiring careful searching of each tree. Koalas can be found in both the saddle of the tree (forked branches) or on the edges of the branches where they feed on epicormic regrowth. It is therefore important that spotlighting examined all parts of the trees.

All nocturnal spotlighting transects were recorded using a GIS-enabled iPad, and all species encountered were identified using visual observation and/or call with a species list generated for each transect. Observations of Koalas, or any other threatened species, had date, time, and geographic coordinates recorded using a GIS-enabled tablet or smartphone. All spotlighting transects were undertaken in dry and calm conditions.

The construction works for the Moorebank Avenue realignment were not underway at the time of the spotlighting, however, it is anticipated that these works and final road construction may impact on Koalas nocturnal surveys. The route shown may need to be modified to accommodate access constraints due to the newly constructed road.

2.4 Habitat monitoring

The improvements to the biobank areas through revegetation will overtime benefit Koalas by providing more suitable feed trees and reducing the density of weedy shrubs such as Lantana (*Lantana camara)*. Habitat monitoring procedures described in the MPW Koala Management Plan allow for the early detection of any problems associated with the development of the biobanking sites to enable swift implementation of appropriate ameliorative measures. Such measures may include watering of plant stock during dry conditions, weed control and fire hazard reduction procedures.

The MPW Koala Management Plan provides a list of vegetation characteristics which should be recorded on an annual basis. However, many of these characteristics are not expected to change in the short term due to limited revegetation works. Arcadis has proposed a new rapid habitat monitoring methodology to ensure the same rigour is applied with reduced survey effort.

The newly proposed rapid habitat monitoring is recommended to assess the relevant vegetation characteristics to Koalas while also ensuring time efficiencies can be maintained. The rapid vegetation assessments were completed on 30 April and 01 May 2025. At each permanent monitoring location, a 20 x 20 metre quadrat was assessed, looking 20m south and 20m east from the stake. Two plots – sites 3 and 6 however had cleared areas to the south, so the plot was undertaken facing north instead. The following vegetation characteristics were recorded:

- Eucalypt canopy – species and percentage of cover
- Mid-storey – species and percentage of cover (below 8m)
- Ground cover – dominant species and percentage of cover
- Leaf litter – percentage of cover
- Estimated cover of weeds
- Any other changes or issues on site

In addition to rapid assessment data collected at each of the habitat monitoring points, existing vegetation monitoring data from across the biobank sites was reviewed to assess broad-scale changes in vegetation condition over time. Vegetation integrity score (VIS) plots undertaken for monitoring of BA341 were reviewed for the purpose of informing changes to Koala habitat across the site. A total of 35 vegetation plots were assessed in 2020 and reassessed again in 2024. The results of the most recent assessment were reviewed for any significance for the Koala population at Moorebank.

2.5 Photo point monitoring

To support the rapid habitat assessments, Arcadis ecologists obtained photos of a south and north orientation at each of the permanent monitoring locations to be used to compare structural vegetation changes across the offset sites. This method provides a visual record of changes, allowing for easy assessment of project progress and effects of management for Koala conservation.

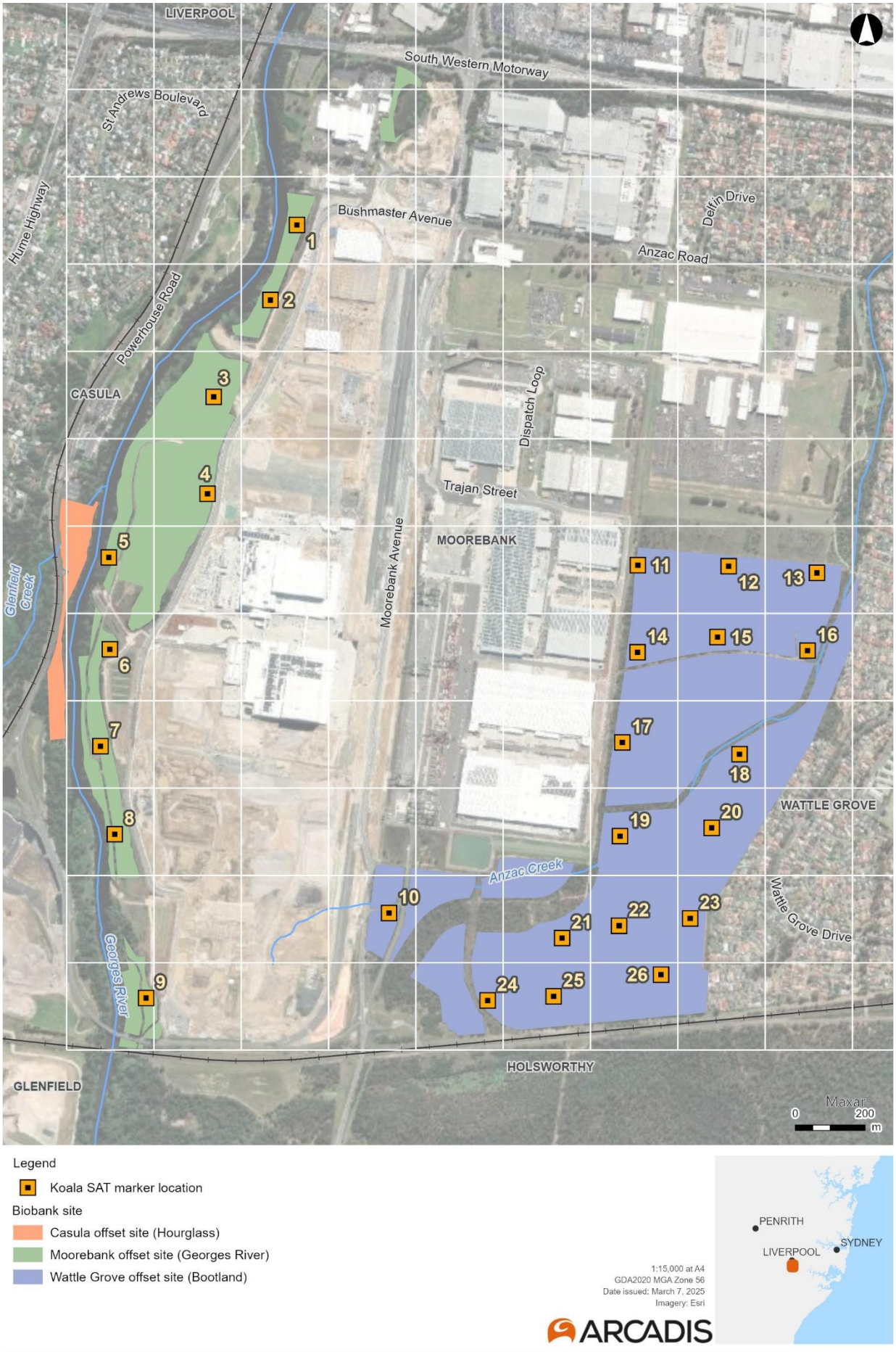

Figure 2-1 Map showing the locations of each Rapid-SAT annual monitoring sites across the Biobank.

2.6 Incidental observations

Incidental observations can make up valuable data for recording the presence and movement of Koalas across the biobank site. A system of reporting of any road kills/injuries has been implemented so that all on-site personnel are aware of the necessary procedures and the significance of such information. This reporting system extended to the sightings of any individuals within the project boundary and offset areas. Information recorded included:

- Location of sighting/animal (location subsequently to be mapped),
- Status of animal (live in tree, injured etc),
- If injured/dead, cause of injury or death; and
- Identification of any relevant factors contributing to the status of the animal.

Camera traps were also deployed annually across the offset sites to monitor connectivity features in the site and pest animal populations. Reports of Koala records on these cameras are captured in the Moorebank Operational Monitoring Annual Monitoring Report. Observations of Koala from the report are to be included in incidental observation data.

The BA341 biobank contractor is to be contacted on an annual basis to get a summary of works undertaken to improve Koala habitat and request any Koala sightings/observations from the previous year.

3 Results

Surveys confirmed Koala presence in both the Wattle Grove offset area, and along the Georges River Corridor. We recorded four observations of Koalas with a maximum of two on one night suggesting that the population is multiple individuals. The following provides a summary of the approaches used.

3.1 Rapid Spot Assessment Technique

Koala scats were detected at four locations within the Wattle Grove offset area. Areas of use include those both in the north and south of Wattle Grove. Scats were found at the base of Scribbly Gum (*E. racemosa*), Grey Box (*E. moluccana*) and Forest Red Gum (*E. tereticornis).* An incidental observation of Koala scats was also recorded on the track near site 8. Koala scats *(*Plate 5-1*)* were also recorded in the central section of the Georges River Corridor, at the base of a Forest Red Gum (*E. tereticornis)*. Table 5-1 shows the centre trees and GPS location for each Rapid SAT site.

3.2 Spotlighting

Koalas were detected on three occasions during spotlighting. Two were observed by sight and a third was heard calling nearby but could not be found due to the thick shrub layer impeding view. Two observations, one by sight and the other by sound (calling Koala) were recorded in a single night further demonstrating that there are multiple individuals. Photographs were also obtained where possible *(*Plate 5-2 and 5-3*).*

3.3 Incidental observations

On 23 September 2024, a Koala was identified in the MPE rail corridor and subsequently was caught and relocated by Wires, a wildlife rescue organisation. Fencing on either side of the rail facility likely rendered the animal trapped. The Koala was found to be in a healthy condition and released by Wires outside of the MLP site or offset areas. The source of the Koala is unknown.

Four Koala observations were recorded on camera traps used for pest animal monitoring. Koala observations 1 (22 October 2024) and 2 (16 October 2024) were recorded on the central access track of the Wattle Grove offset area, close to SAT site 17. Koala observation 3 (16 October 2024) was spotted approximately 1km away in the southwest corner (see Figure 5-1) suggesting that the biobank supports multiple individuals. Koala observation 4 was observed on the MPW site along the Georges River close to SAT monitoring site 8. Photos of two of the Koalas captured on camera traps is shown in Plate 5-4 and 5-5.

Figure 3-1 Map of the Koala scats recorded, and other Koala observations.

Plate 5-1. Example Koala scats found at the base of a E. racemosa not far from where the species was observed the following evening during spotlighting. Deep scratches on the tree were also observed.

Plate 5-2. Koala feeding in a E. moluccana on the northern edge of the Wattle Grove site.

Plate 5-3. Koala observed in a E. tereticornis on the northeast side of the Wattle Grove opposite the warehouses.

Plate 5-4.. This observation was on the western boundary of the Wattle Grove site and another observation was made on the same night near the southern end of the reserve, presumably a different individual.

Plate 5-5. Koala photographed along the Georges River close to the site where scats were detected previously.

Table 3-1 The coordinates for each Rapid-SAT assessment stake, the main canopy tree species at the centre and if Koala Scats were detected in 2024 monitoring.

Site ID	Centre tree species	Lat	Long	Scat detected
1	*Eucalyptus botryoides x saligna*	150.9194316	-33.94385669	
2	Forest Red Gum (*Eucalyptus tereticornis*)	150.9185632	-33.94577864	
3	Lemon-scented Gum (*Corymbia citriodora*)	150.9167464	-33.9482481	
4	Forest Red Gum (*Eucalyptus tereticornis*)	150.9164945	-33.95074482	
5	Forest Red Gum (*Eucalyptus tereticornis*)	150.9133985	-33.95233547	yes
6	*Eucalyptus botryoides x saligna*	150.9133714	-33.95470615	
7	*Eucalyptus botryoides x saligna*	150.9130219	-33.95720291	
8	*Eucalyptus botryoides x saligna*	150.9134071	-33.95948048	
9	*Eucalyptus botryoides x saligna*	150.9142749	-33.96372164	
10	Parramatta Red Gum (*Eucalyptus parramattensis*)	150.9218526	-33.96165702	
11	Forest Red Gum (*Eucalyptus tereticornis*)	150.9297746	-33.95281469	yes
12	Parramatta Red Gum (*Eucalyptus parramattensis*)	150.9325846	-33.95288577	
13	Scribbly Gum (*Eucalyptus racemosa*)	150.9353146	-33.95310377	
14	Parramatta Red Gum (*Eucalyptus parramattensis*)	150.9297098	-33.95506026	
15	Scribbly Gum (*Eucalyptus racemosa*)	150.9321961	-33.9547095	yes
16	Scribbly Gum (*Eucalyptus racemosa*)	150.9349739	-33.95510518	
17	Parramatta Red Gum (*Eucalyptus parramattensis*)	150.9291809	-33.95737755	yes
18	Scribbly Gum (*Eucalyptus racemosa*)	150.9328039	-33.95774268	
19	Scribbly Gum (*Eucalyptus racemosa*)	150.9290531	-33.95979647	
20	Scribbly Gum (*Eucalyptus racemosa*)	150.9318956	-33.95962727	
21	Scribbly Gum (*Eucalyptus racemosa*)	150.9271948	-33.96239298	yes
22	Scribbly Gum (*Eucalyptus racemosa*)	150.9289692	-33.96210604	
23	Scribbly Gum (*Eucalyptus racemosa*)	150.9311751	-33.96195368	
24	Narrow-leaved Ironbark (*Eucalyptus crebra*)	150.9248497	-33.96396587	yes
25	Parramatta Red Gum (*Eucalyptus parramattensis*)	150.9268958	-33.96389432	
26	Parramatta Red Gum (*Eucalyptus parramattensis*)	150.930236	-33.96338924	

3.4 Habitat monitoring

The following provides an overview of the habitat recorded across the sites. Figure 5-2 shows the overall mean cover of canopy, mid-storey and ground layer which can be used for comparison in future years. A full list of the species recorded is shown in Appendix A.

3.4.1 Canopy cover

The preliminary habitat assessments identified that the Wattle Grove and Georges River Corridor offset sites contained differing vegetation and habitat features, however both sites have the potential to support Koala. The Wattle Grove monitoring sites recorded Narrow-leaf Scribbly Gum (*E. racemosa*) as the most encountered canopy tree in amongst patches of Parramatta Red Gum (*E. parramattensis),* Grey box *(E. moluccana),* Narrow-leaved Ironbark, *(E. crebra)* and Broad-leaved Ironbark, *(E. fibrosa) (*see Plate 5-6 and Plate 5-7*).* Habitat assessments along the Georges River Corridor had a canopy dominated by *E. botryoides x saligna*, Forest Red Gum (*E. tereticornis)* and Broad-leaved Apple (*Angophora subvelutina*) *(*see Plate 5-8 and Plate 5-9*)*.

3.4.2 Mid-storey cover

Frequently encountered species in the mid-storey of Wattle Grove included *Acacia falcata, A, parramattensis, A. decurrens, Bursaria spinosa, Hakea sericea* and *Exocarpos cupressiformis*. The mid-stratum of the Wattle Grove sites frequently contained dense stands of *Melaleuca nodosa, Hakea sericea, Banksia spinulosa, Leptospermum parvifolium, L. trinervium* and *Petrophile pulchella*. This dense cover has the potential to impede the movement of Koalas and should be monitored across the site for encroachment into other areas.

The Georges River mid-stratum included species such as *A. binervia, A. decurrens* and *B. spinosa*. The Georges River has areas with a high cover of weeds including *Olea europaea sub cuspidate, Senna pendula var. glabrata* and *Lantana camara*. The Lantana has made access to some sites along the river difficult, particularly while searching for scats within the dense leaf litter. The Georges River Corridor sites to the south has been subject to clearing of Lantana, improving suitability for Koalas.

3.4.3 Ground cover

The ground cover at Wattle Grove largely consisted of patches of grasses such as *Microlaena spp.*, and *Entolasia stricta*, with sedges such as *Lomandra filiformis, Lepidosperma gladiatum* and *Carex gaudichaudiana* increasing in cover in areas closer to Anzac Creek towards the south of the site. In contrast, the Georges River sites contained a grassy understorey consisting of mostly (>90%) exotic species such as *Eragrostis curvula*.

3.4.4 Photo point monitoring

The images (shown in Appendix B) are to be taken annually to assist in evaluating the vegetation changes and allow for intervention if required.

3.4.5 Additional vegetation monitoring assessments

The report found that vegetation integrity scores (VIS) from Biodiversity Assessment Method monitoring plots improved across all Plant Community Types (PCTs), all management zones, burnt areas, unburnt areas, areas that been actively managed through weed removal and areas that have been passively managed. This indicated that, overall, management of the site is progressing toward the objectives of improved biological diversity and ecological function and will enhance opportunities for Koala conservation.

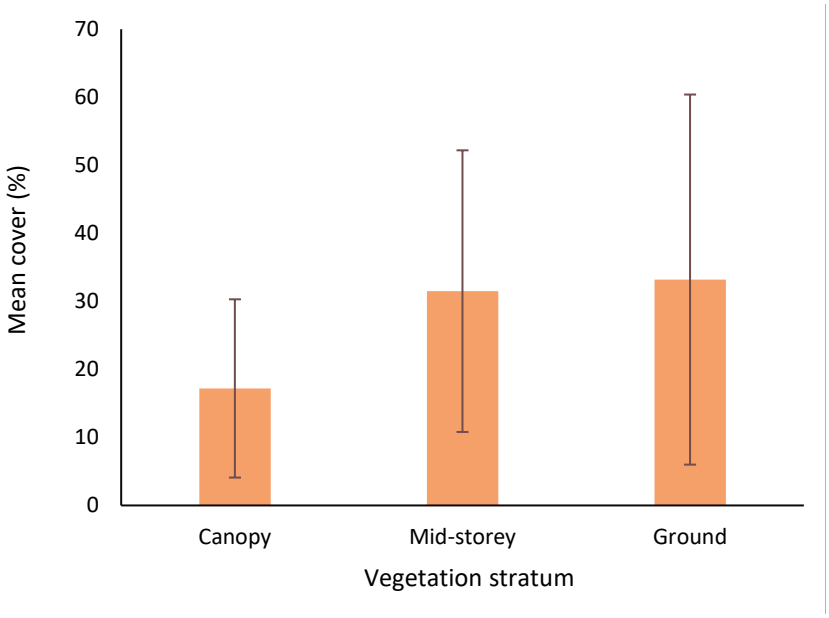

Figure 5-2. Mean (STD) foliage cover of each stratum across the Koala SAT sites.

Plate 3-6 Wattle Grove sites typically consisted of a dominant canopy of Scribbly Gum (a listed preferred Koala Feed Tree), but the dense undergrowth may impede Koala movement in the areas.

Plate 3-7 Most sites were of juvenile or maturing trees with narrow DBH.

Plate 3-8 The Georges River Biobank site consists of Eucalyptus botryoides x saligna, *Forest Red Gum and Broad-leaved Apple. Some areas have recently had the Lantana cleared as seen here which could improve Koala habitat.*

Plate 3-9 The Georges River contains less suitable habitat for Koalas, with areas of dense undergrowth of Lantana.

4 Discussion

This report outlines the baseline surveys undertaken by Arcadis and details methodology for subsequent annual monitoring. Monitoring methodology will remain consistent in subsequent monitoring periods to ensure adequate replication, to allow for annual comparisons of Koala occurrence and habitat quality. The works undertaken fulfil Moorebank Intermodals commitment in the Operational Flora and Fauna Management Plan to design a long-term Koala monitoring program across MIP offset areas.

The habitat at the Moorebank Intermodal Precinct offset sites were found to contain rich resources for Koalas. All species of canopy trees recorded at Moorebank are listed as preferred Koala feed trees in the Central Coast Koala Management Area. Both the Georges River and Wattle Grove offset sites contain access to permanent water which will support Koalas survival during extreme heat in summer.

The detection of Koalas and their scats across the biobank demonstrates that there is an existing population of Koalas within the offset sites, and conservation strategies need to be utilised to conserve this population.

4.1 Annual monitoring

Ongoing annual surveys using the Rapid-SATs and spotlighting as described in this report will be critical for understanding the population dynamics at Moorebank and if site use changes as vegetation matures. This will be of particular importance in areas where revegetation and weed removal works are underway. It is possible that through this habitat improvement, additional habitat for Koalas is created allowing for the population to expand. It could also be beneficial in understanding how the species will respond to the impending Moorebank Avenue realignment which could further fragment the existing habitat on site.

Spotlighting surveys should primarily be undertaken by foot across the same transects as shown in this report. However, modification to the proposed path may be required following the post-construction access from the soon to be built Moorebank Avenue Realignment. Where possible, high-resolution images should be taken of the Koalas which may be able to be used to identify specific individuals. Male Koalas can be easily distinguished by the large dark scent glands on the chest.

4.2 Measuring population

Critical to the management of the Koala population at Moorebank, is determining the number of Koalas that are currently present. Scat surveys and spotlighting have limitations in assessing population numbers. Scats typically can provide insight into how a site is being used. Whereas spotlighting may only detect a small percentage of Koalas which are close to the selected transect. More recently, aerial drone surveys for Koalas have been used as a detection tool for land managers (Chad *et al.* 2021). The heat signatures of Koalas are easily detected allowing for a precise number of Koalas individuals to be counted. The Moorebank site is relatively small and could be traversed by a drone in a single evening. The use of drones should be undertaken to collect specific data on the number of individuals which is to be repeated once every five years.

4.3 Fencing

The existing fencing surrounding the Wattle Grove offset site currently protects Koalas from predation by dogs (Dissanayake et al. 2023) and vehicle strikes. However, the barbed wire on the top of the fence is likely to represent a threat to Koalas (and other fauna) if they climb the fence. During our field assessment, a dead Federally Listed Grey-headed Flying Fox (*Pteropus poliocephalus*) was observed entangled in the barbed wire fencing. Modification to the fence should include removal of barbed wire and the installation of Koala friendly overpass bridges (see Plate 6-1) and gates (see Plate 6-2), to facilitate access in and out of the offset site which would ensure safe passage to the larger Holsworthy Reserve to the south. Details of the specific locations where these should be installed are noted in the original Koala Management Plan (2020). In areas of high risk such as those in close proximity to the road, a floppy top fence may be required to help deter Koalas climbing.

Along the Georges River Corridor, there is also a need to continue to construct a fence that separates the offset site from the MPW operational facility. This will provide long-term benefits to the Koala population by protecting them from vehicle collisions and ensure minimal disturbance.

Plate 4-1 Example of simple Koala bridge to allow for safe passage over a fence. Image Brisbane City Council.

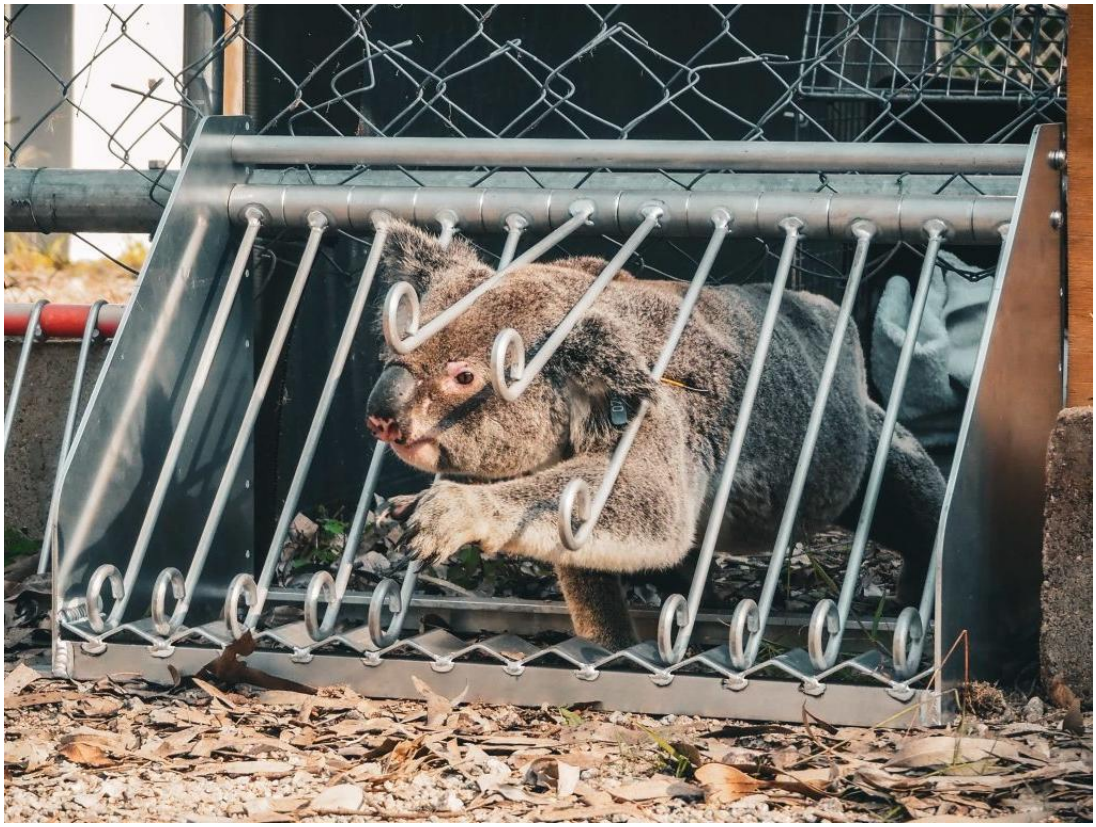

Plate 6-2 The 'Koala Doggy Door' has recently been implemented by Endeavour Veterinary Ecology with evidence of successful use by Koalas.

4.4 Weed control

The infestations of Lantana along the Georges River Biobank represent a challenge for habitat regeneration and Koalas. There is anecdotal evidence to suggest that Koalas may avoid dense thickets infested by Lantana (Tran and Maron 2024). Thickets of weeds also prevent natural regeneration of eucalypts which are a critical food source to Koalas.

We observed very few instances of natural regeneration of eucalypts occurring along the Georges River section. This may be due to dense weed cover that dominates the ground in many areas. Where possible, further weed control is required to control the spread of Lantana. Fortunately, there is no Lantana found in the Wattle Grove section of the site and any emerging weeds in this area should be targeted immediately to prevent them becoming a significant threat. There is a particular risk with the new Moorebank Avenue construction which could introduce exotic seeds or plant material through imported mulch and poor vehicle hygiene measures.

4.5 Key recommendations

Additional recommendations from this report are provided (Table 6-1) to compliment those already provided in the Moorebank Koala Management Plan.

Table 4-1 Koala monitoring actions

No.	Action	Justification	Priority
1	Annual population monitoring	Using the Rapid SAT methodology presented in this report, annual surveys should be undertaken to monitor the population of Koalas to allow for evaluation of effectiveness of land management activities across the site including weed control, revegetation and pest control. Spotlighting and incidental observations should also be recorded annually as per the methodology outlined in the Moorebank Koala Management Plan.	High
2	Annual habitat monitoring	The newly proposed rapid habitat monitoring will include annual permanent monitoring locations at each of the SAT survey stakes. Vegetation characteristics to record include: • Tree canopy species present and estimated cover of preferred Koala feed trees • Shrub species and estimated cover • Estimated cover of weeds • Any other changes or issues on site • Photo point monitoring (images should be aligned with previous year images)	High
3	Remove barbed wire	Barbed wire fencing to be removed from the Biobank and replaced with single strand wires which do not pose a risk to wildlife including Koalas. There is already existing evidence that barbed wire is having a negative impact on threatened species. Koalas are highly likely to either be entangled or injured while attempting to climb.	High
4	Safe fence crossings to be constructed	To ensure free access in and out of the Biobank sites, Koala friendly bridges or 'doggy doors' should be constructed at specific locations described in the original Koala Management Plan or as provided by a qualified ecologist.	Medium
5	Install fence on boundary of Georges River Biobank	A fence is required to ensure that the Georges River corridor Koala population is protected from vehicles and predator species (stray dogs).	Medium
6	Drone survey	Nocturnal drone surveys to be used to individually count the Koalas in the Moorebank Biobank every five years. Such data will be used to assist in evaluating changes to the population and be used to promote the conservation reserve objectives.	Low

5 Monitoring requirements

The annual monitoring should include habitat monitoring (as described in this report), and rapid-SAT surveys at each individual monitoring site. It is anticipated that over time Koala detection will increase across various sections of the biobank area which will assist in decision-making processes to ensure the implementation of adequate management measures to improve habitat quality. A database of each site will be maintained over the course of the initial five-year monitoring period. After this period, a detailed report is to be completed to evaluate the outcomes of the five years of monitoring. The report will detail the progresses to improve outcomes for the conservation of koalas including:

- Specific number of preferred Koala feed trees planted across the biobank sites
- Total hectares of noxious weed removal
- Improvements in connectivity including gates, culvert crossings and overpasses
- Improvements to fencing including removal of barbed wire and new fencing along all boundaries with the biobank
- Total number of Koalas utilising the biobank site and any changes in population size

5.1 Adaptive management

This document is a dynamic document, and changes may be made to the procedures if improvements or issues are identified. Any amendments should be carefully considered and approved by an experienced independent ecologist. It is essential that any changes be recorded in the version control table at the start of this plan to ensure adequate record keeping is maintained.

6 References

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Phillips, S. and Callaghan, J., 2011. The Spot Assessment Technique: a tool for determining localised levels of habitat use by Koalas Phascolarctos cinereus. *Australian Zoologist*, *35*(3), pp.774-780.

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APPENDIX A. Rapid habitat assessment species and foliage cover list

*Exotic

Site ID	Canopy species	Canopy cover %	Dominant mid species	Mid cover %	Dominant ground species	Ground cover %	Leaf litter %
1	*Eucalyptus botryoides x saligna, E. microcorys, E. parramattensis*	30	*Acacia binervia* - all tall and almost canopy. No midstorey otherwise	15	Grass dominated	25	80
2	*E. tereticornis*	20	*Acacia. parramattensis*, **Pittosporum undulatum*, **Lantana camara* (2% of 15% cover is exotic)	15	Grass understory	3	95
3	*Corymbia citriodora*	45	*Arundo donax*, *Melia azedarach*, **L. camara*	5	Entirely leaf litter	0	95
4	*E. tereticornis*	35	*A. binervia, Acacia. decurrens, *P. undulatum, A. parramattensis, Styphelia sieberi, *L. camara* (5% of total)	18	Grass understory	3	90
5	*E. tereticornis, E. botryoides x saligna*	25	**P. undulatum, A. binervia, Olea europaea subsp. cuspidata, *L. camara, **, (exotic cover 55% of the 60%)	60	Grass dominant	5	98
6	*E. botryoides x saligna*	10	*A. decurrens, A. binervia, Bursaria spinosa, *O. europaea subspecies cuspidata, *L. camara* (4% of total is exotic)	15	Grass understory	55	80
7	*E. botryoides x saligna, Angophora subvelutina*	10	*A. binervia, *L. camara* (1%)	40	Grass understory	5	95
8	*E. botryoides x saligna, A. subvelutina*	10	*A. binervia, *L. camara, O. europaea subsp. cuspidata, *Ligustrum sinense* (50% of 60% cover is exotic)	60	Grass understory mostly exotic	60	95
9	*E. botryoides x saligna*	60	**L. camara, *Senna pendula*	5	Grass understory	5	0

10	*E. parramattensis*	15	*A. parramattensis, A. decurrens, Melaleuca nodosa, Acacia falcata, Hakea sericea, Leptospermum trinervium*	30	Sedge dominated with some grass	70	90
11	*E. tereticornis, E. crebra*	20	*M. decora, B. spinosa, A. decurrens, Exocarpos cupressiformis, A. binervata Grevillea spp., Casuarina glauca*	50	Sedge dominated	10	90
12	*E. parramattensis, E. crebra, E. fibrosa*	10	*M. decora, M. nodosa, Casuarina glauca, Exocarpos cupressiformis, A. binervata*	15	Sedge dominated	15	90
13	*E. racemosa, Angophora sp., E. parramattensis*	5	*M. nodosa, H. sericea, B. spinulosa, M. ericifolia,*	60	Sedge dominated	50	80
14	*E. parramattensis, E. crebra,*	15	*A. decurrens, E. cupressiformis, Styphelia sieberi, B. spinosa, M. decora, Allocasuarina spp.*	15	Complete grassy understory	80	20
15	*E. racemosa, Angophora sp., E. parramattensis*	10	*Grevillea spp., H. sericea, Callistemon linearis. M. ericifolia, M. decora, B. spinosa,*	20	Sedge dominated	15	90
16	*E. racemosa, Angophora sp.,*	10	*Persoonia linearis, H. sericea, M. decora, B. spinulosa, Banksia spp., Isopogon spp., A. ulicifolia*	45	Bracken and sedge dominated	25	90
17	*E. parramattensis*	5	*A. decurrens, B. spinosa, H. sericea, Styphelia sieberi, Exocarpos spp.*	50	Grassy dominated understory, some sedges and other forbs	60	60
18	*E. racemosa, Angophora sp., E. parramattensis*	20	*M. decora, B. spinulosa, Acacia falcata*	20	Grass dominated	40	90
19	*n/a*	n/a	n/a	n/a	n/a	n/a	n/a

20	*E. racemosa, Angophora sp., E. parramattensis*	15	*M. decora, M. nodosa, H. sericea, Callistemon linearis.*	45	Sedge and grass co-dominant	65	80
21	*E. racemosa, E. parramattensis, E. crebra*	5	*H. sericea, M. decora, A. falcata, Pultenaea villosa*	45	Grass dominated	15	75
22	*E. racemosa, E. crebra, E. parramattensis, E. fibrosa*	7	*M. nodosa, M. decora, A. falcata, B. spinulosa, H. sericea*	60	Sedge dominated	30	70
23	*E. racemosa, E. parramattensis,* Stringybark eucalypt	25	*P. villosa, Casuarina spp., M. decora, H. sericea, A. falcata*	70	Sedge dominated	40	90
24	*E. crebra, E. parramattensis*	8	*M. decora, Allocasuarina spp. P. villosa, Gaudium parvifolium, M. nodosa*	5	Sedge and rush co-dominant	5	90
25	*E. parramattensis, E. crebra, E. fibrosa*	*7*	*P. villosa. M. decora*	5	Rush dominant	60	90
26	*E. parramattensis, Angophora sp.,*	10	*P. villosa, Leptospermum continentale, M. decora*	20	Sedge and rush co-dominant	90	30

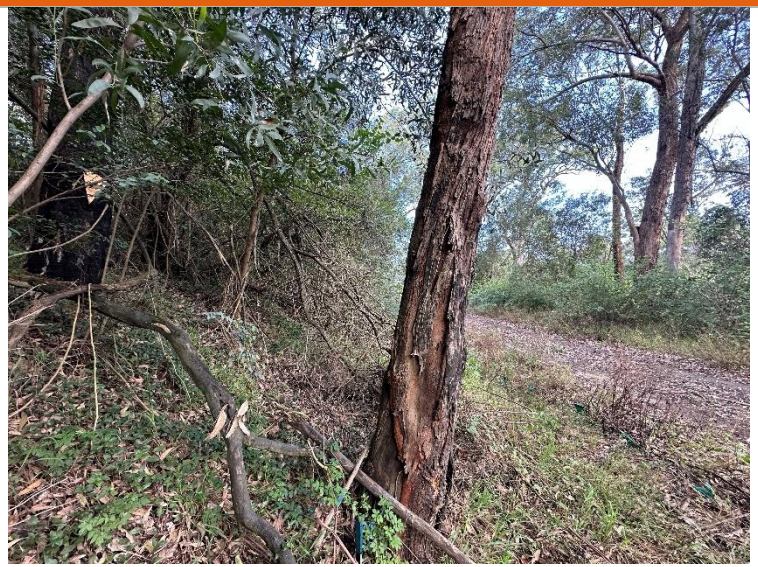
APPENDIX B. Images from photo point monitoring

Site ID	North orientation	South orientation
1		

Site ID	North orientation	South orientation
2		
3		

Site ID	North orientation	South orientation
4		
5		

Site ID	North orientation	South orientation
6		
7		

Site ID	North orientation	South orientation
8		
9		

Site ID	North orientation	South orientation
10		
11		

Site ID	North orientation	South orientation
12		
13		

Site ID	North orientation	South orientation
14		
15		

Site ID	North orientation	South orientation
16		
17		

Site ID	North orientation	South orientation
18		

Site ID	North orientation	South orientation
19		NA

Site ID	North orientation	South orientation
20		
21		

Site ID	North orientation	South orientation
22		
23		

Site ID	North orientation	South orientation
24		
25		

Site ID	North orientation	South orientation
26