Transport for New South Wales

Warrell Creek to Nambucca Heads

Annual Underpass Monitoring Report - Operational Phase, Year Five (2022-2023)

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Pacific Highway upgrade: Warrell Creek to Nambucca Heads (WC2NH)

Underpass and adjacent habitat monitoring – Operational Phase Year Five (2022-23)

Sandpiper Ecological Surveys

Final Report

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Project Team:

Mr L. Andrews (Project management, reporting and fieldwork)

Mrs E. Leal (Reporting and fieldwork)

Dr D. Rohweder (Review)

Ms A. English (Fieldwork)

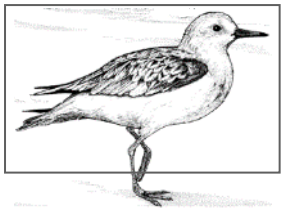
Mrs N. Steel (Fieldwork)

Ms. S. Maclagan (Fieldwork)

Mr. F. Makin (Fieldwork)

Report prepared for:

Transport for New South Wales



ABN: 82 084 096 828

837 Rogerson Road, McKees Hill
david@sandpipereco.com.au

13 Alkina Street, Sapphire Beach
luke@sandpipereco.com.au

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1 Introduction

In 2015, Transport for NSW (TfNSW), in conjunction with Acciona Ferrovial Joint Venture (AFJV), commenced the upgrade of the Pacific Highway between Warrell Creek and Nambucca Heads (WC2NH). The WC2NH project was opened to traffic in two stages:

- Stage 2a - 13.5km section from Lower Warrell Creek Bridge to Nambucca Heads opened on 18 December 2017; and
- Stage 2b - 6.25km section from the southern end of the project to the Lower Warrell Creek bridge opened on 29 June 2018.

The Ministerial Conditions of Approval (MCoA) for the WC2NH upgrade included a requirement (MCoA B10) to prepare an Ecological Monitoring Program (EMP). The EMP was developed and approved in 2014 and later amended in 2018 (RMS 2018). Species and mitigation measures targeted in the EMP include koala, spotted-tailed quoll, grey-headed flying fox, yellow-bellied glider, giant barred frog, green-thighed frog breeding ponds, vegetated median, road-kill, exclusion fencing, threatened flora, and fauna underpasses.

As part of the project's approval (MCoA B1, B2, B3) fauna underpasses were installed "to maintain the viability of local terrestrial fauna populations by facilitating wildlife movement between proximate areas of habitat either side of the upgrade corridor and to accommodate use by several threatened fauna species including the spotted-tailed quoll, koala and giant barred frog" (RMS 2018). To assess the effectiveness of the fauna underpasses the EMP specified that operational phase monitoring should take place bi-annually (i.e., spring/summer and autumn/winter) for 5 years. The seasonal timing of monitoring was intended to align with the breeding and dispersal periods of targeted threatened species (i.e., koala, spotted-tailed quoll and giant barred frog).

The following report presents the methods and results of year five operational phase underpass and adjacent habitat monitoring. It serves as the final report for the operational monitoring period, as outlined in the EMP, and evaluates the effectiveness of the underpass structures as a mitigation measure (RMS 2018). The effectiveness of exclusion fence is assessed in the annual road-kill report (Sandpiper Ecological 2024). The results of underpass and adjacent habitat monitoring are discussed in relation to the potential indicators of success detailed in the WC2NH EMP (RMS 2018) and recommendations regarding future monitoring are provided. The potential indicators of success used to assess the performance of the WC2NH underpasses include:

1. Low rates of use of fauna underpasses and adjacent habitats by feral predators.
2. High levels of fauna underpass use by a wide variety of native fauna species.
3. No change to densities, distribution, habitat use, and movement patterns compared to baseline population data of target species.
4. Evidence of use by dispersing individuals and different age cohorts.
5. Use by cover-dependent species and species with low mobility.

A list of species names for fauna referred to in text and tables is provided in Appendix A.

2 Methods

2.1 Study area

The WC2NH project covers a total length of 19.75km and extends from Warrell Creek in the south to Nambucca Heads in the north (Figure 1). The alignment bypasses the town of Macksville and the northern section traverses Nambucca State Forest. The WC2NH upgrade features 23 fauna underpasses, including 13 box culverts, three pipe culverts and seven bridges. Underpasses targeted for monitoring were specified in the WC2NH EMP and included eleven box culverts and one bridge (RMS 2018; Table 1). Eleven underpasses were situated north of the Nambucca River and one (Site 1) was situated at Upper Warrell Creek near the southern extent of the project (Figure 1). Sites four to 12 adjoined Nambucca State Forest and sites two and three adjoined remnant vegetation on private land (Figure 1). Site five included a dual cell box culvert with one cell designated as a wet passage (for aquatic fauna) and the other as dry passage (Plate 1). The dry cell included a concrete ledge that provided dry passage for terrestrial fauna. Sites 9/10, and 11/12 consisted of corresponding culverts on either side of a vegetated median (Plate 1). Fauna underpasses were designed to target spotted-tailed quoll, koala, and giant barred frog. Giant barred frog is known to occur at site 1 (Upper Warrell Creek) only, whilst quoll and koala could occur at sites 2-12.

Table 1: Underpasses sampled during operational phase monitoring of the WC2NH upgrade. SQ = spotted-tailed quoll; K = koala; GBF = giant barred frog; * sites consist of dual cells 3x3m box culverts with one cell providing wet passage for aquatic fauna; P/A = presence/absence.

Site	Chainage	Type	Structure	Dimensions	Fauna Furniture (P/A)	Substrate	SQ	K	GBF
1	42500	Combined	Bridge		A	Soil			x
2	55120	Dedicated	Box Culvert	1 x 3000 x 3000	P	Concrete	x	x	
3	56410	Combined	Box Culvert	1 x 2400 x 2400	P	Concrete	x	x	
4	57770	Dedicated	Box Culvert	1 x 3000 x 3000	P	Mulch	x	x	
5 *	58510	Combined	Box Culvert	2 x 3000 x 3000	A	Concrete	x	x	
6	58560	Dedicated	Box Culvert	1 x 3000 x 3000	P	Mulch	x	x	
7	59090	Dedicated	Box Culvert	1 x 3000 x 3000	P	Mulch	x	x	
8	59550	Dedicated	Box Culvert	1 x 3000 x 3000	P	Mulch	x	x	
9	59750 NB	Dedicated	Box Culvert	1 x 2400 x 2400	P	Mulch	x	x	
10	59760 SB	Dedicated	Box Culvert	1 x 2400 x 2400	P	Mulch	x	x	
11	60600 NB	Dedicated	Box Culvert	1 x 2400 x 2400	P	Mulch	x	x	
12	60610 SB	Dedicated	Box Culvert	1 x 2400 x 2400	P	Mulch	x	x	

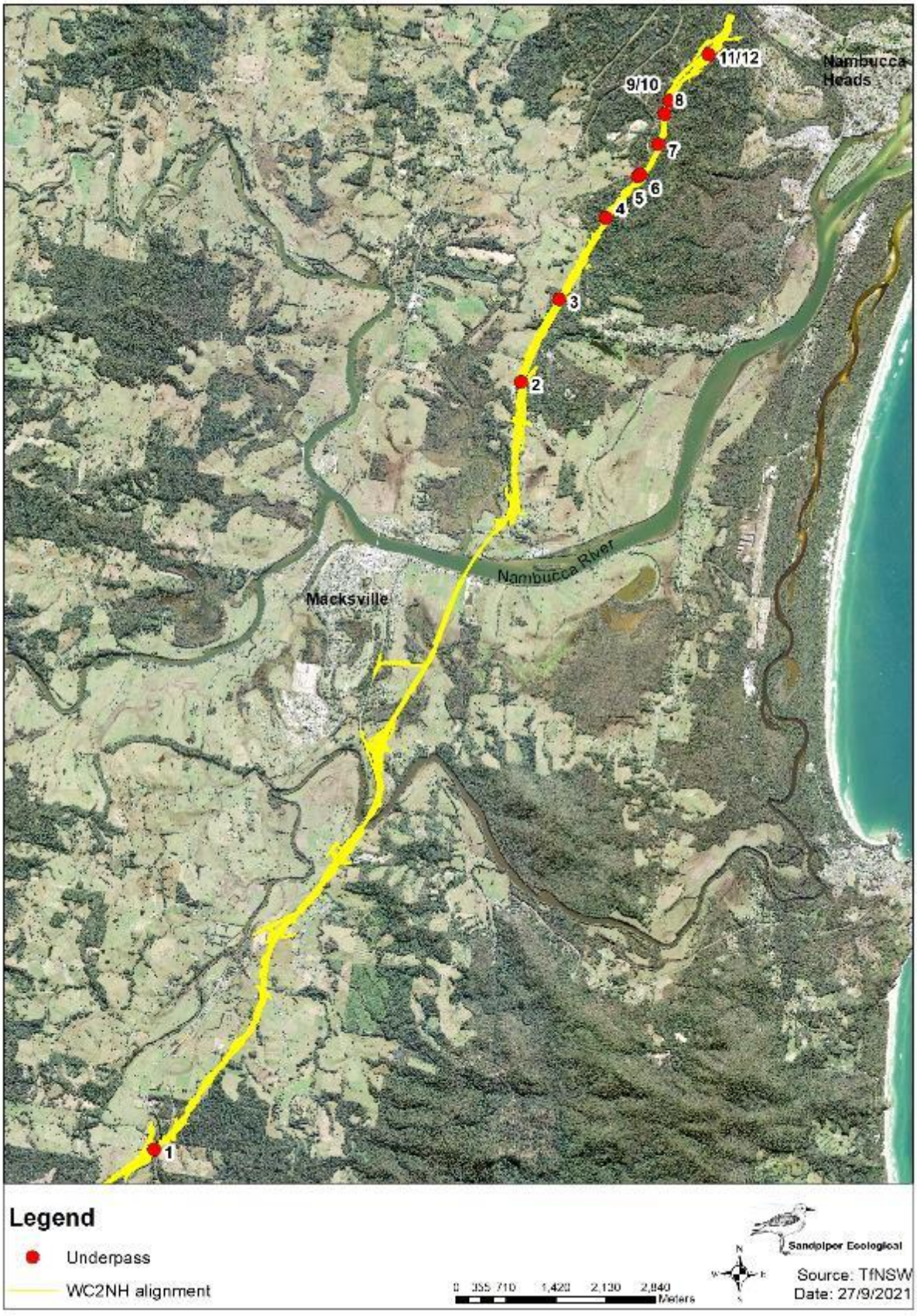

Figure 1: Underpass locations along the WC2NH alignment.

Plate 1. Dual box culverts with designated wet passage at site 5 (top left). Split median box culverts at site 9 and 10 (top right). Fauna furniture entering (bottom left) and exiting site 8 (bottom right).

2.2 Timing and weather conditions

Year 5 spring/summer operational phase underpass and adjacent habitat surveys were conducted between 14 October 2022 to 6 February 2023. Wet conditions were a feature of early spring monitoring when 300mm of rain fell during October (BOM, 2023). Dry conditions persisted from November to February with 175mm recorded at the Bellwood weather station (BOM, 2023). A total of 397mm of rainfall was recorded at the Bureau of Meteorology (BOM) Bellwood station (#059150) throughout the spring/summer monitoring period (BOM, 2023). Over the same period relative humidity was high with >60% recorded on most days and air temperature ranged from 20.8 to 36.9 ^{0}C (BOM, 2023a).

Winter surveys were conducted between 17 July and 22 September 2023. The surveys extended into spring to satisfy the prescribed 8-week underpass camera activity period (RMS, 2018). Conditions during this period were extremely dry with maximum temperatures ranging from 18.5 to 32.9 ^{0}C (Table 2). A total of 14 mm of rainfall was recorded for the entire period (BoM, 2023).

Table 2: Summary of weather conditions recorded at Coffs Harbour Airport (station 059151) and Bellwood weather station (rainfall only, 059150) during year five operational phase monitoring.

Monitoring period	Total rainfall (mm)	No. rain days	Relative humidity (%)	Max temp range (^{0}C)	Min temp range (^{0}C)
Spring/Summer	397	55	>60% on 73% of days	20.8 - 36.9	6.8 - 24.6
Winter	14	6	>60% on 57% of days	18.5 - 32.9	2.6 - 18.3

2.3 Underpass monitoring

2.2.1 Sand pads

Sand pads were installed using a 50:50 mix of brickies sand and washed beach sand. One sand pad was installed centrally in each culvert, whilst at the bridge (site 1), two pads were installed on the northern side of Warrell Creek. Each pad was approximately 50 mm deep by 1m wide and extended for the entire culvert width or 3-4m at site 1. The sand pad covered both the floor and ledge at sites with a concrete ledge (Plate 2). The exception was site 5, where the pad covered the ledge only due to standing water over the culvert floor. Sand pads were installed at the commencement of both the spring/summer and winter sample periods.

Sand pads were inspected on eight consecutive days during the spring/summer and winter sample periods. Inspections were conducted by an ecologist and included a systematic scan of each pad searching for fauna tracks. A small torch was used to illuminate the pad, if required. Information recorded included species or fauna group, number of traverses, direction of traverse and pad condition (good, fair, poor). Tracks were identified with reference to Triggs (2004) and advice from senior ecologists. Tracks that could not be identified insitu were photographed and referred to a senior ecologist for identification.

Plate 2. Sand pad being installed in a fauna underpass (Site 3) on the WC2NH upgrade.

2.2.2 Scat and track searches

An ecologist searched each underpass for scats and tracks on two occasions during both the spring/summer and winter sample periods. The search involved a slow systematic traverse of each culvert using a hand-held spotlight (Led Lenser P14). Fauna furniture, the culvert floor, and the culvert joints were targeted. Sand pads and areas of accumulated fine sediment were inspected for tracks. Tracks and scats were identified in-situ, with reference to Triggs (2004) and the ecologist's experience or photographed and sent to colleagues for identification.

2.2.3 Tile checks

In autumn 2020, two roof tiles (300x200) were installed 5 m from both ends of each underpass, excluding site 1, to target small mammals, reptiles and frogs. Tiles were inspected on eight occasions during the spring/summer and winter year 5 sample periods.

2.2.4 Cameras

Two motion-activated infra-red cameras (Swift 3C, Swift Enduro or Reconyx HC500) were installed centrally in each culvert or were housed in security boxes and attached to concrete posts for the bridge underpass at site 1. A total of 24 cameras were installed with 22 in culverts and two at the site 1 bridge. In culverts, both cameras were installed centrally, one on the fauna furniture, and one approximately 300mm above the culvert floor. All cameras in culverts were installed facing east except site 10 ground which was reorientated west due to repeated false triggers from southbound traffic. At the bridge underpass at site 1, Reconyx cameras were installed at approximately 200 mm above ground near the water's edge attached to a concrete post on each side of Upper Warrell Creek (site 1). Cameras were oriented perpendicular to the creek on the north and south banks.

Swift cameras were set on high sensitivity and programmed to take 10 seconds of video on activation. Reconyx cameras in culverts were set to high sensitivity and programmed to take a three-photo burst on activation. Reconyx cameras at site 1 were set on time-lapse mode and programmed to take a picture at 1-minute intervals between 6 pm and 6 am each day throughout the spring/summer and autumn/winter. Time-lapse mode is better suited to targeting frogs and was used successfully to monitor frog pipes on the Sapphire to Woolgoolga Pacific Highway Upgrade (Sandpiper Ecological 2017a, 2018a).

During the spring/summer sample period, cameras at sites 1-12 were installed on 14 and 21 October 2022 and were retrieved on 30 December 2022 following a total sample period of 77 days (Table 3). During the winter sample period, cameras at sites 1-12 were installed on 19 July 2023 and were retrieved on 22 September 2023 following a total sample period of 65 days (Table 3). On four occasions, camera functionality was compromised due to battery failure or camera malfunction (Table 3). Specifically, camera operation was reduced at site 5 north during summer/spring, site 7 ground in winter, site 9 ground in winter, and site 10 furniture during summer/spring (Table 3). Notably, two cameras fell short of the prescribed activity period of 56 days, or 8 weeks, as specified in the EMP (RMS 2018).

Table 3: Camera survey effort during year five operational phase monitoring. SS = spring/summer. W= Winter.! = SD card error. * = Camera malfunction/battery failure.

Site	Camera type	Camera location	Number of days active		
			Spring/summer	Winter	Total Year 5
1	Reconyx	North	90	63	153
	Reconyx	South	63	66	129
2	Reconyx	Furniture	77	65	142
	Swift enduro	Ground	77	65	142
3	Swift enduro	Furniture	77	65	142

Site	Camera type	Camera location	Number of days active		
			Spring/summer	Winter	Total Year 5
	Swift enduro	Ground	104	65	169
4	Swift 3c	Ground	77	65	142
	Swift enduro	Furniture	77	65	142
5	Swift enduro	North	54*	65	119
	Swift enduro	South	77	65	142
6	Reconyx	Furniture	77	65	142
	Reconyx	Ground	77	65	142
7	Swift 3c	Ground	77	32*	109
	Swift enduro	Furniture	77	65	142
8	Swift enduro	Furniture	77	65	142
	Swift enduro	Ground	77	65	142
9	Swift 3c	Ground	33*	65	98
	Swift enduro	Furniture	77	65	142
10	Swift enduro	Furniture	77	52*	129
	Swift enduro	Ground	77	65	142
11	Swift enduro	Furniture	77	65	142
	Swift enduro	Ground	82	65	147
12	Swift enduro	Furniture	77	65	142
	Swift enduro	Ground	77	65	142

Image review

Images were uploaded to a computer and viewed using Windows Photo Viewer ©. A senior ecologist or ecologist reviewed all images, with reference to standard field guides (i.e., Menkhorst & Knight 2004; Pizzey & Knight 2007; Van Dyck *et al.* undated).

Fauna detected in underpasses were assigned to one of two movement types, “complete” or “incomplete” crossing:

- A complete crossing was scored when an animal showed directional movement when detected by the centrally mounted camera.
- An incomplete crossing was scored when an animal showed no directional movement (i.e. remained stationary in front of camera) or passed the camera but returned within 10 minutes.

Crossing definitions are consistent with those used at other Pacific Highway monitoring sites (e.g. Sandpiper Ecological 2017, 2018, 202022) and crossing structure research programs (e.g. Soanes *et al.* 2015). Further, it represents a conservative approach to identification of complete crossings. Data recorded for fauna records included movement direction (i.e., east, west, or no-directional movement - NDM) and a tally of crossing types. A hierarchical approach was adopted to species identification, including species, genus or group. Microbats were recorded as present only due to their transient nature and non-reliance on underpasses for thoroughfare.

Data analysis and interpretation

To adequately assess "use of underpasses" as per the monitoring aim, complete crossings were used as the standard measure for fauna activity as it encompasses the purpose of fauna underpasses (i.e. A structure that allows fauna to move safely from one side of a road to the other). To account for variations in survey effort (camera activity periods) between sites, complete crossings/week and complete crossings/week/underpass

were adopted. Complete crossings were calculated by summing the number of crossings at each site and then dividing by the total activity period of all cameras at each respective site. This method ensures an accurate representation of crossing frequency relative to monitoring effort.

Complete crossings have been summed and presented in relation to monitoring periods (i.e., year 1 vs year 2), taxa (i.e., bandicoots, koala, and wallabies), and sites (i.e., 1, 2, 3). Survey effort and complete crossings at underpasses 5/6 (proximity), 9/10 (split median), and 11/12 (split median) were combined during data analysis as they function as single sites and lack independence if treated separately. The same approach was applied to data from previous monitoring years and projects. Birds and microbats were excluded from analysis as they do not require underpasses for thoroughfare.

One potential indicator of success identified in the EMP was use of underpasses by cover-dependent species and species with low mobility, yet no specification was given for which species this encompasses. Therefore, it has been inferred that low-mobility fauna includes species whose movements are constrained by their size, behaviour or home range and includes frogs, small reptiles (excluding the goanna and water dragon), some species of rodents (bush rat, swamp rat and fawn-footed melomys), small dasyurids (*Antechinus* spp) and bandicoots. When species-specific identification was not possible, rodents were documented as 'rodent spp.' and their status as either introduced or native remained "undefined". This approach was adopted due to the difficulty in accurately distinguishing between black rat, bush rat and fawn-footed melomys from camera footage. Black rat and water rat tend to traverse open space and have been excluded from the cover dependent classification. Additionally, house mouse has also been excluded as this species is introduced and not a target for underpasses. All records of *Antechinus* spp. are considered as brown antechinus, due to the absence of other species throughout operational monitoring.

Mean capture rates of fauna from the adjacent habitat (refer section 2.3) were calculated for each site over the five-year monitoring period. The total number of captures was divided by five, the number of survey years, to obtain a mean annual capture rate. This facilitated comparison of capture rates for different species across the sites.

2.3 Adjacent habitat survey

2.3.1 Survey design

A total of 18 sites were sampled at the 12 underpasses as part of adjacent habitat survey. Sample sites were established on each side of an underpass or underpass pair in the case of sites 5/6, 9/10 and 11/12. Adjacent habitat at sites 5 and 6 were sampled as one site as the underpass entrances were located within 50 m of each other. Survey effort was reduced at site 3 due to concern about disturbing neighbours. No spotlighting or arboreal Elliott trapping occurred on the west side at site 3 and the diurnal active search was restricted to a small (100m x 30m) triangular-shaped remnant of vegetation in the road reserve.

2.3.2 Trapping

Trapping methods applied during the survey included: cage traps, ground Elliott traps (Type A), arboreal Elliott traps (Type B), pitfall traps, and hair funnels. Trapping occurred within a 1 ha area immediately adjacent to each culvert entrance and was conducted over three nights at each site. All sites were sampled concurrently, with trapping occurring between 30 January and 3 February 2023, and 17 and 20 July 2023.

Traps were set in an "X" formation with five ground and five arboreal traps set at 20 m intervals on one axis, two cage traps, and two hair funnels set at 50 m spacing on the other axis (Plate 3). A line of three pitfall traps with a drift fence set at the intersection of both lines (Plate 3). Pitfall traps typically followed the contour and were set near fallen logs and dense ground cover. Pitfall traps at sites 1, 2 (east) and 4 were closed in the spring/summer survey due to rising groundwater that filled the buckets. Trap effort is summarised in Table 4.

Plate 3: Example of a pitfall trap line installed during adjacent habitat surveys (L). Setting up traps in adjacent habitat at site 1 (R).

Arboreal traps and ground Elliott traps were baited with a peanut butter, honey and oats mixture. Arboreal traps were installed on a platform positioned on the trunk of a rough-barked tree 1.8m above ground. Honey water was sprayed on the trunk above each arboreal trap, and bait was replaced as required. A plastic bag was placed over the end of each trap to provide cover, and a small amount of leaf litter was placed inside the trap. Arboreal traps were set on the western side of trees to provide shelter from the morning sun. Cage traps were set in a sheltered location and alternately baited with either peanut butter, honey and oats, or sardines. A tuna oil and water mix were sprayed around the entrance to cage traps baited with sardines. All traps were checked within four hours of sunrise.

Captured fauna were identified to species or genus, and, where possible, sexed and aged. Fauna were identified with reference to standard field guides (Van Dyck *et al.* 2013; Menkhorst & Knight 2004; Wilson & Swan 2010). Fauna were not marked as sampling aimed to determine the range of species present in adjacent habitat as opposed to population size.

2.3.3 Diurnal active search

Diurnal active searches were conducted by one or two ecologists and involved a meandering traverse of habitat within 100 m of the underpass entrance at each sample site. Surveys involved searching leaf litter, rolling logs, observing reptile habitat (i.e., log piles, rocks, dense leaf litter) and looking for fauna signs such as scats and tracks. Each site was sampled twice during each sample period for a minimum of 30 person minutes/sample.

2.3.4 Nocturnal active search

Nocturnal surveys were conducted by one or two ecologists and involved a meandering traverse of habitat within 100 m of the culvert entrance using hand-held Led Lenser P14 spotlights. Fauna were detected by sight and call and identified to species or genus where possible. Each site was sampled twice during each sample period for a minimum of 30 person minutes/sample.

Table 4: Survey effort for sampling in adjacent habitat on the WC2NH upgrade.

Component	Method / culvert side	No Samples	Total effort
Arboreal Elliott traps	5 x traps @ 20m spacing	3 nights/site	510 trap nights
Ground Elliott traps	5 x Type A Elliott traps @ 20m spacing	3 nights/site	540 trap nights

Cage traps	2 @ 50m spacing	3 nights/site	216 trap nights
Pitfall traps	1 x line of 3 pits with drift fence	3 nights/site	324 trap nights
Hair funnels	2 @ 50m spacing	14 nights/site	504 trap nights
Active diurnal search	30 person minute search at UP entrance	4 samples/site	1080 person minutes
Active nocturnal search	30 person minute search at UP entrance	4 samples/site	1080 person minutes

3 Results

3.1 Underpasses

3.1.1 Year five camera monitoring

Species diversity and underpass use

Excluding microbats and birds, underpass cameras yielded 3095 fauna detections (i.e., sum of complete, incomplete and non-directional movement crossings) during year five operational monitoring (See appendix B, Table B1). Complete crossings (cc) accounted for 93% (2868cc) of all fauna detections. Nineteen species/unique genera and nine fauna groups were confirmed making complete crossings of underpasses at WC2NH during year five operational phase monitoring. Fauna groups included eight taxa that could only be identified to a genus or group, including rodent spp., bandicoot spp., wallaby spp., macropod spp., lizard spp., *Egernia* spp., and *Trichosurus* spp. (Table 5). Rodent spp., bandicoot spp., wallaby spp. and *Trichosurus* spp. likely belong to confirmed species in Table 5 (i.e., *Trichosurus* spp. either short-eared brushtail possum or common brushtail possum). Of the fauna recorded, 24 were native species/groups and four were introduced including cat, wild dog, red fox and black rat. Native fauna diversity was highest at sites 11/12 with 17 species/groups, followed by sites 9/10 with 15 and sites 2 and 4 with 13 species/groups (Table 5). Native fauna diversity was lowest at site 1 with seven species recorded. Sites 3, 5/6, 7 and 8 recorded between nine and twelve native fauna species/groups each.

Complete crossings (CC) by native species were observed at all sites with the frequency of crossings differing among the underpass locations. Sites 4 and 8 featured the highest use by native fauna with a mean of 4.93 and 5.42 cc/week, respectively (Figure 2). Sites 1 and 5/6 exhibited the lowest mean use by native fauna, recording 0.65 and 2.11 cc/week respectively (Figure 2). Native fauna use was higher than that of feral predators and rodent spp. at all sites (Figure 2).

Brown antechinus was the most frequently recorded native species, with a combined mean crossing rate of 29.42cc/week across all sites (Table 5). This was followed by bandicoot species, including long-nosed and northern brown with 23.45cc/week, short-eared brushtail possum (22.91cc/week), swamp wallaby (18.96cc/week), wallaby spp. (10.06cc/week) and *Trichosurus* spp. (5.23cc/week) (Table 5). Noteworthy detections included koala using the culvert floor (ground) at sites 4 (one occasion), 9/10 (two occasions) and 11/12 (two occasions, Plate 4) to make complete crossings of the alignment (Table 5, Figure 2).

Table 5: Mean number of complete crossings/week/site made by each species/group at nine underpass sites monitored on the WC2NH upgrade during year 5 operational monitoring. FF= fauna furniture and G= ground (culvert floor). Site 1 did not contain fauna furniture. Species in bold denote threatened species, ^=Cover-dependent species. * = Introduced species. See appendix B, Table B1 for all data.

	Site and camera location																		
	1		2		3		4		5/6		7		8		9/10		11/12		
Species/fauna groups	N	S	FF	G	FF	G	FF	G	FF	G	FF	G	FF	G	FF	G	FF	G	Total cc/week/spp.
Mammals																			
Short-beaked echidna	-	-	-	0.31	-	-	-	0.31	-	-	-	0.22	-	-	-	0.22	-	0.05	1.10
Brown antechinus ^	0.08	0.11	7.56	0.09	0.41	-	-	-	3.92	0.18	1.29	0.22	6.75	-	5.37	-	3.07	0.38	29.42
Long-nosed bandicoot^	-	-	-	4.04	-	-	-	1.50	-	1.01	-	0.36	-	0.63	-	1.33	-	0.66	9.54
Northern brown bandicoot^	-	-	-	-	-	-	-	0.32	-	-	-	-	-	-	-	0.32	-	0.47	1.12
Bandicoot spp.^	-	-	-	1.06	-	-	-	0.45	-	0.75	-	3.21	-	3.40	-	2.47	-	1.54	12.88
Koala	-	-	-	-	-	-	-	0.09	-	-	-	-	-	-	-	0.11	-	0.11	0.31
Trichosurus spp	-	-	-	-	1.28	-	-	1.91	-	-	-	-	0.76	0.09	0.59	0.28	0.32	-	5.23
Short-eared brushtail possum	-	-	-	0.18	4.62	-	5.75	0.31	-	-	8.97	-	0.36	0.18	0.14	-	2.36	0.04	22.91
Eastern grey kangaroo	-	-	-	-	-	0.67	-	-	-	-	-	-	-	-	-	-	-	-	0.67
Red-necked wallaby	-	-	-	-	-	0.32	-	-	-	-	-	-	-	-	-	0.06	-	0.37	0.75
Swamp wallaby	1.10	0.75	-	1.32	-	0.54	-	2.96	-	0.69	-	4.34	-	5.47	-	0.38	-	1.41	18.96
Wallaby spp.	-	-	-	1.13	-	1.23	-	1.94	-	0.03	-	1.11	-	3.00	-	1.58	-	0.04	10.06
Macropod spp.	-	-	-	-	-	1.21	-	-	-	-	-	-	-	-	-	-	-	-	1.21
Water rat	-	-	-	-	-	-	-	-	-	1.11	-	-	-	-	-	-	-	-	1.11
Bush rat^	-	-	0.09	-	-	-	0.36	-	-	-	0.36	-	-	-	-	-	0.59	-	1.41
Rodent spp.																			
Black rat*	0.30	0.74	-	0.45	-	-	0.73	0.09	0.75	0.14	1.33	0.73	1.26	-	3.13	0.58	3.38	1.07	14.68
Rodent spp.	0.33	0.11	1.58	0.70	-	-	9.89	-	6.09	0.21	6.52	1.33	1.32	0.31	7.40	0.49	4.77	0.27	41.33
Feral predators																			
Red fox*	0.72	0.11	-	1.47	-	0.32	-	0.75	-	0.67	-	4.21	-	2.11	-	3.05	-	4.49	17.91
Wild dog*	-	-	-	-	-	-	-	1.90	-	1.09	-	2.06	-	3.36	-	1.86	-	0.79	11.05
Cat*	0.08	0.22	-	0.11	-	8.47	-	0.29	-	0.24	-	-	-	-	-	0.11	-	0.04	9.55
Reptiles and frogs																			
Blue-tongue lizard^	-	-	-	0.18	-	-	-	-	-	-	-	-	-	-	-	-	-	0.10	0.28
Eastern water dragon	-	-	-	0.09	0.36	-	-	0.09	-	0.03	-	-	-	-	-	-	-	0.11	0.69
Egernia spp.^	-	-	-	-	-	-	-	-	-	-	0.11	-	-	-	1.14	-	-	-	1.24
Lace monitor	0.08	-	-	0.09	0.09	0.79	0.85	2.63	-	0.64	0.64	0.18	-	1.17	-	0.69	-	0.54	8.40
Lizard spp.^	-	-	0.55	0.18	-	-	-	-	-	-	0.18	-	0.64	-	2.00	0.06	-	0.04	3.65
Small frog spp.^	-	0.11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.11
Small-eyed snake^	0.11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.11
Striped marsh frog^	-	0.11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.11
Total no. species/groups	8	8	4	15	5	8	5	15	3	13	8	11	6	10	7	16	6	19	225.79

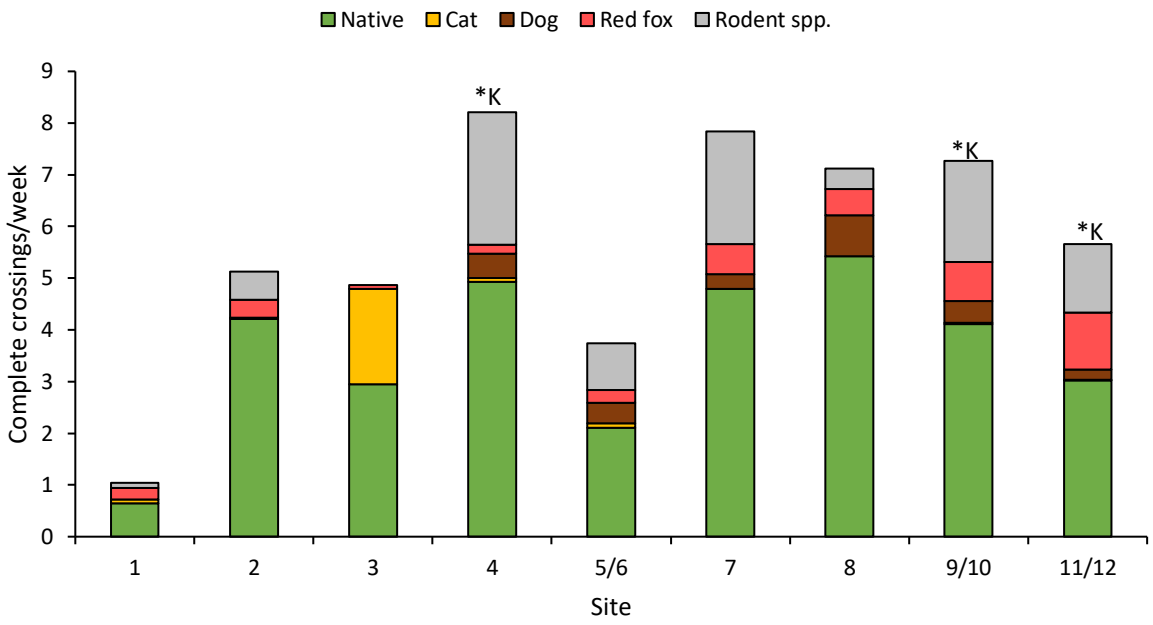

Figure 2: Complete crossings (cc)/week by native species, feral predators (cat, dog and red fox) and rodent spp. (undefined rodent) at each site during year five operational monitoring, WC2NH, 2022-2023. *K = indicates complete crossing by koala.

Plate 4: Images of fauna utilising underpasses. Koala crossing through site 12 then 6 minutes later site 11 during winter (Top Left / Right). Long-nosed bandicoot at site 2 during spring/summer (Middle Left). Fox carrying long-nosed bandicoot at site 11 during spring/summer (Middle right). Eastern grey kangaroo at site 3 during spring/summer (Bottom Left). Dog carrying bird spp. at site 8 during winter (Bottom Right).

Use by cover-dependent species

Cover-dependent fauna (see classification in methods) were recorded at all sites (Table 5), with the highest usage shown by brown antechinus (29.42 cc/week) followed by bandicoots (23.54 cc/week) and lizard spp. (3.65 cc/week) (Table 5). Other cover-dependent species included the eastern blue-tongue lizard using the culvert floor at sites 2 and 11/12, small frog spp. at site 1 and *Egernia* spp. at sites 7 and 9/10 (Table 5). Most cover-depended species favoured the fauna furniture with the exception being bandicoots, which exclusively used the culver floor (ground) (Table 5).

Furniture vs Floor

Fauna were recorded making complete crossings on both the culvert floor (51% of complete crossings) and furniture (49%) during year five operational phase monitoring (Table 5*,* Figure 3). Native fauna accounted for the majority of complete crossings on both the culvert floor (60%) and fauna furniture (53%) (Figure 3). Rodents tended to favour the fauna furniture whereas feral predators showed exclusive use of the culvert floor (Table 5*,* Figure 3). Most of the native fauna usage of the furniture can be attributed to use by brushtail possums (combined short-eared brushtail possum, common brushtail possum and *Trichosurus* spp.) at sites 3, 7, 11/12

and brown antechinus at sites 2, 8 and 9/10 (Table 5*).* Of the threatened fauna, koalas were recorded using the floor only at sites 4, 9/10 and 11/12 on five occasions (Table 5, Plate 4).

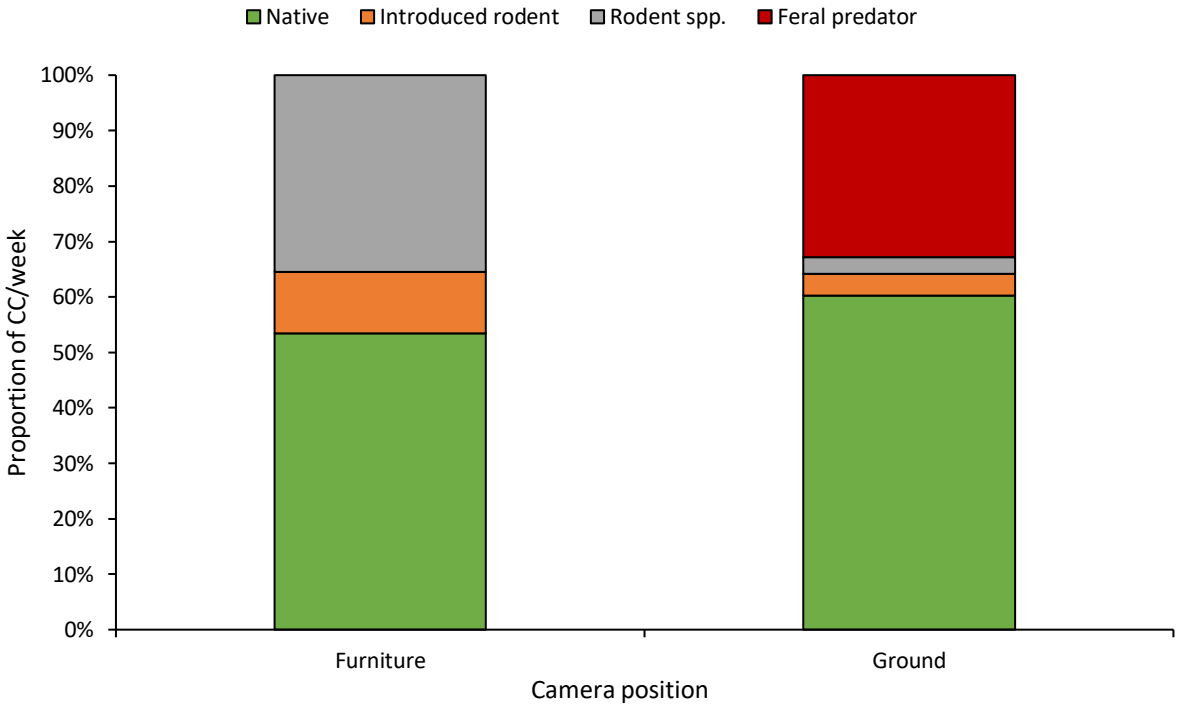

Figure 3: The proportion of complete crossings recorded on the culvert floor (ground) vs the fauna furniture by native species, feral predators (cat, dog, and red fox), introduced rodents and rodent spp., at WC2NH during year five operational monitoring, 2022-2023.

Feral predator activity

Feral predators were recorded in all underpass sites and accounted for 16% of all complete crossings in year five monitoring (Figure 2, Table 5). Red fox displayed the highest combined use (17.91cc/week), followed by dog (11.05 cc/week) then cat (9.55 cc/week) (Figure 2, Table 5). Cat activity was recorded across seven of nine sites, with the highest activity (mean total of 8.47 cc/week) occurring at site 3 (Figure 2, Table 5). Fox activity was recorded at all nine sites with the highest activity at 9/10 and 11.12 (Figure 2, Table 5, Plate 4). Dog activity was recorded at six of the nine sites and was highest at site 8 (Figure 2, Table 5, Plate 4). No instances of predation were recorded within underpasses during year five operational monitoring, however feral predators carrying prey through an underpass was recorded on two occasions (Plate 4).

3.1.2 Operational camera monitoring

Trends in underpass use by native fauna during operational monitoring

Underpass use by native fauna has progressively increased from years one to five of operational monitoring (Figure 4). Initially, the underpass crossing rate by native fauna was 1.29 ± 1.32 cc/week/site in year one. It increased to 1.78 ± 1.35 cc/week/site in year two (38% increase) and further to 1.85 ± 1.78 cc/week/site in year three (4% increase from year two). This upward trend continued, reaching 2.52 ± 1.57 cc/week/site in year four (36% increase from year three), with a subsequent increase to 3.57 ± 1.53 cc/week/site in year five (42% increase from year four). Overall, the trend suggests a rapid initial increase in the usage of underpasses by native species

from year one to two, stabilisation in year two to three and rapid increase in the usage rates from years four to five (Figure 4).

Similarly, underpass use by cover-dependent or low mobility fauna increased over time, although at a greater rate (CD/LM fauna, Figure 4). In year one, the initial underpass usage rate was recorded at 0.08 ± 0.10 cc/week/site. By year two, this rate substantially increased to 0.31 ± 0.42 cc/week/site, a 290% increase from year one. Crossings continued to increase in subsequent years, with year three reaching 0.48 ± 0.44 cc/week/site (a 57% increase from year two), year four 0.98 ± 0.64 cc/week/site (102% increase from year three), and year five peaking at 1.57 ± 1.25 cc/week/site, reflecting a 61% increase from year four (Figure 4). In year five, underpass use by cover-dependent or low mobility fauna accounted for 44% of all native fauna underpass use and had increased by 1862% from the initial year one monitoring period (Figure 4).

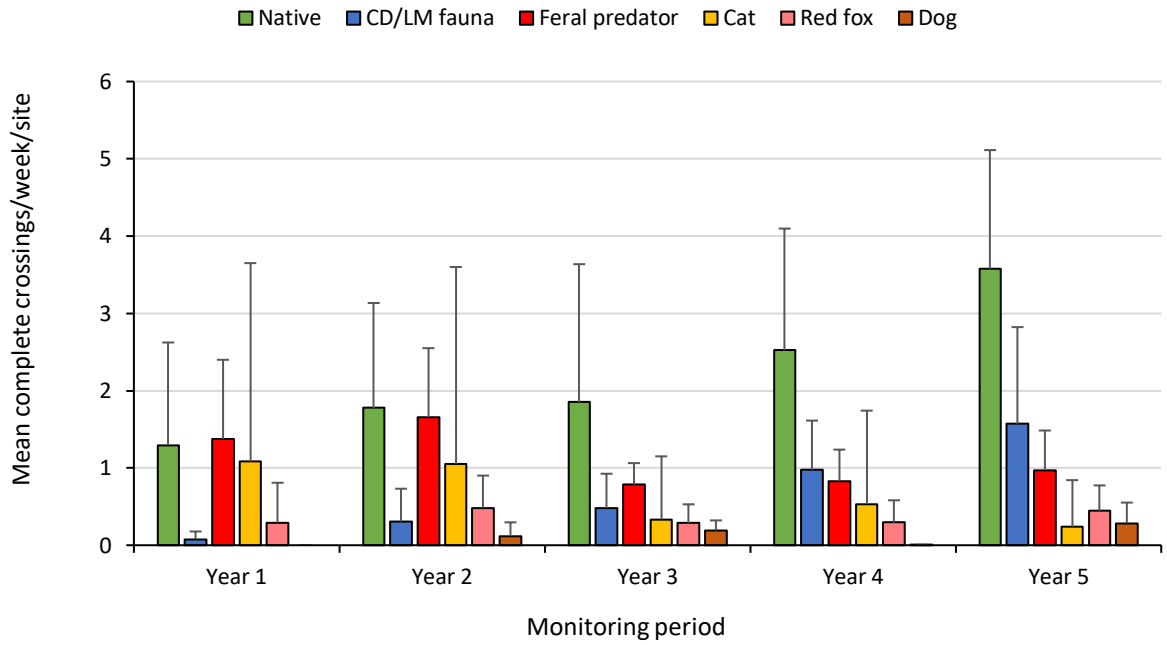

Figure 4: Mean (n=9) complete crossings/week/site (+SD) by native species, cover-dependent or low mobility fauna (CD/LM fauna) and feral predators (cat dog and red fox) at WC2NH during operational monitoring, 2018-2023. Birds and microbats have been excluded. Fauna classed as rodent spp. and introduced rodent have been excluded. Note feral predator bar is combined cat, dog, and fox and native bar is combined CD/LM fauna and other non-cover-dependent native species.

Records of cover-depended fauna throughout operational monitoring (year 1-5) were comprised of (northern brown and long-nosed) bandicoots (54.4% of complete crossings), brown antechinus (35.52%), lizard spp. (4.15%), bush rat (1.59%), *Egernia* spp. (1.34%), eastern crevice skink (0.96%) fawn-footed melomys (0.77%)., medium frog spp. (0.51%), eastern blue-tongue lizard (0.38%), swamp rat (0.13%), small frog spp. (0.13%), striped marsh frog (0.06%) and small-eyed snake (0.06%) (see appendix B, Table B1). Among these, bandicoot, swamp rat, eastern blue-tongue lizard, small-eyed snake and all frogs, were solely recorded using the ground to make complete crossings. Conversely, the remaining species/groups were predominately recorded using the fauna furniture with bush rat and brown antechinus on occasion using the ground. Note all frog records were obtained from site 1 (See appendix B, Table B1).

Variability in underpass use by native fauna was evident during operational monitoring (Figure 5). Site 8 exhibited the highest usage by native fauna with a mean rate of 3.70 ± 1.34 cc/week/year, followed by site 7 with 3.39 ± 1.71 cc/week/year, site 4 at 3.15 ± 1.85 cc/week/year, and site 2 at 2.94 ± 1.48 cc/week/year (Figure 5). In contrast, sites 1 and 5/6 were the least utilised underpasses by native fauna with 0.53 ± 0.57 cc/week/year and 0.99 ± 0.70 cc/week/year, respectively (Figure 5). Sites 9/10, 11/12, and 3 recorded intermediate use with

1.54 ± 1.64 cc/week/year, 1.84 ± 1.17 cc/week/year, and 2.01 ± 0.71 cc/week/year (Figure 5). As a general observation, sites with contiguous habitat on each side of the underpass tended to have the highest use by native fauna such as at sites 4, 7 and 8.

Similar variability was also observed in underpass use across sites by cover-dependent/low mobility fauna (Figure 5). The highest use by cover-dependent and low mobility fauna was recorded at site 2 with a rate of 1.35 ± 1.28 cc/week/year. Conversely, sites 1 and 3 demonstrated the lowest usage with rates of 0.09 ± 0.10 cc/week/year and 0.11 ± 0.10 cc/week/year, respectively. Sites 4 through to 11/12 recorded moderate use ranging from 0.43 ± 0.48 cc/week/year at site 5/6 to 0.99 ± 0.48 cc/week/year at 9/10 (Figure 5). Notably, site 9/10 was the only underpass where cover-depended fauna accounted for the majority (64%) of complete crossing by all native fauna (Figure 5).

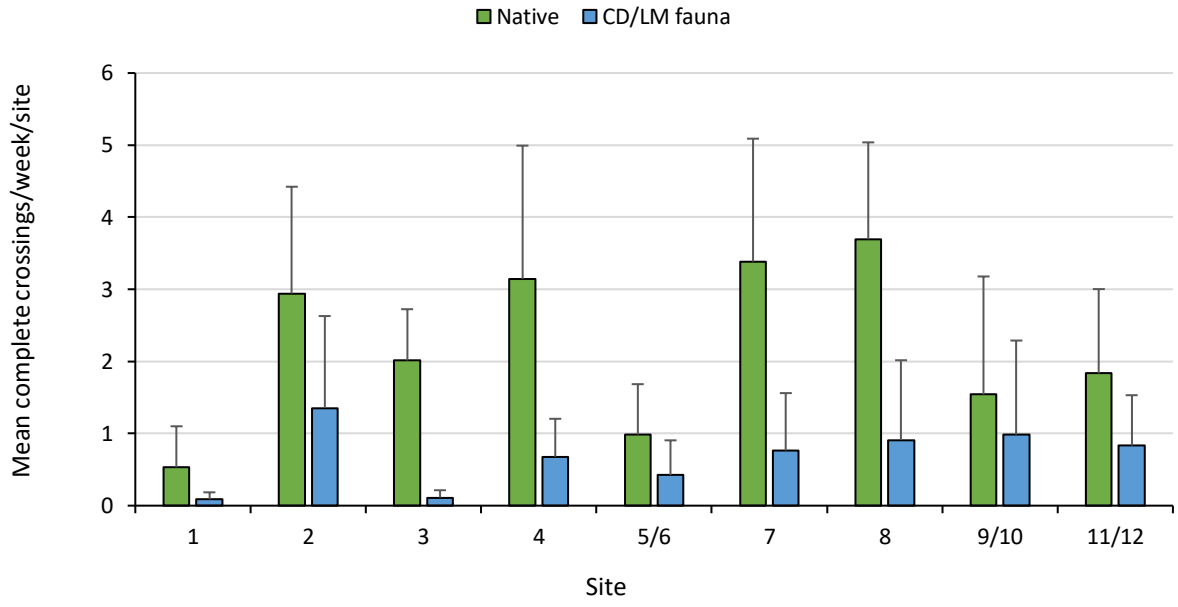

Figure 5: Mean (n=5) complete crossings/week/year (+SD) by native species, cover-dependent or low mobility fauna (CD/LM fauna) at all sites from 2018-2023. CD/LM = cover-dependent or low mobility fauna. Note value for native fauna is combined CD/LM fauna and other non-cover-dependent native species.

One targeted threatened species, koala, was consistently recorded using underpasses throughout operational monitoring (Figure 6). Koalas were recorded making complete crossings at six of the nine underpass sites including sites 2, 4, 7, 8, 9/10 and 11/12 (Figure 7). The highest use was recorded at site 4 with an average crossing rate of 0.16 ± 0.10 cc/week/year, followed by site 11/12 with 0.021 ± 0.023 cc/week/year, site 9/10 with 0.014 ± 0.013 cc/week/year, site 7 with 0.011 ± 0.025 cc/week/year, site 2 with 0.005 ± 0.012 cc/week/year, and site 8 with 0.005 ± 0.011 cc/week/year, while sites 1, 3, and 5/6 recorded no use (Figure 7). Notably, the number of complete crossings by koala has progressively declined over the survey period, from 0.41 ± 0.10 cc/week in year 1 to 0.08 ± 0.10 cc/week in year 5 (Figure 6). The trend observed is attributed to a reduction in koala crossings at site 4, decreasing from eighteen in year one to one in year five, with a consistent temporal decline (See appendix B, Table B1).

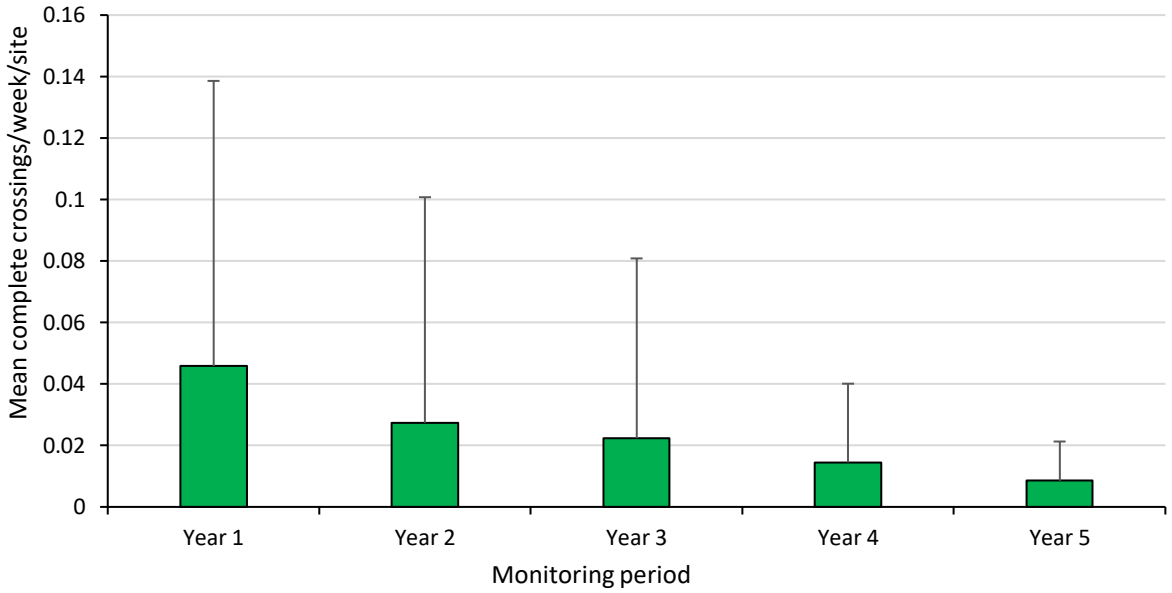

Figure 6: Mean (n=9) complete crossings/week/site (+SD) by koala at WC2NH during operational monitoring, 2018-2023.

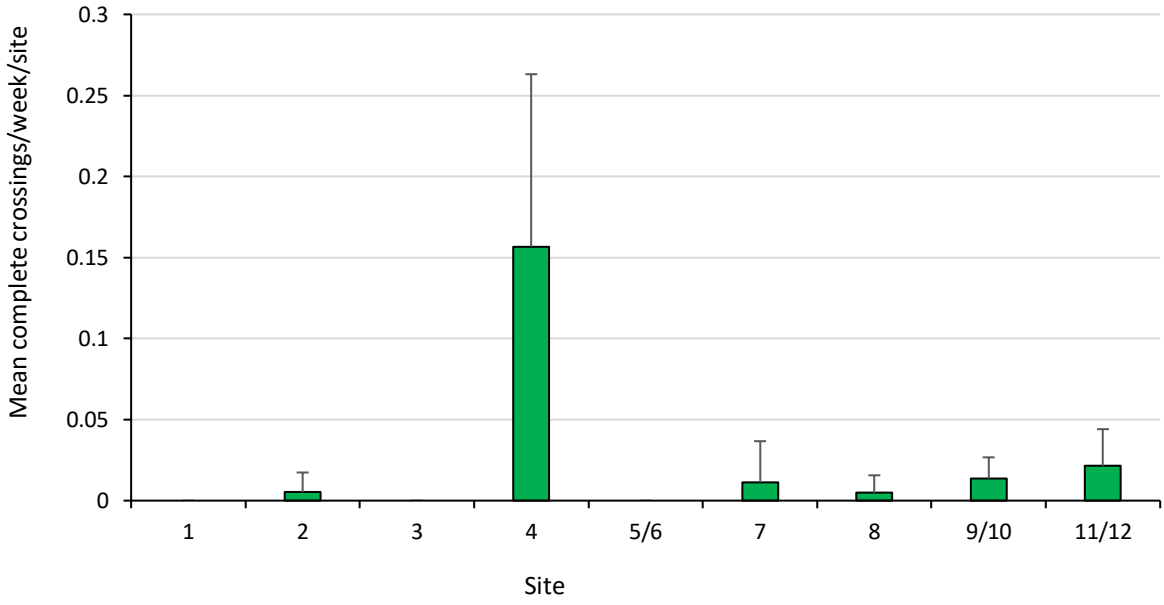

Figure 7: Mean (n=5) complete crossings/week/year (+SD) by koala at each underpass site during operational monitoring at WC2NH, 2018-2023.

Trends in underpass use by feral predators during operational monitoring

Feral predator use of the WC2NH underpasses has fluctuated over the five years of operational monitoring (Figure 4). The average complete crossing rate increased from 1.37 ± 1.03 cc/week/site in year one to 1.66 ± 0.89 cc/week/site in year two before declining substantially to 0.79 ± 0.28 cc/week/site in year three. Subsequently, crossing rates increased from 0.83 ± 0.41 cc/week/site in year four to 0.97 ± 0.52 cc/week/site in year five. The increase in feral predator activity between year four and year five is largely attributed to changes

in dog activity which increased from 0.001 ± 0.001 cc/week/site in year four to 0.29 ± 0.27 cc/week/site during year five (Figure 4). Red fox activity also increased from 0.3 ± 0.1 cc/week/site in year four to 0.45 ± 0.33 cc/week/site in year five monitoring. Whereas cat activity declined between years four and five, going from 0.53 ± 0.4 cc/week/site to 0.24 ± 0.6 cc/week/underpass (Figure 4). All three feral predator species were recorded at each underpass site, with the sole exception being the absence of dog at site 1 (Figure 8).

The frequency of red fox crossings was relatively consistent between sites 2, 3, 4, 7, 8, and 9/10, with crossing rates ranging from 0.29 ± 0.28 at site 9/10 to 0.46 ± 0.66 at site 3 (Figure 8). Underpass usage peaked at sites 11/12 with 0.57 ± 0.43 cc/week and was lowest at site 1, with 0.07 ± 0.09 cc/week, and site 5/6, with 0.18 ± 0.07 cc/week (Figure 8).

Like red fox, dogs exhibited minor variability in their usage across the sites with no apparent preferential use of any sites. Amongst the sites where dogs were recorded, the highest mean usage was at site 8 with 0.17 ± 0.35 cc/week, followed closely by site 4 with 0.17 ± 0.20 cc/week (Figure 8).The lowest recorded usage was at site 5/6 with 0.09 ± 0.23 cc/week. Sites 2, 3, 7, 9/10, and 11/12 exhibited moderate usage rates, ranging from 0.10 to 0.16 cc/week (Figure 8). Cats showed strong preferential use for site 3, recording 4.76 cc/week, and relatively low-moderate use among other sites ranging from 0.05 ± 0.07 at site 1 to 0.28 ± 0.30 at site 3 (Figure 8).

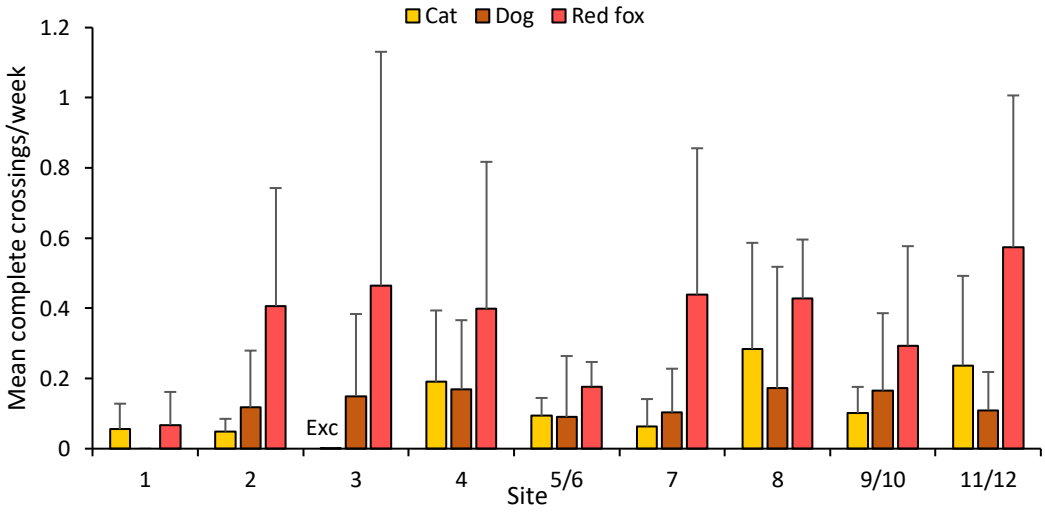

Figure 8: Mean (n=5) complete crossings/week/year (+SD) by cat, dog and red fox at each underpass site during operational monitoring at WC2NH, 2018-2023. Exc = excluded cat data for site three (value = 4.76cc/week).

3.1.3 Sand pads Year five

Eighteen species and fauna groups were recorded on sand pads in year five operational monitoring (Appendix B, Table B2). Of the native species, *Peramelidae* spp. (bandicoot) was the most frequently recorded fauna species, with tracks identified at all sites (Appendix B, Table B2**,** Plate 5). Of the smaller cover-dependent fauna groups (i.e., small mammals, reptiles and amphibians), probable *Antechinus* spp. (sites 1, 2, 3, 5/6, 9/10, 11/12) and small/medium reptiles (1, 2, 3, 5/6, 9/10, 11/12) were recorded during inspections (Appendix B, Table B2). Small lizard tracks are likely to be garden skinks (*Lampropholis* spp.) and are considered to be probable records. No species or groups were recorded in addition to those identified by cameras. However, the detection of *Antechinus* spp. was notably more frequent on sand pads compared to ground cameras located in underpasses, indicating a potential limitation in the detection capabilities of cameras for smaller fauna.

Plate 5: Bandicoot tracks (heading east and west) at site 8 (Left). *Trichosurus* spp. (brushtail possum spp.) tracks heading east through the split median 9/10 underpass (Right).

3.1.4 Scat and track searches and tile checks Year five

Ten species and seven fauna groups were recorded during scat and track surveys during year five monitoring of the WC2NH underpasses (Appendix B. Table B3). Consistent with camera data, native species/fauna groups were recorded using all underpasses. The presence of feral predators (either cat, red fox or dog) was detected through tracks or scats at all underpasses with the exception of site 7 and 8 (Appendix B. Table B3). No fauna was recorded during tile checks (Appendix B, Table B4).

3.2 Adjacent habitat

Forty species/unique genera and eight fauna groups were recorded in habitat adjoining underpasses during year five operational monitoring (Table 6). Most species/groups were detected by diurnal searches (25) and spotlighting (22) (Table 6, Appendix B, Table B5, and B6). Sixteen species were recorded during trapping, while hair funnels recorded four species and two groups (Appendix B Table B7, Table B8). Threatened species records included koala scats on the east side of sites 11/12 during active diurnal searches and sightings on the west side of site 7 and the east side of site 9/10 during spotlighting (Table 6, Appendix B, Table B5 and B6). A selection of fauna recorded in the adjacent habitat are shown in Plate 6.

Table 6: Detection of fauna species and groups during year five adjacent habitat monitoring at WC2NH, 2022-2023. Bold denotes threatened species. [I] = Introduced. Birds and sugar gliders have been excluded as they do not require underpasses for thoroughfare.

Species	Active Search	Spotlight	Trapping	Hair funnel
Mammals				
Brown antechinus			*	*
Antechinus spp.	*	*		*
Northern brown bandicoot			*	*
Long-nosed bandicoot		*		
Peramelidae spp. (bandicoot)	*	*		
Koala	*	*		
Common brushtail possum		*		

Species	Active Search	Spotlight	Trapping	Hair funnel
Short-eared brushtail possum		*	*	
Trichosurus spp.	*			*
Common ringtail possum		*		
Swamp wallaby	*			
Wallaby spp.	*	*		
Fawn-footed melomys		*	*	
Swamp rat			*	
Bush rat			*	*
Black rat [I]		*	*	
House mouse				*
Rattus spp.	*	*		
European Hare	*			
Red fox [I]	*	*		
Cat [I]	*			
Dog [I]	*			
Reptiles				
Lace monitor	*		*	
Eastern water dragon	*	*		
Calyptotis ruficauda	*		*	
Eastern crevice skink				
Lampropholis delicata	*		*	
Lampropholis guichenoti	*			
Lampropholis spp.	*		*	
Bandy bandy		*		
Pygopus lepidopodus		*		
Yellow-faced whipsnake				
Small-eyed snake		*		
Chelidae spp.				
Small reptile	*			
Lophosaurus spinipes	*			
Snake spp.	*			
Frogs				
Amphibian spp.	*			
Litoria gracilenta		*		
Litoria fallax		*		
Litoria peronii		*		
Litoria caerulea		*		
Litoria tyleri				
Mixophyes iteratus				
Crinia signifera	*	*		
Adelotus brevis		*	*	
Uperoleia fusca				
Pseudophryne coriacea		*	*	
Limnodynastes peronii		*	*	

Species	Active Search	Spotlight	Trapping	Hair funnel
Total Nº. Species/groups	22	24	14	6

Plate 6: Fauna recorded in the adjacent habitat during the year 5 WC2NH monitoring period. Top left: Tusked frog.Top right: Bandy bandy. Bottom left: Southern angle-headed dragon. Bottom middle: Northern brown bandicoot. Bottom right: Bush rat.

3.2.1 Trapping in Year 5

During the year 5 trapping surveys, fifteen species were captured in the habitat adjacent to the monitored underpass sites at WC2NH (Table 7). Small mammals were the most frequently captured fauna group, comprising 88% (231 out of 255) of the total captures (Table 7). Captures were highest for brown antechinus (110 captures, 42% of the total), followed by the bush rat (50 captures, 19%), fawn-footed melomys (44 captures, 17%), and black rat (25 captures, 10%) (Table 7, Figure 9). Additionally, a single capture was recorded for both the house mouse and the swamp rat. Other fauna captured included frogs, with ten captures of red-backed toadlet, and single captures of striped marsh frog and the tusked frog. Reptiles captured were garden skink (6

captures), red-tailed skink, and lace monitor (1 capture each). Other mammals captured included northern brown bandicoot (2 captures), short-eared brushtail possum, and sugar glider (1 capture each) (Table 7).

3.2.2 Trapping operational monitoring

During operational monitoring 903 total captures were recorded, with 782 (87%) being mammals, 87 reptiles (10%), 30 frogs (3%) and three birds (<1%) (Table 7). Among these, 503 individuals belonged to cover-dependent/low-mobility species, comprising ~56% of all captures (Table 7).

Total captures has steadily increased over the monitoring period, from 106 individuals in year one to 258 in year five (Table 7, Figure 9). The most frequently recorded species was brown antechinus (259 captures), fawn-footed melomys (180), bush rat (155), and black rat (108), which collectively represent 78% of all captures (Table 7). The brown antechinus and bush rat, in particular, have exhibited a consistent increase in annual captures, peaking at 110 and 50 individuals respectively in year five (Figure 9). Captures of fawn-footed melomys also exhibited a general increase from 16 in year one to 44 in year 5 (Figure 9). Black rat captures were variable, with 20 captures in year one decreasing to 12 in year three an increasing to 24 and 25 in years four and five respectively (Table 7, Figure 9). The small number of individuals recorded for other species, such as reptiles, frogs, and other mammals, make it challenging to identify trends.

The annual capture rate (mean number of captures/year) of the four most frequently recorded species (i.e., brown antechinus, fawn-footed melomys, bush rat, and black rat) differed between sites at WC2NH (Figure 10). The combined (total) capture rate of the four species was highest at sites 2 (23 captures ± 6.01/year), 4 (21.6 ± 9.4/year) and 5/6 (21.2 ± 8.52/year) and lowest at sites 3 (3 ± 2.24/year) and 1 (10.6 ± 4.24/year) (Figure 10). Brown antechinus and black rat were the only species recorded across all sites. Bush rat was not recorded at site 3 and fawn-footed melomys were absent from site 1, and had a low capture rate at site 3 (Figure 10). Brown antechinus was the most frequently recorded species at sites 2, 5/6, 7, 8 and 9/10 (Figure 10). Fawn-footed melomys was the most frequently recorded species at sites 4 and 11/12 and black rat was the most frequently recorded species at sites 1 and 3. Despite not being the most frequently captured species at any site, the bush rat was the most frequently captured species at sites 4, 5/6, and 7.

Table 7: Temporal comparison of the number of species recorded within the adjacent habitat during trapping surveys at WC2NH during operational monitoring. [I] = Introduced. ^= cover dependent fauna.

Species	Year 1	Year 2	Year 3	Year 4	Year 5	Total
Mammals						
Brown antechinus^	25	28	38	58	110	259
Sugar glider	1	6	8	5	1	21
Long-nosed bandicoot^				1		1
Fawn-footed melomys^	16	44	36	40	44	180
Northern brown bandicoot^	1	3	2	5	2	13
Short-eared brushtail possum	4	7	4	4	1	20
Common brushtail possum				1		1
Bush rat^	9	13	39	44	50	155
Swamp rat^			1		1	2
House mouse[I]	7	7	6	1	1	22
Black rat[I]	20	26	13	24	25	108
Cat[I]	1					1
Birds						
Eastern whipbird	1					1
Green catbird	1					1
Yellow-throated scrubwren		1				1

Species	Year 1	Year 2	Year 3	Year 4	Year 5	Total
Reptiles						
Lace monitor			3	4	1	8
Blackish blind snake^	1	1				2
Dwarf-crowned snake^		1	2			3
Marsh snake^		2				2
Red-tailed skink^	7	3	4	2	1	17
Garden skink^	9	7	10	12	13	51
Grass skink^	4					4
Frogs						
Tusked frog^				1	1	2
Striped marsh frog^	2	3			1	6
Red-backed toadlet^	2	6	2	2	10	22
Grand Total	111	158	168	204	262	903

Figure 9: Temporal comparison of the total number of trap captures for each species or fauna group recorded in the adjacent habitat during operational monitoring at WC2NH, 2018-2023.

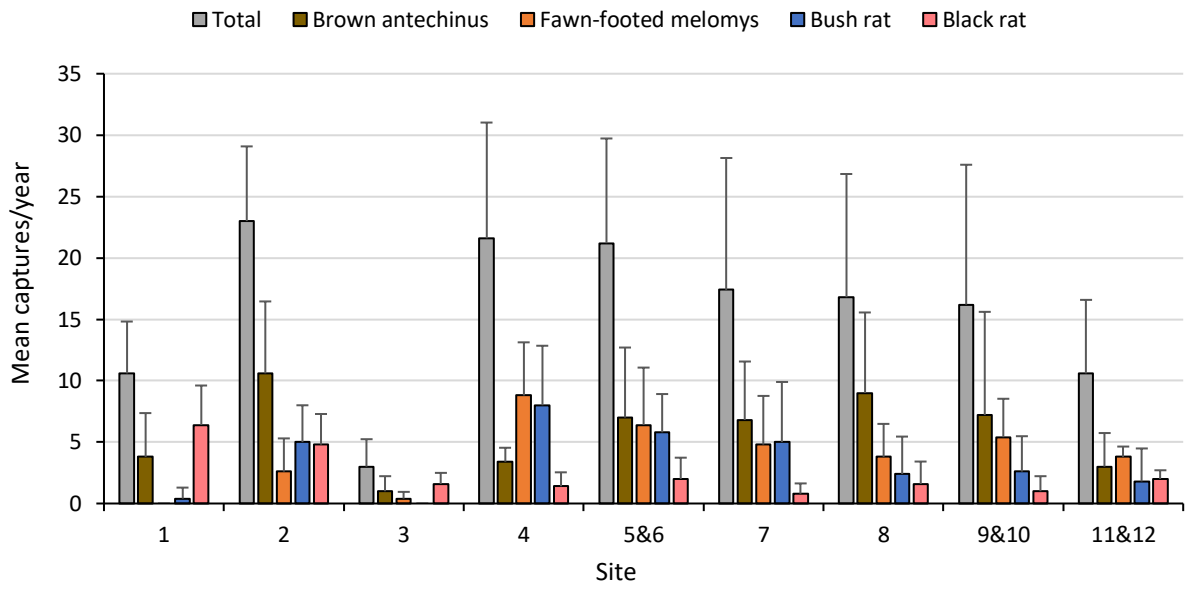

Figure 10: Mean (+SD) annual capture rate (n=5) of the four most frequently recorded species during adjacent habitat trapping at WC2NH throughout operational monitoring, 2018-2023. The total mean captures presented represent the combined capture rates of the four species.

3.2.3 Species recorded in underpasses and adjacent habitat

Excluding unconfirmed species and genera (see Table 8 caption), 39 vertebrate species and unique genera were recorded within the adjacent habitat and underpasses in year five (Table 8). Among these, 22 species were recorded using the underpasses, which accounts for 56% of the species present in the adjacent habitat (Table 8). Of the 22 species recorded in underpasses 17 (77%) were native. In the adjacent habitat, 33 species were native, indicating that 51% of all native species in the adjacent habitat were also recorded in the underpasses during year five operational monitoring (Table 8).

For mammals specifically, 76% of those recorded in the adjacent habitat were observed using the underpasses (Table 8). The common ringtail possum, common brushtail possum, swamp rat, fawn-footed melomys and European hare being the only mammal species not recorded in underpasses during year five (Table 8). Of these species, the European hare is introduced and not considered a target species for underpasses. Further, swamp rat, fawn-footed melomys, and common brushtail possum have previously been recorded using underpasses at WC2NH (Sandpiper Ecological 2022, 2023). Among these, the common ringtail possum is the only mammal species found in adjacent habitat that has not been recorded using underpasses to date at WC2NH. When all species recorded using underpasses to date is considered, 95% of mammal species recorded in year five have been recorded using underpasses.

In addition to mammals, reptiles and frogs were recorded both within underpasses and the adjacent habitat. Among the ten reptile species present in the adjacent habitat six (60%) were recorded using underpasses. Probable garden skinks were recorded during sand pad monitoring and lace monitor, eastern water dragon, eastern blue-tongue, eastern small-eyed snake (site 1 bridge) and *Egernia* spp. were recorded during camera monitoring. Among the eight frog species only one (12.5%), the striped marsh frog, was recorded during camera monitoring at site 1 Warrell Creek Bridge. Notably of the 22 cover-dependent/low mobility fauna species in the adjacent habitat, nine of them (40%) were recorded within the underpasses.

Table 8: Species and unique genera recorded in adjacent habitat and using underpasses during year five monitoring at WC2NH, 2022-2023. Due to duplication between species and fauna groups (e.g. wallaby spp. includes both red-necked and swamp wallaby), only confirmed species and unique genera have been included. Fauna in bold denotes threatened species. *Denotes presence. # = Species presence assumed due to detection in only the underpass. [I] = Introduced. ^= cover dependent fauna.

Species	Underpass	Adjacent Habitat
Mammals		
Short-beaked echidna	*	#
Brown antechinus ^	*	*
Northern brown bandicoot ^	*	*
Long-nosed bandicoot ^	*	*
Koala	*	*
Common brushtail possum		*
Short-eared brushtail possum	*	*
Common ringtail possum		*
Swamp wallaby	*	*
Red-necked wallaby	*	#
Eastern grey kangaroo	*	#
Fawn-footed melomys ^		*
Swamp rat ^		*
Bush rat ^	*	*
Water rat	*	#
Black rat [I]	*	*
House mouse[I]	*	*
European Hare[I]		*
Red fox [I]	*	*
Cat [I]	*	*
Dog [I]	*	*
Sub-total mammals	16	21
Reptiles		
Lace monitor	*	*
Eastern blue-tongued lizard^	*	#
Eastern water dragon	*	*
Red-tailed calyptotis ^		*
Egernia spp.^	*	#
Garden skink ^	*	*
Bandy bandy ^		*
Common scaly-foot^		*
Eastern small-eyed snake ^	*	*
Southern angle-headed dragon^		*
Sub-total reptiles	5	10
Frogs		
Dainty green tree frog ^		*

Species	Underpass	Adjacent Habitat
Eastern dwarf tree frog ^		*
Peron's tree frog ^		*
Australian green tree frog^		*
Common eastern froglet ^		*
Tusked frog ^		*
Red-backed toadlet ^		*
Striped marsh frog ^	*	*
Sub-total frogs	1	8
Total No. Species/groups	22	39

4 Discussion

Operational monitoring of underpasses at WC2NH has demonstrated that monitored structures fulfill their intended purpose of facilitating safe passage for both common and threatened fauna between habitat located either side of the project alignment. In the following section, key findings from operational monitoring will first be discussed in light of relevant literature and other monitoring projects. Subsequently, the results will be evaluated against the potential indicators of success as outlined in the EMP.

4.1 Proportion of species from the adjacent habitat using underpasses

As documented in the first four years of operational monitoring (Sandpiper Ecological 2019, 2020, 2022, 2023a), numerous native species and unique genera (17 in total) were recorded utilising underpasses at WC2NH during year five. Native species recorded in underpasses represented 51% of all native species detected within the adjacent habitat in year five. This utilisation rate is comparable to Nambucca Heads to Urunga (NH2U) where it reached 52% in year 7 (Sandpiper Ecological 2024b) and surpasses the 23% to 50% range recorded at Sapphire to Woolgoolga (S2W) (Sandpiper Ecological 2018). Particularly noteworthy is the utilisation of underpasses by 95% of mammal species (all species except common ringtail possum) and 60% of reptile species detected in the adjacent habitat during year five. Additionally, two frog species, specifically the striped marsh frog (recorded at site 1 year five) and the green tree frog (scat recorded at 9/10 during year three), have been detected within underpasses at WC2NH during operational monitoring. The low level of underpass use by frogs at WC2NH is consistent with other equivalent underpass monitoring programs like NH2U (Sandpiper Ecological 2024b). Frog tracks have been noted on sand pads on several occasions during operational monitoring, although species identification is challenging. The infrequent detection of frogs may stem from the limitations of camera traps rather than avoidance of the underpasses.

4.2 Temporal trends in overall underpass use by native species

Use of underpasses at WC2NH by native fauna has progressively increased throughout the operational monitoring period, with an overall increase in the number of complete crossings of 176% from year one (1.29 ± 1.32 cc/week/site) to year five (3.57 ± 1.53 cc/week/site). This result aligns with expectations, as the use of underpasses by native fauna is expected to increase over time as site features improve (Gagnon *et al.* 2011), a pattern also documented at Sapphire to Woolgoolga (S2W) and in recent monitoring at Nambucca Heads to Urunga (NH2U) (Sandpiper Ecological 2018, 2024b). High rainfall in years three to four led to a noticeable increase in vegetation growth and cover around the culvert entrances in year five (Pers obs. L. Andrews).

Improved cover and vegetation connectivity with retained vegetation has likely facilitated increased use of the underpasses by native species, especially cover-dependent fauna such as bandicoots and brown antechinus which were frequent users of underpasses during year five.

Interestingly, the mean complete crossing rate by native species at WC2NH (3.57 ± 1.53 cc/week/site) was 51% higher than the usage rates observed at the nearby NH2U project (2.36 ± 1.99 cc/week/site), despite NH2U being in a later stage of operational monitoring (i.e., seven years since completion) where higher use might be expected (Sandpiper Ecological, 2024b). Given the similarity in the adjoining habitat type between the two projects, the higher usage at WC2NH may be due to a combination of design features such as mulch on the culvert floor and minimal scour protection, landscape position, and distance from retained vegetation to the underpass entrance. Underpasses at WC2NH are primarily dedicated to fauna passage and include mulched culvert floors, entrances close to retained vegetation, and minimal scour protection at the entrances. In contrast, the NH2U underpasses are mostly dual-purpose (i.e. drainage and fauna passage) structures with concrete floors, scour protection adjoining entrances and some flow following rainfall.

While further analysis is required to confirm the presence of a relationship between fauna abundance in adjoining habitat, weather conditions, and increased use of underpasses, such a correlation is plausible. At WC2NH, native fauna use of underpasses increased substantially from the first to the second year, with this trend continuing from years three to five. This pattern closely aligns with the climatic conditions observed throughout the monitoring period, where 2018-19 (year one) experienced below-average to severe drought conditions, followed by La Niña conditions from 2020 to early 2023. Higher rainfall years, known for enhancing foraging conditions and breeding success, have been directly linked to higher abundances of small native fauna (Magnusdottir *et al*., 2008; Lock & Wilson, 2017). Trapping data support these findings, showing a similar temporal increase in capture rates for the three most frequently recorded native species (brown antechinus, bush rat and fawn-footed melomys) within the adjacent habitat over time. The relationship between higher abundance and increased underpass use is supported by Chambers & Bencini (2015), who documented a positive correlation between underpass crossing rates and the overall population size of southern brown bandicoots in adjoining habitat. These findings point to a link between weather conditions, fauna abundance and rate of underpass use at WC2NH over time.

Notably, underpasses at WC2NH experienced a marked increase in usage by native fauna from year three (2021) to year five (2023), which is in contrast to NH2U where only a marginal increase occurred over the same period. The pronounced increase at WC2NH is a probable synergistic effect of site-specific features, such as improved vegetation cover at culvert entrances (enhanced by high rainfall), mulched culvert floors, proximity to retained vegetation, and the improved weather conditions, further increasing underpass usage by native fauna in comparison to NH2U. In summary, the overall increase in native fauna use at WC2NH appears to be the result of a combination of factors, including the establishment of vegetation cover at the culvert entrances over time, improved weather conditions throughout the monitoring period, and design specific factors of dedicated fauna underpasses such as mulched culvert floors and positioning in close proximity to retained vegetation.

4.3 Site specific trends for native fauna underpass use

Native fauna utilisation rates (cc/week) varied among the underpass sites during operational monitoring at WC2NH. The level of variability suggests that site-specific features or design factors may be influencing use by native fauna. There is evidence to show that even within areas of relatively homogenous habitat a species use of underpasses can vary substantially (Goldingay *et al.* 2022). However, exploring such relationships at WC2NH requires an advanced level of statistical analysis beyond the scope of this report and the EMP. As a general observation, sites with continuous vegetation extending over 100 metres from the culvert entrance, such as sites 4, 7, 8, and 9/10, typically had higher usage by native species. Conversely, sites with fragmented adjacent habitat on either side of the underpass, such as sites 1 and 3, exhibited the lowest native fauna usage. Correspondingly, sites 11/12 and 5/6, with moderate adjacent habitat fragmentation to the west, exhibited

intermediate level of native fauna use. The west side of site 11/12 is fragment by a stockpile site and Old Coast Road, whereas the western side of site 5/6 is fragmented by various features including a retention pond, scour protection drainage lines, and farmland within a 100-metre radius of the culvert entrance.

The mean capture rates of small fauna from trapping generally mirrored trends in cover-dependent mammal use of underpasses, except for site 5/6, which recorded the third highest mean capture rate of small, cover-dependent mammals yet exhibited the third lowest rate of underpass usage by cover-dependent and low mobility species, and the second lowest crossing rate by native fauna among all monitored structures. This discrepancy is likely a combined result of the fragmented landscape on the western side and the frequency of inundation of site 5, which deters fauna from crossing. These results suggest that both the continuous habitat surrounding an underpass and the underpass's location in the landscape are crucial for encouraging more frequent use by native fauna.

Native fauna regularly used fauna furniture at WC2NH. This is consistent with findings in various highway monitoring programs that have demonstrated the effectiveness of furniture to facilitate movement of both common and threatened species (Sandpiper Ecological 2024b, Sandpiper Ecological 2021c and Sandpiper Ecological 2022b). *Trichosurus* spp. and *Antechinus* spp, demonstrated preferential use of the fauna furniture, while lace monitor, water dragon and *Egernia* spp displayed occasional use. In contrast, feral predators tended to use the culvert floor with only limited use of furniture by cat. Despite no evidence of predation occurring in the underpasses, the furniture is likely to act as a refuge for native fauna, alleviating predation risk and encouraging underpass crossings (Goldingay *et al.* 2017).

4.4 Targeted threatened fauna use of underpasses

During camera monitoring at WC2NH, two of the three target threatened species (spotted-tailed quoll and giant barred frog), were not recorded using underpasses. The absence of spotted-tailed quolls is consistent with the findings of targeted surveys which suggest the species is uncommon in the locality (GeoLink 2014), and their absence should not be interpreted as avoidance of underpasses. Spotted-tailed quolls have been recorded using underpasses sporadically on several highway upgrades (AMBS 2002; Sandpiper Ecological 2017b; 2024b; Michniewicz & Danvers, 2020). Similarly, no crossings by the giant barred frog were recorded at Site 1 (dedicated giant barred frog underpass) by cameras, although a mark-release-recapture study confirmed movement under the highway (Sandpiper Ecological 2023b). The absence of camera detection is not surprising given the underpass's substantial size (168m wide x 30m long).

Koalas have consistently used dedicated underpasses at WC2NH. Encouragingly, six out of the eight (75%) dedicated underpasses have been used by koalas. In terms of usage frequency, site 4 had the highest average complete crossing rate of 0.16 ± 0.10 cc/week/year, followed by sites 11/12, 9/10, 7, 2, and 8 with rates ranging from of 0.021 ± 0.023 to 0.005 ± 0.011 cc/week/year. No crossings were recorded at sites 1, 3, and 5/6. This pattern of usage contrasts with sporadic and occasional underpass use reported for other highway projects (Sandpiper Ecological 2024b, 2021c, 2022b). The frequency of crossings strongly suggests that the upgrade has been successful in maintaining habitat connectivity for koalas. In their study area, Frere *et al.* (2023) estimated that a minimum of eight koalas would need to disperse from each side of a highway per generation to maintain genetic connectivity. With a generation length of 6-8 years (NSW Scientific Committee 2022) it is likely that dispersal at WC2NH is sufficient to maintain genetic connectivity.

Importantly, the patterns of underpass use at WC2NH suggests use by resident, dispersing and breeding individuals. For example, a (likely) resident koala used site 4 to cross the highway 27 times during year one and year two and an individual or scats have been repeatedly recorded near site 4 over the five-year monitoring period. This contrasts with the occasional winter dispersal or spring/summer breeding movements recorded at other underpasses. Furthermore, the relatively consistent use of Sites 4, 9/10, and 7 over time likely indicate that the features and location of these specific underpasses are well-suited to facilitating koala use.

Notably, the average crossing rate (cc/week) by koalas at WC2NH has declined over time. The trend is largely attributed to a decrease in crossings at site 4 by the resident koala. At site 4, 18 crossings were recorded in year one, 9 in year two, and one each in years 3, 4 and 5. Single crossings are interpreted as more indicative of dispersal rather than breeding or home range movement. There are several possible reasons for the change in crossing frequency, including readjustment of home range to align with the highway, such as occurred at Bonville (Lassua *et al.* 2008), influence of weather (i.e., drought and La Nina) on movement, or mortality of the resident individual.

4.5 Trends in underpass use by feral predators

During the initial two years of operational monitoring at WC2NH, feral predators, notably cat and red fox, accounted for approximately 50% of the total underpass crossings (Sandpiper Ecological 2019, 2020). This pattern highlights the adaptability of both species to using artificial structures, aligning with observations from other underpass monitoring programs along the Pacific Highway (Sandpiper Ecological 2017, 2021c, 2022b, 2024b) and their established behaviour for adapting to and thriving in disturbed landscapes (Graham *et al*., 2012). Notably, underpass use by feral predators exhibited a general downward trend from year one and two, with slight increases in year four and five.

Fox activity initially increased between years one and two before declining in year three following the collaborative trapping program and removal of six individuals caught at the culvert entrances (Saltair Flora and Fauna 2021). Since trapping, fox activity increased between year three (0.29 ± 0.08 cc/week/underpass) and five (0.45 ± 0.33 cc/week/underpass). The increase in fox detection despite the removal of six individuals in 2021 is consistent with many fox control programs where individuals removed are replaced the following year. Favourable climatic conditions in year five summer (high rainfall) and an associated higher abundance of prey items would have ensured the rapid replacement of individuals (Johnson and Vanderwal 2009).

Cat activity decreased from 0.53 ± 0.4 cc/week/site in year four to 0.24 ± 0.6 cc/week/underpass in year 5, with continued high use at site 3, where a resident cat has been consistently recorded throughout operational monitoring (Sandpiper Ecological 2021b). The reasons for this decline are unclear but may be related to increased dog activity in year five (Fancourt et al. 2019; Kreplins et al. 2020). Despite targeted cage trapping since year two, the individual at site three has not been captured and survey findings illustrate how use by a single individual can skew underpass monitoring data.

Dog crossings have fluctuated over the monitoring period. An increase in crossings was recorded from years 1 (nil crossings) to 3 (0.19 crossings/week/underpass) and then declined substantially in year 4 (0.002 crossings/week/underpass) and increased substantially in year 5 (0.29 crossings/week/underpass). The majority of records in year five involved two individuals, with several instances of the dogs traveling in pairs across multiple sites. The presence of dogs is concerning due to the threat they pose to koalas (Lunney *et al.*, 2004, 2007). Consistent with findings on the adjoining NH2U upgrade (Sandpiper Ecological, 2024b) there was overlap in underpass use by dogs and koalas indicating that koalas do not avoid structures used by dogs. Overlap in underpass use is cause for concern, as it increases the risk that an interaction will occur within or at the entrance of the underpasses.

Both dog and red fox exhibited no strong preference for specific sites, though they demonstrated noticeably lower detection rates at sites 5/6 and site 1. The reduced detections at site 1 can likely be attributed to the limited coverage of the camera setup, while the avoidance of site 5/6 may be due to the wet conditions at site 5, which likely deter predators, as recorded at the McGrath's Creek underpass (Sandpiper Ecological, 2024b). The general lack of site preference displayed by dog and red fox could be related to their extensive home ranges and adaptability to diverse landscape types in south-eastern Australia. Wild dogs in this region are known to occupy large home ranges, spanning between 10,000 and 39,000 hectares (Claridge et al., 2009), whereas adult red foxes in coastal wilderness areas have home ranges that vary from 120 to 520 hectares (Phillips and Catling,

1991). These home range sizes fall within the range of habitat that spans between sites 2 to 11/12, suggesting that the same individuals are likely using all underpasses, except site 1, to traverse their home ranges.

4.6 Potential indicators of success summary

4.6.1 Low rates of use of fauna underpasses and adjacent habitats by feral predators

The WC2NH EMP (RMS 2018) does not define "low use" by feral predators. However, underpass use by cats and red foxes has continued to decline in comparison to the first two years of monitoring, while dog has returned to levels recorded in year 3. Levels of dog use remain higher than what was been recorded at NH2U (Sandpiper Ecological, 2024b) and at W2B S3-11 (Sandpiper Ecological, 2022b). Crucially, there was no evidence of predation by feral predators within underpasses, nor was there support for the prey-trap hypothesis, consistent with the findings of multiple studies (Little *et al.*, 2002; Martinig *et al.*, 2020; Goldingay *et al.*, 2022). A concern is the increased underpass usage by two dogs, particularly due to the potential risk of koala predation at known koala sites. The previous targeted control program conducted in year three was largely successful with few records of wild dog during year four. Implementing a similar control program in conjunction with Forestry Corporation should be considered. Whilst the benefits of such a program are short-term there is a high likelihood that it would provide a tangible benefit to koalas.

4.6.2 High levels of fauna underpass use by a variety of native species

The underpasses at WC2NH are used by a wide range of native species from the adjacent habitat, indicating their effectiveness in achieving their intended purpose. The variety of native fauna observed using the underpasses and growing rate of use over time can be attributed to their placement within the landscape, the improvement of environmental conditions, and the gradual enhancement of site features, such as vegetation cover at culvert entrances. Overall, these findings suggest the underpass structures have been a success at Warrell Creek in facilitating high levels of use by various native species.

4.6.3 No change to densities, distribution, habitat use, and movement patterns compared to baseline population data of target species.

The target species for underpass monitoring, as outlined in the EMP, are spotted-tailed quoll, koala and giant barred frog. The absence of spotted-tailed quolls is consistent with baseline monitoring (GeoLink 2014). Importantly, underpasses at WC2NH are equivalent to structures used elsewhere and use is considered likely should a quoll encounter an underpass. One giant barred frog was recorded crossing the alignment during population monitoring at site 1 and a detailed discussion on the population of barred frogs at that site is provided by Sandpiper Ecological (2023a). Confirming population trends for koalas in the study area is challenging due to changes in survey effort over time (see Sandpiper Ecological 2024a), however, there is no evidence of changes in abundance or distribution. Sandpiper Ecological (2024a) provides a detailed discussion of koala population monitoring, focusing on distribution, movement patterns and habitat use over time.

4.6.4 Evidence of use by dispersing individuals and different age cohorts

Accurately confirming the age of individuals using underpasses is difficult using the survey methods outlined in the EMP. Other methods such as mark-release-recapture would likely be required to provide definitive proof of use by dispersing individuals and different age cohorts. Such a survey is not warranted at WC2NH.

4.6.5 Use by cover-dependent species with low mobility

Eleven cover-dependent and/or low mobility species have been recorded during operational monitoring using underpasses at WC2NH. The rate of use by cover dependent and low mobility fauna has consistently increased over time and is likely a function of improving site features such as vegetated culvert entrances and ground cover connectivity to retained vegetation. Low occurrence of frogs and reptiles is most likely due to the inability of cameras to detect these species as opposed to avoidance of underpasses. This shortfall is overcome to some extent by using other survey methods like sand pads and scat and track surveys. The culvert floor and furniture were both used by cover dependent species. Fawn-footed melomys, brown antechinus and eastern crevice skink predominantly used fauna furniture, highlighting the value of this feature in providing connectivity for cover dependent species. The increasing presence of lizards, such as eastern blue-tongue lizard and eastern crevice skink using underpasses in year five is encouraging, as these species tend to have small home ranges and predominantly reside in habitat with dense cover. Overall, underpasses at WC2NH have successfully provided connectivity for cover dependent fauna and use is increasing.

5. Contingency Measures and Recommendations

5.1 Contingency Measures

Contingency measures are summarised in Table 9.

Table 9: Potential problems outlined in the EMP and possible contingency measures. Proposed mitigation measures applicable to the project are addressed in bold text.

Problem	Contingency/Corrective Action	Proposed action
High rates of feral predator activity;	Control program	The use of underpasses by dogs reached its highest recorded levels to date at WC2NH, surpassing the levels recorded at NH2U and W2B in sections 3-11. Given the risk of koala predation at sites frequented by koalas, consideration should be given to implementing a control program similar to that of year three, in conjunction with the Forestry Corporation. Although the benefits of such a program are short-term, it is highly likely to offer a tangible benefit to koalas.
Low levels of native fauna movement and species diversity in underpasses;	Modify habitat structure near underpass entrances and/or modify underpass fauna furniture	No action is required – monitoring has shown that fauna furniture is functional, and underpasses provide safe passage for 95% of mammal species and 60% of reptile species recorded in adjacent habitats in year five.
No use of underpasses by cover-dependent species or species with low mobility or target threatened species	Modify or add potential groundcover resources	Eleven native cover-dependent species and one threatened species (koala) have been recorded using underpasses on several occasions. Tiles have proved ineffective at detecting cover-dependent fauna. No further action is warranted.
High rates of fauna road mortality.	Modify exclusion fencing design, location or extent depending on the species and location of mortalities	Issues relating to road mortality are addressed in the quarterly and annual road-kill reports.

5.2 Recommendations

Recommendations are summarised in Table 10.

Table 10: Recommendations based on findings from operational phase monitoring and response from TfNSW.

Number	Recommendation	Transport for NSW Response
1.	Liaise with Forestry Corporation to undertake a coordinated feral predator (fox and dog) control program in the vicinity of underpasses.	Agree.

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Appendix A – Species list

Table A1: Common and scientific names for all species recorded during operational monitoring at WC2NH. Species in bold = Threatened species.

Common Name	Scientific Name
Mammals	
Koala	*Phascolarctos cinereus*
Swamp wallaby	*Wallabia bicolor*
Red-necked wallaby	*Macropus rufogriseus*
Wallaby spp.	
Short-beaked echidna	*Tachyglossus aculeatus*
Yellow-bellied glider	*Petaurus australis*
Sugar glider	*Petaurus breviceps*
	Petaurus spp.
Short-eared brushtail possum	*Trichosurus caninus*
Common brushtail possum	*Trichosurus vulpecula*
Brushtail possum spp.	*Trichosurus spp.*
Common ringtail possum	*Pseudocheirus peregrinus*
Northern brown bandicoot	*Isoodon macrourus*
Long-nosed bandicoot	*Perameles nasuta*
Bandicoot species	*Peramelidae spp.*
Fawn-footed melomys	*Melomys cervinipes*
	Melomys spp.
Water rat	*Hydromys chrysogaster*
Bush rat	*Rattus fuscipes*
Swamp rat	*Rattus lutreolus*
Brown antechinus	*Antechinus stuartii*
	Antechinus spp.
Grey-headed flying red fox	*Pteropus poliocephalus*
Flying red fox spp.	*Pteropus spp.*
Bent-wing spp.	*Miniopterus spp.*
Small mammal spp.	
	Dasyuridae spp.
Reptiles	
Eastern crevice skink	*Egernia mcpheii*
Garden skink	*Lampropholis delicata*
Grass skink	*Lampropholis guichenoti*
	Lampropholis spp.
Red-tailed calyptotis	*Calyptotis ruficauda*
Eastern water-skink	*Eulamprus quoyii*
Three-toed skink	*Saiphos equalis*
Skink spp.	*Scincidae spp.*
Coastal carpet python	*Morelia spilota*
Red-bellied black snake	*Pseudechis porphyriacus*
Yellow-faced whipsnake	*Demansia psammophis*
Black-bellied swamp snake	*Hemiaspis signata*
Blackish blind snake	*Anilios nigrescens*
Bandy bandy	*Vermicella annulata*
Coastal carpet python	*Morelia spilota*
Burton's legless lizard	*Lialis burtonis*
Lace monitor	*Varanus varius*
Eastern water dragon	*Intellagama lesueurii*
	Agamid spp.
Freshwater turtle spp.	*Chelidae spp.*

Common Name	Scientific Name
Frogs	
Eastern dwarf tree frog	*Litoria fallax*
Tyler's tree frog	*Litoria tyleri*
Red-eyed tree frog	*Litoria chloris*
Green tree frog	*Litoria cerulea*
Dusky toadlet	*Uperolia fusca*
Tusked frog	*Adelotus brevis*
Common eastern froglet	*Crinia signifera*
Giant barred frog	*Mixophyes iteratus*
Striped marsh frog	*Limnodynastes peronii*
Red-backed toadlet	*Pseudophryne coriacea*
Medium frog spp.	
Introduced	
Cat	*Felis catus*
Red fox	*Vulpes vulpes*
Black rat	*Rattus rattus*
European hare	*Lepus europaeus*
House mouse	*Mus musculus*

Appendix B – Field data

Table B1: Underpass camera data recorded during spring/summer and winter of year five operational monitoring WC2NH, 2022-2023.

Season	Site	Cam Location	Common name	Class	Specific taxa	Complete	Incomplete	NDM	Comments
Spring/Summer	1	South	Cat	Introduced	Feral predator				
Spring/Summer	1	South	Swamp wallaby	Native	Macropod		1		
Spring/Summer	1	South	Rodent spp.	NA	Introduced rodent				
Spring/Summer	1	North	Swamp wallaby	Native	Macropod			1	
Spring/Summer	1	North	Antechinus spp.	Native	Antechinus				
Spring/Summer	1	North	Fox	Introduced	Feral predator				
Spring/Summer	1	North	Small frog spp.	Native	Frog				Difficult to distinguish - most likely striped marsh 20mm
Spring/Summer	1	North	Lace monitor	Native	Lizard				
Spring/Summer	1	North	Cat	Introduced	Feral predator				
Spring/Summer	1	North	Black rat	Introduced	Introduced rodent				
Spring/Summer	2	Furniture	Antechinus spp.	Native	Antechinus	31	3		
Spring/Summer	2	Furniture	Bush rat	Native	Native rodent	1	4		
Spring/Summer	2	Furniture	Short-eared brushtail possum	Native	Possum	0	3		
Spring/Summer	2	Furniture	Lizard spp.	NA	Lizard	6			
Spring/Summer	2	Furniture	Rattus spp.	NA	Rodent	2			
Spring/Summer	2	Gound	Long-nosed bandicoot	Native	Bandicoot	35	6		
Spring/Summer	2	Gound	Short-beaked echidna	Native	Echidna	1			
Spring/Summer	2	Gound	Eastern water dragon	Native	Lizard	1			
Spring/Summer	2	Gound	Black rat	Introduced	Introduced rodent	5			
Spring/Summer	2	Gound	Swamp wallaby	Native	Macropod	5	3		
Spring/Summer	2	Gound	Wallaby spp.	Native	Macropod	3			
Spring/Summer	2	Gound	Red fox	Introduced	Feral predator	2			
Spring/Summer	2	Gound	Rattus spp.	NA	Rodent	3			
Spring/Summer	2	Gound	Short-eared brushtail possum	Native	Possum	2			
Spring/Summer	2	Gound	Blue-tongue lizard	Native	Lizard	2			

Season	Site	Cam Location	Common name	Class	Specific taxa	Complete	Incomplete	NDM	Comments
Spring/Summer	2	Gound	Lace monitor	Native	Lizard	1			
Spring/Summer	2	Gound	Lizard spp.	NA	Lizard	2			
Spring/Summer	2	Gound	Bandicoot spp.	Native	Bandicoot	1			
Spring/Summer	2	Gound	Antechinus spp.	Native	Antechinus	1			
Spring/Summer	3	Furniture	Brush-tail possum spp.	Native	Possum	7			Microbats and welcome swallows present
Spring/Summer	3	Furniture	Short-eared brushtail possum	Native	Possum	39	3		
Spring/Summer	3	Furniture	Eastern water dragon	Native	Lizard	4			
Spring/Summer	3	Furniture	Lace monitor	Native	Lizard	1			
Spring/Summer	3	Furniture	Antechinus spp.	Native	Antechinus	1			
Spring/Summer	3	Ground	Macropod spp.	Native	Macropod	18			
Spring/Summer	3	Ground	Lace monitor	Native	Lizard	7			
Spring/Summer	3	Ground	Cat	Introduced	Feral predator	9			Cat at site three still present - must be restricted and kept indoors more often - in the past crossings were nightly
Spring/Summer	3	Ground	Eastern grey kangaroo	Native	Macropod	10			
Spring/Summer	3	Ground	Wallaby spp.	Native	Macropod	7			
Spring/Summer	4	Furniture	Lace monitor	Native	Lizard	7			
Spring/Summer	4	Furniture	Rattus spp.	NA	Rodent	78	2		
Spring/Summer	4	Furniture	Short-eared brushtail possum	Native	Possum	17	1		
Spring/Summer	4	Furniture	Black rat	Introduced	Introduced rodent	8			
Spring/Summer	4	Furniture	Bush rat	Native	Native rodent	4			
Spring/Summer	4	Ground	Koala	Native	Koala	1			
Spring/Summer	4	Ground	Black rat	Introduced	Introduced rodent				
Spring/Summer	4	Ground	Bandicoot spp.	Native	Bandicoot				
Spring/Summer	4	Ground	Long-nosed bandicoot	Native	Bandicoot	13	3		
Spring/Summer	4	Ground	Swamp wallaby	Native	Macropod	16			
Spring/Summer	4	Ground	Red fox	Introduced	Feral predator	0	2		
Spring/Summer	4	Ground	Short-beaked echidna	Native	Echidna	1			
Spring/Summer	4	Ground	Lace monitor	Native	Lizard	23	1		

Season	Site	Cam Location	Common name	Class	Specific taxa	Complete	Incomplete	NDM	Comments
Spring/Summer	4	Ground	Wallaby spp.	Native	Macropod	13			
Spring/Summer	4	Ground	Cat	Introduced	Feral predator	2			
Spring/Summer	4	Ground	Dog	Introduced	Feral predator	9			
Spring/Summer	4	Ground	Short-eared brushtail possum	Native	Possum	1			
Spring/Summer	4	Ground	Eastern water dragon	Native	Lizard	1			
Spring/Summer	4	Ground	Brush-tail possum spp.	Native	Possum	21			
Spring/Summer	5	North	Dog	Introduced	Feral predator	1			Microbats present
Spring/Summer	5	North	Bandicoot spp.	Native	Bandicoot	1			
Spring/Summer	5	North	Rattus spp.	NA	Rodent	1			
Spring/Summer	5	North	Water rat	Native	Native rodent	1	2		
Spring/Summer	5	North	Black rat	Introduced	Introduced rodent	0	7		
Spring/Summer	5	North	Antechinus spp.	Native	Antechinus	1			
Spring/Summer	5	South	Dog	Introduced	Feral predator	0	1		Microbats present
Spring/Summer	5	South	Water rat	Native	Native rodent	1			
Spring/Summer	6	Furniture	Rattus spp.	NA	Rodent	48	2		
Spring/Summer	6	Furniture	Antechinus spp.	Native	Antechinus	4			
Spring/Summer	6	Ground	Cat	Introduced	Feral predator	6	1		
Spring/Summer	6	Ground	Wonga pigeon		Bird	0	1		don’t include birds in the analysis
Spring/Summer	6	Ground	Long-nosed bandicoot	Native	Bandicoot	12	1		
Spring/Summer	6	Ground	Red fox	Introduced	Feral predator	5	1		
Spring/Summer	6	Ground	Lace monitor	Native	Lizard	18	1		
Spring/Summer	6	Ground	Dog	Introduced	Feral predator	10	1		
Spring/Summer	6	Ground	Swamp wallaby	Native	Macropod	12	1		
Spring/Summer	6	Ground	Wallaby spp.	Native	Macropod	1			
Spring/Summer	6	Ground	Chicken	Introduced	Bird	2	3		
Spring/Summer	6	Ground	Bandicoot spp.	Native	Bandicoot	1			
Spring/Summer	6	Ground	Black rat	Introduced	Introduced rodent	1			
Spring/Summer	6	Ground	Eastern water dragon	Native	Lizard	1			

Season	Site	Cam Location	Common name	Class	Specific taxa	Complete	Incomplete	NDM	Comments
Spring/Summer	7	Furniture	Bush rat	Native	Native rodent	4			
Spring/Summer	7	Furniture	Short-eared brushtail possum	Native	Possum	56			
Spring/Summer	7	Furniture	Rattus spp.	Introduced	Rodent	51	6		
Spring/Summer	7	Furniture	Black rat	Introduced	Introduced rodent	4	4		
Spring/Summer	7	Furniture	Lace monitor	Native	Lizard	7	1		
Spring/Summer	7	Furniture	Rattus spp.	NA	Rodent	3	2		
Spring/Summer	7	Furniture	Lizard spp.	NA	Lizard	2			
Spring/Summer	7	Ground	Swamp wallaby	Native	Macropod	2			
Spring/Summer	7	Ground	Long-nosed bandicoot	Native	Bandicoot	4	2		
Spring/Summer	7	Ground	Dog	Introduced	Feral predator	1			
Spring/Summer	7	Ground	Black rat	Introduced	Introduced rodent	8	1		
Spring/Summer	7	Ground	Red fox	Introduced	Feral predator	3			
Spring/Summer	7	Ground	Rattus spp.	NA	Rodent	5			
Spring/Summer	7	Ground	Short-beaked echidna	Native	Echidna	0	1		
Spring/Summer	7	Ground	Wallaby spp.	Native	Macropod	5			
Spring/Summer	7	Ground	Lace monitor	Native	Lizard	2			
Spring/Summer	7	Ground	Bandicoot spp.	Native	Bandicoot	4			
Spring/Summer	8	Furniture	Short-eared brushtail possum	Native	Possum	4			
Spring/Summer	8	Furniture	Lizard spp.	Native	Lizard	7			
Spring/Summer	8	Furniture	Antechinus spp.	Native	Antechinus	2			
Spring/Summer	8	Furniture	Brush-tail possum spp.	Native	Possum	6	2		
Spring/Summer	8	Furniture	Black rat	Introduced	Introduced rodent	2			
Spring/Summer	8	Furniture	Rattus spp.	NA	Rodent	5			
Spring/Summer	8	Furniture	Bush rat	Native	Native rodent	0	1		
Spring/Summer	8	Ground	Wallaby spp.	Native	Macropod	20			
Spring/Summer	8	Ground	Long-nosed bandicoot	Native	Bandicoot	1			
Spring/Summer	8	Ground	Red fox	Introduced	Feral predator	9			

Season	Site	Cam Location	Common name	Class	Specific taxa	Complete	Incomplete	NDM	Comments
Spring/Summer	8	Ground	Swamp wallaby	Native	Macropod	14			
Spring/Summer	8	Ground	Brush-tail possum spp.	Native	Possum	1			
Spring/Summer	8	Ground	Bandicoot spp.	Native	Bandicoot	9			
Spring/Summer	8	Ground	Dog	Introduced	Feral predator	5			
Spring/Summer	8	Ground	Lace monitor	Native	Lizard	7			
Spring/Summer	8	Ground	Short-eared brushtail possum	Native	Possum	2			
Spring/Summer	8	Ground	Rattus spp.	NA	Rodent	1			
Spring/Summer	9	Furniture	Bush rat	Native	Native rodent	0	1		
Spring/Summer	9	Furniture	Lizard spp.	NA	Lizard	37			
Spring/Summer	9	Furniture	Black rat	Introduced	Introduced rodent	3			
Spring/Summer	9	Furniture	Rattus spp.	NA	Rodent	40	3		
Spring/Summer	9	Furniture	Antechinus spp.	Native	Antechinus	1			
Spring/Summer	9	Ground	Northern-brown bandicoot	Native	Bandicoot	0			
Spring/Summer	9	Ground	Brush-tail possum spp.	Native	Possum	1			
Spring/Summer	9	Ground	Red fox	Introduced	Feral predator	1			
Spring/Summer	9	Ground	Lizard spp.	NA	Lizard	1			
Spring/Summer	9	Ground	Long-nosed bandicoot	Native	Bandicoot	1			
Spring/Summer	9	Ground	Black rat	Introduced	Introduced rodent	2			
Spring/Summer	9	Ground	Dog	Introduced	Feral predator	1			
Spring/Summer	10	Furniture	Brush-tail possum spp.	Native	Possum	5	1		
Spring/Summer	10	Furniture	Lizard spp.	NA	Lizard	7			
Spring/Summer	10	Furniture	Short-eared brushtail possum	Native	Possum	3	1		
Spring/Summer	10	Furniture	Rattus spp.	NA	Rodent	3	1		
Spring/Summer	10	Ground	Red fox	Introduced	Feral predator	8			
Spring/Summer	10	Ground	Bandicoot spp.	Native	Bandicoot	10	2		
Spring/Summer	10	Ground	Swamp wallaby	Native	Macropod	0	1		
Spring/Summer	10	Ground	Dog	Introduced	Feral predator	18			
Spring/Summer	10	Ground	Long-nosed bandicoot	Native	Bandicoot	8			

Season	Site	Cam Location	Common name	Class	Specific taxa	Complete	Incomplete	NDM	Comments
Spring/Summer	10	Ground	Wallaby spp.	Native	Macropod	7			
Spring/Summer	10	Ground	Lace monitor	Native	Lizard	4			
Spring/Summer	10	Ground	Red-necked wallaby	Native	Macropod	1	1		
Spring/Summer	10	Ground	Black rat	Introduced	Introduced rodent	2			
Spring/Summer	10	Ground	Rattus spp.	NA	Rodent	1			
Spring/Summer	11	Furniture	Rattus spp.	NA	Rodent	92	2		Microbats present - also don't include in the analysis
Spring/Summer	11	Furniture	Bush rat	Native	Native rodent	13	2		
Spring/Summer	11	Furniture	Short-eared brushtail possum	Native	Possum	44			
Spring/Summer	11	Furniture	Brush-tail possum spp.	Native	Possum	7			
Spring/Summer	11	Furniture	Black rat	Introduced	Introduced rodent	2			
Spring/Summer	11	Furniture	Lizard spp.	NA	Lizard	0	1		
Spring/Summer	11	Ground	Wonga pigeon		Bird	1			
Spring/Summer	11	Ground	Bandicoot spp.	Native	Bandicoot	17			Fixed 114 to 14 - error in recording data - additional records added from reinstall
Spring/Summer	11	Ground	Red fox	Introduced	Feral predator	10			
Spring/Summer	11	Ground	Dog	Introduced	Feral predator	7			
Spring/Summer	11	Ground	Lace monitor	Native	Lizard	2			
Spring/Summer	11	Ground	Wallaby spp.	Native	Macropod	1			
Spring/Summer	11	Ground	Lizard spp.	NA	Lizard	1			
Spring/Summer	12	Furniture	Short-eared brushtail possum	Native	Possum	8			
Spring/Summer	12	Ground	Red fox	Introduced	Feral predator	26			
Spring/Summer	12	Ground	Northern-brown bandicoot	Native	Bandicoot	7			
Spring/Summer	12	Ground	Long-nosed bandicoot	Native	Bandicoot	4			
Spring/Summer	12	Ground	Dog	Introduced	Feral predator	6			
Spring/Summer	12	Ground	Lace monitor	Native	Lizard	3			
Spring/Summer	12	Ground	Black rat	Introduced	Introduced rodent	1	1		
Spring/Summer	12	Ground	Red-necked wallaby	Native	Macropod	1			
Spring/Summer	12	Ground	Wonga pigeon		Bird	0	6		

Season	Site	Cam Location	Common name	Class	Specific taxa	Complete	Incomplete	NDM	Comments
Spring/Summer	12	Ground	Bandicoot spp.	Native	Bandicoot	7			
Spring/Summer	12	Ground	Cat	Introduced	Feral predator	1			
Spring/Summer	12	Ground	Blue tongue lizard	Native	Lizard	1			
Spring/Summer	12	Ground	Short-eared brushtail possum	Native	Lizard	1			
Spring/Summer	12	Ground	Swamp wallaby	Native	Macropod	4	1		
Winter	12	Ground	Bandicoot spp.	Native	Bandicoot	5	0	0	Nil
Winter	12	Ground	Black rat	Introduced	Introduced rodent	19	2	1	Nil
Winter	12	Ground	Brown antechinus	Native	Antechinus	7	0	1	Nil
Winter	12	Ground	Eastern blue-tongued lizard	Native	Lizard	1	0	0	Nil
Winter	12	Ground	Eastern water dragon	Native	Lizard	2	0	0	Nil
Winter	12	Ground	Koala	Native	Koala	1	0	0	Appears healthy, unsure of sex
Winter	12	Ground	Lace monitor	Native	Lizard	3	0	0	Nil
Winter	12	Ground	Long-nosed bandicoot	Native	Bandicoot	6	0	0	Nil
Winter	12	Ground	Northern-brown bandicoot	Native	Bandicoot	3	0	0	Nil
Winter	12	Ground	Rattus spp.	NA	Rodent	5	0	0	Nil
Winter	12	Ground	Red fox	Introduced	Feral predator	35	0	0	Nil
Winter	12	Ground	Red-necked wallaby	Native	Macropod	3	0	0	Nil
Winter	12	Ground	Short-beaked echidna	Native	Echidna	1	0	0	Nil
Winter	12	Ground	Swamp wallaby	Native	Macropod	12	0	0	Nil
Winter	12	Ground	Wild dog	Introduced	Feral predator	0	0	0	One black and one sandy dog, two individuals
Winter	12	Furniture	Black rat	Introduced	Introduced rodent	35	1	5	Nil
Winter	12	Furniture	Brown antechinus	Native	Antechinus	19	0	0	Nil
Winter	12	Furniture	Rattus spp.	Native	Rodent	7	0	0	Nil
Winter	11	Ground	Bandicoot spp.	Native	Bandicoot	4	0	0	Nil
Winter	11	Ground	Koala	Native	Koala	1	0	0	Made complete crossing on 25/8/2023 2:20am
Winter	11	Ground	Lace monitor	Native	Lizard	3	0	0	Nil
Winter	11	Ground	Long-nosed bandicoot	Native	Bandicoot	3	0	0	Nil
Winter	11	Ground	Red fox	Introduced	Feral predator	19	1	0	Nil

Season	Site	Cam Location	Common name	Class	Specific taxa	Complete	Incomplete	NDM	Comments
Winter	11	Ground	Red-necked wallaby	Native	Macropod	3	0	0	Nil
Winter	11	Ground	Swamp wallaby	Native	Macropod	11	0	0	Nil
Winter	11	Ground	Wild dog	Introduced	Feral predator	4	0	0	One black and one sandy dog, two individuals
Winter	11	Furniture	Black rat	Introduced	Introduced rodent	26	0	0	Nil
Winter	11	Furniture	Brown antechinus	Native	Antechinus	38	9	0	Nil
Winter	11	Furniture	Rattus spp.	NA	Rodent	4	0	0	Nil
Winter	10	Ground	Bandicoot spp.	Native	Bandicoot	17	1	0	Nil
Winter	10	Ground	Black rat	Introduced	Introduced rodent	3	0	0	Nil
Winter	10	Ground	Brush-tail possum spp.	Native	Possum	3	0	0	Nil
Winter	10	Ground	Cat	Introduced	Feral predator	1	0	0	Nil
Winter	10	Ground	Koala	Native	Koala	1	0	0	Completed crossing in 9 and 10
Winter	10	Ground	Lace monitor	Native	Lizard	4	0	0	Nil
Winter	10	Ground	Long-nosed bandicoot	Native	Bandicoot	5	0	0	Nil
Winter	10	Ground	Northern-brown bandicoot	Native	Bandicoot	2	0	0	Nil
Winter	10	Ground	Rattus spp.	NA	Rodent	6	0	0	Nil
Winter	10	Ground	Red fox	Introduced	Feral predator	26	3	0	Nil
Winter	10	Ground	Short-beaked echidna	Native	Echidna	1	0	0	Nil
Winter	10	Ground	Swamp wallaby	Native	Macropod	2	0	0	Nil
Winter	10	Ground	Wallaby spp.	Native	Macropod	13	0	0	Nil
Winter	10	Ground	Wild dog	Introduced	Feral predator	3	0	0	Same individuals at 11/12, in pairs at times
Winter	10	Furniture	Black rat	Introduced	Introduced rodent	16	2	0	Nil
Winter	10	Furniture	Brown antechinus	Native	Antechinus	78	17	1	Nil
Winter	10	Furniture	Brush-tail possum spp.	Native	Possum	2	0	0	Nil
Winter	10	Furniture	Rattus spp.	NA	Rodent	32	0	0	Nil
Winter	9	Ground	Bandicoot spp.	Native	Bandicoot	17	1	0	Nil
Winter	9	Ground	Black rat	Introduced	Introduced rodent	3	0	0	Nil
Winter	9	Ground	Brush-tail possum spp.	Native	Possum	1	0	0	Nil
Winter	9	Ground	Cat	Introduced	Feral predator	1	0	0	Nil

Season	Site	Cam Location	Common name	Class	Specific taxa	Complete	Incomplete	NDM	Comments
Winter	9	Ground	Koala	Native	Koala	1	0	0	Nil
Winter	9	Ground	Lace monitor	Native	Lizard	4	0	0	Nil
Winter	9	Ground	Long-nosed bandicoot	Native	Bandicoot	9	0	0	Nil
Winter	9	Ground	Northern-brown bandicoot	Native	Bandicoot	4	0	0	Nil
Winter	9	Ground	Rattus spp.	NA	Rodent	2	0	0	Nil
Winter	9	Ground	Red fox	Introduced	Feral predator	20	0	0	Nil
Winter	9	Ground	Short-beaked echidna	Native	Echidna	3	0	0	Nil
Winter	9	Ground	Swamp wallaby	Native	Macropod	5	0	0	Nil
Winter	9	Ground	Wallaby spp.	Native	Macropod	8	0	0	Nil
Winter	9	Ground	Wild dog	Introduced	Feral predator	9	2	0	Same individuals at 11/12, in pairs at times
Winter	9	Furniture	Black rat	Introduced	Introduced rodent	34	5	4	Nil
Winter	9	Furniture	Brown antechinus	Native	Antechinus	11	1	1	Nil
Winter	9	Furniture	Brush-tail possum spp.	Native	Possum	4	0	0	Nil
Winter	9	Furniture	Egernia spp.	Native	Lizard	19	3	3	Nil
Winter	9	Furniture	Rattus spp.	NA	Rodent	59	1	1	Nil
Winter	8	Ground	Bandicoot spp.	Native	Bandicoot	24	0	0	Nil
Winter	8	Ground	Lace monitor	Native	Lizard	5	0	0	Nil
Winter	8	Ground	Long-nosed bandicoot	Native	Bandicoot	5	0	1	Nil
Winter	8	Ground	Rattus spp.	NA	Rodent	2	0	0	Nil
Winter	8	Ground	Red fox	Introduced	Feral predator	12	0	1	Nil
Winter	8	Ground	Swamp wallaby	Native	Macropod	39	0	3	Nil
Winter	8	Ground	Wallaby spp.	Native	Macropod	11	0	0	Nil
Winter	8	Ground	Wild dog	Introduced	Feral predator	27	0	0	Same individuals at 11/12, in pairs at times
Winter	8	Furniture	Black rat	Introduced	Introduced rodent	10	1	0	Nil
Winter	8	Furniture	Brown antechinus	Native	Antechinus	61	11	5	Nil
Winter	8	Furniture	Brush-tail possum spp.	Native	Possum	2	0	0	Nil
Winter	8	Furniture	Rattus spp.	NA	Rodent	8	0	0	Nil
Winter	7	Ground	Bandicoot spp.	Native	Bandicoot	13	0	0	Nil
Winter	7	Ground	Brown antechinus	Native	Antechinus	1	0	0	Nil

Season	Site	Cam Location	Common name	Class	Specific taxa	Complete	Incomplete	NDM	Comments
Winter	7	Ground	Rattus spp.	NA	Rodent	4	0	2	Nil
Winter	7	Ground	Red fox	Introduced	Feral predator	18	0	0	Nil
Winter	7	Ground	Short-beaked echidna	Native	Echidna	1	0	0	Nil
Winter	7	Ground	Swamp wallaby	Native	Macropod	19	0	0	Nil
Winter	7	Ground	Wallaby spp.	Native	Macropod	3	0	0	Nil
Winter	7	Ground	Wild dog	Introduced	Feral predator	9	0	0	Same individuals at 11/12, in pairs at times
Winter	7	Furniture	Black rat	Introduced	Introduced rodent	9	0	0	Nil
Winter	7	Furniture	Brown antechinus	Native	Antechinus	12	0	0	Nil
Winter	7	Furniture	Egernia spp.	Native	Lizard	1	0	0	Nil
Winter	7	Furniture	Rattus spp.	Introduced	Rodent	15	0	0	Nil
Winter	7	Furniture	Short-eared brushtail possum	Native	Possum	36	0	0	Nil
Winter	6	Ground	Bandicoot spp.	Native	Bandicoot	12	0	0	Nil
Winter	6	Ground	Cat	Introduced	Feral predator	1	1	0	Nil
Winter	6	Ground	Lace monitor	Native	Lizard	1	0	0	Nil
Winter	6	Ground	Long-nosed bandicoot	Native	Bandicoot	17	0	1	Nil
Winter	6	Ground	Red fox	Introduced	Feral predator	14	0	0	Nil
Winter	6	Ground	Swamp wallaby	Native	Macropod	8	0	0	Nil
Winter	6	Ground	Wild dog	Introduced	Feral predator	20	0	0	Same individuals at 11/12, in pairs at times
Winter	6	Furniture	Black rat	Introduced	Introduced rodent	7	0	0	Nil
Winter	6	Furniture	Brown antechinus	Native	Antechinus	33	4	0	Nil
Winter	6	Furniture	Rattus spp.	NA	Rodent	16	0	0	Nil
Winter	5	Ground	Bandicoot spp.	Native	Bandicoot	1	1	0	Nil
Winter	5	Ground	Water rat	Native	Native rodent	17	2	0	Nil
Winter	5	Ground	Bandicoot spp.	Native	Bandicoot	6	3	0	Nil
Winter	5	Ground	Black rat	Introduced	Introduced rodent	3	1	0	Nil
Winter	5	Ground	Brown antechinus	Native	Antechinus	4	4	0	Nil
Winter	5	Ground	Rattus spp.	NA	Rodent	5	2	0	Nil
Winter	5	Ground	Water rat	Native	Native rodent	12	6	0	Nil

Season	Site	Cam Location	Common name	Class	Specific taxa	Complete	Incomplete	NDM	Comments
Winter	4	Ground	Cat	Introduced	Feral predator	1	1	0	Nil
Winter	4	Ground	Eastern water dragon	Native	lizard		0	0	Nil
Winter	4	Ground	Lace monitor	Native	Lizard	5	0	0	Nil
Winter	4	Ground	Long-nosed bandicoot	Native	Bandicoot	3	1	0	Nil
Winter	4	Ground	Northern-brown bandicoot	Native	Bandicoot	3	0	0	Nil
Winter	4	Ground	Red fox	Introduced	Feral predator	7	0	0	Nil
Winter	4	Ground	Short-beaked echidna	Native	Echidna	2	0	0	Nil
Winter	4	Ground	Short-eared brushtail possum	Native	Possum	2	0	0	Nil
Winter	4	Ground	Swamp wallaby	Native	Macropod	14	0	0	Nil
Winter	4	Ground	Wallaby spp.	Native	Macropod	7	0	0	Nil
Winter	4	Ground	Wild dog	Introduced	Feral predator	10	0	0	Same individuals at 11/12, in pairs at times
Winter	4	Furniture	Lace monitor	Native	Lizard	2	0	0	Nil
Winter	4	Furniture	Rattus spp.	NA	Rodent	26	2	0	Probable bush rat
Winter	4	Furniture	Short-eared brushtail possum	Native	Possum	39	3	0	Carrying back young
Winter	3	Ground	Cat	Introduced	Feral predator	73	6	0	Two individuals (same a previous years) white socks and tabby
Winter	3	Ground	Lace monitor	Native	Lizard	3	0	0	Nil
Winter	3	Ground	Red fox	Introduced	Feral predator	3	0	0	Nil
Winter	3	Ground	Red-necked wallaby	Native	Macropod	3	0	0	Nil
Winter	3	Ground	Swamp wallaby	Native	Macropod	5	0	0	Nil
Winter	3	Ground	Wallaby spp.	Native	Macropod	7	0	0	Nil
Winter	3	Furniture	Brown antechinus	Native	Antechinus	3	0	0	Nil
Winter	3	Furniture	Brush-tail possum spp.	Native	Possum	6	0	0	Nil
Winter	3	Furniture	Short-eared brushtail possum	Native	Possum	10	0	0	Nil
Winter	2	Gound	Bandicoot spp.	Native	Bandicoot	9	1	1	Nil
Winter	2	Gound	Cat	Introduced	Feral predator	1	0	0	Nil
Winter	2	Gound	Long-nosed bandicoot	Native	Bandicoot	8	3	0	Nil
Winter	2	Gound	Rattus spp.	NA	Rodent	4	0	0	Nil
Winter	2	Gound	Red fox	Introduced	Feral predator	12	0	0	Nil

Season	Site	Cam Location	Common name	Class	Specific taxa	Complete	Incomplete	NDM	Comments
Winter	2	Gound	Short-beaked echidna	Native	Echidna	2	0	0	Nil
Winter	2	Gound	Swamp wallaby	Native	Macropod	8	0	2	Nil
Winter	2	Gound	Wallaby spp.	Native	Macropod	8	0	0	Nil
Winter	2	Furniture	Brown antechinus	Native	Antechinus	44	0	0	Nil
Winter	2	Furniture	Rattus spp.	NA	Rodent	13	0	0	Nil
Winter	1	North	Rattus spp.	NA	Rodent	3			Nil
Winter	1	North	Black rat	Introduced	Introduced rodent	2			Nil
Winter	1	North	Swamp wallaby	Native	Macropod	5			Nil
Winter	1	North	Small-eyed snake	Native	Snake	1			Nil
Winter	1	North	Red fox	Introduced	Feral predator	3			Nil
Winter	1	South	Brown antechinus	Native	Antechinus	1			Nil
Winter	1	South	Striped marsh frog	Native	Frog	1			Nil
Winter	1	South	Small frog spp.	Native	Frog	1	3		Frog resting on grass prob L. Fallax
Winter	1	South	Black rat	Introduced	Introduced rodent	7			Nil
Winter	1	South	Swamp wallaby	Native	Macropod	6			Nil
Winter	1	South	Red fox	Introduced	Feral predator	1			Nil

Table B2: Sand pad data recorded over 8 nights in spring/summer (ss) and winter (w) during year five of operational phase monitoring WC2NH, 2023. [1]= Introduced, + = probable records.

	1		2		3		4		5/6		7		8		9/10		11/12	
Species/group	SS	W	SS	W	SS	W	SS	W	SS	W	SS	W	SS	W	SS	W	SS	W
Short-beaked echidna							*	*										
Antechinus spp.	*		*			*			*	*			*	*	*	*	*	
Peramelidae spp. (bandicoot)	*			*	*		*	*	*	*	*	*	*	*	*	*		*
Trichosurus spp.					*										*	*		
Red-necked wallaby																		
Swamp wallaby																		

Wallaby spp.	*		*	*		*	*			*	*	*		*		*		
House mouse																*		*
Water rat										*								
Rodent spp.			*	*			*	*	*	*	*	*	*		*	*	*	*
Dog												*		*		*		*
Red fox [I]	*	*					*	*	*	*		*		*		*		*
Cat [I]					*	*				*				*		*		
Lace monitor			*				*		*		*		*		*		*	
Water dragon					*													
Skink															*		*	
Small lizard	*								*								*	
Small reptile																	*	*
Medium lizard				*						*					*		*	
Medium reptile									*									
Total no. Species/groups	5	1	4	4	4	3	5	4	7	8	4	5	4	6	7	9	7	6

Table B3: Scat and track data recorded during camera monitoring during winter (w) and summer (ss) year five operational phase monitoring WC2NH, 2023.

	1		2		3		4		5/6		7		8		9/10		11/12	
Species/group	**SS**	**W**	**SS**	**W**	**SS**	**W**	**SS**	**W**	**SS**	**W**	**SS**	**W**	**SS**	**W**	**SS**	**W**	**SS**	**W**
Short-beaked echidna									*						*	*	*	*
Antechinus spp.			*	*					*						*	*	*	*
Peramelidae spp. (bandicoot)		*	*	*			*	*	*		*		*	*	*	*	*	*
Short-eared brushtail possum							*						*	*				
Trichosurus spp.	*							*	*									
Red-necked wallaby																		
Swamp wallaby				*							*	*	*	*				
Wallaby spp.	*		*				*		*		*							
Water rat										*								
Rodent spp.	*	*	*	*			*	*		*	*	*	*	*	*	*	*	*
Dog									*			*						*
Red fox [I]	*	*	*	*				*	*	*					*	*	*	*
Cat [I]				*	*	*				*								

Lace monitor							*		*	*	*		*	*				
Water dragon					*					*								
Small lizard															*	*		
Small reptile	*	*		*											*	*		
Medium lizard																	*	*
Medium reptile						*				*								
Total no. Species/groups	5	4	5	7	2	2	5	4	8	7	5	3	5	5	7	7	6	7

Table B4: Tile inspection data recorded during year five operational phase monitoring WC2NH, 2023.

Site	No. Tiles	Check no.	Date	Fauna present	Comments
2	1	1	31/01/23	Nil	1 tile destroyed
		2	01/02/23	Nil	
		3	02/02/23	Nil	
		4	03/02/23	Nil	
		5	04/02/23	Nil	
		6	05/02/23	Nil	
		7	06/02/23	Nil	
		8	07/02/23	nil	
3	1	1	31/01/23	Nil	1 tile destroyed/missing
		2	01/02/23	Nil	
		3	02/02/23	Nil	
		4	03/02/23	Nil	
		5	04/02/23	Nil	
		6	05/02/23	Nil	
		7	06/02/23	Nil	
		8	07/02/23	nil	

Site	No. Tiles	Check no.	Date	Fauna present	Comments
4	2	1	31/01/23	Nil	
		2	01/02/23	Nil	
		3	02/02/23	Nil	
		4	03/02/23	Nil	
		5	04/02/23	Nil	
		6	05/02/23	Nil	
		7	06/02/23	Nil	
		8	07/02/23	nil	
5N	1	1	31/01/23	Nil	
		2	01/02/23	Nil	
		3	02/02/23	Nil	
		4	03/02/23	Nil	
		5	04/02/23	Nil	
		6	05/02/23	Nil	
		7	06/02/23	Nil	
		8	07/02/23	nil	
5S		1		No check	Missing
		2		No check	
		3		No check	
		4		No check	
		5		No check	
		6		No check	
		7		No check	
		8		No check	
6	2	1	31/01/23	Nil	
		2	01/02/23	Nil	
		3	02/02/23	Nil	
		4	03/02/23	Nil	
		5	04/02/23	Nil	
		6	05/02/23	Nil	
		7	06/02/23	Nil	
		8	07/02/23	nil	
7	2	1	31/01/23	Nil	
		2	01/02/23	Nil	
		3	02/02/23	Nil	
		4	03/02/23	Nil	
		5	04/02/23	Nil	
		6	05/02/23	Nil	
		7	06/02/23	Nil	
		8	07/02/23	nil	
8	2	1	31/01/23	Nil	
		2	01/02/23	Nil	

Site	No. Tiles	Check no.	Date	Fauna present	Comments
		3	02/02/23	Nil	
		4	03/02/23	Nil	
		5	04/02/23	Nil	
		6	05/02/23	Nil	
		7	06/02/23	Nil	
		8	07/02/23	nil	
9 East	2	1	31/01/23	Nil	
		2	01/02/23	Nil	
		3	02/02/23	Nil	
		4	03/02/23	Nil	
		5	04/02/23	Nil	
		6	05/02/23	Nil	
		7	06/02/23	Nil	
		8	07/02/23	nil	
10 West	2	1	31/01/23	Nil	
		2	01/02/23	Nil	
		3	02/02/23	Nil	
		4	03/02/23	Nil	
		5	04/02/23	Nil	
		6	05/02/23	Nil	
		7	06/02/23	Nil	
		8	07/02/23	nil	
11 East	2	1	31/01/23	Nil	
		2	01/02/23	Nil	
		3	02/02/23	Nil	
		4	03/02/23	Nil	
		5	04/02/23	Nil	
		6	05/02/23	Nil	
		7	06/02/23	Nil	
		8	07/02/23	nil	
12 West	2	1	31/01/23	Nil	
		2	01/02/23	Nil	
		3	02/02/23	Nil	
		4	03/02/23	Nil	
		5	04/02/23	Nil	
		6	05/02/23	Nil	
		7	06/02/23	Nil	
		8	07/02/23	Nil	

Table B5: Daytime searches of adjacent habitat data during winter year five WC2NH monitoring, 2023. Msb = moves small branches, Mlb = moves large branches and RL = rustles leaves, NR = no record.

Site	Side	Obs. No.	Date	Observers	Wind	Cloud	Rain	Temp	Humidity	Start	Finish	Species
11&12	E	1	19/7/23	AE & NM	NR	NR	NR	NR	NR	1605	1620	Koala scat, bandicoot digging
	W	1	19/7/23	AE & NM	NR	NR	NR	NR	NR	1540	1555	Wallaby scat
	E	2	21/7/23	AE SM	NR	NR	NR	NR	NR	1100	1115	Wallaby scat, bandicoot digs, bent wing in culvert gap, fox scat, koala scat
	W	2	21/7/23	AE SM	NR	NR	NR	NR	NR	1045	1100	Lampropholis guichenoti, wallaby scat
9&10	E	1	19/7/23	AE & NM	NR	NR	NR	NR	NR	1520	1535	BTP scat, wallaby scat, bandicoot digs, rodent scat, old Turkey mound (nest)
	W	1	19/7/23	AE & NM	NR	NR	NR	NR	NR	1545	1600	Fox scat, swamp wallaby scat
	E	2	21/7/23	AE SM	NR	NR	NR	NR	NR	11:23	11:40	Nil
	W	2	21/7/23	AE SM	NR	NR	NR	NR	NR	11:42	11:55	Lampropholis delicata x3
8	E	1	17/7/23	AE & NM	NR	NR	NR	NR	NR	1445	1500	Bandicoot spp. digging wallaby scat
	W	1	17/7/23	AE & NM	NR	NR	NR	NR	NR	1500	1515	Dog scat, bandicoot digs, wallaby scat
	E	2	31/7/23	LA/SM	NR	NR	NR	NR	NR	1433	1448	Bandicoot digs, wallaby scat,dog , bandicoot scat
	W	2	31/7/23	LA/SM	NR	NR	NR	NR	NR	1451	1506	Uk scat, rodent scat, wallaby scat, cat scat
7	E	1	19/7/23	LA NM and AE	NR	NR	NR	NR	NR	15:40	15:50	Swamp wallaby scat, fox scat, Lampropholis x 3, C. signifera HC
	W	1	19/7/23	LA NM and AE	NR	NR	NR	NR	NR	15:55	16:05	Swamp Wallaby scat, antechinus scat
	E	2	31/7/23	LA/SM	NR	NR	NR	NR	NR	1513	1528	Bandicoot digs, dog scat
	W	2	31/7/23	LA/SM	NR	NR	NR	NR	NR	1541	1556	Antechinus scat
5&6	E	1	19/7/23	AE & NM	NR	NR	NR	NR	NR	1405	1420	Bandicoot spp. Digging, wallaby scat, lampropholis spp.
	W	1	19/7/23	LA AE & NM	NR	NR	NR	NR	NR	1400	1425	Wallaby scat, old native bee hive, crinia signifera
	E	2	17/7/23	AE & NM	NR	NR	NR	NR	NR	1311	1326	BtP scat
	W	2	17/7/23	AE & NM	NR	NR	NR	NR	NR	1335	1350	Lampropholis spp. x 2
4	E	1	19/7/23	NM	NR	NR	NR	NR	NR	850	920	Wallaby scat
	W	1	19/7/23	LA	NR	NR	NR	NR	NR	850	920	Bandicoot spp.
	E	2	17/7/23	AE & NM	NR	NR	NR	NR	NR	12:30	12:45	Nil
	W	2	17/7/23	AE & NM	NR	NR	NR	NR	NR	12:48	13:03	Bandicoot digs and wallaby spp. scat
3	E	1	19/7/23	AE NM	MLB	nil	nil	18	38	12:30	12:45	Bandicoot spp. Digging, wallaby scat
	W	1	19/7/23	LA	NR	NR	NR	NR	NR	12:00	12:30	Bandicoot digging, crinia signifera hc
	E	2	3/8/23	LA	NR	NR	NR	NR	NR	1515	1545	No new records
	W	2	3/8/23	LA	Nil	Nil	Nil	18.2	58	1552	1622	Lampropholis delicata x3
2	E	1	31/7/23	LA/sM	NR	NR	NR	NR	NR	1625	1640	Wallaby scat and bandicoot scats
	W	1	31/7/23	LA/SM	NR	NR	NR	NR	NR	1615	1621	Wallaby scat, bandicoot digs, old eaten European hare

	E	2	3/8/23	LA	Nil	Nil	Nil	18.2	58	1624	1654	No new records
	W	2	3/8/23	LA	Nil	Nil	Nil	18.2	58	1525	1555	Egernia spp.
1	E	1	19/7/23	LA	NR	NR	NR	NR	NR	802	832	Swamp wallaby scat and tracks, fox tracks
	E	1	21/7/23	NM,LA	NR	NR	NR	NR	NR	915	930	Wallaby scat
	W	2	19/7/23	NM	NR	NR	NR	NR	NR	802	832	Fox scat
	W	2	21/7/23	AE SM	NR	NR	NR	NR	NR	915	930	BtP scat, bandicoot diggings, wallaby, reptile and rodent scat

Table B6: Nocturnal spotlight surveys of adjacent habitat during winter year five WC2NH monitoring, 2023. GHFF = grey-headed flying fox, SuG = sugar glider, Lit = Litoria species, A. brevis = Adelotus brevis, ONJ = Owlet-Nightjar. SE = saw eyeshine, HC = heard call, SM = saw movement, HM = heard movement.

Site	Side	Sample	Date	Staff	Visibility	Rain	Wind	Temp	RH (%)	Start	End	Species	Comment
11&12	E	1	31/07/23	AE&NM	Good	Nil	RL	14.8	86%	1800	1800	Owl spp. SE, bandicoot HC	
	W	1	31/07/23	AE&NM	Good	Nil	RL	14.8	86%	1745	1800	Nil	
	E	2	02/08/23	AE&SM	Good	nil	nil	14	76	1820	1835	Owlet nightjar hc	
	W	2	02/08/23	AE&SM	Good	nil	nil	14	76	1800	1816	Nil	
9&10	E	1	31/07/23	AE&NM	Good	Nil	RL	14.8	86%	1940	1955	Nil	
	W	1	31/07/23	AE&NM	Good	Nil	RL	14.8	86%	1910	1925	Crinia signifera, adelotus brevis	
	E	2	02/08/23	AE&SM	Good	nil	nil	14	76	1930	1945	Bandicoot HM	
	W	2	02/08/23	AE&SM	Good	nil	nil	14	76	1945	2000	Microbat spp. SM, crinia signifera HC, frogmouth SM, bandicoot HC	
8	E	1	02/08/23	AE&SM	Good	nil	Nil	14	76	1800	1816	Nil	
	W	1	31/07/23	AE&NM	Good	Nil	RL	14.8	86%	1830	1845	2xmicrobats (flying around)	
	E	2	02/08/23	AE&SM	Good	nil	nil	14	76	1845	1900	Bandicoot x2 HM, HC rattus spp. possible melomy climbed not a black rat SE, microbat SM	
	W	2	02/08/23	AE&SM	Good	nil	nil	14	76	1905	1920	SuG HM, microbat SM	
7	E	1	31/7/23	LA	Good	Nil	RL	14.8	86%	1841	1911	Crinia signifera	
	W	1	31/7/23	SM	Good	Nil	RL	14.8	86%	1841	1911	Koala, melomys, bandicoot spp	Koala 30m from culvert entrance,496454, 6608790
	E	2	3/8/23	LA	Good	Nil	Nil	14.6	74%	2047	2107	C. Signifera	
	W	2	3/8/23	LA	Good	Nil	Nil	14.6	74%	2016	2046	Long-nosed bandicoot	
5&6	E	1	31/7/23	SM	Good	Nil	RL	14.8	86%	1926	1956	C. Signifera	
	W	1	31/7/23	LA	Good	Nil	RL	14.8	86%	1926	1956	L. Caerula	
	E	2	02/08/23	AE&SM	Good	nil	Nil	14	76	2030	2045	Bandicoot HC, wallaby HM, SuG SE	
	W	2	02/08/23	AE&SM	Good	nil	Nil	14	76	2015	2030	Crinia signifera	

Site	Side	Sample	Date	Staff	Visibility	Rain	Wind	Temp	RH (%)	Start	End	Species	Comment
4	E	1	31/7/23	LA	Good	Nil	RL	14.8	86%	2000	2030	Nil	
	W	1	31/7/23	SM	Good	Nil	RL	14.8	86%	2000	2030	Microbat spp.	
	E	2	3/8/23	LA	Good	Nil	Nil	14.6	74%	1902	1932	Nil	
	W	2	3/8/23	LA	Good	Nil	Nil	14.6	0.74	1933	2003	Melomys sm	
3 (E only)	E	1	31/07/23	AE&NM	Good	Nil	RL	14.8	86%	2010	2025	Nil	crinia signifera HC West side
	E	2	02/08/23	AE&SM	Good	nil	Nil	14	76	2120	2135	Nil	
2	E	1	31/07/23	AE&NM	Good	Nil	RL	14.8	86%	2035	2050	Nil	
	W	1	31/7/23	LA &SM	Good	Nil	RL	14.8	86%	2044	2059	Litoria fallax (HC).	
	E	2	3/8/23	LA	Good	Nil	Nil	14.6	76	2113	2143	GHFF, SuG	
	W	2	02/08/23	AE&SM	Good	nil	Nil	14	76	2120	2135	GHFF HC	
1	E	1	31/7/23	LA	Good	Nil	Nil	14.8	86%	1750	1820	Eastern water dragon	
	W	1	31/7/23	SM	Good	Nil	RL	14.8	86%	1750	1820	Sebtp, microbat spp.	
	E	2	3/8/23	LA	Good	Nil	Nil	14.6	74%	1746	1816	Fox and rodent scat	
	W	2	3/8/23	LA	Good	Nil	Nil	14.6	74%	1818	1848	Fox Se, Sebtp SE	

Table B7: Fauna captured during adjacent habitat trapping surveys during year five operational monitoring WC2NH, 2022-2023. Uk = unknown, FF = Fawn-footed, NR= no record, W = winter, SS = spring/summer

Season	Date	Site	E or W	Trap type	Species	Sex	Weight (g)	Comments
W	19/7/23	1	East	Cage trap	Black rat	-	-	Escape
W	19/7/23	1	East	Ground Elliot	Brown Antechinus	F	27	
W	19/7/23	1	west	Ground Elliot	Brown Antechinus	M	Uk	-
W	19/7/23	1	west	Ground Elliot	Brown Antechinus	F	Uk	-
W	19/7/23	1	west	Ground Elliot	Bush rat	F	74	-
W	20/7/23	1	East	Cage trap	Black rat	-	-	Escape
W	20/7/23	1	East	Ground Elliot	Brown Antechinus	-	-	-
W	21/7/23	1	East	Cage trap	Black rat	-	-	Escape
W	21/7/23	1	East	Ground Elliot	Brown Antechinus	-	-	-
W	21/7/23	1	West	Ground Elliot	Brown Antechinus	F	-	-
W	18/7/23	11/12	west	Ground Elliot	Brown Antechinus	M	34	Nil
W	18/7/23	11/12	East	Ground Elliot	Fawn-footed melomys	M	87	Nil

Season	Date	Site	E or W	Trap type	Species	Sex	Weight (g)	Comments
W	19/7/23	11/12	West	Ground Elliot	Black rat	-	-	Deceased
W	19/7/23	11/12	East	Ground Elliot	Brown Antechinus	F	26	-
W	19/7/23	11/12	East	Ground Elliot	Bush rat	-	-	-
W	19/7/23	11/12	West	Arboreal elliot	Sugar glider	F	Uk	
W	20/7/23	11/12	East	Arboreal elliot	Brown Antechinus	-	-	-
W	20/7/23	11/12	East	Ground Elliot	Brown Antechinus	-	-	-
W	20/7/23	11/12	West	Arboreal elliot	Brown Antechinus	-	-	-
W	20/7/23	11/12	West	Ground Elliot	Brown Antechinus	-	-	-
W	20/7/23	11/12	East	Ground Elliot	Fawn-footed melomys	-	-	-
W	20/7/23	11/12	East	Ground Elliot	Fawn-footed melomys	-	-	-
W	20/7/23	11/12	West	Ground Elliot	Swamp rat	M	-	Swamp rat
W	18/7/23	2	East	Ground Elliot	Brown Antechinus	F	25	-
W	18/7/23	2	East	Arboreal elliot	Brown Antechinus	Uk	Uk	Escapee
W	18/7/23	2	East	Arboreal elliot	Brown Antechinus	M	32	-
W	18/7/23	2	west	Ground Elliot	Brown Antechinus	-	19	Female
W	18/7/23	2	West	Arboreal elliot	Brown Antechinus	-	40	Male
W	18/7/23	2	west	Ground Elliot	Brown Antechinus	-	32	Male
W	18/7/23	2	East	Ground Elliot	Bush rat	M	145	-
W	18/7/23	2	East	Ground Elliot	Bush rat	F	133	-
W	18/7/23	2	East	Pitfall	House mouse	F	-	Escapee
W	19/7/23	2	West	Ground Elliot	Black rat	-	-	Euthanised
W	19/7/23	2	East	Ground Elliot	Brown Antechinus	F	29	-
W	19/7/23	2	East	Ground Elliot	Brown Antechinus	M	33	-
W	19/7/23	2	West	Arboreal elliot	Brown Antechinus	M	31	-
W	19/7/23	2	West	Ground Elliot	Brown Antechinus	M	27	-
W	19/7/23	2	East	Ground Elliot	Bush rat	F	74	-
W	19/7/23	2	East	Cage trap	Northern brown bandicoot	Uk	Uk	Released
W	19/7/23	2	East	Pitfall	Red-backed toadlet	Uk	Uk	-
W	20/7/23	2	West	Ground Elliot	Black rat	-	-	Euthanised
W	20/7/23	2	East	Arboreal elliot	Brown Antechinus	-	-	-

Season	Date	Site	E or W	Trap type	Species	Sex	Weight (g)	Comments
W	20/7/23	2	East	Arboreal elliot	Brown Antechinus	-	-	-
W	20/7/23	2	East	Arboreal elliot	Brown Antechinus	-	-	-
W	20/7/23	2	East	Arboreal elliot	Brown Antechinus	-	-	-
W	20/7/23	2	East	Ground Elliot	Brown Antechinus	-	-	-
W	20/7/23	2	East	Ground Elliot	Brown Antechinus	M	-	-
W	20/7/23	2	East	Arboreal elliot	Fawn-footed melomys	M	-	-
W	20/7/23	2	East	Cage trap	Northern brown bandicoot	-	-	-
W	20/7/23	3	West	Ground Elliot	Black rat	-	-	Euthanised
W	20/7/23	3	West	Ground Elliot	Brown Antechinus	-	-	-
W	20/7/23	3	East	Ground Elliot	Brown Antechinus	-	-	-
W	21/7/23	3	East	Ground Elliot	Brown Antechinus	-	-	-
W	21/7/23	3	West	Ground Elliot	Fawn-footed melomys	-	-	-
W	19/7/23	4	West	Ground Elliot	Bush rat	F	85	-
W	19/7/23	4	West	Ground Elliot	Bush rat	M	109	-
W	19/7/23	4	West	Cage trap	Bush rat	Uk	Uk	-
W	19/7/23	4	West	Arboreal elliot	Fawn-footed melomys	F	55	-
W	20/7/23	4	East	Ground Elliot	Brown Antechinus	-	-	-
W	20/7/23	4	West	Ground Elliot	Fawn-footed melomys	-	-	-
W	21/7/23	4	West	Ground Elliot	Brown Antechinus	M	-	-
W	21/7/23	4	West	Ground Elliot	Brown Antechinus	M	-	-
W	21/7/23	4	East	Arboreal elliot	Brown Antechinus	-	-	-
W	21/7/23	4	East	Arboreal elliot	Brown Antechinus	-	-	-
W	21/7/23	4	West	Cage trap	Bush rat	-	-	-
W	21/7/23	4	East	Arboreal elliot	Fawn-footed melomys	-	-	-
W	20/7/23	5/6	East	Ground Elliot	Fawn-footed melomys	F	-	-
W	18/7/23	5/6	west	Ground Elliot	Black rat	-	-	Euthanised
W	18/7/23	5/6	west	Ground Elliot	Brown Antechinus	F	16	-
W	18/7/23	5/6	west	Ground Elliot	Brown Antechinus	F	17	-
W	18/7/23	5/6	East	Cage trap	Bush rat	Uk	Uk	-
W	18/7/23	5/6	west	Arboreal elliot	Bush rat	M	Uk	Trap on Ground Elliotound

Season	Date	Site	E or W	Trap type	Species	Sex	Weight (g)	Comments
W	18/7/23	5/6	East	Ground Elliot	Fawn-footed melomys	M	85	-
W	18/7/23	5/6	East	Arboreal elliot	Fawn-footed melomys	M	80	-
W	18/7/23	5/6	East	Ground Elliot	Fawn-footed melomys	M	Uk	-
W	19/7/23	5/6	west	Ground Elliot	Black rat	-	-	Euthanised
W	19/7/23	5/6	west	Ground Elliot	Brown Antechinus	M	22	-
W	19/7/23	5/6	west	Arboreal elliot	Brown Antechinus	M	30	-
W	19/7/23	5/6	west	Ground Elliot	Bush rat	M	105	-
W	20/7/23	5/6	East	Arboreal elliot	Brown Antechinus	-	-	-
W	20/7/23	5/6	East	Ground Elliot	Brown Antechinus	-	-	-
W	20/7/23	5/6	West	Ground Elliot	Brown Antechinus	-	-	Nil
W	20/7/23	5/6	West	Ground Elliot	Brown Antechinus	-	-	-
W	20/7/23	5/6	West	Ground Elliot	Brown Antechinus	M	-	-
W	20/7/23	5/6	East	Ground Elliot	Fawn-footed melomys	-	-	-
W	18/7/23	7	west	Arboreal elliot	Brown Antechinus	Uk	Uk	Escapee - tail caught in trap door
W	18/7/23	7	west	Ground Elliot	Brown Antechinus	M	31	-
W	18/7/23	7	west	Ground Elliot	Brown Antechinus	M	38	-
W	18/7/23	7	west	Ground Elliot	Brown Antechinus	F	20	-
W	18/7/23	7	west	Ground Elliot	Bush rat	F	98	-
W	18/7/23	7	East	Ground Elliot	Fawn-footed melomys	F	65	-
W	18/7/23	7	East	Ground Elliot	Fawn-footed melomys	M	90	-
W	19/7/23	7	West	Arboreal elliot	Black rat	-	-	Euthanised
W	19/7/23	7	East	Ground Elliot	Black rat	-	-	Euthanised
W	19/7/23	7	West	Ground Elliot	Brown Antechinus	M	37	-
W	19/7/23	7	West	Ground Elliot	Brown Antechinus	M	30	-
W	19/7/23	7	West	Arboreal elliot	Brown Antechinus	M	36	-
W	19/7/23	7	West	Arboreal elliot	Brown Antechinus	M	37	-
W	19/7/23	7	East	Ground Elliot	Brown Antechinus	F	Uk	Nil
W	19/7/23	7	East	Arboreal elliot	Brown Antechinus	M	Uk	-
W	19/7/23	7	West	Ground Elliot	Bush rat	M	116	-
W	19/7/23	7	East	Ground Elliot	Fawn-footed melomys	F	Uk	-

Season	Date	Site	E or W	Trap type	Species	Sex	Weight (g)	Comments
W	19/7/23	7	East	Pitfall	Red-backed toadlet	-	-	-
W	20/7/23	7	West	Ground Elliot	Brown Antechinus	-	-	-
W	20/7/23	7	West	Ground Elliot	Brown Antechinus	-	-	-
W	20/7/23	7	West	Ground Elliot	Bush rat	-	-	-
W	20/7/23	7	West	Ground Elliot	Fawn-footed melomys	-	-	-
W	18/7/23	8	west	Ground Elliot	Brown Antechinus	M	31	Nil
W	18/7/23	8	west	Ground Elliot	Brown Antechinus	M	24	Nil
W	18/7/23	8	East	Arboreal elliot	Brown Antechinus	F	21	-
W	18/7/23	8	East	Ground Elliot	Brown Antechinus	M	34	-
W	18/7/23	8	East	Ground Elliot	Brown Antechinus	M	28	-
W	18/7/23	8	East	Ground Elliot	Brown Antechinus	M	22	-
W	18/7/23	8	west	Ground Elliot	Bush rat	M	155	Nil
W	18/7/23	8	west	Pitfall	Red-backed toadlet	-	-	-
W	18/7/23	8	west	Pitfall	Red-backed toadlet	-	-	-
W	19/7/23	8	west	Arboreal elliot	Black rat	-	-	Uk
W	19/7/23	8	west	Ground Elliot	Brown Antechinus	M	32	-
W	19/7/23	8	west	Ground Elliot	Brown Antechinus	M	22	-
W	19/7/23	8	east	Ground Elliot	Brown Antechinus	F	27	-
W	19/7/23	8	east	Ground Elliot	Brown Antechinus	M	37	-
W	19/7/23	8	east	Arboreal elliot	Brown Antechinus	M	35	-
W	20/7/23	8	West	Arboreal elliot	Black rat	-	-	Uk
W	20/7/23	8	East	Ground Elliot	Brown Antechinus	-	-	-
W	20/7/23	8	East	Ground Elliot	Brown Antechinus	-	-	-
W	20/7/23	8	East	Ground Elliot	Bush rat	-	-	-
W	20/7/23	8	West	Ground Elliot	Bush rat	-	-	-
W	18/7/23	9/10	west	Arboreal elliot	Brown Antechinus	Uk	Uk	Escaped
W	18/7/23	9/10	west	Ground Elliot	Brown Antechinus	M	36	-
W	18/7/23	9/10	East	Ground Elliot	Brown Antechinus	F	23	-
W	18/7/23	9/10	East	Pitfall	Brown Antechinus	F	-	-
W	18/7/23	9/10	East	Pitfall	Brown Antechinus	F	-	-

Season	Date	Site	E or W	Trap type	Species	Sex	Weight (g)	Comments
W	18/7/23	9/10	west	Ground Elliot	Fawn-footed melomys	M	73	-
W	18/7/23	9/10	East	Ground Elliot	Fawn-footed melomys	M	71	-
W	18/7/23	9/10	East	Ground Elliot	Fawn-footed melomys	M	73	-
W	19/7/23	9/10	west	Ground Elliot	Brown Antechinus	M	36	-
W	19/7/23	9/10	west	Ground Elliot	Brown Antechinus	F	28	-
W	19/7/23	9/10	west	Ground Elliot	Brown Antechinus	M	26	-
W	19/7/23	9/10	west	Arboreal elliot	Brown Antechinus	M	25	-
W	19/7/23	9/10	East	Arboreal elliot	Brown Antechinus	M	35	-
W	19/7/23	9/10	East	Arboreal elliot	Brown Antechinus	UK	-	Escaped in same trap as one above
W	19/7/23	9/10	East	Ground Elliot	Brown Antechinus	F	20	-
W	19/7/23	9/10	East	Ground Elliot	Fawn-footed melomys	M	60	-
W	19/7/23	9/10	East	Cage trap	Short-eared brushtail possum	F	-	-
W	20/7/23	9/10	west	Ground Elliot	Brown Antechinus	M	-	-
W	20/7/23	9/10	west	Arboreal elliot	Brown Antechinus	Uk	-	-
W	20/7/23	9/10	west	Ground Elliot	Brown Antechinus	M	-	-
W	20/7/23	9/10	west	Ground Elliot	Brown Antechinus	M	-	-
W	20/7/23	9/10	East	Arboreal elliot	Brown Antechinus	-	-	-
W	20/7/23	9/10	East	Arboreal elliot	Brown Antechinus	-	-	-
W	20/7/23	9/10	East	Ground Elliot	Brown Antechinus	-	-	Deceased
W	20/7/23	9/10	East	Ground Elliot	Brown Antechinus	-	-	-
W	20/7/23	9/10	west	Ground Elliot	Bush rat	Uk	-	-
W	20/7/23	9/10	East	Ground Elliot	Fawn-footed melomys	-	-	-
W	20/7/23	9/10	East	Ground Elliot	Fawn-footed melomys	-	-	-
SS	1/2/23	1	E	Ground Elliot	Brown Antechinus	F	19	
SS	2/2/23	1	E	Ground Elliot	Bush rat	F	Uk	
SS	2/2/23	1	E	Ground Elliot	Brown Antechinus	F	Uk	
SS	2/2/23	1	W	-	Nil			Raided by brushtail possum
SS	3/2/23	1	E	-	Nil			
SS	3/2/23	1	W	Arboreal elliot	Brown Antechinus	F	23	

Season	Date	Site	E or W	Trap type	Species	Sex	Weight (g)	Comments
SS	31/1/23	2	E	Ground Elliot	Bush rat	M	150	
SS	31/1/23	2	E	Ground Elliot	Brown Antechinus	F	32	
SS	31/1/23	2	E	Ground Elliot	Bush rat	M	135	
SS	31/1/23	2	E	Pitfall	Tusked frog			
SS	31/1/23	2	W	Ground Elliot	Black rat			Euthanized
SS	31/1/23	2	W	Ground Elliot	Black rat			Euthanized
SS	1/2/23	2	E	Ground Elliot	Bush rat	M	133	
SS	1/2/23	2	W	Ground Elliot	Bush rat	F	119	
SS	2/2/23	2	E	Ground Elliot	Bush rat	F	Uk	
SS	2/2/23	2	E	Pitfall	P. coriacea			
SS	2/2/23	2	W	Ground Elliot	Bush rat	M	Uk	
SS	2/2/23	2	W	Ground Elliot	Bush rat	F	Uk	
SS	31/1/23	3	E	Ground Elliot	Black rat			Euthanized
SS	31/1/23	3	W	-	Nil			
SS	1/2/23	3	E	Pitfall	P. coriacea			
SS	1/2/23	3	W	Pitfall	Lampro x2			
SS	2/2/23	3	E	Pitfall	Lampro delicata x5			
SS	2/2/23	3	W	Pitfall	Lampro delicata x2			
SS	1/2/23	4	E	Ground Elliot	Bush rat (w/ 3 young)	F	125	
SS	1/2/23	4	E	Ground Elliot	FF Melomys	M	72	
SS	1/2/23	4	W	Ground Elliot	FF Melomys	M	82	
SS	1/2/23	4	W	Arboreal elliot	FF Melomys	F	66	
SS	2/2/23	4	E	Ground Elliot	Bush rat	M	Uk	
SS	2/2/23	4	E	Ground Elliot	Bush rat	F	Uk	
SS	2/2/23	4	E	Arboreal elliot	FF Melomys	F	Uk	

Season	Date	Site	E or W	Trap type	Species	Sex	Weight (g)	Comments
SS	2/2/23	4	W	Ground Elliot	Black rat			Escaped
SS	3/2/23	4	E	Ground Elliot	Black rat			Unsure of ID released
SS	3/2/23	4	E	Ground Elliot	Bush rat	M	Uk	
SS	3/2/23	4	E	Ground Elliot	Bush rat	F	Uk	
SS	3/2/23	4	W	Ground Elliot	Bush rat	M	Uk	
SS	3/2/23	4	W	Ground Elliot	FF Melomys Juvenile	Uk	Uk	
SS	31/1/23	5/6	E	Ground Elliot	Melomys	F	80	
SS	31/1/23	5/6	E	Ground Elliot	Melomys	M	90	
SS	31/1/23	5/6	W	Ground Elliot	Brown Antechinus	Uk	23	
SS	31/1/23	5/6	W	Ground Elliot	Bush rat	M	94	
SS	31/1/23	5/6	W	Ground Elliot	Brown Antechinus	F	28	
SS	31/1/23	5/6	W	Ground Elliot	Melomys	M	80	
SS	31/1/23	5/6	W	Pitfall	Antechinus, Striped marsh frog (deceased)			
SS	1/2/23	5/6	E	Ground Elliot	FF Melomys	F	68	
SS	1/2/23	5/6	E	Pitfall	P. coriacea			
SS	1/2/23	5/6	W	Ground Elliot	Brown Antechinus	F	32	
SS	1/2/23	5/6	W	Ground Elliot	Brown Antechinus	F	27	
SS	1/2/23	5/6	W	-	Black rat			Euthanized
SS	2/2/23	5/6	E	Pitfall	Lampropholis spp.			
SS	2/2/23	5/6	E	Ground Elliot	Brown Antechinus	F	Uk	
SS	2/2/23	5/6	E	Arboreal elliot	Black rat			Euthanized
SS	2/2/23	5/6	E	Arboreal elliot	Black rat			Euthanized
SS	2/2/23	5/6	W	Ground Elliot	Brown Antechinus	F	16	
SS	31/1/23	7	E	Arboreal elliot	FF Melomys	F	72	
SS	31/1/23	7	E	Ground Elliot	FF Melomys	M	82	

Season	Date	Site	E or W	Trap type	Species	Sex	Weight (g)	Comments
SS	31/1/23	7	E	Pitfall	Red backed toadlet, F antechinus			
SS	31/1/23	7	W	Ground Elliot	Bush rat	F	135	
SS	31/1/23	7	W	Ground Elliot	Bush rat	M	175	
SS	31/1/23	7	W	Ground Elliot	Bush rat	M	165	
SS	1/2/23	7	E	Ground Elliot	FF Melomys	M	75	
SS	1/2/23	7	E	Ground Elliot	FF Melomys	Uk	55	
SS	1/2/23	7	W	Ground Elliot	Bush rat	F	89	
SS	1/2/23	7	W	Ground Elliot	Bush rat	M	166	
SS	2/2/23	7	E	Ground Elliot	FF Melomys	-	-	Escaped
SS	2/2/23	7	E	Ground Elliot	Brown Antechinus	F	26	
SS	2/2/23	7	E	Ground Elliot	FF Melomys	F	67	
SS	31/1/23	8	E	Ground Elliot	Black rat			Euthanized
SS	31/1/23	8	W	Ground Elliot	Brown Antechinus	F	37	
SS	31/1/23	8	W	Ground Elliot	Bush rat	M	164	
SS	31/1/23	8	W	-	Black rat			Euthanized
SS	31/1/23	8	W	Pitfall	Brown Antechinus	M	-	Deceased
SS	31/1/23	8	W	Pitfall	Brown Antechinus	F	22	
SS	31/1/23	8	W	Pitfall	Brown Antechinus	M	16	
SS	31/1/23	8	W	Pitfall	FF Melomys	F	28	
SS	1/2/23	8	E	-	Nil			
SS	1/2/23	8	W	Ground Elliot	Brown Antechinus	M	21	
SS	1/2/23	8	W	Cage	Lace monitor			Released during day AdHab searches
SS	2/2/23	8	E	Ground Elliot	Bush rat	M	70	
SS	2/2/23	8	E	Ground Elliot	Bush rat	Uk	65	
SS	2/2/23	8	W	Pitfall	Lampro delicata x2, P. Coriacea x1			

Season	Date	Site	E or W	Trap type	Species	Sex	Weight (g)	Comments
SS	2/2/23	8	W	Ground Elliot	Bush rat	F	Uk	
SS	31/1/23	9/10	E	Pitfall	Antechinus	F	34	
SS	31/1/23	9/10	E	Ground Elliot	Melomys	F	89	
SS	31/1/23	9/10	W	Ground Elliot	Bush rat	M	130	
SS	1/2/23	9/10	W	Arboreal elliot	Melomys	M	87	
SS	1/2/23	9/10	W	Cage	Bush rat	Uk	Uk	
SS	1/2/23	9/10	W	Pitfall	Red backed toadlet			
SS	1/2/23	9/10	W	Ground Elliot	Melomys	F	61	
SS	2/2/23	9/10	E	-	Nil			
SS	2/2/23	9/10	W	Arboreal elliot	Melomys	F	70	
SS	2/2/23	9/10	W	Pitfall	L. delicata			
SS	31/1/23	11/12	E	Ground Elliot	Bush rat	M	187	
SS	31/1/23	11/12	E	Pitfall	Antechinus	F	23	
SS	31/1/23	11/12	E	Ground Elliot	Bush rat	F	128	
SS	1/2/23	11/12	E	Ground Elliot	Bush rat	F	127	
SS	1/2/23	11/12	E	Ground Elliot	Bush rat	F	151	
SS	1/2/23	11/12	E	Ground Elliot	Black rat			Escaped
SS	31/1/23	11/12	W	Ground Elliot	Black rat			Euthanized
SS	1/2/23	11/12	W	Pitfall	Red backed toadlet			
SS	2/2/23	11/12	E	Ground Elliot	Bush rat	M	Uk	
SS	2/2/23	11/12	E	Ground Elliot	FF Melomys	F	Uk	
SS	2/2/23	11/12	E	Pitfall	Calyptotis ruficauda			

Table B8: Fauna recorded in hair funnel surveys during year four operational monitoring WC2NH, 2022-2023.

Date	Site	Position	Species #1	Species #2
21/7/23	1	West	Isoodon macrourus	Nil
21/7/23	1	East	Mus musculus	Trichosurus sp.

21/7/23	2			Isoodon macrourus
21/7/23	2	West	Antechinus stuartii	Nil
21/7/23	3	West	Mus musculus	Nil
21/7/23	3	East	Mus musculus	Nil
21/7/23	4	West	Antechinus sp.	Nil
21/7/23	4	East	Mus musculus	Antechinus sp.
21/7/23	5/6	West	Mus musculus	Nil
21/7/23	5/6	East	Rattus fuscipes	Nil
21/7/23	7	East	Antechinus stuartii	Nil
21/7/23	8	East	Antechinus stuartii	Nil
21/7/23	8	West	Antechinus stuartii	Nil
21/7/23	9/10	East	Mus musculus	Nil
21/7/23	9/10	East	Antechinus stuartii	Nil
21/7/23	11/12	West	Mus musculus	Nil
21/7/23	11/12	East	No hair	Nil