Transport for
New South Wales

Woolgoolga to Ballina Pacific Highway

Koala Monitoring Program Annual Report: Year 4 2020/21

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Woolgoolga to Ballina (W2B) Pacific Highway Upgrade

Koala Monitoring Program

Annual Report 2020-21 (Year 4)

Sandpiper Ecological

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Cover Photo: Koala (*Phascolarctos cinereus*) moving southward through a box culvert (KWmid) under Wardell Road on 27 September 2020.

Executive Summary

Sandpiper Ecological Surveys (SES) was contracted by Transport for NSW (TfNSW) to implement the Woolgoolga to Ballina (W2B) Pacific Highway upgrade koala monitoring program in accordance with section 8 of the approved Koala Management Plan (KMP) (RMS version 4.4, July 2016). The broad aim of the monitoring program is to determine the effectiveness of mitigation measures implemented in Sections 1-11 of the upgrade for koalas. The following report presents results of year four (2020/21) of the monitoring program and builds upon results of years one, two and three monitoring (Sandpiper Ecological 2019a, 2019b, 2020).

Year four population surveys were completed at 99 sites – 50 in the Broadwater focal area (sections 8-9) and 49 in the Bagotville focal area (section 10) – during spring 2020 and autumn 2021. Fewer koalas were recorded in year 4 than year 3 in both focal areas. Bayesian estimation analyses of survey data suggest there is increasing evidence of a negative population trend at Broadwater and a stable population at Bagotville, even though the latter did have lower empirical counts and densities compared to Year 3. More years of population data are required to reduce the level of uncertainty and improve the level of confidence in determining population trends.

A prospective power analysis demonstrated that the koala population monitoring program at Bagotville was above the target level of statistical power (>0.7) whereas Broadwater was marginally below. Measures of power and statistical certainty remain low but are improving with each successive year of data. The modelling exercises confirmed the challenge of sampling populations at very low densities and drawing conclusions from sparse counts. Subsequent monitoring years should improve the precision of density estimates.

In working towards achieving the key mitigation measure for section 10 to reduce koala mortality by 4-8 individuals per year, TfNSW have implemented a predator control program, installed six vehicle-activated signs at road mortality hot-spots across the broader section 10 study area, fenced Wardell Road and the existing Pacific Highway and installed crossing structures on Wardell Road. These measures are in excess of those required by the Koala Management Plan. Since installation of fencing, no vehicle strikes have been reported on these two stretches of road compared to 10 in 2016/17 (FOK, unpublished data). There were no koala vehicle strikes within the focal population or recorded during the 2020 road mortality surveys conducted on the old Pacific Highway between Wardell Road and Coolgardie interchange, on Wardell Road between Gulbay Lane and Thurgates Lane or within sections 1-2 of the upgrade alignment. One incidental koala road mortality was recorded on 15/9/2020 within the Wells Crossing to Glenugie section of the Old Pacific Highway during construction, and a second road-kill was recorded in a fenced section of highway just south of the Devils Pulpit rest area in December 2020.

Camera monitoring of 14 koala crossing structures (i.e. underpasses) – 11 within sections 1-2 and three along Wardell Road – during spring 2020 revealed one complete crossing of a box culvert on Wardell Road. Koala scats were also recorded in habitat adjacent to the three underpass structures on Wardell Road. Complete crossings by fox increased over the three year monitoring period and peaked at 13.63 complete crossings/week at site K3 in Section 1. In 2020, foxes were recorded with prey on five occasions, however, the prey species could not be identified. The number of complete crossings by cats and dogs declined from year two to year 3.

Recover of habitat in the Bagotville focal area following the 2019 wildfire has been variable with several population monitoring transects showing signs of slow recovery in canopy vegetation.

Acknowledgements

We wish to thank the landholders who approved access to their properties to conduct the population surveys. Numerous monitoring sites are on private property, so landholder support is critical to achieving the goals of the monitoring program. We also extend appreciation to the Jali Local Aboriginal Land Council for their approval, support, and involvement with surveys within the Ngunya Jargoon IPA.

We would also like to extend a special note of appreciation to Friends of the Koala (FOK), particularly Maria Mathes, for her tireless work in supporting the persistence of koalas in the region.

The final report was improved by comments from Pacific Complete and TfNSW.

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1. Introduction

1.1 Background

Sandpiper Ecological Surveys (Sandpiper) was contracted by Transport for NSW (TfNSW) to implement the Woolgoolga to Ballina (W2B) Pacific Highway upgrade koala monitoring program in accordance with section 8 of the approved Koala Management Plan (KMP) (RMS version 4.4, July 2016), excluding phased resource reduction. The primary aims of the monitoring program are to: determine the effectiveness of mitigation measures implemented in Sections 1-11 of the upgrade for koalas; and monitor trends in the size of koala populations surrounding the alignment at Broadwater (Sections 8-9) and Coolgardie-Bagotville (Section 10; hereafter referred to as Bagotville).

The three main mitigation measures requiring monitoring are koala-proof fencing along the length of the upgrade; connectivity structures along the length of the upgrade, and koala food tree plantings (focus mainly in Section 10). Both population monitoring areas are described as focal populations that could be adversely affected by the highway upgrade (RMS 2016). The two focal areas featured the highest density of koala records along the W2B alignment during environmental assessment population surveys (RMS 2016).

Baseline data on the focal koala populations have come from a variety of sources. Population surveys of the Broadwater focal area were conducted during 2014 and 2015 (Ecosure 2014, 2015). The Bagotville koala focal population has been the subject of detailed field and laboratory studies (see Phillips and Chang 2013; Phillips *et al.* 2015), which informed the preparation of a Population Viability Analysis (PVA) (Kavanagh 2016). The PVA was conducted in accordance with the Commonwealth Conditions of Approval (CoA 5 and CoA 7) and its outcomes have been used to guide management of koalas within this area.

The PVA for the Bagotville focal population indicated that this population is projected to decline significantly over the next 50 years (Kavanagh 2016) unless key threatening processes are controlled. Monitoring of this population is considered important to determine whether mitigation actions have been effective in slowing population decline. As such, the Bagotville focal population will be assessed against the PVA predictions. The Broadwater population, which was not subjected to a PVA, will be assessed against a statistically significant decline at year 15 compared with baseline survey values (RMS 2016).

1.2 Scope of works, program objectives and performance indicators

The monitoring program is designed to provide reliable information with which to inform management of koalas *Phascolarctos cinereus* along the highway upgrade. Koalas are listed as vulnerable in NSW by the NSW *Biodiversity Conservation Act 2016* (BC Act) the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). The objectives of the monitoring program for sections 1-11 of the highway upgrade as stated in the KMP and expanded upon in the Ecological Services Brief (RMS 2017) are described below. Those applicable to year 4 (2020/21) are shown in italics.

1. *Evaluate the success of mitigation measures against the performance measures and corrective actions.*
2. *Assess the effectiveness of the fauna crossing structures and fauna exclusion fencing to facilitate movement of koalas across the upgraded highway.*
3. Determine whether there is a statistically significant decline at year 15 compared with no decline in section 8-9.

4. Determine whether the corrective actions of the KMP have been triggered by estimated population trends in section 10 in accordance with predictions of the Population Viability Analysis.
5. Provide information that supports a program review by RMS at years 5 and 10 in accordance with the KMP (years 5, 10 & 15).
6. Assess effectiveness of the revegetation program in providing additional habitat for koalas.

Based on the above objectives, the success or otherwise of the monitoring program shall be determined by program performance against relevant performance indicators (PI). In addition, scat sampling will be conducted every three years in section 10 for the purposes of genetic analysis. These analyses aim to provide information on distribution and relatedness of individuals across the study area.

Table 8-4 in the KMP details eight performance indicators and their corresponding thresholds, corrective actions and agency responsible. The performance indicators and corrective actions relevant to the current year 4 report are described in Table 1.

Table 1: KMP performance indicators and corrective actions relevant to current report.

Performance indicator	Performance threshold	Corrective actions
1. Road mortality	• No injury to an individual koala as a result of vehicle strike across all upgraded sections. • Section 10: no koala road mortality within the fenced areas of the upgrade, on existing Pacific Highway or Wardell Road.	• Examine fencing for breach or obstruction within 3 days of report & repair. • Retrofit exclusion fencing, or part there-of, with additional measures to deter koalas. • Section 10: RMS would consider erecting koala-proof fencing on Bruxner Hwy (a known koala road-kill black spot), in an effort to reduce koala mortality across the region.
2. Fauna crossing structures	• Evidence of at least one completed crossing by koalas at targeted fauna crossing structures. • Evidence of individual koalas using structures and/or breeding on either side of the highway, via scat analysis. • No evidence of high visitation/usage rates by exotic predators.	• Review monitoring methods. Consider increasing frequency, intensity and duration, to ensure individuals are identified. • Check fauna furniture associated with underpass for damage and rectify. • Investigate habitat adjoining underpass. Consider improving habitat condition and connectivity.
3. Fauna exclusion fence	• No breaches in fauna exclusion fence.	• Check fauna exclusion fencing and fauna crossing structures for damage/blockage and rectify.
4. Predator attack near fauna crossing structures	• No koala deaths or injuries due to predator attack in the vicinity of fauna crossing structures.	• Where monitoring indicates that predators are a threat to koala movement through crossing structures, RMS will engage with North Coast LLS, NSW NPWS (Grafton), RLP Board (North East) & adjacent landowners to identify and implement strategies to reduce this predation risk.

The following report describes the methods and results of the year 4 (2020/21) monitoring period and includes an assessment of statistical power of population surveys going forward. It represents year 4 of population monitoring (construction phase) and year 3 of the crossing structure monitoring (operation phase in sections 1-2). It also represents year 4 road mortality/exclusion fence monitoring in section 10 along Wardell Road and the existing Pacific Highway and year 3 road mortality/exclusion fence monitoring in sections 1-2. Main alignment crossing structure monitoring is due to commence in spring 2021.

The report also addresses the monitoring objectives and assesses monitoring outcomes against the relevant performance indicators and whether thresholds have been breached and require corrective actions. The year 4 report builds upon years 1, 2 and 3 results. It will be used to inform a comprehensive program review at year 5.

2. Study area

The broader study area includes sections 1-11 of the W2B Pacific Highway upgrade alignment and adjoining habitat. The 155 km-long upgrade stretches from Woolgoolga in the south to Ballina in the north. It is wholly located within the NSW North Coast Bioregion, one of the most diverse in NSW (W2B Planning Alliance 2012). The project boundary is located within a landscape that has been either fragmented or cleared for agriculture and rural development although a substantial area of forest persists across the broader study area (W2B Planning Alliance 2012).

For the purposes of the year 4 report, monitoring activities were conducted in sections 1-2 (crossing structure and road mortality monitoring) and sections 8-10 (population monitoring and road mortality monitoring) (Figures 1 & 2). In sections 8-9, the Broadwater focal population area extends 3-5 km either side of an 11 km portion of the highway upgrade from Lang Hill (northern part of section 8) north to the Richmond River (including all of section 9; Figure 2). The Richmond River forms a major movement barrier to the west and north. Within section 10, the Bagotville koala focal population area extends 13.5 km north of the Richmond River and includes the localities of Bagotville and Coolgardie (Figure 2).

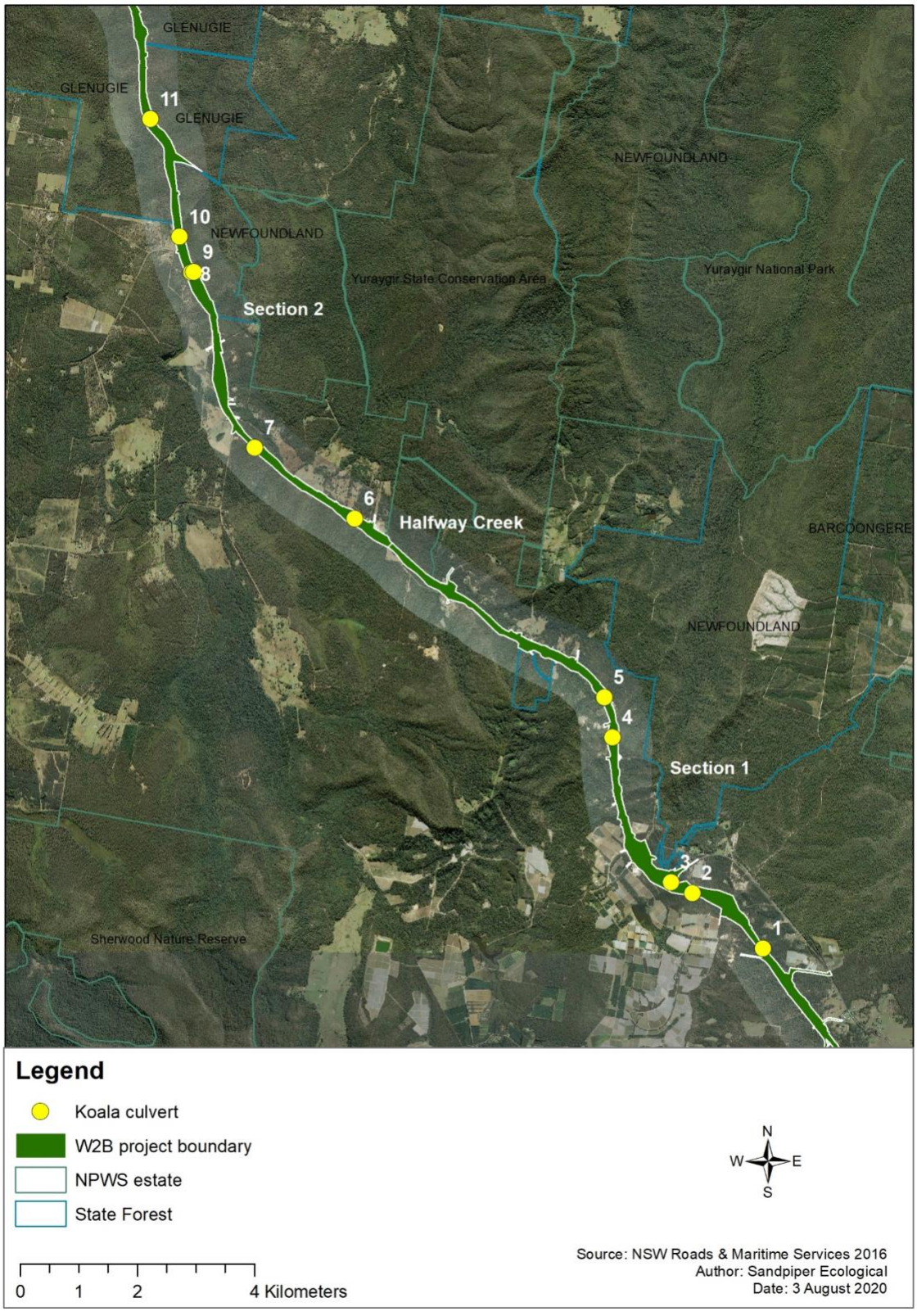

Figure 1: Sections 1-2 of the W2B Pacific Highway Upgrade.

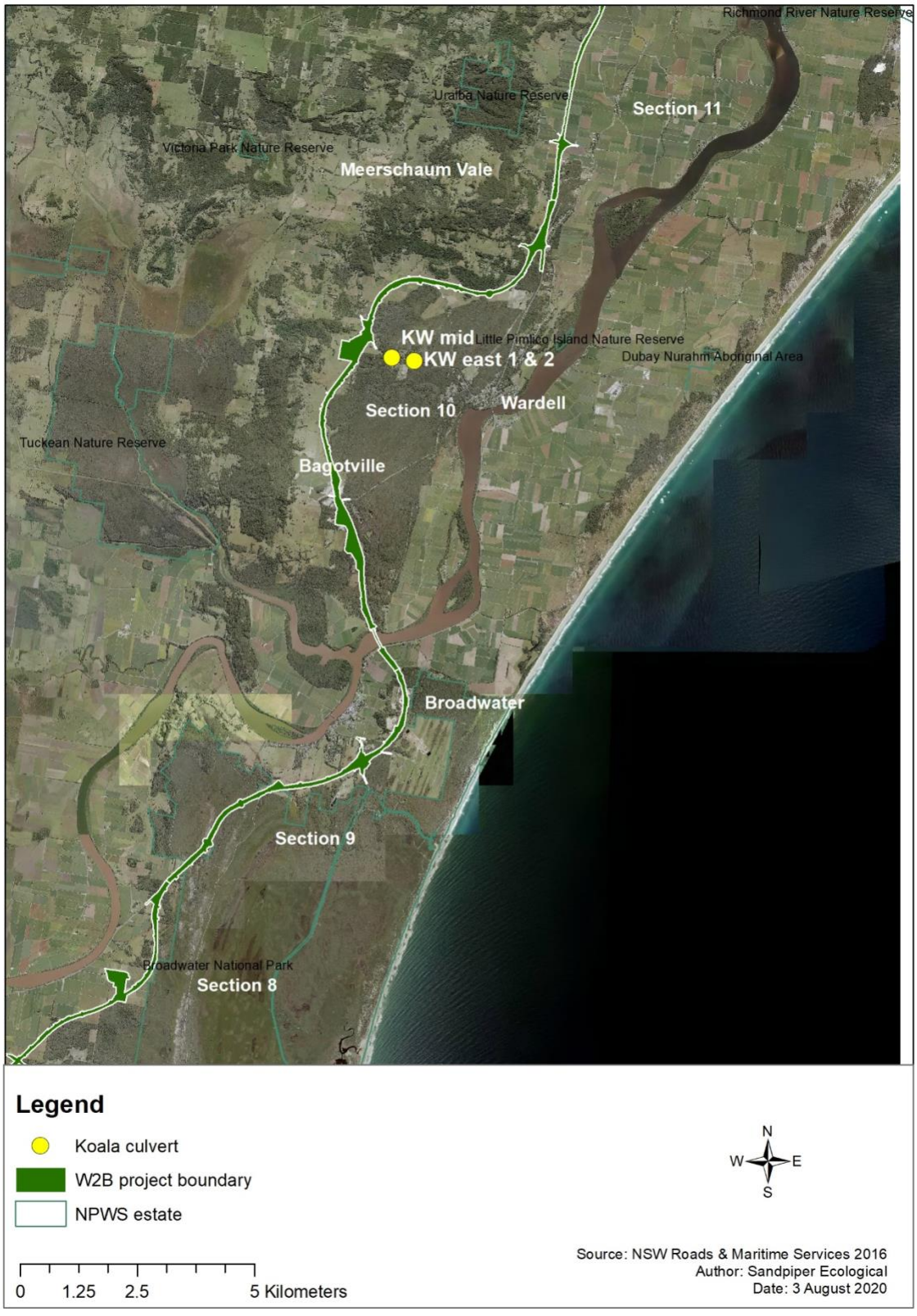

Figure 2: Sections 8-11 of the W2B Pacific Highway Upgrade.

3. Methods

3.1 Population surveys

Diurnal and nocturnal population surveys were conducted during spring 2020 and autumn/winter 2021. Surveys covered 100 sites (50 each in Broadwater and Bagotville) and were completed by teams of three ecologists experienced in koala surveys (Figures 3 and 4). At each site two direct count methods were used:

1. **Transect searches**

   Direct counts on 250 m x 40 m transect (approximately 1 ha) involved three observers walking 20m apart – one on the centerline and one on each side. Observers were equipped with binoculars (& spotlight) and searched trees for koalas.

2. **Radial searches**

   Direct counts within a radial area involved three observers slowly searching all trees within a 25m radius of the mid-point of the belt transect (approximately 0.196 ha). Radial areas and transects were conducted concurrently.

During year 1 and year 2 surveys, the same team completed diurnal followed by nocturnal surveys on the same day. To address concerns about inadequate survey independence, year 3 and 4 diurnal and nocturnal surveys were completed on non-consecutive days.

All koala observations were recorded with a handheld GPS unit and data collected on individual characteristics (e.g. sex, age class, health status, behaviour, identifying features), tree species and diameter at breast height of tree. Handheld spotlights were used to assist with nocturnal surveys.

Spring 2020 surveys were completed between 29 September and 3 December 2020. Diurnal surveys were generally completed between 0800 hours and 1830 hours and nocturnal surveys between 1900 hours and 2400 hours. Weather conditions were mostly fine during the survey period. Temperatures ranged from 15°C to 31°C and winds were variable.

Autumn 2021 population surveys were completed between 14 May and 24 June 2021. The autumn survey was delayed slightly to coincide with drone surveys, which will be reported on elsewhere. Diurnal surveys were generally completed between 0900 hours and 1700 hours and nocturnal surveys between 1730 hours and 2430 hours. Weather conditions were good for surveying koalas, with clear days and nights and occasional light wind recorded throughout. Temperatures ranged from 8°C to 23°C and light rain was recorded briefly on five occasions.

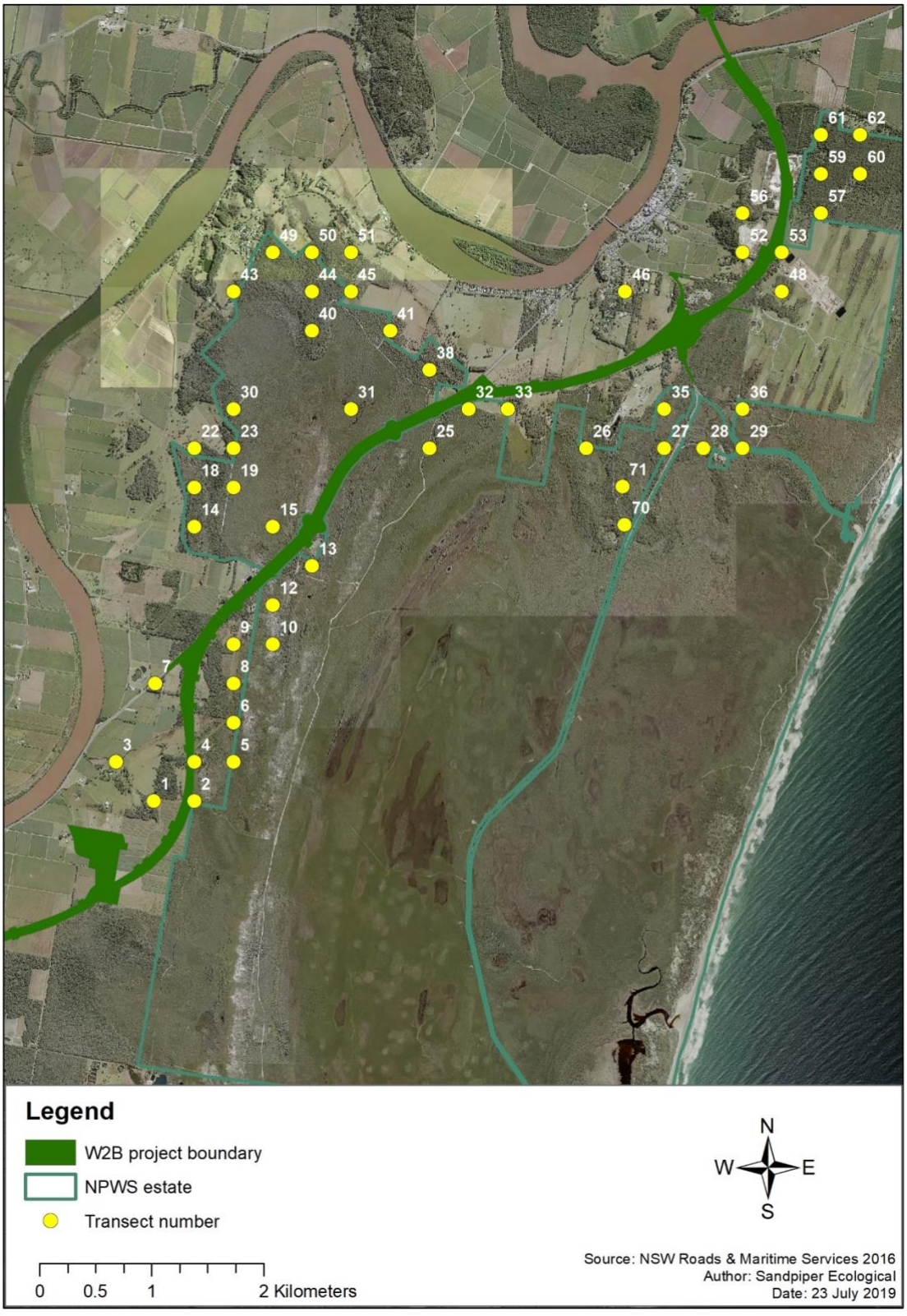

Figure 3: Broadwater (sections 8-9) sample sites.

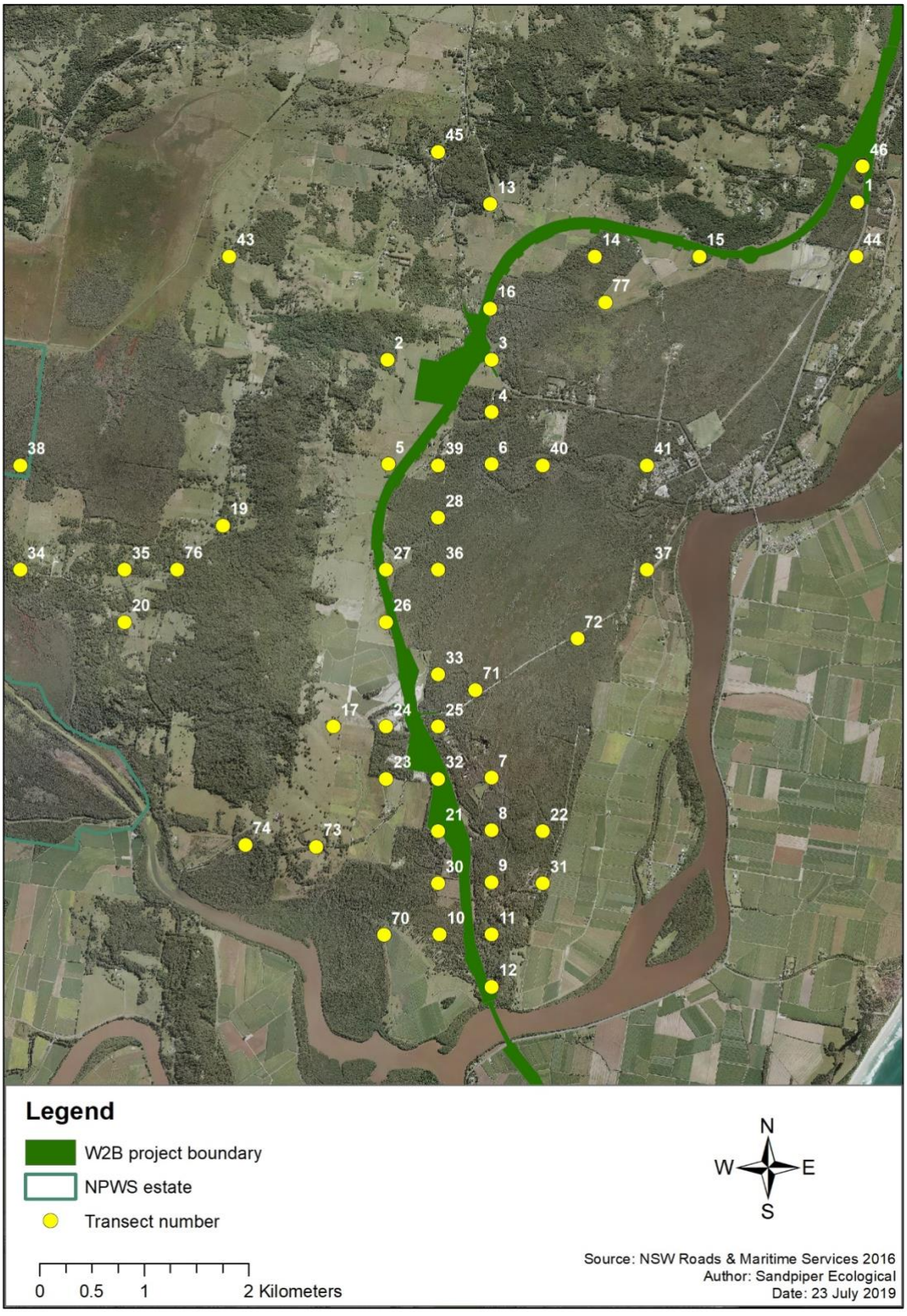

Figure 4: Bagotville (section 10) sample sites.

3.2 Koala density and population size estimates

A detailed report on statistical analysis of koala population data is provided by Rankin (2021) and included in Appendix A. Following is a summary of methods.

3.2.1 Bayesian modelling

A Bayesian estimation exercise was used to estimate densities at Broadwater and Bagotville for year 4 spring and autumn, and year 4 as a whole. The procedure included multi-model uncertainty for effects: night-time vs day-time effect, a radial- vs linear-transect effect; a seasonal effect; log-linear trend vs no trend vs each year having its own unique density, and five different amounts of over dispersion (excess count-variation). Each of these core specifications was repeated five times for five different Negative Binomial over dispersion priors (which broadly represented a spectrum of high-to-low over dispersion, the latter being equivalent to a Poisson). For this exercise, there were a total of 280 models. To acknowledge multi-model uncertainty, these models were model-averaged using posterior probabilities derived from the Watanabe-Akaike Information Criterion (Watanabe 2010, Gelman *et al.* 2014), as in previous reports (Sandpiper 2019a, 2019b, 2020).

In using the model-based approach, as described above, a Bayesian regression model is applied to the entire dataset to project the population back to Year zero based on the overall population trend. In so doing, this approach smooths-over the high natural-variation in counts and more accurately reflects the population density. The estimates include multiple sources of uncertainty resulting in conservative trend estimates. A disadvantage of this approach is that baseline and trend estimates need to be re-calculated as more data are acquired, which is why density estimates for the same years vary between reports. By contrast, a 'fixed baseline' approach employs a simple descriptive statistic, calculated as the mean (and standard deviation) of the raw counts during the baseline year. The baseline value is not updated as more data are acquired.

A disadvantage of the fixed-baseline approach is that due to the large natural-variation in koala counts (i.e. much year-on-year variation) and the sparsity of koala counts (i.e. few koalas in any year) the fixed-baseline reflects the random-variation during the baseline year, rather than the overall population density. Because the fixed baseline is sensitive to high variation in counts, it is more alarmist as a decision-making tool. In contrast, the model-based baseline focuses on the magnitude of the overall population trend, rather than the exact density in any one year. The trend is less sensitive to alarmist changes in koala counts although it may react quickly to a catastrophic drop in density, which is more likely with a fixed baseline approach. Due to high variability in counts between years and the focus on temporal population trends the model-based baseline approach was considered to be more consistent with the intent of the KMP/PVA.

For the Bagotville focal area, baseline density values derived from Bayesian modeling were then extrapolated across the total area of preferred koala habitat prior to clearing (i.e. 2,152 ha) and post-clearing/monitoring years (2,135 ha – as used in the PVA (Kavanagh 2016)), to derive a population size estimate for each period. To be consistent with the PVA population estimation methodology (Kavanagh 2016), a correction factor of 0.204 was then applied to Bagotville population estimates to account for the unsampled 0-1 year-old age cohort. The derived population estimates are referred to as 'revised population estimates'.

It should be noted that in applying the above approach, the Bagotville baseline population estimate presented in the PVA/KMP differs from the revised Bayesian modelling-derived baseline population estimate presented in the current report. Whereas population estimates are presented, determining population trends is focused on comparison of density estimates rather than population estimates. Focusing on density trends is more robust and reduces bias (Rhodes *et al*. 2015). Density estimates are also more reliable because the extrapolated area of preferred koala habitat differs between baseline and post-clearing (and differs between

actual area cleared (i.e. 28 ha) and that predicted in the PVA (i.e. 17 ha)) and its quality and extent will likely change during the 15 year-long monitoring program.

For the Broadwater focal area, which is not informed by a PVA and will be assessed according to a statistically significant decline at year 15, population trends are assessed according to density estimates.

3.2.2 Supplementary analysis to estimate trend in density estimates

A supplemental analysis was conducted to further investigate evidence for or against the presence of a trend in density estimates. The intent of the supplementary analysis was to complement and contextualise the main results. The supplementary analysis used frequentist Negative-Binomial GLMs models and performed model-averaging by AICc weights (Akaike 1974, 1998, Schwarz 1978) to estimate the trends at Broadwater and Bagotville.

These models can be thought of as pseudo-Bayesian models whereby the i) priors-on-parameters have been weakened to zero-influence, and ii) priors-on-model-probabilities are adaptive (i.e., they become more conservative with less data, and more liberal with more data). In other words, the AICc "reacts" faster to new data as compared to the static Bayesian priors used in the main analyses. The trade-off is that: the AICc may be more sensitive to developing trends, but may result in some over fitting and be alarmist, as compared to the Bayesian models with stronger priors.

3.3 Prospective power analysis

The KMP includes background information on use of a Power Analysis (PA) to determine minimum survey effort to reliably detect a decline in focal koala populations. It states, survey effort that achieved 70% power (or confidence) to detect a 30% decline in the Bagotville population was acceptable (RMS 2016). Using baseline data for each focal population and a diurnal search detection probability of 1.0/observer, the KMP PA determined that to achieve the 70%/30% target 50 survey sites within each focal area would need to be double sampled (i.e. two surveys/session) every six months (J. Rhodes unpub. data).

A subsequent prospective PA, which included current density data, would then be completed at the end of each reporting period to determine the minimum survey effort required going forward. Whereas the PA used to inform the KMP was based on a frequentist/null hypothesis testing approach, the prospective PA used in the current and previous reporting periods was based on a Bayesian estimation analysis.

The prospective analysis uses a Monte Carlo simulation procedure. The goal of the power analyses is to estimate the rate of Type-II errors (falsely rejecting the hypothesis of a trend, $H_a: \beta_t \neq 0$) while detecting a -30% decline from baseline levels at Broadwater and Bagotville between years 2015 and 2031. The error rates were conditional on:

1. a negative trend of -30% from baseline levels until Year 15 of monitoring;
2. a cap on the rate of Type-I errors at $\alpha \leq 0.3$;
3. a monitoring effort of 400 transects per year each at Broadwater and Bagotville (i.e. 50 sites surveyed twice/season and two seasons/year at each area);
4. marginal effects for survey-design factors (day-time/night-time, spring/autumn, line-transect/radial-search transects) empirically derived from the Bayesian analysis;
5. baseline koala densities derived from the Bayesian estimation analysis.

The prospective analyses were conducted in the same manner as previous reports with no supplements. Because the prospective analysis assumed the (simulated) existence of 15 years of data, it was considered less sensitive to prior distributions and issues of small sample-sizes. However, because the analysis is conditional on some empirically estimated features, the results are still somewhat sensitive to the estimated baseline conditions and the models used to estimate those conditions.

3.4 Crossing structure monitoring

3.4.1 Camera traps

Fourteen connectivity structures or underpasses (11 box culverts in sections 1-2; one single pipe, one twin pipe and one box culvert in section 10) were monitored for three months during spring/summer 2020 (Table 2). Underpasses monitored in sections 1-2 were as per year 3.

Box culverts in sections 1 and 2 featured timber post-and-rail (fauna) furniture through their length (Plate 1). Underpass floor substrate varied and included concrete (Kweast1, Kweast2 and Kwmind), concrete and raised gravel path (K1, K7-K10), timber mulch on concrete floor (K2-K5 and K11) and a combination of gravel and loose soil (K6). Underpass lengths at highway sites ranged from 18m at the split median (K8 & K9) to 57m at K4 (Table 2). Underpasses on Wardell Road were 15m long.

Table 2: Location of koala dedicated box culverts monitored in sections 1 and 2 (K1-11) and 10 (KWeast1, KWeast2, KWmid). All culverts featured wooden post-and-rail structures except KWmid, which featured a concrete ledge. Regrade refers to the % of underpass entrance visible from the horizontal level of the surrounding natural ground which is indicative of the perspective of an approaching terrestrial mammal.

Site No.	Chainage	Sctn	Easting	Northing	Dimensions H x W (m)	Length (m)	Floor substrate	Regrade (% east/west)
K1	6890	1	515767	6681254	3 x 3	45	Raised gravel path & concrete	0/100
K2	8470	1	514567	6682196	3 x 3	51	Mulch on concrete	25/0
K3	8800	1	514201	6682384	3 x 3	50	Mulch on concrete	100/100
K4	11710	1	513204	6684852	3 x 3	57	Mulch on concrete	55/80
K5	12420	1	513062	6685536	3 x 3	52	Mulch on concrete	95/70
K6	17710	1	508804	6688587	3 x 3	57	Gravel and dirt	0/50
K7	19880	2	507098	6689798	3 x 3	52	Raised gravel path & concrete	100/15
K8	23110 (west)	2	506010	6692784	3 x 2.4	18	Raised gravel path & mulch on concrete	90/40
K9	23110 (east)	2	506057	6692791	3 x 2.4	18	Raised gravel path & mulch on concrete	0/60
K10	23750	2	505811	6693395	3 x 2.4	21	Raised gravel path & mulch on concrete	50/50
K11	25850	2	505317	6695401	3 x 3	27	Mulch on concrete	100/95
KWeast1	152500	10	543646	6798096	1 x 1050	15	Single cell concrete pipe	
KWeast2	152500	10	543646	6798096	2 x 1200	15	Twin cell concrete pipe	
KWmid	152547	10	543646	6798187	2.4 x 2.4	15	Concrete	

Plate 1: Box culverts monitored in sections 1-2 contained fauna furniture and some featured mulch spread over the concrete floor.

Underpasses were monitored with either Swift 3C or Swift Enduro cameras for three months during spring/summer 2020. For box culverts in sections 1 and 2, two cameras were mounted on the central post of the fauna furniture – one positioned to capture animals moving along the furniture and the other positioned approximately 400mm above ground level to capture animals moving along the floor (Plate 2). Both cameras were oriented east. For the culvert on Wardell Road, a camera was mounted at approximately 400mm above ground level and just inside the entrance of each end and oriented inwards (Plate 2). For pipes on Wardell Road, a camera was mounted to a tree or post within 5m of the entrance of each end (Plate 2). All cameras were contained in security cases with padlocks.

All cameras were installed on 17 and 18 September 2020 and were removed on 21 and 23 December 2020. Cameras were set on high sensitivity and programmed to take 10 seconds of video on activation. They were scheduled to turn on at 1800hr and turn off at 0600hr. Cameras were inspected during the middle of the session to change batteries and SD cards. Cameras affected by false triggers were assessed and, if necessary re-oriented to reduce false triggers. Twenty-two of the 28 cameras were active for the full duration of the sample period, three cameras were active for between 81 and 90% of the sample period, two cameras for 59% of the time, and one camera for 27% of the time. Cameras that were not active for the entire sample period experienced various issues including full memory, false triggers and card error (Table 3).

Camera monitoring targeting threatened mammals was also undertaken at nine koala underpasses (i.e. K1, K2, K4, K5, K7-11) during autumn/winter 2020 (i.e. 04/05/2020 – 08/07/2020) and summer 2021 (i.e. 05/01/2021 – 23/3/2021). Any koalas recorded during threatened mammal monitoring are reported on separately in the results section.

Plate 2: Typical underpass camera set-up: box culvert within sections 1-2 (A); Wardell Road box culvert – camera at each end (B); Wardell Road twin-pipe – camera at each end (C).

Table 3: Koala underpass camera monitoring effort during 2020. For Wardell Road underpasses, 'floor/rail' refers to 'north/south' camera. [P] = Pipe.

Site No.	Chainage	Section	No. of videos (floor/rail)	Days active (floor/rail)	% of period active (floor/rail)
K1	6890	1	261/146	95/95	100/100
K2	8470	1	76/110	95/95	100/100
K3	8800	1	255/167	95/56	100/59
K4	11710	1	59/1482	95/56	100/59
K5	12420	1	92/218	95/95	100/100
K6	17710	1	67/54	95/95	100/100
K7	19880	1	22/46	95/95	100/100
K8	23110 (west)	2	73/143	26/95	27/100
K9	23110 (east)	2	145/117	95/95	100/100
K10	23750	2	31/127	95/95	100/100
K11	25850	2	185/98	95/95	100/100
KWe1[P]	Wardell Rd	10	127/725	96/86	100/90
KWe2[P]	Wardell Rd	10	1074/715	96/85	100/89
KWmid	Wardell Rd	10	1027/158	78/96	81/100

3.4.2 Camera image analysis

Camera images were uploaded to a desktop computer and viewed using Windows Photo Viewer. Data recorded included: site, date, time, species, number of images and image numbers. An ecologist reviewed all images, with reference to standard field guides (i.e. Menkhorst & Knight 2010; Menkhorst *et al.* 2017; Swan *et al.* 2004) and senior staff. A hierarchical approach was adopted for species identification, which included: species, genus or group. Identification accuracy was scored as either definite (90%+ certainty), probable (75-90% certainty), or possible (60-75% certainty).

To determine the likelihood of a culvert crossing, footage was scored according to the following criteria:

- *Complete crossing* - animal demonstrates directional movement along floor/furniture and does not return within 10 minutes.
- *Incomplete crossing* – animal demonstrates directional movement along floor/furniture but returns within *10* minutes or exhibits no directional movement along floor/furniture.

According to these definitions, a 'complete crossing' is inferred from display of strong directional movement and no evidence of return movement. For pipes, where cameras are installed at either end of the structure, the absence of concurrent footage at the other end of the pipe is presumed to be an instance of detection evasion. These definitions are consistent with other underpass investigations (see Goldingay *et al.* 2019), including other Pacific Highway upgrade sites (see Sandpiper 2017, 2018, 2019d, 2019e).

To control for variation in camera effort between sites, totals for complete crossings were converted to a per week value by dividing the number of crossings by the number of sample weeks. The number of sample weeks was derived by dividing the number of sample days by seven. Data were summarised according to underpass, native or introduced species, introduced predators (i.e. cat, dog, fox), and compared between monitoring years.

3.4.3 Scat and scratch searches

Scat and scratch searches were conducted at each underpass on three occasions during the monitoring period. Searches involved scanning the culvert floor and habitat within 50m of each underpass entrance for koala scats, predator scats and scratches on trees. Search effort was equivalent to 15 person-minutes/side. Any predator scats collected were sent to a recognised hair analyst for identification of mammal prey species.

3.5 Road mortality surveys and fauna fence inspections

Koala road mortality surveys were undertaken on two occasions, once in winter (9&10/7/2020) and once in spring (12&16/10/2020). Whereas year 1 and 2 surveys involved walking along the side of the highway, year 3 and 4 surveys were changed to car-based to address safety concerns. Car-based surveys were conducted in the section 10 areas along Wardell Road (Gulbay Lane to Thurgates Lane – 1.54 km), along the existing Pacific Highway (Carlyle Street to the Coolgardie interchange – 3.3 km) and along sections 1 and 2 (28.6 km).

Car-based surveys entailed a driver and passenger/observer travelling the length of the subject road in both directions. The survey vehicle featured a 'Vehicle Frequently Stopping' sign on the back and flashing light and travelled at 80-90 km/h in the left-hand lane. Surveys involved the passenger scanning the road surface and road shoulder for animal carcasses. When a carcass was observed, the vehicle would pull over at the nearest safe location and the passenger would walk back to inspect and identify the carcass from behind the guard rail/rope. The exact location of each carcass was recorded on a data sheet and referred to in subsequent surveys to avoid double-counting. Unidentified mammal carcasses were scored as either small (e.g. rodent, bat, glider, brush-tailed phascogale), medium (i.e. long-nosed potoroo, rufous bettong, bandicoot, cat, spotted-tail quoll, possum), or large (i.e. wallaby, kangaroo, dog, fox)

A hair sample was collected from any unidentifiable carcass suspected of being a threatened mammal. Samples were sent to a recognised hair analyst for identification. Road mortality results were supplemented by other data sources including incidental observations from Sandpiper staff while traveling focal roads, RMS staff, construction personnel and road mortality reports from Lismore-based Friends of the Koala (FOK). It is intended that these data be captured on the W2B Project Wide Koala Observations database curated by Pacific Complete. The fauna fence was inspected for breaches during road mortality surveys and during installation/retrieval of underpass cameras.

4. Results

4.1 Population survey koala observations

4.1.1 Broadwater focal area

During spring 2020 surveys, three koalas were observed on transects during diurnal searches and two on transects during nocturnal searches (Table 4; Figure 5). These included two males and two females and a recently independent young that was a probable male. No individuals were observed within radial plot areas. A further two koalas were observed incidentally off-transect while moving between sites. The body condition of individuals that could be viewed was generally good.

During autumn 2021 surveys, one koala were observed on transect during diurnal searches, and one during nocturnal surveys (Table 4). No individuals were recorded within radial plot areas. A further two koalas were observed incidentally off-transect while moving between sites. The body condition of individuals that could be viewed was good.

Full details of Broadwater koala observations are provided in Table B1, Appendix B.

Table 4: Broadwater focal area koala observations – baseline to year 4 (2020/21).

Survey session (no. of transects surveyed)	Diurnal transect	Nocturnal transect	Diurnal radial	Nocturnal radial	Incidental
Baseline (54)	7	NA	1	NA	1
Yr.1 spring (52)	1	2	0	0	2
Yr.1 autumn (50)	4	4	1	1	8
Yr.2 spring (50)	1	1	0	0	11
Yr.2 autumn (50)	1	2	0	0	3
Yr.3 spring (50)	2	3	0	0	6
Yr.3 autumn (50)	2	5	1	2	4
Yr.4 spring (50)	3	2	0	0	2
Yr4.autumn (50)	1	1	0	0	2

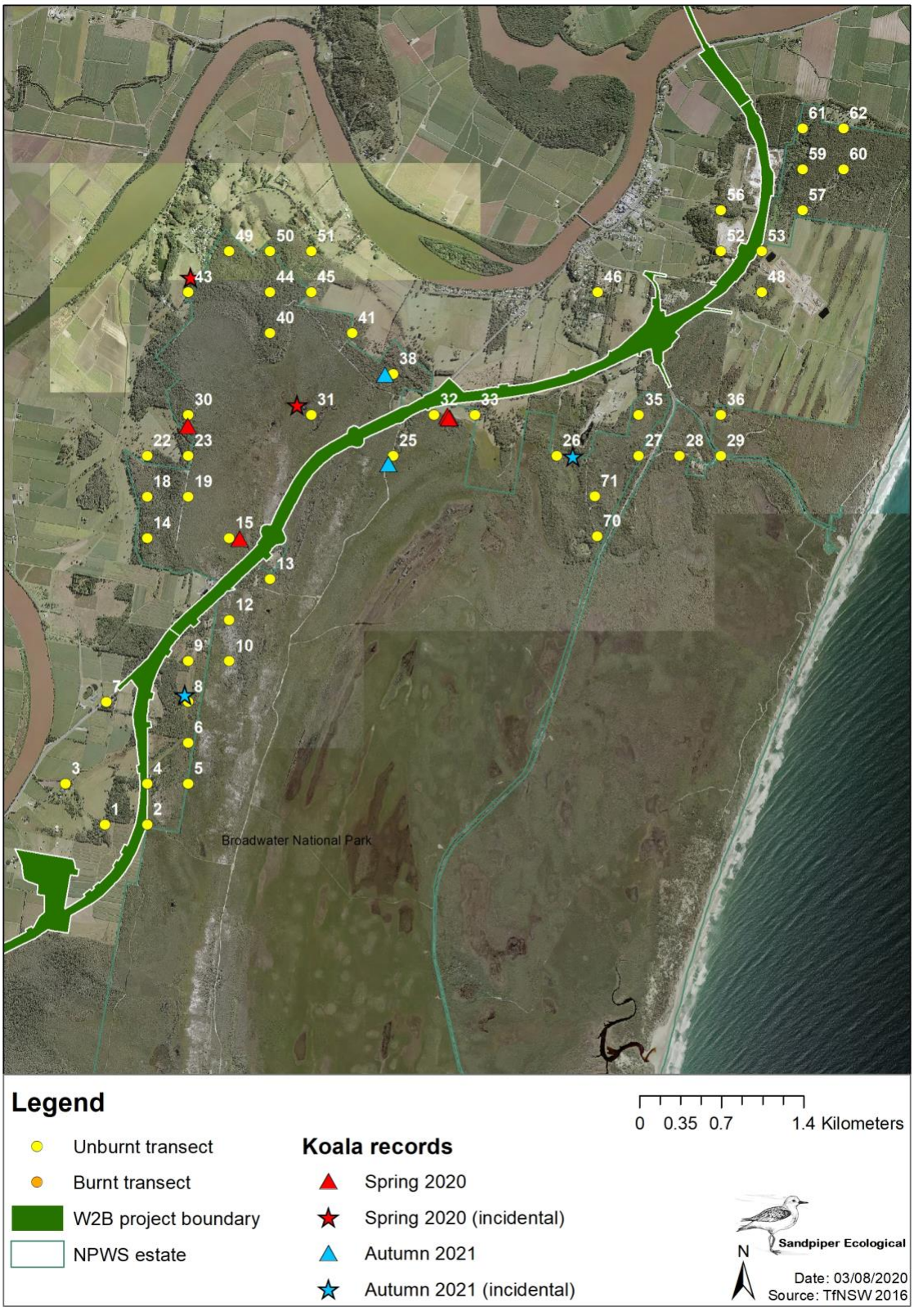

Figure 5: Broadwater survey sites and location of koalas observed during spring 2020 and autumn 2021 surveys.

4.1.2 Bagotville focal area

During spring 2020 surveys, three koalas were observed on transects during diurnal searches, one of which was also within a radial plot area (Table 5, Figure 6). During nocturnal surveys, five individuals were observed on transects and none within radial plot areas. One female was observed with a large back-young. A further four koalas were observed incidentally off-transect while moving between sites. The body condition of individuals' that could be viewed was generally good except one individual at site 20 had a dirty tail. A large carpet python was constricting the female with back young at site 74.

Transects affected by the spring 2019 wildfire were in varying stages of recovery. Canopy vegetation at transects 7, 22 and 41 had not recovered by the autumn 2021 survey. Over the spring and autumn surveys three koalas were recorded on previously burnt transects (#9, 33 & 36).

During autumn 2021 surveys, three koalas were observed on transect during diurnal searches and four during night searches (Table 5). No individuals were observed within radial plot areas. An adult female recorded on transect 36 had a back young. A further four koalas were observed incidentally off-transect while moving between sites. The body condition of individuals that could be viewed was generally good except four individuals (sites 20, 34, & 36) featured dirty tails.

Full details of Bagotville koala observations are provided in Table B2, Appendix B.

Table 5: Bagotville focal area koala observations - baseline to year 4 (2020/2021).

Survey session (no. of transects surveyed)	Diurnal transect	Nocturnal transect	Diurnal radial	Nocturnal radial	Incidental
Baseline (46)	3	NA	NA	NA	5
Baseline (42)	NA	NA	1	NA	?
Yr.1 spring (43)	2	3	0	0	5
Yr.1 autumn (50)	5	5	1	1	8
Yr.2 spring (50)	3	5	1	2	4
Yr.2 autumn (50)	3	3	0	0	3
Yr.3 spring (50)	6	5	1	0	6
Yr.3 autumn (50)	5	4	0	0	3
Yr.4 spring (50)	3	5	1	0	4
Yr.4 autumn (49)	3	4	0	0	4

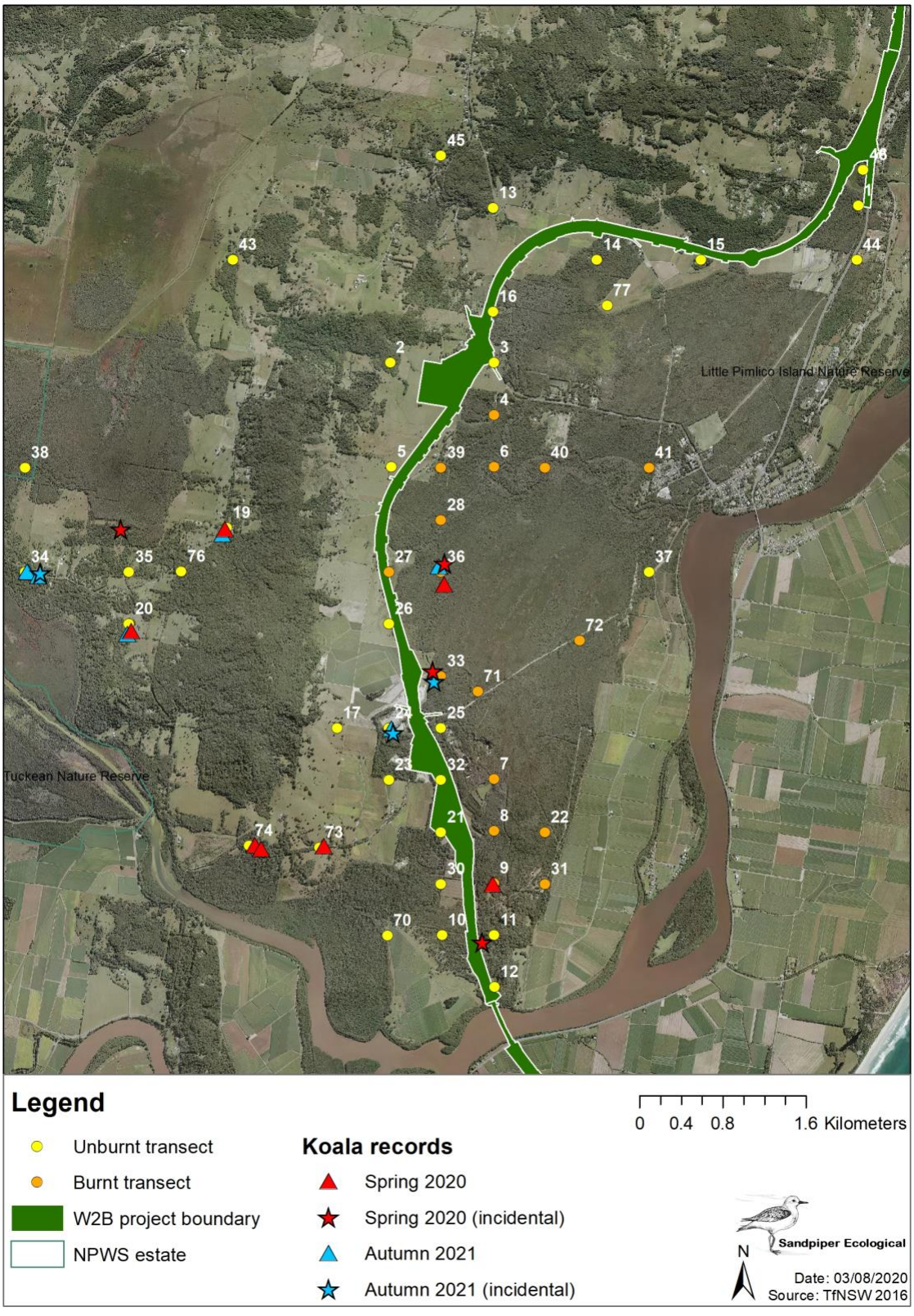

Figure 6: Bagotville survey sites and location of koalas observed during spring 2020 and autumn 2021 surveys including sites that were burnt during the spring 2019 wildfire.

4.2 Koala density, population size estimate and trend estimate

4.2.1 Broadwater

Based on the Bayesian estimation analysis, the density estimate for spring 2020 was 0.047 koalas ha^{-1} (95%CI: 0.031-0.066) and autumn 2021 was 0.046 koalas ha^{-1} (95%CI: 0.031-0.065). Overall, the Year 4 density estimate for Broadwater was 0.046 koalas ha^{-1} (95%CI: 0.032-0.065). This compares to a modeled baseline density estimate of 0.060 (95%CI: 0.040-0.086) koalas ha^{-1} (Figure 7).

The estimated trend in density estimates at Broadwater was a 3.3%/year decline (SE: 0.043; 95%CI -0.127-0.028) with a 0.756 posterior probability of a decline. This is approximately double the decline that was estimated following the year three analyses. The hypothesis-testing posterior odds ratio (Bayes Factor) was 2.071, which is slight evidence of a declining trend. However, according to conventional categories, a value of 2.071 is considered 'barely worth mentioning' (Jeffreys 1961; Kass & Raftery 1995).

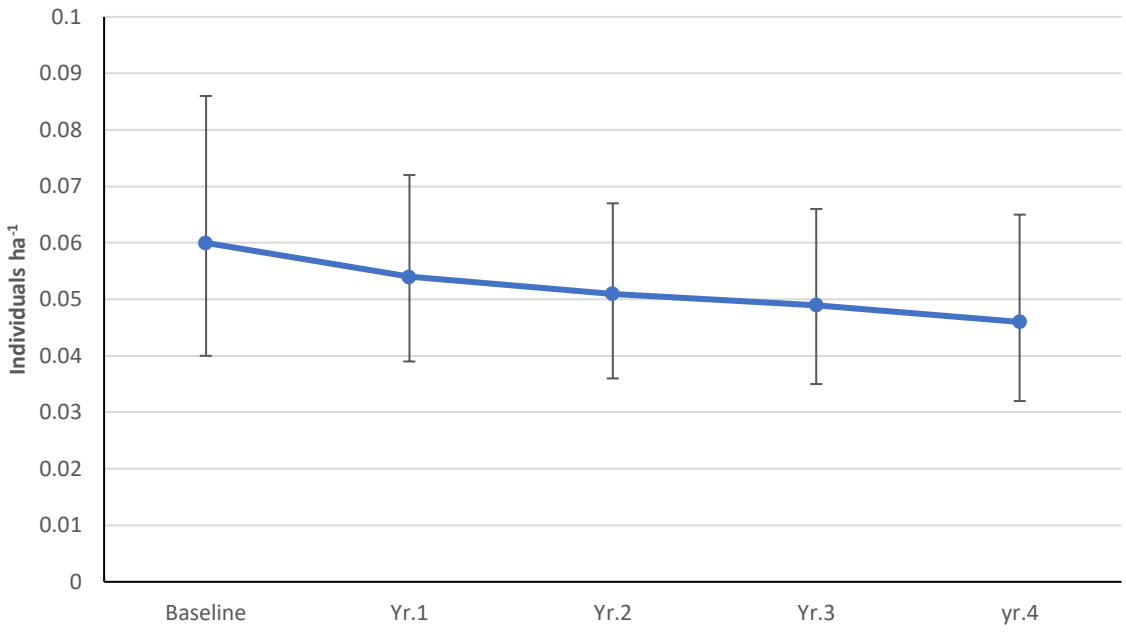

Figure 7: Comparison of Broadwater focal area density estimates (± 95%CI) for the modeled baseline and monitoring years.

4.2.2 Bagotville

Based on the Bayesian estimation analysis, the density estimate at Bagotville for spring 2020 was 0.081 koalas ha^{-1} (95%CI: 0.058-0.108) and for autumn 2021 was 0.080 koalas ha^{-1} (95%CI: 0.057-0.107). The overall Year 4 density estimate was 0.080 koalas ha^{-1} (95%CI: 0.058-0.106). This compares to a modeled baseline density estimate of 0.081 (95%CI: 0.057-0.111) koalas ha^{-1} (Figure 8). The estimated trend in density estimates at Bagotville was a 0.0%/year (SE: 0.025; 95%CI -0.061-0.060) with a 0.488 posterior probability of a decline. The hypothesis-testing posterior odds ratio (Bayes Factor) was 0.782, which is slight evidence against a decline. However, according to conventional categories, a value of 0.782 is considered 'barely worth mentioning' (Jeffreys 1961; Kass & Raftery 1995).

Extrapolated population size estimate for year 4 overall was 171 koalas (95%CI: 124-226) across 2,135 ha of preferred koala habitat (Figure 9). This compares to a modeled extrapolated baseline population estimate of 174 koalas (95%CI: 122-237) across 2,152 ha.

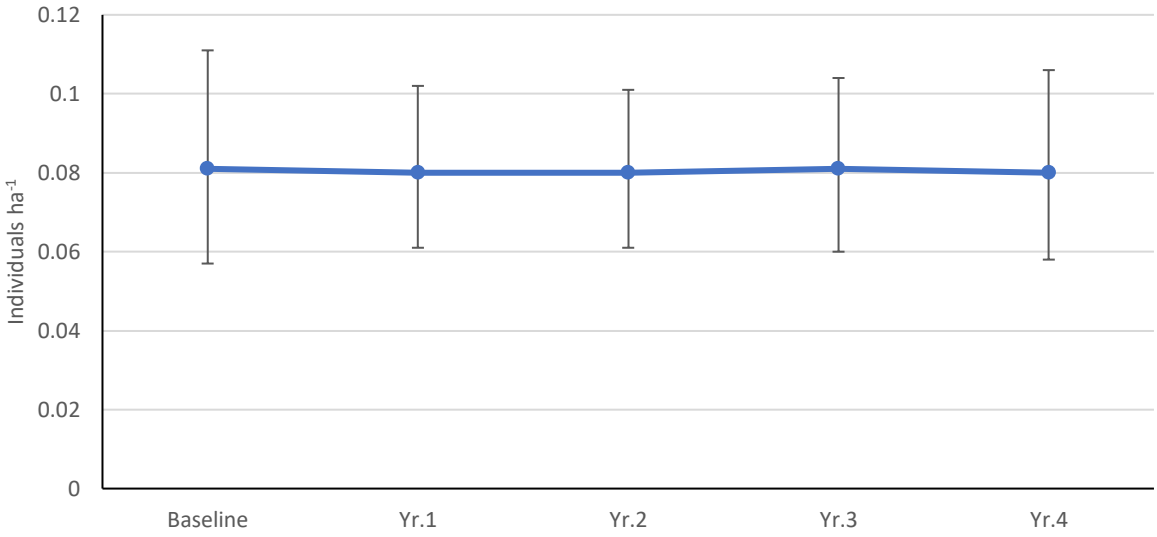

Figure 8: Comparison of Bagotville focal area density estimates (± 95%CI) for the modeled baseline and monitoring years.

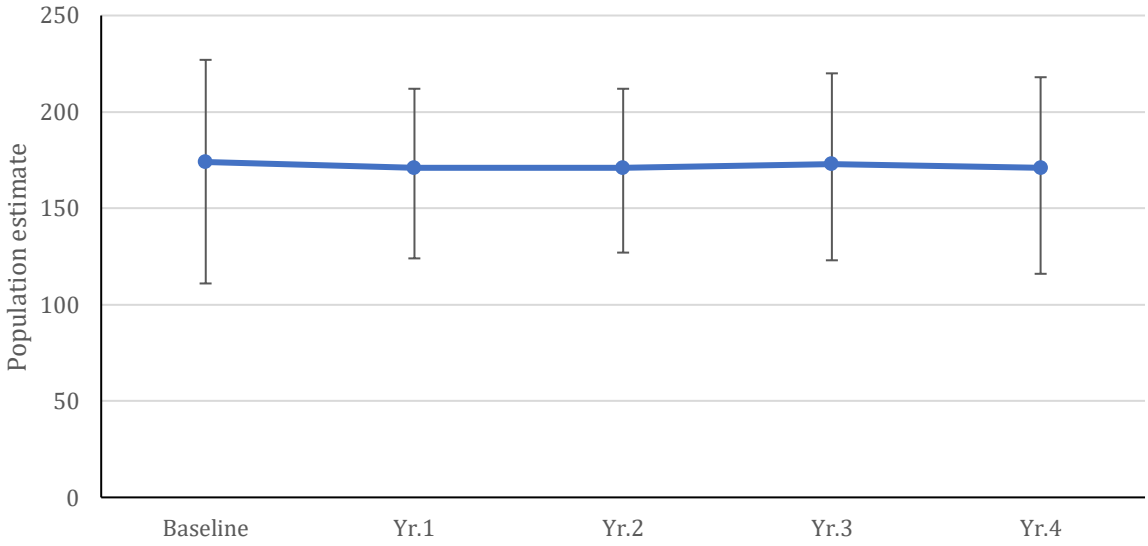

Figure 9: Comparison of Bagotville focal area population estimates (± 95%CI) for the modeled baseline and monitoring years. Population estimates are based on 2152 ha (baseline) and 2135 ha (monitoring years) of preferred koala habitat, as informed by the PVA (Kavanagh 2016).

4.3 Power analysis

For a maximum Type-I error rate of 0.3, the estimated power at Bagotville and Broadwater was 0.726 and 0.667, respectively (Figure 10). For a maximum Type-I error rate of 0.35, the estimated power for Bagotville and Broadwater were 0.764 and 0.7, respectively.

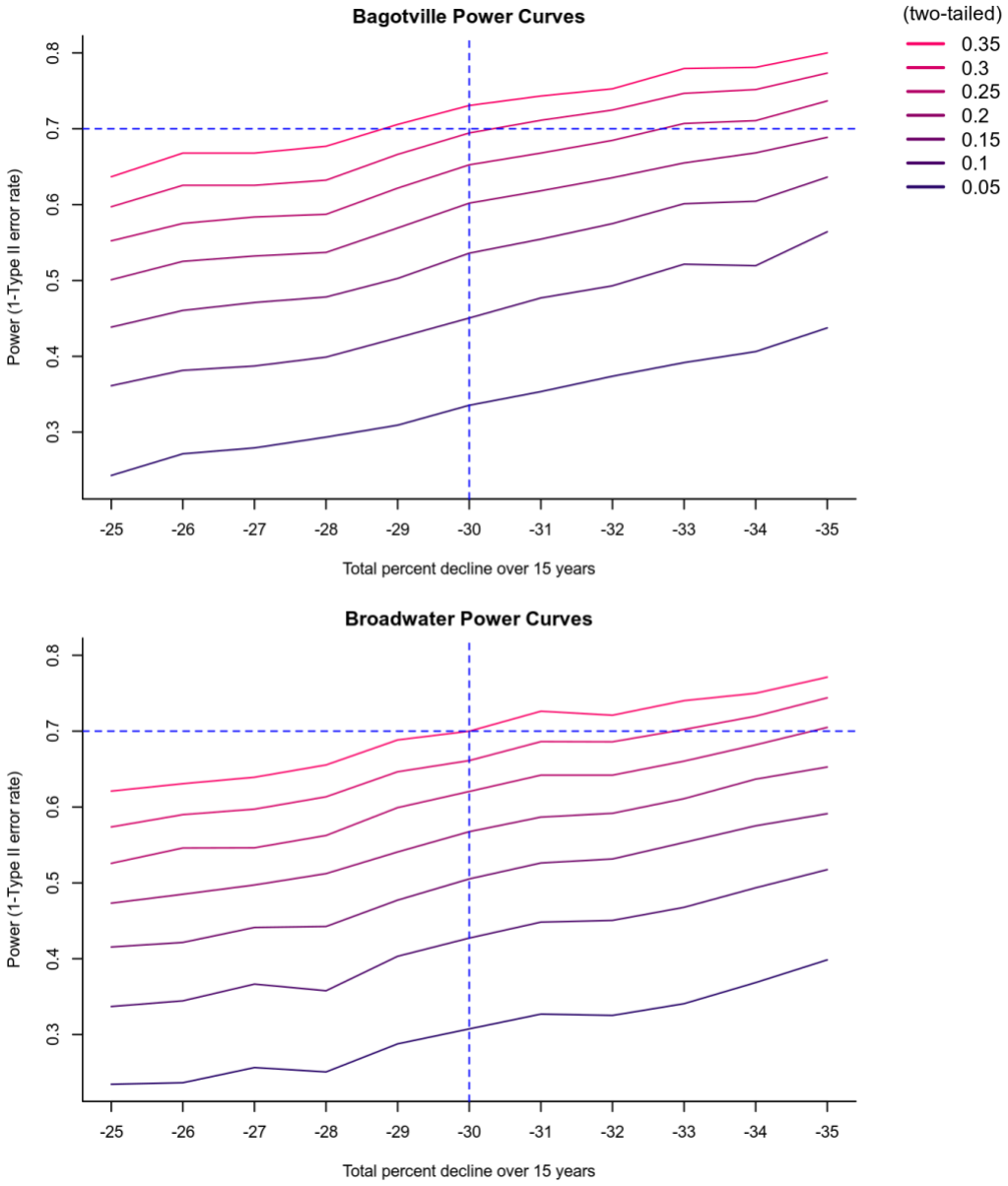

Figure 10: Statistical power to detect a 30% decline in baseline densities over a 15 year monitoring period for different maximum levels of Type-I errors (lines).

4.5 Crossing structure monitoring

4.5.1 Camera traps

Fauna crossings

Twenty species and four fauna groups were confirmed using koala underpasses during the spring/summer 2020 monitoring period (Table 6). Overall, 138.37 fauna detections/week (i.e. sum of complete {cc} and incomplete {ic} crossings/week) were recorded with the majority of detections (78.46%) being complete crossings (108.56cc/week) at a rate of 7.75 ± 7.74cc/week/underpass (Table 6). Native species accounted for the majority of complete crossings at all underpasses except for K3 and K6, which were dominated by red fox *Vulpes vulpes* (Table 6). Complete crossings by native taxa, excluding rodent spp., small mammal spp., and *Rattus* spp., which may include native and/or introduced species, were highest at culverts K4 (16.08cc/week), K3 (13.87cc/week) and K5 (9.06cc/week) (Figure 11). Sites K7 and K6 recorded the lowest use by native fauna with 0.81cc and 0.66cc/week, respectively (Figure 11). *Antechinus* spp. was the most frequently detected species/fauna group. It was recorded in 10 of the 14 underpasses at an overall rate of 35.11cc/week (Table 6).

An adult koala was recorded making a complete southward crossing at the Wardell Road culvert (KWmid) on 27/9/2020 (Plate 3). Sex could not be determined and the individual did not show obvious signs of cystitis (i.e. wet/stained rump).

Other threatened species detected included rufous bettong *Aepyprymnus rufescens*, which was recorded making four complete eastward crossings at K11. No koalas were recorded during threatened mammal underpass monitoring in sections 1 and 2 during autumn/winter 2020 and summer 2021.

Full details of underpass camera detections are provided in Table C1, Appendix C.

Table 6: Number of complete and incomplete crossings/week by mammals at 14 koala underpasses during spring/summer 2019. Floor and fauna furniture crossings have been pooled. KW=Wardell Rd structure; C = complete crossing/week; I = incomplete crossing/week; P = present within structure; ^{P} = pipe structure; * = includes native &/or introduced species. ** = introduced species. Threatened species in bold.

Species/group	Site and crossing type																													
	K1		K2		K3		K4		K5		K6		K7		K8		K9		10		11		KWe1		KWe2		KWmid		Total	Total
	C	I	C	I	C	I	C	I	C	I	C	I	C	I	C	I	C	I	C	I	C	I	C	I	C	I	C	I	C	I
Short-beaked echidna			0.15	0.00	0.81	0.15																	0.08				0.07		1.03	0.23
Antechinus spp.	2.21	1.11	1.33	0.15	5.25	0.25	15.42	22.20	5.53	0.44			0.52		3.32		0.59	0.29	0.88	0.66	0.07	0.07							35.11	25.18
Northern brown bandicoot	0.22				0.07										0.27		0.44						0.24		0.08		0.07		1.41	0.00
Long-nosed bandicoot	0.29				0.07				0.07						0.27		0.22	0.07			0.07	0.15	0.85	0.23	0.15				2.00	0.45
Bandicoot spp.	1.62	0.07			0.22				1.69				0.07		0.81		2.28				0.29	0.07	0.45		0.24	0.08	0.15		7.83	0.23
Koala																											0.09		0.09	0.00
Short-eared brushtail possum	0.07	0.22			6.82				0.88	0.07													2.81	0.15	0.69	0.16	2.02		13.30	0.61
Common brushtail possum	0.66		2.14												0.49		1.25		0.52	0.07									5.06	0.07
Brushtail possum spp.	0.29		0.44		0.32				0.37		0.07						0.07						0.45		0.64		0.07		2.74	0.00
Common ringtail possum																							0.24						0.24	0.00
Rufous bettong																					0.29								0.29	0.00
Swamp wallaby	0.07						0.15																0.08	0.16	0.08	0.32	1.61		1.99	0.48
Red-necked wallaby	0.22						0.22								0.81		0.22		0.15										1.62	0.00
Wallaby spp.	0.22						0.29		0.37		0.15		0.07		0.27		0.07												1.45	0.00
Eastern grey kangaroo	0.81										0.52	0.15																	1.33	0.15
Large macropod spp.	0.29										0.07								0.07										0.44	0.00
Microbat spp.	Present				Present		Present		Present		Present		Present				Present		Present		Present		Present							0.00
Swamp rat									0.15												0.07								0.22	0.00
Bush rat	0.07				0.07												0.29						0.08						0.52	0.00
Water rat	0.07																												0.07	0.00
Rattus spp*	1.62		0.07		0.22																0.07								1.99	0.00
Rodent spp*	0.44					0.07			0.15				0.07				0.07				0.07		0.08	0.24		0.16			0.89	0.47
Small mammal spp*								0.07									0.07				0.07								0.15	0.07
House mouse**																	0.15				0.07		0.16				0.18		0.56	0.00
Black rat**	4.27	0.59	0.07	0.15	1.52	0.13													0.15	0.15	0.37	0.15							6.39	1.16
Dog**									0.07	0.07	0.15																		0.22	0.07
Fox**	0.74		0.96		13.63	0.15					0.96		0.29														1.31		17.89	0.15
Cat**	0.44				0.07				0.07		0.37	0.07							0.15								0.09		1.20	0.07
Lace monitor			0.07	0.07	0.22										1.35	0.27	0.07		0.07		0.74	0.07							2.53	0.42
Total																													108.56	29.81

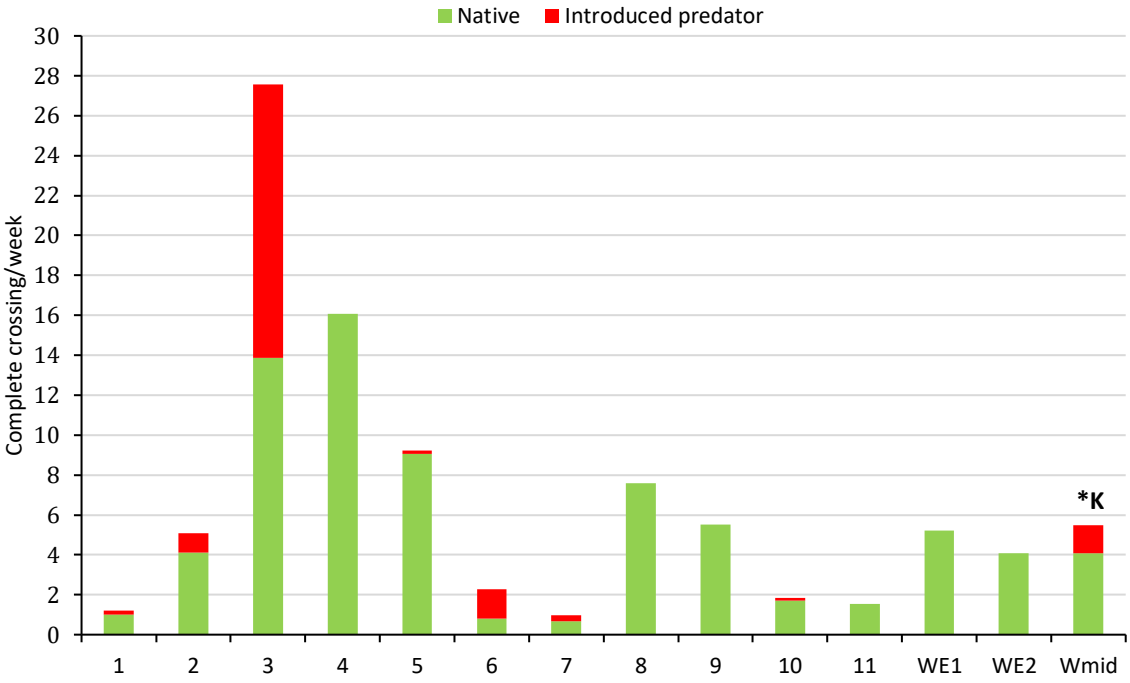

Figure 11: Complete crossings per week by native fauna and introduced predators (cat, dog, fox). ***K** = complete crossing by koala. Graph does not include taxa groups that include both native and/or introduced species (i.e. rodent spp., small mammal, and rattus spp.).

Plate 3: A koala was recorded making a southward crossing at KWmid underpass on 27 September 2020.

Introduced predator activity

Introduced predators (i.e. cat, fox & dog) were recorded at eight of the 14 koala underpasses at an average rate of 1.31 ± 3.61cc/week/underpass (Table 6; Figure 11). Fox and cat *Felis catus* were recorded at six of the 14 sites, whereas dog *Canis lupus familiaris* was recorded at two sites (i.e. K5 and K6) (Table 6). Fox had the highest detection rate of 1.28 ± 3.59cc/week/underpass with most crossings occurring at K3 (Figure 11; Table 6). Cat was recorded at a rate of 0.09 ± 0.14cc/week/underpass and dog had the lowest detection rate of 0.02 ± 0.04cc/week/underpass (Figure 12). Introduced predators were not recorded at K4, K8, K9, K11, WE1 and WE2. Footage showed fox with prey in K3, but it was unclear what the prey species was (Plate 4).

The mean number of introduced predators across all sites increased over the monitoring period, from 0.17 cc/week (± 0.20) in year 1 to 0.29 cc/week (± 0.37) in year 2 to 1.38 cc /week (± 3.59) in year 3 (Figure 13). In particular, the mean number of cc/week by foxes increased substantially between years two and three (Figure 12). Fox crossings peaked at site K3 where an average 13.63 cc/week were recorded (Table 11). Complete crossings by dog peaked in year 2 (Figure 12). Complete crossings/week/underpass by cat have decreased across years from 0.15 (± 0.20) in year 1, to 0.09 (± 0.11) in year 2, and 0.06 (± 0.10) (Figure 12).

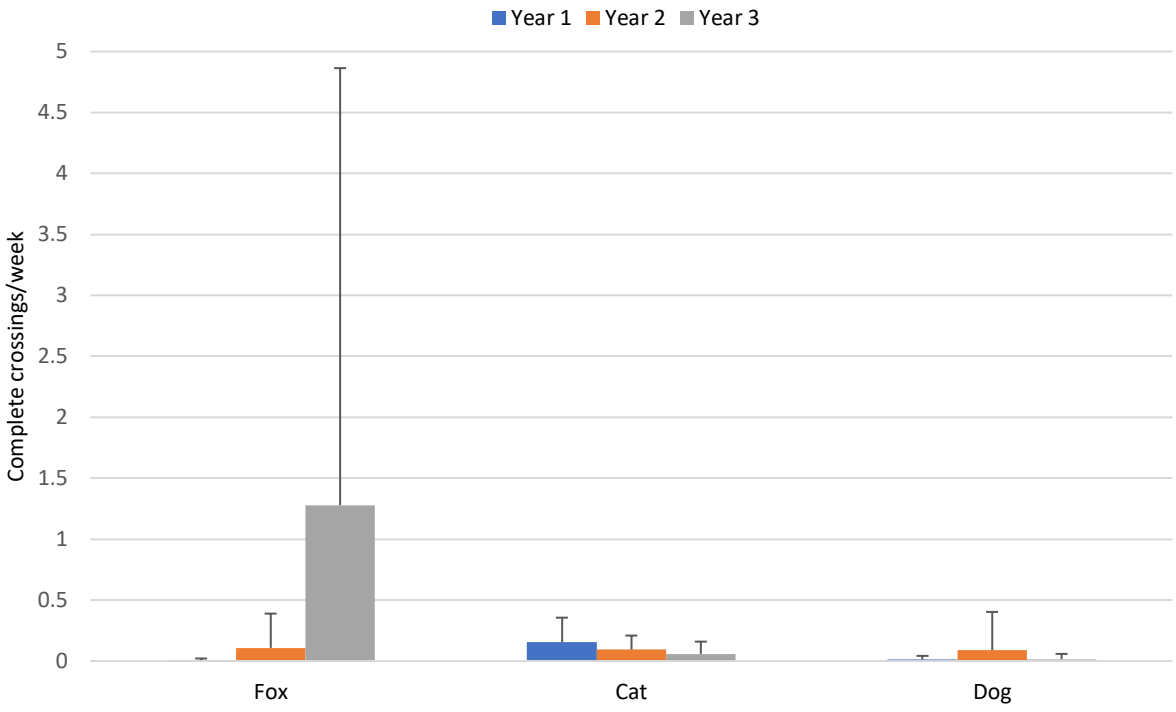

Figure 12: Mean (+SD) number of complete crossings/underpass/week for introduced predators during year 1 (2018), year 2 (2019) and year 3 (2020).

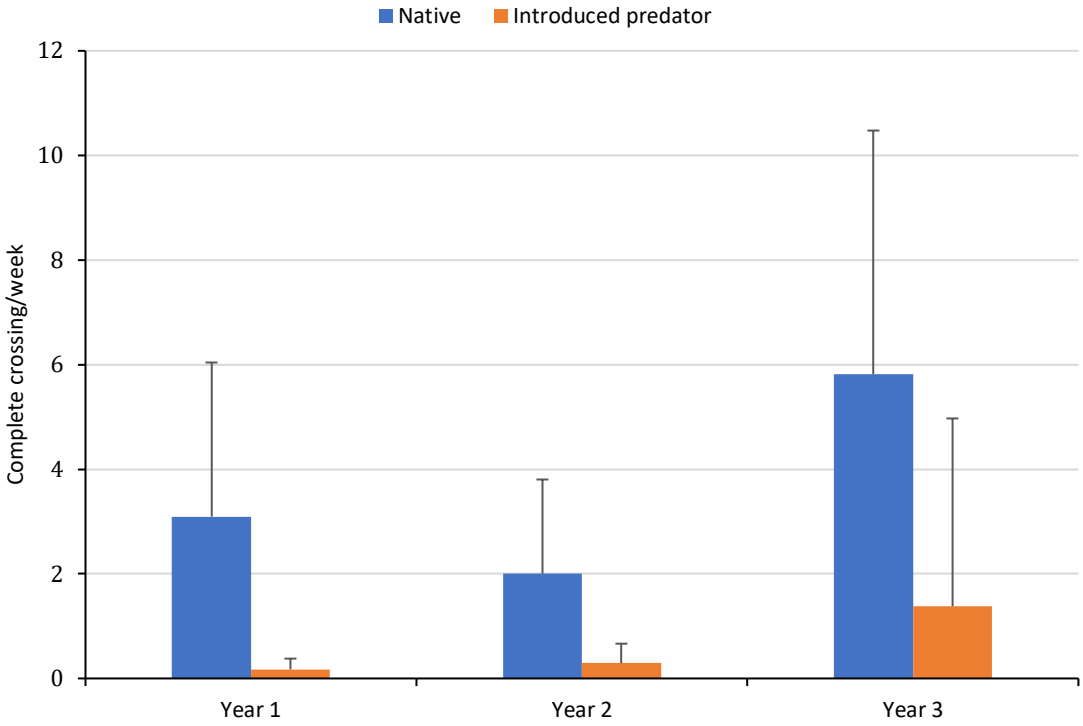

Figure 13: Mean (± SD) number of complete crossings/underpass/week for native species and introduced predator species (cat, dog, fox) during year 1 (2018), year 2 (2019) and year 3 (2020). Graph does not include taxa groups that include both native and/or introduced species (i.e. rodent spp., small mammal, and rattus spp.).

Plate 4: Fox recorded with prey in mouth at K3 on 6 November 2020.

4.5.2 Scat and scratch searches

Four species and nine fauna groups were recorded during scat and scratch searches (Table 7). K1, K3 and K11 had the highest number of species/groups with five, and K10 the lowest with one (Table 7). Koala scat was recorded on both sides of the Wardell Road culvert (KWmid) and pipes (KWe1 and KWe2).

Table 7: Scat and scratch records from three searches of culverts and adjacent habitat during the year 3 (2020) camera monitoring period. W=Wardell; ^{P} = pipe structure, X = scat record, * = scratch record, threatened species in bold.

Species/group	K1	K2	K3	K4	K5	K6	K7	K8	K9	K10	K11	KWe1^{P}/ KWe2^{P}	KWmid
Antechinus spp.	X	X		X	X		X	X	X	X			
Bandicoot spp.	X			X									
Koala												**X**	**X**
Brushtail possum spp.			X									X	
Wallaby spp.	X	X	X	X	X	X	X				X	X	X
Eastern grey kangaroo			X								X		
Microbat spp.					X								
Rodent spp.	X							X	X				
Fox			X										
Horse						X					X		
Small reptile spp.											X		
Small bird spp.						X					X		
Unidentified spp.	*		*	*				*	*				

4.6 Road mortality surveys and fauna fence condition

4.6.1 Road mortality

Road mortality surveys detected 12 individuals representing 11 species/taxa groups at a rate of 0.18 individuals/km (Table 8). No koalas were recorded during the surveys. One incidental koala road mortality was recorded on 15/9/2020 within the Wells Crossing to Glenugie area of sections 1-2 at approximate location E 505541, N6694870 (GDA94). One additional koala road mortality was recorded in the Project Wide Koala Observations Register, curated by Pacific Complete, during the reporting period. It occurred on 1/12/20 at chainage 106750, approximately 350m south of the northbound rest area at Devils Pulpit. The fence was inspected in that area and no breaches were detected.

Mammals were the most frequently recorded taxa (n = 11), followed by birds (n = 1). Bandicoot spp. was the most frequently recorded group (n = 2). Road-kill rates were highest along the Old Pacific Highway (0.30 individuals/km) followed by sections 1-2 (0.17 individuals/km). No road mortalities were reported along Wardell Road (Table 8).

Full details of road mortality surveys are provided in Table D1, Appendix D.

Table 8: Fauna road mortalities recorded during two surveys conducted in spring/summer 2020. Records are pooled for the two surveys.

Location (survey distance)	Fauna recorded	Number of roadkill	Roadkill/km
Wardell Road (1.54 km)	Nil	0	0
Old pacific highway (3.3 km)	- Short-beaked echidna - Brushtail possum spp.	2	0.30
Sections 1-2 (28.6 km)	- Northern brown bandicoot - Bandicoot spp. x 2 - Eastern grey kangaroo - Medium mammal - European hare - Cat - Fox - Dog - Laughing kookaburra	10	0.17
Total (33.44 km)		**12**	**0.18**

4.6.2 Fauna fence

No detectable breaches were observed in fauna fence on Wardell Road, old Pacific Highway or along sections 1-2.

5. Discussion

5.1 Koala population surveys

5.1.1 Koala counts, density estimates and trend estimates

Broadwater

The aggregate count of koalas (i.e. spring + autumn) in the Broadwater focal area during year 4 were similar to levels recorded in year 2 and less than those recorded in the baseline, years 1 and 3. The number recorded during the baseline is expected to be higher due to greater survey effort at that time. The number recorded in spring year 4 was equivalent to spring year 3 but declined substantially during the autumn sample. Bayesian modelling of density, which largely controls for differences in survey effort between survey periods, suggests a downward trend from baseline to year 4 {i.e. from 0.060 koalas ha^{-1} (95%CI: 0.040-0.086) to 0.046 koalas ha^{-1} (95%CI: 0.032-0.065)}. Analysis shows there is increasing evidence of a downward trend, however, the strength of the trend remains weak.

Overall, at Broadwater, the estimated densities in year 4 were lower and the downward trend was more pronounced. The estimate of the year 4 density at Broadwater was 0.046 koalas/ha (SE: 0.008; CI: 0.032-0.065), which was lower than the preceding years. The estimated trend (-3.3%/a) was double the magnitude of the year 3 analysis (-1.6%/year). However, given the uncertainty in the estimates, the Bayes Factors do not provide strong evidence of a decline. Rankin (2021) also presented supplemental analysis using frequentist model-averaging. The AICc-based model-averaged estimate showed a 21.8%/year decline with a Fisher p-value against a decline of 0.094. This p-value is much lower than that recorded in year 3 (0.145) and is moving in the direction of rejecting the “no-trend” null hypothesis. Rankin (2021) points out “If the Broadwater population density in Year 5 is similar to or smaller than the Year 4 density, it could be that the future Year 5 p-value will reach the conventional cut-off of 0.05 (i.e., a 95% Type I error rate), at which point the null-hypothesis of “no trend” would be rejected.

Bagotville

Compared with Broadwater, counts for the Bagotville focal area have been relatively consistent across the survey period. The aggregate count (i.e. spring + autumn) in year 4 (15 individuals) was equivalent to years 1 (15 individuals) and 2 (14 individuals) and less than year 3 (20 individuals). Density estimates have been stable between the baseline {0.081/ha^{-1} (95%CI: 0.057-0.111)} and year 4 {0.080/ha^{-1} (95%CI: 0.058-0.106)}.

The per-year densities have lower overall standard errors, suggesting improving certainty in the estimates. There is no evidence of a trend, which was estimated to be 0.000%/year and had a high frequentist p- value. Compared to the Year 3 report, there is increasing confidence that Bagotville has little to no trend (Rankin 2021).

5.1.2 Power analysis

The current update to the prospective power analysis found that Bagotville has exceeded the 0.70 target, while Broadwater is marginally below the target threshold with an estimated power of 0.667. The value for Broadwater is a slight improvement to previous estimates. The power analysis relies heavily on the empirical estimates from the other analyses which, given the high uncertainty in the density estimates and covariate-effects, are likely contributing to a persistent inability to gain higher statistical power.

Improvements in statistical power has not been as large as the improvements in other statistical measures,

such as declining p-values or reductions in standard errors of density estimates. Statistical power is sensitive to the overall uncertainty in the entire system, because it incorporates empirical estimates of variance in the MCMC routine (Rankin 2021). It is likely that more transects would have to be sampled to meaningfully improve the power at Broadwater.

5.1.3 Statistical uncertainty

Following year 4 analysis a high level of uncertainty remains about the system (including sparse koala counts and uncertain estimates) making it difficult to resolve hypotheses and produce definitive statistical statements. The strength of predictions has increased slightly with each additional year of sampling, however, the high standard errors of density estimates, high p-values of trend estimates, moderate power, and low evidence ratios for Bayesian hypothesis tests contribute to statistical uncertainty. As noted previously more years of data-collection will alleviate some of these problems, however additional within-season sampling may be required to produce the requisite power and clarity.

5.1.4 Catastrophic events and other exogenous factors

As with any long-term population monitoring program, the focal koala populations may be affected by a range of catastrophic events and exogenous factors outside of the control of the upgrade project. The wildfire that burnt through approximately 470 ha of the Ngunya Jargoon IPA was one such catastrophic event. It followed a wildfire in the eastern part of the Ngunya Jargoon IPA that burnt out 350 ha in September 2017. The PVA modelling for Bagotville estimated catastrophic fire events at a frequency of once every 35 years with each event encompassing only 10% (i.e. 215 ha) of the 2152 ha study area (Kavanagh 2016). However, within the first three years of the monitoring program wildfire has occurred twice and encompassed 16-22% of the study area. This suggests that the frequency and extent of wildfire modelled in the PVA may have been underestimated.

The other 'catastrophe' input in the PVA is drought (Kavanagh 2016). Drought is modelled to occur at a frequency of every 4-5 years. Records from the closest long-term weather station (i.e. Bureau of Meteorology Weather Station No. 58171, Meerschaum Vale) show that for the first three years of the monitoring program (i.e. July 2017 to June 2020) annual rainfall totals were 16.4% - 21.8% below average. Moreover, the calendar year of 2019 was 44.2% below average and the later half of 2019 was by Bureau of Meteorology definitions a serious to severe drought. It was also the lowest annual rainfall total on record (since records began in 1977). Further monitoring years will be required to determine the veracity of PVA drought predictions.

Other exogenous factors may include local land development, clearing activities, euthanasia of diseased individuals, and the emergence of other diseases and/or pathogens. One such pathogen – myrtle rust – was observed in and around site 14 during autumn 2020 surveys. Myrtle rust is a fungal pathogen that infects plants in the Myrtaceae family, which includes plants of the genus *Eucalyptus* (DPI NSW 2015). The potential impact on koalas would primarily be the loss of food resources within infected areas. Infestations were not observed at other sites. To reduce the risk of spreading myrtle rust the site 14 transect was shifted from the infestation area prior to the spring year 4 survey.

5.23 Use of crossing structures

5.3.1 Koalas

The absence of koala detections in underpasses within section 1-2 during the spring/summer 2020 monitoring period is broadly consistent with results of 2018 and 2019 monitoring when one and zero crossings were recorded in each year respectively. Absent or infrequent use of underpasses by koalas has also been reported at other monitoring sites along the Pacific Highway upgrade (e.g. Sandpiper 2017, 2018, 2019d, 2019e). This is

particularly so for sections featuring low koala densities in the adjoining habitat, which is the case for sections 1 and 2 (RMS 2016). In fact, no scats were detected in habitat adjoining underpasses in sections 1 and 2.

Conversely, monitoring at sites with a resident koala population has shown rapid and consistent use of underpasses (Sandpiper Ecological 2020a). This is reflected in results at Wardell Road (section 10) where koala scats were recorded in habitat on both sides of the road at all three underpass structures and an individual was detected making a complete crossing of the box culvert on one occasion. The record was a healthy individual using the raised concrete ledge to move south across the road.

Whilst limited evidence of koalas using structures in S1 and 2 has been recorded these sections were not considered likely to support koalas and findings are consistent with results of monitoring for the Glenugie Upgrade where one koala crossing was recorded in three years of sampling (Sandpiper Ecological 2017).

5.3.2 Exotic predators

Introduced predators (cat, fox, dog) were detected in nine of the 14 underpasses, which was lower than in 2019 when they were recorded in 12 of 14 structures. The frequency of crossings by dogs and cats decreased from year 2 (2019) to year 3 (2020), whilst fox crossings increased substantially from 0.11/week in 2019 to 1.28/week in 2020. Foxes were recorded at six structures including KWmid where a koala was recorded. Fox activity peaked at K3 with 13.63 cc/week. Foxes were recorded moving through K3 with prey on five occasions, however, the species of prey could not be confirmed.

Cat crossings were recorded at six sites, including the Wardell Road box culvert where a koala was detected, and peaked at K1 (0.44cc/week) and K6 (0.37cc/week). There has been a steady decline in cat use across all sites with crossing/week declined from 0.15 in 2018 to 0.09 in 2019 and 0.06 in 2020. Cats pose a low predation risk and we are not aware of any substantiated reports of koala predation by cats. Similarly, while fox was detected at six structures, there is limited evidence to verify that foxes predate koalas although back young may be vulnerable when mothers are moving across the ground.

In contrast, predation of koalas by wild and domestic dogs is well established (e.g. Lunney *et al.* 2004, 2007). Dogs were recorded at two sites in 2020, K5 and K6 and use of these structures was relatively low at 0.07cc/week and 0.15cc/week respectively. This result contrasts the 2019 results when frequent use by several individual dogs was recorded at K1 in section 1 (Sandpiper Ecological 2020b). In 2019, K1 contributed 95% of all recorded dog crossings. No dogs were recorded within the Wardell Road underpasses during camera monitoring in 2020.

Based on the results of year 2 monitoring, Sandpiper Ecological (2020b) recommended targeted predator control at K1. Based on year 3 results such action was unwarranted and findings highlight the importance of considering predator activity over multiple years before implementing control.

5.3.3 Performance indicators

Fauna crossing structures.

1. Evidence of at least one completed crossing by koalas at targeted fauna crossing structures.
    a. *One completed crossing at KWmid (Wardell road culvert).*
    b. *A complete crossing by a koala was recorded at site K5 on 26/10/2018.*
2. Evidence of individual koalas using structures and/or breeding on either side of the highway, via scat analysis.
    a. *Scats were detected in habitat adjacent to three structures on Wardell road (KWe1, KWe2 and KWmid)*
    b. *DNA analysis of scats collected near underpasses will recommence in 2021.*
3. No evidence of high visitation/usage by exotic predators.

a. *Low frequency use of most underpasses by cats and dogs; high frequency use of K3 by foxes.*

Predator attack near fauna crossing structures.

1. No koala deaths or injuries due to predator attack in the vicinity of fauna crossing structures.
    a. *No evidence of koala deaths/injuries due to predator attack was recorded.*

5.4 Road mortality and fauna fence

5.4.1 Road mortality

Road mortality rates declined from 1.37 individuals/km during year 1 to 0.62 individuals/km in year 2 and 0.18 individuals/km in year 3. The decline in road mortality rates from years 1 to 3 may be an artefact of reduced rate of detection with car-based surveys although detectability trials of car-based surveys found them to be highly effective at detecting medium-sized fauna (Taylor & Goldingay 2004) and the same methods were applied in years two and three. No koala mortalities were recorded along survey road sections although two koala road mortalities were reported for the broader study area (i.e. W2B S1-11). This finding is consistent with year 1 (1 individual) and year 2 (2 individuals). The two mortalities in S1-11 equate to a density 0.012 individuals/km, which is less than half the rate 0.026 ind/km cited by RMS (2016) for the old Pacific Highway in S10. Of the two mortalities recorded in 2020/21, one occurred in an area with no exclusion fence.

5.4.2 Fauna fence

The fauna fence was generally in good repair, although observation has shown that koalas can move through small gaps at gates and the point of entry may not always be obvious. No breach of the fauna fence was detected near chainage 106750 where a road-killed individual was recorded.

5.4.3 Performance indicators

Road mortality

1. No injury to an individual koala as a result of vehicle strike across all upgraded sections.
    a. *Two koalas were struck and killed during the 2020/21 sample period*.
2. Section 10: no koala road mortality within the fenced areas of the upgrade, on existing Pacific Highway or Wardell Road.
    a. *No koala road mortalities observed or reported.*

Fauna exclusion fence.

1. No breaches in fauna exclusion.
    a. *Exclusion fence in the vicinity of the road-kill at chainage 106750 was inspected and no gaps in the fauna fence were recorded.*
    b. *The presence of a koala within the alignment suggests that the fence may have been breached, however, there is also a gap in the exclusion fence at the nearby rest area.*

6. Recommendations

The following actions are recommended for year five of the koala monitoring program:

1. Continue the koala population monitoring program in year 5 (2021/22) and include a program review in the year 5 report.
2. Cease monitoring of structures K1-K11 in Sections 1 and 2 as the three year monitoring requirement has been completed.

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Appendix A: Bayesian estimation analysis and power analysis report Year 4

Year 4 Monitoring Report: Updated Analysis of the W2B Koala Monitoring Programs in Bagotville and Broadwater, NSW, Australia.

10 September 2021

By Robert W Rankin, Ph.D.

under contract by Rankin Holdings, 1035179 Ontario Inc.

1 Summary

This report provides an updated analysis for Year 4 of the W2B Pacific Highway Upgrade koala population monitoring program being conducted in sections 8/9 (Broadwater) and 10 (Bagotville) in accordance with the Koala Management Plan (RMS 2017). The analyses have been updated using the latest data following completion of the spring 2020 and autumn 2021 field seasons.

This report presents four analyses: i) estimation of koala densities; ii) estimation of possible emerging trends; iii) hypothesis-testing of a night-time *vs.* day-time effect; and iv) an updated prospective power analysis.

Summary of results:

- In general, the estimates of trends, densities and power continue to show modest increases in statistical certainty and an improved ability to detect trends, but are still nonetheless high in overall statistical uncertainty in absolute terms.
- There was an error detected in the analytical scripts for the Year 3 report (but not prior reports) which miscalculated the densities at radial surveys at Bagotville. These affected Year 3 Bagotville density estimates but not trends. The error has been corrected and the updated Bagotville densities in this report are correct.
- The estimated population densities at Broadwater and Bagotville for Year 4 2020/21 were, respectively, 0.046 koala/ha (SE: 0.008; 95%CI: 0.032-0.065) and 0.080 (SE: 0.012; 95%CI: 0.058-0.106). The estimate for Year 4 at Broadwater is lower than the Year 3 estimate of 0.049 (SE: 0.008; CI: 0.035-0.066), while Bagotville shows little-to-no change.
- Broadwater has an estimated trend of -3.3%/year ($\bar{\beta}_t$= -0.033 per year; SE: 0.043; 95%CI -0.127-0.028). The estimated trend at Bagotville was 0.0%/year increase ($\bar{\beta}_t$= 0.000 per year; SE: 0.025; 95%CI -0.061-0.060). There was no evidence of a significant trend, according to Bayesian hypothesis testing. The Frequentist methods continue to estimate a steep decline at Broadwater.

- There was slight evidence *against* the presence of a "night-time effect", i.e., there was no meaningful difference between night-time and day-time surveys. The statistical evidence (Bayes Factor) to support this conclusion is stronger than the conclusion in the Year 3 analysis.
- The estimated power at Broadwater and Bagotville were and 0.667 and 0.726, respectively, which are slight improvements from the Year 3 report.

2 Introduction

2.1 Background

This report presents the forth statistical analysis of koala densities and trends, commissioned in support of Sandpiper Ecological Survey's ongoing koala population monitoring in sections 8/9 (Broadwater) and 10 (Bagotville) of the W2B Pacific Highway Upgrade which are being conducted in accordance with the Koala Management Plan (RMS 2017). The intent of these analyses is to evaluate the program's goal of being able to detect a potentially large decline in koala densities. Specifically, the survey effort and statistical modelling should be able to detect a 30% decline over 15 years with a power of at least 70% and a Type-I error rate (α) of 0.30.

This report updates the statistical analyses of previous reports, including a Bayesian trend analysis and simulation-based power-analysis. The methodological details have been described in previous reports (Sandpiper Ecological 2020), and will be summarised here.

2.2 Objectives

There are four objectives addressed in this report:

Objective #1. Update the koala population density estimates at Broadwater and Bagotville for Year 4, including segregated estimates for Spring (2020), Autumn (2021), and a pooled estimate for Year 4 (both seasons).

Objective #2. Update the trend analyses and evaluate the evidence of an emerging trend at either Broadwater or Bagotville. This objective has been addressed according to the original Bayesian trend estimation method proposed in the original report from Year 1 (Sandpiper Ecological 2019a), and has been supplemented with an alternative frequentist paradigm (based on the AICc a) that was explored in the Year 2 and Year 3 reports (Sandpiper Ecological 2019b; Sandpiper Ecological 2020).

Objective #3. Evaluate whether there is an important difference between densities during night-time *vs.* day-time surveys.

Objective #4. Update the prospective power analyses; determine whether the program can detect a 30% decline over 15 years with a power of 0.70 ($\alpha \leq 0.3$ and $power > 0.3$).

3 Important Updates

There are two important methodological updates for the Year 4 analysis compared to the Year 3 report:

3.1 Multi-model Inference: Accounting for Inter-Annual Differences

Throughout these reports, we have employed a model-averaging approach to pool estimates from multiples models (trend vs no trend, night-time effect vs no-effect, and more) based on their predictive accuracy. Previously, the inter-annual variation in counts/densities was parametrised according to three possibilities: i) no trend, ii) trend, iii) no trendbut each year was allowed to have an independent density (i.e., inter-annual variation).

Because of the availability of 5 years of count data, the specification of option (iii) has been revised to include both a trend as well as inter-annual variation, resulting in the following three possibilities: i) no trend, ii) trend, iii) inter-annual variation around a dominant trend.

This change makes option (iii) more realistic, given that most ecological processes include both inter-annual variation as well as a long-term trend. This updated specification is currently only possible for the Bayesian models.

3.2 Error in Year 3 Areas at Bagotville

An error was detected and corrected in how the raw spreadsheet data was being imported for the Bagotville transect areas. Prior data-sheets recorded per-year and per-transect areas separately, whereas the Year 3 and Year 4 data-sheets consolidated the per-transect areas into a single column in the datasheet. An error resulted in declaring the radial-search areas to be the same as the per-row transect-areas at Bagotville, whereas these should be 0.19ha for the radial search-areas.

Because the error was consistent across all years in the Year 3 data-sheet, there should not have been a large effect on the trend analyses and power analyses, but the Year 3 reported densities at Bagotville at the radial-surveys were not correct. For instance, Tables 1 & 2 in Section 4.2 of the Year 3 report are now known to be incorrect, for Bagotville.

These errors are have been corrected for the Year 4 analyses. The updated and correct densities for Bagotville are included in the results.

4 Methods

The following sections will review major methodological features of the analyses. More details about the methodologies can be found in previous reports (see Sandpiper Ecological 2019a, b & 2020).

4.1 Statistical Model for Counts and Density

We are interested in modelling koala density $\eta_{l,t,j}$, using observations of the counts of koalas $y_{l,t,j}$ at location *l (Broadwater vs. Bagotville)*, in year *t*, at transect *j*. Each transect *j* also has a record for its area A_j, and indicator variables X_j denoting whether the survey occurred at night-time or daytime, whether it was a radial survey or line-transect, and whether the survey happened during the autumn or spring. We combine these variables into a log-linear GLM statistical model according to the following reasoning. We start with the formula for density (number of koalas per area):

$$\eta_{l,t,j} = \frac{N_{l,t,j}}{A_{l,t,j}} \iff N_{l,t,j} = \eta_{l,t,j} A_{l,t,j}$$

Where η is the density of koalas at location *l* at time *t* and transect *j; N* is the (true) number of koalas; and *A* is the area at transect *j*. We substitute *N* for its statistical expectation *E[y]* (from a count distribution like the Negative Binomial), and take the natural logarithm of both sides to yield:

$$\mathbb{E}[y]_{l,t,j} = \eta_{l,t,j} \cdot A_{l,t,j}$$
$$\log(\mathbb{E}[y]_{l,t,j}) = \log(\eta_{l,t,j}) + \log(A_{l,t,j})$$

Finally, we substitute the density term η for its linear-model decomposition ($\boldsymbol{\beta}^{\mathsf{T}}\mathbf{x}_{l,t,j}$), thus arriving at our familiar equation of a line with an area offset.

$$\log(\mathbb{E}[y]_{l,t,j}) = \boldsymbol{\beta}^{\mathsf{T}}\mathbf{x}_{l,t,j} + \log(A_{l,t,j})$$

This means we can use a Negative Binomial distribution to model counts *y* and perform linear regression to estimate parameters β, as well as estimate other interesting quantities, such as the koala densities for each year, location and season. Estimating the densities per year satisfies Objective #1, while a trend parameter in $\boldsymbol{\beta}$ helps satisfy Objective #2.

4.2 Parameters, Priors and MCMC

The regression parameters β and the covariates in the model-matrix *X* include different features like: year, daytime *vs.* night-time effect, radial- *vs.* line-transects, and a seasonal effect. According to the Bayesian estimation paradigm, each of these parameters requires a prior distribution.

The priors used in this analysis were the same as used in the Year 1, 2 and 3 reports. The motivation and description of the priors can be found in the Year 1 report; the values are reported here without extensive expository detail.

Priors. The prior distribution on the trend parameters were set to $\pi(\beta_{t,l}) = \mathcal{N}(0, 0.05^2)$. The prior on the (log) baseline density at Bagotville was given a Gaussian distribution $\pi(\beta_0) = \mathcal{N}(\log(0.091), 0.41^2)$. The prior on the marginal difference between the Broadwater log-density *vs.* Bagotville was $\pi(\beta_l) = \mathcal{N}(0, 0.54^2)$. The prior on the marginal affect of the radial- *vs.* line-transects was $\pi(\beta_r) = \mathcal{N}(0, 0.54^2)$. The marginal effects of night-time *vs.* day-time, and autumn *vs.* spring, had the same prior mean and variance. Finally, for the Negative Binomial over dispersion parameter θ, a Gamma prior was used with a prior mean of 5. The strength of this prior was determined according to a model-selection exercise (see next section) where the shape and rate parameters of the Gamma distribution were: {(5,1), (10,2), (20,4), (40,8),(500,100)}, thereby allowing the models to vary between a near-Poisson distribution, or an overdispersed Negative-Binomial distribution.

MCMC. Given the data and the priors, the regression coefficients β could be estimated according to Monte Carlo Markov Chain (MCMC) algorithm, in particular, using the statistical package JAGS (Plummer 2007, 2014)

in R (R Core Team 2016). Each model used 80000 MCMC samples plus a 5000 sample burn-in period. Posteriors were inspected for adequate mixing and convergence.

4.3 Multi-Model Inference

In the regression analyses, there were a high number of plausible explanatory covariates which could influence population density (time, location, time-of-day, season, etc.), but only a small amount of survey data. In such situations, it is common in ecological studies to employ "multi-model inference" (Johnson and Omland 2004). This technique was used in previous reports, and the technique is summarised here.

Briefly, the core idea is that one never knows which subset of covariates are "best" *a priori*, and so a prediction-based criteria, such as the corrected Akaike Information Criteria (AIC/AICc; Akaike 1974, 1998, Hurvich and Tsai 1989) or the Watanabe-Akaike Information Criteria (WAIC; Watanabe 2010)(Watanabe 2010)(Watanabe 2010), are useful to weight models and combine their estimates according to each models' predictive performance. Specifically for the Bayesian models, the model-averaging uses model-weights based on the WAIC criterion (Watanabe 2010, Link and Sauer 2015):

$$p(m|\mathbf{y}) \approx \frac{e^{-0.5\mathrm{WAIC}^{(m)}}}{\sum_m^M e^{-0.5\mathrm{WAIC}^{(m)}}}$$

where *m* indexes a particular model with its own unique specification of covariates β_m.

Model-averaging is important because some models are bad at prediction because they are *overfitting* the data (they have too many covariates with too little data) and some models are *underfitting* the data (they omit an important covariate). Using a predictive criteria like the WAIC or AICc helps find the best combination of parameters which yield the highest predictive accuracy, while minimising the influence of spurious covariates.

There were 280 possible models, which included various combinations of the following:

1. a night-time *vs.* day-time effect, or not;
2. a radial vs. line-transect effect, or not;
3. a season-effect, or not;
4. a log-linear trend *vs.* no trend *vs.* each year has its own density; and
5. 5 different amounts of over dispersion (excess count-variation).

As mentioned in Section 3.1, there was a slight modification the analyses regarding the specification of (4) "each year has its own density": in prior years, this meant that each years' density was independently estimated, but there was no explicit trend. The growing availability of data and number of years allows us to incorporate both a trend-component and an inter-annual variability component, and estimate them jointly i.e., the years' densities vary around a main trend.

Previously, with fewer years and fewer data-points, this type of model would be over-determined and unestimable. It is preferable to use this model going-forward because it better reflects reality.

4.4 Hypothesis Testing

Objectives #2 and #3 pertained to evaluating hypotheses, such as: whether there was a trend, and whether there was a night-time *vs.* day-time effect.

As was developed in previous reports, these hypothesis-type objectives were addressed through a Bayesian quantitative technique called posterior odds-ratios (also known as Bayes Factors; Jeffreys 1961, Kass and Raftery 1995).

The odds ratios are calculated by taking the ratio of two quantities, which, respectively, represent the strength of support for a hypothesis H_1 *vs.* its complimentary alternative hypotheses H_0 (i.e., a "null-hypothesis" of no effect). In this report, we used the sum of WAIC model probabilities for those models that supported the H_1 (the numerator of the odds-ratio), *vs.* those models that constituted the null hypothesis (the denominator of the odds-ratio). For example, the odds-ratio in favour of a trend would be:

$$BF_{\text{trend}>\text{no trend}} \approx \frac{\sum_{k \in \mathcal{M}_{\text{trend}}} \text{WAIC}_k}{\sum_{k \in \mathcal{M}_{\text{no trend}}} \text{WAIC}_k}$$

where $\mathcal{M}_{\text{trend}}$ represents the set of models that included a trend, and $\mathcal{M}_{\text{no trend}}$ represents models without a trend (which thereby act as a composite null hypothesis). The *BF* ratio must be substantially greater than 1 to provide evidence in favour of a trend. A *BF* of ~1 suggests that there is no meaningful difference between the H_1 and its compliment. A *BF* << 1, suggests strong refutation of the existence of a trend.

Similarly, another analysis used Bayesian odds-ratios to evaluate the evidence in favour of *no* night-time effect *vs.* evidence of a difference between night-time and day-time surveys.

As was done in previous reports, the strength of the odds-ratios were evaluated against established quantitative cut-offs (Jeffreys 1961, Kass and Raftery 1995). For instance, a ratio above 10:1 is considered "strong" evidence in favour of a trend; a ratio above 3.2:1 is "substantial" evidence; and a ratio between 3.1:1 to 1:1 is considered "barely worth a mention".

4.5 Prospective Power Analysis

The power analysis used the same Monte Carlo simulation method as in the Year 1 report. The goal of the power analyses was to estimate the rate of Type-II errors (falsely rejecting the hypothesis of a trend, $H_a: \beta_t \neq 0$) while simultaneously detecting a 30% decline from baseline levels at Broadwater and Bagotville, between years 2015 to 2031. The error rates were conditional on:

1. a negative trend of -30% from baseline levels until Year 15 of monitoring;
2. a cap on the rate of Type-I errors at $\alpha \leq 0.3$;
3. monitoring effort of 400 transects per year per location (Broadwater and Bagotville separately);
4. marginal effects for other independent covariates (such as day-time/night-time, spring/autumn, and line-transect/radial-search transects) empirically derived from the Bayesian estimation analysis (from Objective #1); and

5. baseline koala densities in 2015 derived from the Bayesian estimation analysis.

A key-point to note is item (4): notice how the Monte-Carlo procedure incorporates several sources of empirically-derived uncertainty. First, there is the uncertainty in the baseline densities at Bagotville and Broadwater, as quantified by the posterior distributions of Year 0 densities from the Bayesian estimation exercise (Objective #1). Secondly, there is the uncertainty in the magnitude of marginal effects (such as day-time/night-time, spring/autumn, and line-transect/radial-search). This uncertainty was incorporated by using the posterior distributions from the Bayesian estimation exercise. Finally, there is the *multi-model* uncertainty due to multiple plausible models for estimating statistical power. The latter point reflects the fact that a future analyst will want to improve their statistical accuracy by including or excluding certain covariates, and will likely perform model-selection by AIC (Akaike 1974, 1998).[1]

These three sources of uncertainty make the calculation of Type-II errors non-trivial. They are best estimated through Monte Carlo simulations. This Monte Carlo power analysis proceeded as follows:

1. set the annual percent decline to $-\delta$, and set parameters $\beta_t = \log(1-\delta),\ \beta_{t,bw} = 0$;
2. set the desired Type-I error rate to α;
3. for *i* in 1 to 4000 Monte Carlo iterations, do:
   I. get a sample of parameter values from the Bayesian posteriors (e.g., baseline densities, over dispersion, marginal effects of day-time/night-time, spring/autumn, and line-transect/radial-search) $\boldsymbol{\beta}_{\neg t}^{(i)} \sim \pi(\boldsymbol{\beta}_{\neg t}|\mathbf{y}),\ \theta^{(i)} \sim \pi(\theta|\mathbf{y})$, and combine these samples with the specified trend in (1) above: $\boldsymbol{\beta}^{(i)} = (\boldsymbol{\beta}_{\neg t}^{(i)}, \beta_t, \beta_{t,bw})^{\mathsf{T}}$;
   II. simulate count data ***y*** using the linear model in Eqn. 1 and parameters $\boldsymbol{\beta}^{(i)}$

$$y_{l,t,j}^{(i)} \sim \mathrm{NB}\left(e^{(\mathbf{x}_{l,t,j}\boldsymbol{\beta}^{(i)} + \log(p_d \cdot A_{l,t,j}))}, \theta^{(i)}\right);$$

   III. use the simulated data $\mathbf{y}^{(i)}$ to get maximum-likelihood estimates of the trend and standard error $(\hat{\beta}_t^{(i)}, \hat{\mathrm{se}}(\beta_t)^{(i)})$ for both Broadwater and Bagotville, including:
      i. option 1: use the Poisson *full-model* (model m_8 in Eqn. 2), or
      ii. option 2: use the best AIC Poisson model from models m_1 to m_8

      (this analysis proceeded with option 2, but I also ran option 1 for comparison purposes)
   IV. for each location *l* (Broadwater and Bagotville) compare the two-tailed Fisher p-value to α and calculate the score statistic *I*

1 Note: in the future, there will be a lot of data, which will make the difference between the AICc vs AIC unimportant. The AICc is a correct for small-sample sizes, and converges to the AIC with increasing data.

$$I_l^{(i)} = 2\left(1 - \text{PDF}_{\mathcal{N}}\left(\frac{|\hat{\beta}_t^{(i)}|}{\hat{\text{se}}(\beta_t)^{(i)}}\right)\right) \leq \alpha$$

Over all 4000 iterations, the estimated Type-II error rate (per *l* location Broadwater and Bagotville) was $\hat{b}_{l,\alpha,\beta_t} \approx \frac{1}{4000}\sum_{i=1}^{4000} I_l^{(i)}$ and the power is $1 - \hat{b}_{l,\alpha,\beta_t}$

4.6 Supplemental Analyses

The Year 2 report (Sandpiper Ecological 2019b) introduced several supplementary analyses that were continued in the Year 3 and Year 4 studies. These supplementary analyses were meant to investigate alternative methods of estimating trends and evaluating evidence for or against the presence of a trend. These supplements varied according to the hypothetical strength of prior information, and merely helped to contextualise the main results. The present report continued with only one such supplementary technique which used the AICc as a model-averaging criteria to get an alternative indicator of a trend that is more sensitive to changes.

4.6.1 Estimation According to AICc Model-Averaging

This analysis used frequentist Negative-Binomial GLMs and performed model-averaging by AICc weights (Akaike 1974, 1998, Schwarz 1978) to estimate the trends at Broadwater and Bagotville. As described in the Year 2 report, these models can be thought of as pseudo-Bayesian models whereby i) the priors-on-parameters have been weakened to zero-influence, and ii) priors-on-model-probabilities are adaptive (i.e., they become more conservative with less data, and more liberal with more data). In other words, the AICc "reacts" faster to new data compared to static Bayesian priors used in the main analyses.

The trade-off is that while the AICc may be more sensitive to developing trends, it may result in some overfitting and be alarmist, as compared to the Bayesian models with stronger priors. See the Year 2 report (Sandpiper Ecological 2019b) for more discussion on the difference between the Bayesian-WAIC models and the frequentist-AICc models.

4.6.2 Hypothesis Testing According to AICc-Evidence Ratios

In the same way that one can garner evidence for or against a hypothesis according to Bayesian posterior odds-ratios (see above), the sum-of-AICc weights can also be used to produce odds-ratios (Lukacs et al. 2007). The AICc-based odds-ratios are analogous to the WAIC-based Bayes Factors but are simply called "evidence" ratios, according to the "Evidentialist" approach (Taper and Ponciano 2016). The interpretation is largely the same as for the Bayesian approach: high ratios > 1 are evidence in favour of a trend *vs.* no trend (except that the AIC controls Type-I errors more consistently across sample sizes, Taper and Ponciano 2016). The sum-of-AICc ratios was used to assess the evidence in favour of a trend *vs.* no-trend, to supplement the Bayesian odd-ratios.

5 Results

5.1 Descriptive Statistics

The following are descriptive summaries about the observed counts and (unmodelled) densities of koalas at Broadwater and Bagotville. Both time-series seem to reveal a decrease in counts and densities at both locations compared to Year 3, but approximately the same values as was seen in Year 2.

Table 1: Empirical total counts aggregated per year and location

Location	Baseline	Year 1	Year 2	Year 3	Year 4
Broadwater	8	13	5	15	7
Bagotville	4	17	18	22	16

Table 2: Empirical densities (koalas/ha), pooled, per year and location

Location	Baseline	Year 1	Year 2	Year 3	Year 4
Broadwater	0.117	0.053	0.013	0.069	0.018
Bagotville	0.093	0.069	0.077	0.063	0.051

5.2 Results for Objective #1: Density Estimation

The following tables show the updated estimates for all years, segregated by location and season. Table 3 shows pooled estimates; Table 4 shows seasonal estimates. The estimates were calculated by model-averaging according to WAIC model probabilities.

Broadwater continues to show a decrease in densities (although the 95%CI are strongly overlapping), whereas Bagotville continues to show little-to-no trend.

Table 3: Bayesian estimates densities (koalas/ha), pooled, per year and location

Location	Baseline	Year 1	Year 2	Year 3	Year 4
Broadwater	0.060 (SE: 0.012; CI: 0.040-0.086)	0.054 (SE: 0.009; CI: 0.039-0.072)	0.051 (SE: 0.008; CI: 0.036-0.067)	0.049 (SE: 0.008; CI: 0.035-0.066)	0.046 (SE: 0.008; CI: 0.032-0.065)
Bagotville	0.081 (SE: 0.014; CI: 0.057-0.111)	0.080 (SE: 0.011; CI: 0.061-0.102)	0.080 (SE: 0.010; CI: 0.061-0.101)	0.081 (SE: 0.011; CI: 0.060-0.104)	0.080 (SE: 0.012; CI: 0.058-0.106)

Table 4: Bayesian estimates of densities (koalas/ha), per year and season

Location	Base-line	Year 1 Spring	Year 1 Autumn	Year 2 Spring	Year 2 Autumn	Year 3 Spring	Year 3 Autumn	Year 4 Spring	Year 4 Autumn
Broadwater	0.060 (SE: 0.012; CI: 0.040-0.086)	0.054 (SE: 0.009; CI: 0.038-0.073)	0.054 (SE: 0.009; CI: 0.038-0.073)	0.051 (SE: 0.008; CI: 0.036-0.068)	0.051 (SE: 0.008; CI: 0.036-0.068)	0.049 (SE: 0.008; CI: 0.034-0.067)	0.049 (SE: 0.008; CI: 0.034-0.067)	0.047 (SE: 0.009; CI: 0.031-0.066)	0.046 (SE: 0.009; CI: 0.031-0.065)
Bagotville	0.081 (SE: 0.014; CI: 0.057-0.111)	0.081 (SE: 0.011; CI: 0.060-0.105)	0.080 (SE: 0.011; CI: 0.060-0.103)	0.081 (SE: 0.011; CI: 0.060-0.104)	0.080 (SE: 0.011; CI: 0.060-0.102)	0.081 (SE: 0.012; CI: 0.059-0.105)	0.081 (SE: 0.011; CI: 0.059-0.104)	0.081 (SE: 0.013; CI: 0.058-0.108)	0.080 (SE: 0.013; CI: 0.057-0.107)

5.2.1 Supplementary Analysis: AICc-based model-averaged model estimates

Table 5 shows the supplementary density estimates using AICc-based model weights to produce model-averaged estimates. The method reveals a decrease in koala density in Year 4 compared to Year 3 and Year 2, at both locations.

Table 5: AICc-based estimates of densities, by year and location.

Location	Baseline	Year 1	Year 2	Year 3	Year 4
Broadwater	0.105 (SE: 0.053; CI: 0.055-0.259)	0.061 (SE: 0.015; CI: 0.033-0.093)	0.045 (SE: 0.017; CI: 0.010-0.066)	0.045 (SE: 0.020; CI: 0.027-0.101)	0.032 (SE: 0.012; CI: 0.016-0.062)
Bagotville	0.082 (SE: 0.040; CI: 0.033-0.183)	0.081 (SE: 0.018; CI: 0.048-0.121)	0.080 (SE: 0.017; CI: 0.049-0.116)	0.082 (SE: 0.020; CI: 0.056-0.135)	0.077 (SE: 0.019; CI: 0.042-0.115)

5.3 Objective #2: Emerging Trends

5.3.1 Trend Estimate

The estimated log-linear trend at Broadwater was -0.033/year (SE: 0.043; 95%CI -0.127-0.028), i.e. 3.3% decline per year, with a 0.756 posterior probability of decline. This is approximately double the decline that was estimated during the 2019/20 Year 3 report (which was -0.016 per year).

The estimated log-linear trend at Bagotville was -0.000/year (SE: 0.025; 95%CI -0.061-0.060), with a 0.488 posterior probability of a decline. This is nearly the same as the prior year's estimate of 0.001/year.

5.3.2 Trend Hypothesis-Testing

The trend at Broadwater had a posterior odds ratio (Bayes Factor) of 2.071 in favour of a trend *vs.* no-trend. This is slight evidence that there was a trend. This is nearly double the Bayes Factor that was estimated in the previous report (1.172), but is nonetheless considered 'barely worth mentioning' (Jeffreys 1961, Kass and Raftery 1995).

The trend at Bagotville had a posterior odds ratio (Bayes Factor) of 0.782, which is slightly lower than last year's estimate of 0.847. It is slight evidence *against* there being a trend. This ratio falls into the conventional descriptive bin 'barely worth mentioning'.

5.3.3 Supplementary Trend Analysis by AICc Model-Averaging

According to the frequentist AICc-based model-averaged estimates, the estimated log-linear trend at Broadwater was -0.218/year (SE 0.131), i.e., a 21.8%/year decline. Despite the extreme trend, it is less extreme than the trend produced during the Year 3 report, which was estimated to be -0.259/year (SE: 0.177). The variance was so high that the hypothesis testing statistics do not provide overwhelming evidence in favour of a trend: the AICc-based odds-ratio in favour of a trend at Broadwater was 2.563 which is 'barely worth mentioning' (but is more than double the evidence estimated from the Year 3 report, which was 0.966). The Fisher p-value against a trend was 0.094, which is much lower than the prior year's estimate of 0.145, and is moving in the direction of rejecting the "no trend" null-hypothesis.

The estimated AICc-based log-linear trend at Bagotville was -0.006/year (SE: 0.085), i.e., a 0.6% decline per year. For both the absolute magnitude of the trend and its uncertainty, both values were lower than the Year 3 estimates of 0.042/year (SE: 0.123). At Bagotville, the AICc-based odds-ratio in favour of a trend was 0.155, which is 'barely worth mentioning', and less than half the evidence from the Year 3 report (0.389). The Fisher p-value against the no-trend null-hypothesis was 0.945 (i.e., cannot reject the no-trend null-hypothesis).

5.4 Objective #3: Day-Time vs. Night-Time Effect

A posterior odds-ratio (Bayes Factor) was employed to determine whether night-time surveys yielded meaningfully different densities than day-time surveys. In this case, the favoured hypothesis of *no*-difference constitutes the numerator of the odds-ratio, and the alternative hypothesis of *yes*-difference constitutes the denominator. Therefore, odds-ratios values above 1 support the conjecture that there is *no* difference between night-time and day-time surveys, and values <1 support the conjecture that there *is* a night-time effect.

The posterior odds-ratio was 2.141, i.e., there was some slight evidence against the presence of a night-time effect. This estimate was approximately 60% higher than the Year 3 estimate of 1.369. This ratio is within the ratio-category which is conventionally described as "barely worth mentioning" (Kass and Raftery 1995).

5.5 Objective #4: Prospective Power Analysis

The results of the prospective power analysis are showing in figure 1.

For a maximum Type-I error rate of 0.3, the estimated power for Bagotville and Broadwater were 0.726 and 0.667 respectively. These are slight improvements upon the estimates from the previous year's report of 0.695 and 0.661 respectively.

For a maximum Type-I error rate of 0.35, the estimated power for Bagotsville and Broadwater were 0.764 and 0.700 respectively, both of which are as good or better than the estimates from the Year 3 report.

The Bayes' p-values for Bagotville and Broadwater were 0.945 and 0.919, which improved upon the Year 3 report estimates of 0.928 and 0.916 respectively. [2]To interpret these values, it means that if there was a 30% decline, a Bayesian analyst would be able to conclude that there was a trend with 94.5% certainty at Bagotville, and likewise 91.6% certainty at at Broadwater. In other words, there is more certainty about the Bagotville system than there is at the Broadwater system.

6 Discussion and Conclusions

This report presents a quantitative assessment of the Year 4 (2020/21) W2B Pacific Highway upgrade koala population monitoring program at Bagotville (section 10) and Broadwater (section 8/9).

Overall, there is increasing evidence of a negative population trend at Broadwater and a stable population at Bagotville, even though the latter did have lower empirical counts and densities compared to Year 3.

Measures of power and statistical certainty remain low but are improving.

6.1 Trends and Densities

At Bagotville, the pooled Year 4 density was 0.080 koalas/ha (SE: 0.012; CI: 0.058-0.106), which shows no difference from the Year 3 density 0.081 (SE: 0.011; CI: 0.060-0.104). The per-year densities have lower overall standard-errors, suggesting improving certainty in the estimates. There is no evidence of a trend, which was estimated to be 0.000%/year and had a high frequentist p-value. Compared to the Year 3 report, there is increasing confidence that Bagotville has little to no trend.

Overall, at Broadwater, the estimated densities were lower and the downward trend was more pronounced. The estimate of the Year 4 density at Broadwater was 0.046 koalas/ha (SE: 0.008; CI: 0.032-0.065), which was lower than the preceding years. The estimated trend (-3.3%/a) was double the magnitude of the Year 3 analysis (-1.6%/year). However, given the uncertainty in the estimates, the Bayes Factors do not provide strong evidence of a decline.

A supplemental analysis using frequentist model-averaging and Fisher p-values likewise do not provide strong evidence against the no-trend hypothesis (p=0.094). However, the p-value is smaller than the Year 3 estimate of p=0.145. If the Broadwater population density in Year 5 is similar to or smaller than the Year 4 density, it could be that the future Year 5 p-value will reach the conventional cut-off of 0.05 (i.e., a 95% Type I error rate), at which point one will no longer be able to reject the null-hypothesis of "no trend".

6.2 Night-Time Effects

This report revisited the question about whether there was a meaningful difference between night-time vs. day-time surveys. In previous reports, the odd-ratio statistic provided slight evidence *against* a night-time effect (Year 2: 2.21; Year 3:1.369). Based on the updated data from Year 4, this statistic is close to its previous

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2 Frequentists are concerned about capping the Type-I error rate below some threshold, then maximizing the power (minimising the Type-II error rate), whereas Bayesian merely want the probability of a decline.

value at 2.141. In other words, there seems to be little concern that night-time surveys are providing materially different information compared to day-time surveys.

6.3 Prospective Power Analysis

The latest update to the prospective power analysis suggests that Bagotville has a statistical power that is above the 0.7 target at 0.726. Broadwater had an estimated power of 0.667 which is slightly higher than the Year 3 estimate of 0.661, but still below the 0.7 target.

The improvements in statistical power has not been as large as the improvements in other statistical measures, such as declining p-values or reductions in standard errors of density estimates. As mentioned previously, the statistical power is sensitive to the overall uncertainty in the entire system, because it incorporates empirical estimates of variance in the MCMC routine. It may be that more transects will have to be conducted in order to meaningfully improve the power at Broadwater.

6.4 Final Thoughts

Overall, there remains a high-level of statistical uncertainty across various measures, such as the standard errors of density estimates, the high p-values of trend estimates, the moderate power-levels for the prospective power analyses, and the low evidence ratios for Bayesian hypothesis tests.

These measures have improved since the Year 3 report with the addition of the Year 4 data. However, the additional data did not create a large boost in statistical certainty to detect what appears (according to the raw numbers) to be a large negative trend at Broadwater. More years of data-collection will alleviate this problem, but more within-season transects may be what is ultimately necessary to get stronger power and adequate statistical certainty.

Finally, one should keep in mind some of the findings of the Year 2 supplementary analyses (Sandpiper Ecological 2019b) which studied the degree of conservativeness vs sensitivity of the different trend-detection statistics (such as the frequentist p-values, the Bayes Factor, and AICc-evidence ratios). Those Year 2 supplementary studies concluded that the Bayes Factor was the most conservative, followed by the frequentist p-values, and the AICc-evidence ratio was the most sensitive. In keeping with those results, the AICc-evidence ratio method was the first (in Year 2) to declare a trend at Broadwater, and the frequentist p-values are getting close to declaring a trend, while the Bayes Factor method continues to find no evidence of a trend.

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Appendix B: Population survey koala detections

Table B1: Details of koala observations during year 4 population monitoring in the Broadwater focal area. Uk = unknown, pr = priobable

Site	Date	Day/ Night	Koalas	Koala Easting	Koala Nthing	Tran, Rad, Incidental	Tree sp.	DBH	Sex	Notes/Condition
Spring 2019										
S15	2/10/20	D	**1**	538945	6787789	Tran	Swamp mahogany	200	M	Clean bum, clear eyes, no tags
S30	1/10/20	D	**1**	538500	6788750	Tran	Broad-leaved paperbark	120	F	Clean bum, clear eyes, no tags
S32	30/9/20	D	1	540719	6788835	Tran	Blackbutt	26	M	Clear eyes, dry/stained bum. No ear tags
S32	20/10/20	N	1	540741	6788820	Tran	Swamp mahogany	18	F	dry/stained bum. No ear tags
S32	20/10/20	N	1	540731	6788816	Tran	Swamp mahogany	15	Mro	Prob recently independent young
s43a	21/10/20	N	1	538527	6790021	Incidental	Unknown	Uk	Uk	Individual not sighted
S31a	8/10/20	N	1	539438	6788932	Incidental	Swamp mahogany	~30	Uk	Sighted in distance
Autumn 2019										
S25	30/5/21	N	1	540215	6788428	Tran	Swamp mahogany	30	Fpr	Healthy, clean bum, pr sub adult
S38	10/5/21	D	1	540188	6789191	Tran	Scribbly gum	31	M	Clean bum, no tags
S08	31/5/21	N	1	538477	6786454	Incidental	Swamp mahogany	35	Uk	Uk
S26	1/6/21	N	1	541793	6788490	Incidental	Swamp mahogany	32	Uk	Healthy

Table B2: Details of koala observations during year 4 population monitoring in the Bagotville focal area. Yng = young, pr = probable, Uk = unknown

Site	Date	Day/ Night	Koalas	Koala Easting	Koala Nthing	Tran, Rad, Incidental	Tree sp.	DBH	Sex	Condition/Notes
Spring 2019										
N09	16/11/20	D	1	542749	6793508	Rad&Tran	Red mahogany	21	Uk	Clean bum
N19	1/12/20	N	1	540174	6796922	Tran	Red mahogany	25	Uk	Dry bum, clear eyes, no tags
N20	1/12/20	N	1	539273	6795942	Tran	Tallowwood	32	Fpr	Dirty bum, clear eyes, no tags
N36	16/11/20	D	1	542281	6796392	Tran	Swamp mahogany	38	Uk	Clean bum
N73	2/12/20	N	1	541126	6793875	Tran	Swamp mahogany	65	Uk	Clean bum
N74	8/10/20	D	1	540464	6793885	Tran	Ficus macrophylla	40	F	Clean bum & eyes. No tags
N74	2/12/20	N	1	540520	6793847	Tran	Swamp box	65	F	& Back yng . Python wrapped around mum
	2/12/20	N	1	540520	6793847	Tran	Swamp box	65	M	Clear eyes
N36a	18/11/20	N	1	542288	6796593	Incidental	Swamp mahogany	28	Uk	No tags
N33a	18/11/20	N	1	542174	6795557	Incidental	Swamp mahogany	42	Uk	No tags
N20a	1/12/20	N	1	539173	6796922	Incidental	Flood gum	25	Fpr	Dry bum, clear eyes, no tags
N11a	2/12/20	N	1	542648	6792950	Incidental	Sf grey gum	29	M	Clean bum & eyes. No tags
Autumn 2020										
N19	6/06/21	N	1	540150	6796876	Tran	Flooded gum	110	Uk	Healthy
N20	18/05/21	D	1	539237	6795914	Tran	Pink bloodwood	55	F	Dirty bum, cant tell if wet
N24	20/05/21	D	1	541774	6795006	Tran	Blackbutt	39	M	Healthy
N34	7/06/21	N	3	538273	6796515	Tran	Ironbark	28	F	Healthy
N34	7/06/21	N	3	538382	6796474	Tran	Forest red gum	25	F	Dirty,wet bum
N36	23/06/21	N	2	542231	6796567	Tran	Swamp mahogany	24	F + yng	Dirty bum not wet
N36	23/06/21	N	2	538285	6796512	Tran	Tallowwood	46	Mpr	Clean bum and eyes
N34	7/06/21	N	3	538401	6796499	Incidental	Forest red gum	50	Uk	Unknown health
N24	24/06/21	N	1	541791	6794962	Incidental	Blackbutt	45	Uk	
N33	20/05/21	D	1	542185	6795460	Incidental	Tallowwood	55	Uk	Clean bum
N34	18/05/21	D	2	538401	6796499	Incidental	Forest red gum	50	M	Dirty bum, not wet

Appendix C: Culvert camera detections

Table C1: Details of camera detections at 14 koala underpasses on W2B sections 1, 2, and 10 (Wardell Road) during year 4 monitoring. FF = fauna furniture. W = Wardell Road underpasses.

Site No.	Cam position	Date	Time	Species	Accuracy	Crossing type	Movement direction	Image No's	Comments
1	Floor	17/09/2020	1823	Rattus spp	D	C	E	2	
1	Floor	17/09/2020	1951	Bandicoot spp	D	C	E	3	
1	Floor	18/09/2020	0216	Long-nosed bandicoot	Pr	C	E	5	
1	Floor	20/09/2020	0237	Rattus spp	D	C	E	7	
1	Floor	20/09/2020	1923	Rattus spp	D	C	E	9	
1	Floor	21/09/2020	1946	Rattus spp	D	C	E	11	
1	Floor	22/09/2020	0210	Bandicoot spp	D	C	E	13	
1	Floor	22/09/2020	2158	Black rat	D	C	E	15	
1	Floor	24/09/2020	0210	Bandicoot spp	D	C	E	16	
1	Floor	24/09/2020	1812	Rattus spp	D	C	E	17	
1	Floor	25/09/2020	1803	Rattus spp	D	C	E	21	
1	Floor	25/09/2020	2352	Black rat	Pr	C	E	22-23	
1	Floor	26/09/2020	0438	Rattus spp	D	C	W	24	
1	Floor	26/09/2020	1945	Black rat	Pr	C	E	25	
1	Floor	27/09/2020	1835	Rattus spp	D	C	W	28	
1	Floor	28/09/2020	0135	Red-necked wallaby	Pr	C	W	30	
1	Floor	29/09/2020	2130	Black rat	Pr	C	E	32	
1	Floor	30/09/2020	0204	Red-necked wallaby	Pr	C	EWE	33-35	
1	Floor	30/09/2020	1957	Bandicoot spp	D	C	E	36	
1	Floor	30/09/2020	2125	Red-necked wallaby	Pr	C	W	37	
1	Floor	1/10/2020	0116	Wallaby spp	D	C	E	38	
1	Floor	1/10/2020	1822	Rattus spp	D	C	E	39	
1	Floor	1/10/2020	1856	Northern brown bandicoot	Pr	C	W	40	
1	Floor	2/10/2020	1936	Bandicoot spp	D	C	E	42	
1	Floor	2/10/2020	2035	Black rat	D	C	EW	43-46	
1	Floor	3/10/2020	2022	Black rat	Pr	C	E	47	
1	Floor	3/10/2020	2044	Black rat	Pr	C	W	48	
1	Floor	3/10/2020	2048	Wallaby spp	D	C	E	49	
1	Floor	4/10/2020	0105	EG kangaroo	Pr	C	W	50	With joey in pouch
1	Floor	4/10/2020	0309	EG kangaroo	Pr	C	W	51-52	
1	Floor	4/10/2020	1928	Black rat	Pr	C	W	54	
1	Floor	4/10/2020	1947	Bandicoot spp	D	C	W	55	
1	Floor	5/10/2020	0548	Black rat	Pr	C	E	56	
1	Floor	5/10/2020	1903	Rattus spp	D	C	E	57	
1	Floor	5/10/2020	2009	Rattus spp	D	C	W	58	
1	Floor	5/10/2020	2318	Black rat	D	I	EW	60-61	
1	Floor	6/10/2020	0118	Black rat	D	C	E	63-64	
1	Floor	6/10/2020	0156	Rattus spp	D	C	E	66	
1	Floor	6/10/2020	0238	Black rat	Pr	C	W	67	
1	Floor	6/10/2020	2048	Bandicoot spp	D	C	E	70	
1	Floor	7/10/2020	0226	Black rat	D	C	E	72-75	
1	Floor	7/10/2020	1934	Black rat	Pr	C	E	77	
1	Floor	7/10/2020	2341	Black rat	D	C	W	78	
1	Floor	8/10/2020	0321	Black rat	D	C	W	80-82	
1	Floor	8/10/2020	2050	Black rat	D	C	W	83	
1	Floor	8/10/2020	2122	Black rat	D	C	E	84-85	x 2 ind.
1	Floor	8/10/2020	2230	Black rat	Pr	C	E	87	
1	Floor	8/10/2020	2324	Black rat	D	I	WE	88-91	
1	Floor	9/10/2020	1943	Black rat	D	C	E	93	
1	Floor	9/10/2020	2121	Black rat	D	C	W	96	
1	Floor	10/10/2020	1819	Black rat	D	C	W	97	

Site No.	Cam position	Date	Time	Species	Accuracy	Crossing type	Movement direction	Image No's	Comments
1	Floor	10/10/2020	2055	Bandicoot spp	D	C	E	98	
1	Floor	11/10/2020	2030	Bandicoot spp	D	C	E	101	
1	Floor	11/10/2020	2103	Black rat	D	C	W	102	
1	Floor	12/10/2020	0114	Black rat	D	C	E	103-108	
1	Floor	12/10/2020	0146	Black rat	D	C	E	109	
1	Floor	12/10/2020	1927	Bandicoot spp	D	C	E	111	
1	Floor	12/10/2020	1943	Black rat	D	C	W	112	
1	Floor	12/10/2020	2035	Black rat	D	C	E	113-115	
1	Floor	12/10/2020	2112	Black rat	D	C	E	116	
1	Floor	12/10/2020	2159	Black rat	D	C	W	117	
1	Floor	13/10/2020	1818	Rattus spp	D	C	E	118	
1	Floor	14/10/2020	0434	Bandicoot spp	D	C	E	120	
1	Floor	14/10/2020	1906	Bandicoot spp	Pr	C	E	122	
1	Floor	14/10/2020	1914	Rattus spp	D	C	E	123	
1	Floor	14/10/2020	2007	Northern brown bandicoot	D	C	W	124	
1	Floor	14/10/2020	2108	Rattus spp	D	C	E	125	
1	Floor	14/10/2020	2153	Black rat	Pr	I	WE	126-127	
1	Floor			Microbat spp	present				
1	Floor	17/10/2020	2025	Bush rat	Pr	C	E	2	
1	Floor	23/10/2020	1925	Large macropod spp	D	C	W	3	
1	Floor	24/10/2020	0137	Bandicoot spp	D	C	E	5	
1	Floor	24/10/2020	0408	Long-nosed bandicoot	D	C	W	6	
1	Floor	29/10/2020	2253	EG kangaroo	Pr	C	W	10	
1	Floor	3/11/2020	0100	EG kangaroo	Pr	C	W	16	
1	Floor	3/11/2020	2230	Wallaby spp	D	C	E	18	
1	Floor	4/11/2020	2147	Fox	D	C	E	19	
1	Floor	5/11/2020	0230	Black rat	Pr	C	W	20	
1	Floor	6/11/2020	1914	Bandicoot spp	D	C	E	21	
1	Floor	6/11/2020	2148	Fox	D	C	E	23	
1	Floor	11/11/2020	2029	Fox	D	C	E	24	
1	Floor	13/11/2020	2301	Northern brown bandicoot	Pr	C	E	25	
1	Floor	14/11/2020	2008	Rattus spp	D	C	E	26	
1	Floor	18/11/2020	2007	Fox	D	C	W	27	
1	Floor	21/11/2020	0134	Fox	D	C	W	28	
1	Floor	24/11/2020	0435	EG kangaroo	Pr	C	W	29	
1	Floor	26/11/2020	2304	Fox	D	C	E	13	
1	Floor	27/11/2020	0312	Bandicoot spp	D	C	W	14	
1	Floor	28/11/2020	0043	Swamp wallany	Pr	C	W	17	
1	Floor	28/11/2020	0424	Cat	D	C	W	19-22	Black
1	Floor	28/11/2020	1854	Cat	D	C	W	23	Black
1	Floor	29/11/2020	0214	Large macropod spp	D	C	W	25	
1	Floor	30/11/2020	605	EG kangaroo	D	C	E	26	2 x ind. Mother and joey
1	Floor	1/12/2020	2344	Cat	D	C	W	29	Black
1	Floor	2/12/2020	0459	EG kangaroo	D	C	E	30	2 x ind. Mother and joey
1	Floor	3/12/2020	1930	Black rat	D	C	W	31	
1	Floor	3/12/2020	2109	Black rat	D	C	E	32	
1	Floor	3/12/2020	2129	Long-nosed bandicoot	Pr	C	W	33	
1	Floor	4/12/2020	0315	Rodent spp	D	C	E	34	
1	Floor	4/12/2020	1936	Black rat	D	C	W	35	
1	Floor	5/12/2020	0145	Fox	D	C	W	37-39	
1	Floor	5/12/2020	0349	Rodent spp	D	C	E	40	
1	Floor	5/12/2020	0402	Rodent spp	D	C	E	41	
1	Floor	5/12/2020	1925	Black rat	D	C	W	42	
1	Floor	5/12/2020	2001	Bandicoot spp	Pr	C	E	44	
1	Floor	6/12/2020	0340	Rattus spp	D	C	E	45	
1	Floor	7/12/2020	0208	Bandicoot spp	D	C	E	46	

Site No.	Cam position	Date	Time	Species	Accuracy	Crossing type	Movement direction	Image No's	Comments
1	Floor	7/12/2020	0501	EG kangaroo	D	C	E	47	2 x ind. Mother and joey
1	Floor	8/12/2020	2303	Fox	D	C	E	51	
1	Floor	9/12/2020	0138	Large macropod	D	C	E	52	
1	Floor	9/12/2020	0325	Rodent spp	D	C	E	54	
1	Floor	9/12/2020	1937	Rattus spp	D	C	W	55	
1	Floor	10/12/2020	0006	Rattus spp	D	C	E	56	
1	Floor	10/12/2020	0314	Rattus spp	D	C	E	57	
1	Floor	10/12/2020	0320	Black rat	Pr	C	E	58	
1	Floor	10/12/2020	1802	Large macropod	D	C	E	60	
1	Floor	10/12/2020	1946	Black rat	D	C	W	61	
1	Floor	10/12/2020	2124	Long-nosed bandicoot	D	C	W	62	
1	Floor	11/12/2020	1942	Rattus spp	D	C	W	64	
1	Floor	12/12/2020	1944	Rodent spp	D	C	E	65	
1	Floor	12/12/2020	2350	Black rat	Pr	I	EW	66-67	
1	Floor	13/12/2020	0032	Black rat	Pr	C	W	68	
1	Floor	13/12/2020	0106	Black rat	Pr	I	EW	69-70	
1	Floor	13/12/2020	0143	Black rat	Pr	C	E	71	
1	Floor	13/12/2020	0235	Rattus spp	D	C	E	74	
1	Floor	13/12/2020	0340	Black rat	Pr	C	E	75	
1	Floor	14/12/2020	0345	Black rat	Pr	C	E	76	
1	Floor	15/12/2020	0416	Rodent spp	Pr	C	E	77	
1	Floor	15/12/2020	2243	Bandicoot spp	D	C	E	78	
1	Floor	16/12/2020	2327	Fox	D	C	E	80	
1	Floor	17/12/2020	2048	Bandicoot spp	D	C	E	81	
1	Floor	17/12/2020	2304	Water rat	D	C	E	82-84	
1	Floor	18/12/2020	2004	Fox	D	C	W	88	
1	Floor	18/12/2020	2127	Bandicoot spp	Pr	I	EW	89-90	
1	Floor	18/12/2020	2226	Bandicoot spp	D	C	E	91	
1	Floor	19/12/2020	2341	Bandicoot spp	D	C	E	95	
1	Floor	20/12/2020	0112	Bandicoot spp	D	C	W	96	
1	Furniture	17/09/2020	2239	Black rat	D	C	E	1	
1	Furniture	18/09/2020	1950	Antechinus spp	D	I	EXM	2-6	
1	Furniture	18/09/2020	2011	Antechinus spp	D	C	E	7-9	
1	Furniture	19/09/2020	0311	BtPoss spp	D	C	E	10	
1	Furniture	19/09/2020	2011	Antechinus spp	D	C	W	11	
1	Furniture	22/09/2020	1903	Antechinus spp	D	C	W	12	
1	Furniture	23/09/2020	0205	Antechinus spp	D	C	E	13	
1	Furniture	23/09/2020	0229	Antechinus spp	D	C	E	16	
1	Furniture	23/09/2020	2332	Black rat	Pr	C	E	17	
1	Furniture	23/09/2020	2341	Black rat	D	C	W	17	
1	Furniture	24/09/2020	2056	CBtP	D	C	W	19	
1	Furniture	25/09/2020	0319	BtPoss spp	D	C	E	20	
1	Furniture	26/09/2020	2033	CBtP	D	C	W	21	
1	Furniture	27/09/2020	0245	CBtP	D	C	W	22	
1	Furniture	27/09/2020	2204	Black rat	Pr	C	E	23	
1	Furniture	27/09/2020	2235	Black rat	D	C	W	24	
1	Furniture	28/09/2020	0439	Antechinus spp	D	C	W	25	
1	Furniture	28/09/2020	2240	CBtP	D	C	W	26	
1	Furniture	29/09/2020	2055	CBtP	D	C	W	27	
1	Furniture	3/10/2020	0451	BtPoss spp	D	C	E	29	
1	Furniture	3/10/2020	1919	CBtP	D	C	W	30	
1	Furniture	4/10/2020	2100	Black rat	D	I	WE	31,33	
1	Furniture	5/10/2020	1955	Antechinus spp	D	C	W	34	
1	Furniture	5/10/2020	2123	Antechinus spp	D	C	E	35	
1	Furniture	5/10/2020	2159	Black rat	D	I	WE	36-38	
1	Furniture	7/10/2020	1816	Antechinus spp	D	I	NDM	39-40	
1	Furniture	9/10/2020	0258	Antechinus spp	D	I	WE	41-42	
1	Furniture	9/10/2020	328	Antechinus spp	D	C	E	43	

Site No.	Cam position	Date	Time	Species	Accuracy	Crossing type	Movement direction	Image No's	Comments
1	Furniture	9/10/2020	1952	CBtP	Pr	C	E	44	
1	Furniture	9/10/2020	2141	CBtP	D	C	W	45	
1	Furniture	9/10/2020	2252	SEBtP	D	I	EW	46-47	Joey on back
1	Furniture	12/10/2020	0429	Antechinus spp	D	C	E	48-53	
1	Furniture	14/10/2020	2132	Black rat	D	C	W	54	
1	Furniture	14/10/2020	2212	Black rat	D	C	E	55	
1	Furniture	15/10/2020	0429	Antechinus spp	D	C	E	57	
1	Furniture	16/10/2020	0213	Antechinus spp	D	C	W	58	
1	Furniture	16/10/2020	0330	Antechinus spp	D	C	E	59	
1	Furniture	16/10/2020	2016	Black rat	D	C	E	1	
1	Furniture	16/10/2020	2048	Black rat	D	C	W	2	
1	Furniture	17/10/2020	0024	Black rat	D	C	W	3	
1	Furniture	17/10/2020	0340	Antechinus spp	D	I	WE	4-5	
1	Furniture	17/10/2020	2037	Black rat	D	C	W	6	
1	Furniture	17/10/2020	2125	Antechinus spp	D	C	W	7	
1	Furniture	17/10/2020	2149	Antechinus spp	D	C	E	8-9	
1	Furniture	17/10/2020	2212	Antechinus spp	D	I	WE	10-11	
1	Furniture	18/10/2020	0302	Antechinus spp	D	C	W	12	
1	Furniture	18/10/2020	0322	Antechinus spp	D	C	E	13	
1	Furniture	19/10/2020	0342	Antechinus spp	D	C	E	16	
1	Furniture	19/10/2020	2013	Black rat	D	C	E	17-18	
1	Furniture	19/10/2020	2037	Black rat	D	C	W	19	
1	Furniture	19/10/2020	2219	Antechinus spp	D	I	WE	20-21	
1	Furniture	20/10/2020	1915	Black rat	Pr	C	E	22	
1	Furniture	21/10/2020	1901	Black rat	D	C	E	26-27	
1	Furniture	22/10/2020	2346	Antechinus spp	D	I	WE	28-29	
1	Furniture	23/10/2020	2132	Antechinus spp	D	C	WE	31-32	
1	Furniture	24/10/2020	0126	Black rat	D	I	EW	33-37	
1	Furniture	24/10/2020	0301	Antechinus spp	D	C	W	38	
1	Furniture	24/10/2020	0317	Antechinus spp	D	C	E	39-40	
1	Furniture	25/10/2020	0409	Antechinus spp	D	I	WE	41-42	
1	Furniture	26/10/2020	0239	CBtP	D	C	W	43	
1	Furniture	27/10/2020	0355	Antechinus spp	D	C	E	45	
1	Furniture	28/10/2020	2007	BtPoss spp	D	C	E	46	
1	Furniture	28/10/2020	2105	SEBtP	D	C	W	47	
1	Furniture	28/10/2020	2141	SEBtP	D	I	EW	48-49	
1	Furniture	30/10/2020	1943	Antechinus spp	D	C	W	50	
1	Furniture	30/10/2020	1956	Antechinus spp	D	C	E	51	
1	Furniture	31/10/2020	0254	Black rat	Pr	C	E	53	
1	Furniture	1/11/2020	2207	Antechinus spp	D	I	WE	54-55	
1	Furniture	4/11/2020	2106	Antechinus spp	D	C	W	56	
1	Furniture	4/11/2020	2123	Antechinus spp	D	C	E	57	
1	Furniture	5/11/2020	0335	Antechinus spp	D	I	WE	59-60	
1	Furniture	5/11/2020	2006	Antechinus spp	D	I	WE	63-64	
1	Furniture	6/11/2020	2258	Black rat	D	C	W	65	
1	Furniture	7/11/2020	0316	Antechinus spp	D	I	WE	66-7	
1	Furniture	10/11/2020	0338	Antechinus spp	D	I	WE	69-70	
1	Furniture	11/11/2020	2241	Black rat	D	C	W	71	
1	Furniture	15/11/2020	0314	Antechinus spp	D	I	WE	72-3	
1	Furniture	15/11/2020	1850	Antechinus spp	D	I	WE	74-5	
1	Furniture	17/11/2020	1912	Antechinus spp	D	C	E	76	
1	Furniture	18/11/2020	1910	Antechinus spp	D	C	E	77	
1	Furniture	19/11/2020	1849	Cat	D	C	W	78	
1	Furniture	26/11/2020	2053	Cat	D	C	W	3	
1	Furniture	26/11/2020	2130	Cat	D	C	E	4	
1	Furniture	8/12/2020	0217	Antechinus spp	D	C	E	8	
1	Furniture	9/12/2020	1914	Antechinus spp	D	C	W	9	
2	Floor	22/09/2020	2011	Rattus spp	D	C	E	1	

Site No.	Cam position	Date	Time	Species	Accuracy	Crossing type	Movement direction	Image No's	Comments
2	Floor	2/10/2020	1834	Echidna	D	C	E	31	
2	Floor	6/10/2020	0428	Echidna	D	C	W	33	
2	Floor	24/10/2020	0329	Fox	Pr	C	E	3	
2	Floor	1/11/2020	0054	Fox	D	C	W	6	
2	Floor	5/11/2020	0029	Fox	D	C	W	7	
2	Floor	7/11/2020	0203	Fox	D	C	W	9	
2	Floor	12/11/2020	2028	Fox	D	C	W	14	
2	Floor	13/11/2020	0149	Fox	D	C	E	15-16	
2	Floor	18/11/2020	1955	Fox	D	C	W	19	
2	Floor	20/11/2020	2251	Fox	D	C	W	21	
2	Floor	22/11/2020	0234	Fox	D	C	W	22	
2	Floor	22/11/2020	2031	Fox	D	C	W	23	
2	Floor	24/11/2020	2005	Fox	D	C	W	26	
2	Floor	27/11/2020	0002	Fox	D	C	W	1	
2	Floor	27/11/2020	0735	Lace monitor	D	C	E	2	
2	Floor	27/11/2020	1730	Lace monitor	D	I	WE	3-5	
2	Floor	28/11/2020	2148	Fox	D	C	W	6	
2	Furniture	17/09/2020	2250	antechinus spp	D	I	EW	1-2	
2	Furniture	20/09/2020	0050	antechinus spp	D	C	E	3	
2	Furniture	20/09/2020	0148	antechinus spp	D	C	E	5	
2	Furniture	20/09/2020	2147	antechinus spp	D	C	E	7	
2	Furniture	22/09/2020	0357	Black rat	D	I	WE	9-10	
2	Furniture	22/09/2020	0402	antechinus spp	D	C	W	11-16	
2	Furniture	23/09/2020	2320	antechinus spp	D	C	E	17	
2	Furniture	26/09/2020	0130	antechinus spp	D	C	E	20	
2	Furniture	26/09/2020	0307	antechinus spp	D	C	W	21	
2	Furniture	26/09/2020	0326	antechinus spp	D	C	W	22-24	
2	Furniture	10/10/2020	0349	antechinus spp	D	C	E	26	
2	Furniture	10/10/2020	0411	antechinus spp	D	C	W	27	
2	Furniture	12/10/2020	1951	antechinus spp	D	C	E	28	
2	Furniture	14/10/2020	0232	Black rat	D	C	E	31	
2	Furniture	20/10/2020	0203	CBtP	D	C	W	3	
2	Furniture	20/10/2020	1947	CBtP	Pr	C	E	5	
2	Furniture	20/10/2020	2028	CBtP	D	C	W	6	
2	Furniture	23/10/2020	0328	CBtP	D	C	W	8	
2	Furniture	23/10/2020	2150	BtPoss spp	D	C	E	9	
2	Furniture	24/10/2020	0209	CBtP	D	C	W	10	
2	Furniture	26/10/2020	2133	BtPoss spp	D	C	E	12	
2	Furniture	27/10/2020	0329	BtPoss spp	D	C	W	13	
2	Furniture	29/10/2020	2107	BtPoss spp	D	C	E	14	
2	Furniture	30/10/2020	2025	CBtP	D	C	E	15	
2	Furniture	31/10/2020	0408	CBtP	D	C	W	16	
2	Furniture	31/10/2020	2008	CBtP	Pr	C	E	17	
2	Furniture	1/11/2020	0404	CBtP	D	C	W	18	
2	Furniture	1/11/2020	2013	CBtP	Pr	C	E	19	
2	Furniture	2/11/2020	0349	CBtP	D	C	W	20	
2	Furniture	3/11/2020	1922	CBtP	Pr	C	E	21	
2	Furniture	4/11/2020	0346	CBtP	D	C	W	22	
2	Furniture	6/11/2020	1926	CBtP	Pr	C	E	24	
2	Furniture	7/11/2020	0316	CBtP	Pr	C	W	25	
2	Furniture	8/11/2020	1929	CBtP	Pr	C	E	26	
2	Furniture	11/11/2020	2015	CBtP	Pr	C	E	27	
2	Furniture	13/11/2020	0238	CBtP	D	C	W	28	
2	Furniture	13/11/2020	0334	CBtP	Pr	C	E	29	
2	Furniture	13/11/2020	2214	CBtP	D	C	W	30	
2	Furniture	14/11/2020	0405	CBtP	Pr	C	E	31	
2	Furniture	16/11/2020	2032	CBtP	D	C	W	32	
2	Furniture	16/11/2020	2153	CBtP	D	C	E	33	

Site No.	Cam position	Date	Time	Species	Accuracy	Crossing type	Movement direction	Image No's	Comments
2	Furniture	17/11/2020	2138	BtPoss spp	D	C	W	34	
2	Furniture	17/11/2020	2257	CBtP	Pr	C	E	35	
2	Furniture	19/11/2020	0322	CBtP	D	C	W	36	
2	Furniture	19/11/2020	0348	CBtP	Pr	C	E	37	
2	Furniture	22/11/2020	0216	antechinus spp	Pr	C	E	39	
2	Furniture	25/11/2020	0210	CBtP	D	C	W	41	
2	Furniture	25/11/2020	0333	CBtP	Pr	C	E	42	
2	Furniture	27/11/2020	0206	antechinus spp	D	C	E	1	
2	Furniture	27/11/2020	1909	antechinus spp	D	C	E	5	
2	Furniture	27/11/2020	2334	antechinus spp	D	C	EW	9,11	
2	Furniture	28/11/2020	0307	antechinus spp	D	C	E	13	
2	Furniture	28/11/2020	2123	antechinus spp	Pr	C	E	17	
2	Furniture	3/12/2020	2323	Black rat	D	I	EW	21-25	
2	Furniture	10/12/2020	2343	CBtP	D	C	W	27	
2	Furniture	11/12/2020	0245	BtPoss spp	D	C	E	30	
2	Furniture	13/12/2020	1943	antechinus spp	D	I	EW	31-34	
2	Furniture	19/12/2020	0052	antechinus spp	D	C	W	35-36	
3	Floor	19/09/2020	1930	Fox	Pr	C	E	1	
3	Floor	22/09/2020	0503	Fox	D	C	E	4	
3	Floor	22/09/2020	2004	Fox	D	C	W	5	
3	Floor	23/09/2020	2044	Fox	D	C	W	6	
3	Floor	24/09/2020	0514	Fox	D	C	E	7	
3	Floor	24/09/2020	1917	Fox	D	C	W	8	
3	Floor	25/09/2020	0510	Fox	D	C	E	9	
3	Floor	26/09/2020	0505	Fox	D	C	E	10	
3	Floor	27/09/2020	1913	Fox	D	C	W	12	
3	Floor	28/09/2020	0447	Fox	D	C	E	13	
3	Floor	29/09/2020	0406	Fox	D	C	E	14	
3	Floor	30/09/2020	0131	Echidna	D	C	E	16	
3	Floor	30/09/2020	0445	Fox	D	C	E	17	
3	Floor	1/10/2020	203	Fox	D	C	E	18	
3	Floor	1/10/2020	0228	Fox	D	C	W	19	
3	Floor	1/10/2020	0436	Fox	D	C	E	20	
3	Floor	1/10/2020	2001	Fox	D	C	W	21	
3	Floor	2/10/2020	0507	Fox	D	C	E	22	
3	Floor	3/10/2020	0255	Fox	D	C	E	23	
3	Floor	3/10/2020	2120	Rattus spp	D	C	E	24	
3	Floor	4/10/2020	0330	Rattus spp	D	C	E	25	
3	Floor	4/10/2020	1836	Echidna	D	C	E	26	
3	Floor	5/10/2020	0355	Echidna	D	C	E	28	
3	Floor	5/10/2020	1907	Fox	D	C	W	29	
3	Floor	6/10/2020	0411	Fox	D	C	E	30	
3	Floor	6/10/2020	1911	Echidna	D	C	E	33	
3	Floor	7/10/2020	0419	Fox	D	C	E	34	
3	Floor	7/10/2020	1945	Fox	D	C	W	35	
3	Floor	8/10/2020	1852	Black rat	D	C	E	36	
3	Floor	8/10/2020	1901	Fox	D	C	W	37	
3	Floor	9/10/2020	0427	Fox	D	C	E	38	
3	Floor	9/10/2020	1905	Fox	D	C	W	39	
3	Floor	10/10/2020	1843	Black rat	Pr	C	E	40	
3	Floor	10/10/2020	2107	Bush rat	Pr	C	E	41	
3	Floor	11/10/2020	2026	Fox	D	C	W	42	
3	Floor	12/10/2020	0341	Echidna	D	C	E	43	
3	Floor	13/10/2020	0443	Fox	D	C	E	44	
3	Floor	14/10/2020	0432	Fox	D	C	E	45	
3	Floor	14/10/2020	2118	Fox	D	C	W	46	
3	Floor	18/10/2020	2122	Echidna	D	I	EW	1-2	
3	Floor	18/10/2020	2237	Echidna	D	C	E	4	

Site No.	Cam position	Date	Time	Species	Accuracy	Crossing type	Movement direction	Image No's	Comments
3	Floor	19/10/2020	2016	Fox	D	C	W	5	
3	Floor	21/10/2020	2151	BtPoss spp	Pr	C	E	6	
3	Floor	22/10/2020	0328	Fox	D	C	E	7	
3	Floor	23/10/2020	0349	Fox	D	C	E	8	
3	Floor	25/10/2020	0334	Fox	D	C	E	9	
3	Floor	27/10/2020	2108	Echidna	D	C	E	10	
3	Floor	28/10/2020	2117	Rodent spp		I	NDM	11	
3	Floor	30/10/2020	1839	Echidna	D	C	E	12	
3	Floor	31/10/2020	1713	Lace monitor	D	C	W	13	
3	Floor	31/10/2020	2018	Fox	D	C	W	14	
3	Floor	2/11/2020	0120	Fox	D	C	E	15	
3	Floor	2/11/2020	1951	Fox	D	C	W	16	
3	Floor	2/11/2020	2107	Fox	D	C	E	17	w prey?
3	Floor	2/11/2020	2303	Fox	D	C	E	18	w prey?
3	Floor	2/11/2020	2314	Fox	D	C	W	19	
3	Floor	2/11/2020	2339	Fox	D	C	E	20	
3	Floor	3/11/2020	0037	Fox	D	C	E	21	
3	Floor	3/11/2020	2230	Fox	D	C	E	22	
3	Floor	3/11/2020	2345	Fox	D	C	W	23	
3	Floor	4/11/2020	0056	Fox	D	C	E	24	
3	Floor	4/11/2020	2115	Bandicoot spp	D	C	E	26	
3	Floor	4/11/2020	2209	Fox	D	C	E	27	
3	Floor	5/11/2020	0146	Fox	D	C	E	28	
3	Floor	5/11/2020	0329	Fox	D	C	E	29	
3	Floor	5/11/2020	2214	Fox	D	C	E	30	
3	Floor	6/11/2020	0014	Fox	D	C	E	31	something in mouth
3	Floor	6/11/2020	0240	Fox	D	C	E	32	something in mouth
3	Floor	7/11/2020	0103	Fox	D	C	E	33	
3	Floor	7/11/2020	2311	Fox	D	C	E	35	something in mouth
3	Floor	8/11/2020	0034	Fox	D	C	E	36	
3	Floor	8/11/2020	2341	Fox	D	C	E	37	
3	Floor	9/11/2020	0258	Fox	D	C	E	38	
3	Floor	9/11/2020	0402	Fox	D	C	E	39	
3	Floor	10/11/2020	0346	Fox	D	C	E	40	
3	Floor	10/11/2020	2114	Fox	D	C	E	41	
3	Floor	10/11/2020	2213	Fox	D	C	W	42	
3	Floor	10/11/2020	2325	Fox	D	C	E	43	
3	Floor	11/11/2020	0237	Fox	D	C	E	44	
3	Floor	11/11/2020	2024	Fox	D	C	W	45	
3	Floor	11/11/2020	2159	Fox	D	C	E	46	
3	Floor	12/11/2020	0121	Fox	D	C	E	47	
3	Floor	12/11/2020	0350	Fox	D	C	E	48	
3	Floor	13/11/2020	0040	Fox	D	C	E	49	
3	Floor	13/11/2020	0041	Fox	D	I	WE	50-51,53,55-66	Carrying road kill
3	Floor	13/11/2020	2040	Fox	D	C	W	67	
3	Floor	13/11/2020	2136	Fox	D	C	E	68	
3	Floor	13/11/2020	2313	Fox	D	C	E	69	
3	Floor	14/11/2020	0213	Fox	D	C	E	70	
3	Floor	14/11/2020	0237	Fox	D	I	WE	71-72	
3	Floor	14/11/2020	2019	Fox	D	C	W	67-8	
3	Floor	14/11/2020	2127	Long-nosed bandicoot	Pr	C	W	75	
3	Floor	14/11/2020	2157	Fox	D	C	E	76	
3	Floor	15/11/2020	0039	Bandicoot spp	D	C	W	77	
3	Floor	15/11/2020	0227	Fox	D	C	W	78	
3	Floor	15/11/2020	0412	Fox	D	C	E	79	
3	Floor	15/11/2020	1935	Fox	D	C	W	80	
3	Floor	15/11/2020	2217	Fox	D	C	E	81	

Site No.	Cam position	Date	Time	Species	Accuracy	Crossing type	Movement direction	Image No's	Comments
3	Floor	16/11/2020	0130	Fox	D	C	W	82	
3	Floor	16/11/2020	0326	Fox	D	C	E	85	
3	Floor	16/11/2020	2133	Fox	D	C	W	86	
3	Floor	17/11/2020	0016	Fox	D	C	E	87	
3	Floor	17/11/2020	0059	Fox	D	C	W	88	
3	Floor	17/11/2020	0154	Fox	D	C	E	89	
3	Floor	17/11/2020	0226	Fox	D	C	W	90	
3	Floor	17/11/2020	0350	Fox	D	C	E	91	
3	Floor	17/11/2020	2039	Fox	D	C	W	92	
3	Floor	17/11/2020	2153	Fox	D	C	E	93	
3	Floor	17/11/2020	2239	Fox	D	C	E	94	
3	Floor	18/11/2020	0057	Fox	D	C	E	95	
3	Floor	18/11/2020	0124	Fox	D	C	W	96	
3	Floor	18/11/2020	0154	Fox	D	C	E	97	
3	Floor	18/11/2020	0225	Fox	D	C	W	98	
3	Floor	18/11/2020	0307	Fox	D	C	E	99	
3	Floor	18/11/2020	2149	Fox	D	C	E	100	
3	Floor	19/11/2020	0100	Fox	D	C	E	101	
3	Floor	19/11/2020	0133	Fox	D	C	W	102	
3	Floor	19/11/2020	0230	Fox	D	C	E	103	
3	Floor	19/11/2020	0251	Fox	D	C	W	104	
3	Floor	19/11/2020	0411	Fox	D	C	E	105	
3	Floor	19/11/2020	1923	Fox	D	C	W	106	
3	Floor	19/11/2020	2024	Fox	D	C	E	107	
3	Floor	19/11/2020	2121	Fox	D	C	W	108	
3	Floor	19/11/2020	2359	Fox	D	C	E	109	
3	Floor	20/11/2020	0026	Fox	D	C	W	110	
3	Floor	20/11/2020	0134	Fox	D	C	E	111	
3	Floor	20/11/2020	0153	Fox	D	C	W	112	
3	Floor	20/11/2020	0349	Fox	D	C	E	113	
3	Floor	20/11/2020	2000	Fox	D	C	W	114	
3	Floor	20/11/2020	2055	Fox	D	C	E	115	
3	Floor	20/11/2020	2155	Fox	D	C	W	116	
3	Floor	20/11/2020	2323	Fox	D	C	E	117	
3	Floor	21/11/2020	0243	Fox	D	C	E	118	
3	Floor	21/11/2020	0357	Fox	D	C	E	119	
3	Floor	21/11/2020	0718	Lace monitor	D	C	E	120	
3	Floor	21/11/2020	2045	Fox	D	C	W	121	
3	Floor	21/11/2020	2211	Fox	D	C	E	122	
3	Floor	22/11/2020	0220	Fox	D	C	E	123	
3	Floor	22/11/2020	0400	Fox	D	C	E	124	
3	Floor	22/11/2020	2350	Fox	D	C	W	125	
3	Floor	23/11/2020	0224	Fox	D	C	E	126	
3	Floor	23/11/2020	0252	Fox	D	C	W	127	
3	Floor	23/11/2020	0348	Fox	D	C	E	128	
3	Floor	23/11/2020	2143	Fox	D	C	E	129	
3	Floor	24/11/2020	0238	Fox	D	C	E	130	
3	Floor	24/11/2020	0302	Fox	D	C	W	131	
3	Floor	24/11/2020	0354	Fox	D	C	E	132	
3	Floor	24/11/2020	1839	Cat	D	C	E	133-4	
3	Floor	24/11/2020	2104	Fox	D	C	E	135	
3	Floor	24/11/2020	2137	Fox	D	C	W	136	
3	Floor	24/11/2020	2157	Fox	D	C	W	137	
3	Floor	24/11/2020	2337	Fox	D	C	E	138	
3	Floor	25/11/2020	0322	Fox	D	C	W	139	
3	Floor	25/11/2020	0416	Fox	Pr	C	E	140	
3	Floor	25/11/2020	1936	Fox	D	C	W	1	
3	Floor	25/11/2020	2059	Echidna	D	I	NDM	2-3	

Site No.	Cam position	Date	Time	Species	Accuracy	Crossing type	Movement direction	Image No's	Comments
3	Floor	25/11/2020	2203	Fox	D	C	E	4	
3	Floor	25/11/2020	2341	Fox	D	C	E	8	2 x ind
3	Floor	26/11/2020	0217	Fox	D	C	E	9	
3	Floor	26/11/2020	0248	Fox	D	C	W	10	
3	Floor	26/11/2020	0342	Fox	D	C	E	11	
3	Floor	26/11/2020	2211	Fox	D	C	E	12	
3	Floor	27/11/2020	0051	Fox	D	C	E	13	stuff in mouth
3	Floor	27/11/2020	0205	Fox	D	C	W	14	
3	Floor	27/11/2020	2159	Fox	D	C	W	15	
3	Floor	28/11/2020	0050	Fox	D	C	E	16	
3	Floor	28/11/2020	0146	Bandicoot spp	Pr	C	W	17	
3	Floor	28/11/2020	0312	Fox	D	C	E	18	
3	Floor	28/11/2020	0746	Lace monitor	D	C	E	19	
3	Floor	28/11/2020	2329	Fox	D	C	E	20	
3	Floor	29/11/2020	0219	Fox	D	C	E	21	
3	Floor	29/11/2020	1944	Fox	D	C	W	22	
3	Floor	29/11/2020	2038	Fox	Pr	C	E	23	
3	Floor	29/11/2020	2140	Fox	D	C	E	24	
3	Floor	30/11/2020	0055	Fox	D	C	E	25	
3	Floor	30/11/2020	0316	Fox	D	C	E	26	
3	Floor	30/11/2020	1955	Fox	D	C	E	27	
3	Floor	30/11/2020	2159	Fox	D	C	W	28	
3	Floor	30/11/2020	2318	Fox	D	C	E	29	
3	Floor	30/11/2020	2337	Fox	D	C	W	30	
3	Floor	1/12/2020	0107	Fox	D	C	W	32	
3	Floor	1/12/2020	0138	Fox	D	C	W	33	
3	Floor	1/12/2020	0348	Fox	D	C	E	34	
3	Floor	1/12/2020	2122	Fox	D	C	W	35	
3	Floor	1/12/2020	2202	Fox	D	C	W	36	
3	Floor	1/12/2020	2249	Fox	D	C	E	37	
3	Floor	2/12/2020	0128	Echidna	D	C	W	38	
3	Floor	3/12/2020	0114	Fox	D	C	E	40	
3	Floor	3/12/2020	0127	Fox	D	C	W	41	
3	Floor	3/12/2020	0253	Fox	D	C	E	42	
3	Floor	3/12/2020	0315	Fox	D	C	E	43	
3	Floor	3/12/2020	0321	Fox	D	C	W	44	
3	Floor	3/12/2020	0423	Fox	D	C	E	45	
3	Floor	3/12/2020	2115	Fox	D	C	W	46	
3	Floor	4/12/2020	0048	Fox	D	C	E	48	
3	Floor	4/12/2020	0358	Fox	D	C	E	49	
3	Floor	4/12/2020	2027	Fox	D	C	E	50	
3	Floor	4/12/2020	2228	Fox	D	C	W	51	
3	Floor	4/12/2020	2339	Fox	D	C	E	52	
3	Floor	5/12/2020	2053	Fox	D	C	W	53	
3	Floor	6/12/2020	0403	Fox	D	C	E	54	
3	Floor	8/12/2020	0242	Fox	D	C	E	55	
3	Floor	9/12/2020	0114	Fox	D	C	W	56	
3	Floor	9/12/2020	0134	Fox	D	C	E	57	
3	Floor	9/12/2020	2303	Fox	D	C	E	58	
3	Floor	12/12/2020	1915	Fox	D	C	W	59	
3	Floor	14/12/2020	1951	Fox	D	C	W	60	
3	Floor	14/12/2020	2356	Fox	D	C	W	61	
3	Floor	16/12/2020	0014	Echidna	D	C	W	62	
3	Floor	16/12/2020	1939	Fox	D	C	W	63	
3	Floor	17/12/2020	0043	Northern brown bandicoot	D	C	E	64	
3	Floor	17/12/2020	1947	Fox	D	C	W	65	
3	Floor	18/12/2020	2057	Rattus spp	Pr	C	E	66	
3	Floor	19/12/2020	0023	Echidna	D	C	E	67	

Site No.	Cam position	Date	Time	Species	Accuracy	Crossing type	Movement direction	Image No's	Comments
3	Floor	20/12/2020	0135	SEBtP	Pr	C	W	68	
3	Floor	20/12/2020	2302	Fox	D	C	E	69	
3	Furniture	17/09/2020	2017	Antechinus spp	D	C	E	1	
3	Furniture	17/09/2020	2052	SEBtP	D	C	E	2-3	
3	Furniture	18/09/2020	2000	Antechinus spp	D	C	E	4	
3	Furniture	18/09/2020	2201	SEBtP	D	C	W	5	
3	Furniture	19/09/2020	0020	Antechinus spp	D	I	EW	6-7	
3	Furniture	20/09/2020	0049	Antechinus spp	D	C	E	8	
3	Furniture	20/09/2020	2208	Antechinus spp	D	C	W	10	
3	Furniture	20/09/2020	2303	Antechinus spp	D	C	E	11	
3	Furniture	21/09/2020	1849	SEBtP	D	C	E	13	
3	Furniture	22/09/2020	0119	SEBtP	D	C	W	14	
3	Furniture	22/09/2020	2059	SEBtP	D	C	E	15	
3	Furniture	22/09/2020	2209	SEBtP	D	C	W	16	
3	Furniture	23/09/2020	0446	Antechinus spp	D	C	E	18	
3	Furniture	24/09/2020	1800	Antechinus spp	D	C	E	22	
3	Furniture	24/09/2020	2225	Antechinus spp	D	C	E	23	
3	Furniture	25/09/2020	0335	SEBtP	D	C	W	25	
3	Furniture	25/09/2020	1917	SEBtP	D	C	E	26	
3	Furniture	26/09/2020	2037	SEBtP	Pr	C	E	27	
3	Furniture	26/09/2020	2240	SEBtP	D	C	W	30	
3	Furniture	27/09/2020	0427	Antechinus spp	D	C	E	31	
3	Furniture	29/09/2020	0246	SEBtP	D	C	W	33	
3	Furniture	29/09/2020	1850	SEBtP	Pr	C	E	34	
3	Furniture	29/09/2020	2230	SEBtP	Pr	C	E	35	
3	Furniture	1/10/2020	0443	Antechinus spp	D	C	E	36	
3	Furniture	1/10/2020	2200	SEBtP	D	C	E	38	
3	Furniture	2/10/2020	2347	SEBtP	D	C	E	40	
3	Furniture	4/10/2020	1934	Black rat	D	C	E	43	
3	Furniture	5/10/2020	0352	Antechinus spp	D	C	E	44	
3	Furniture	5/10/2020	2319	SEBtP	D	C	W	45	
3	Furniture	6/10/2020	2044	SEBtP	D	C	W	48	
3	Furniture	7/10/2020	1928	Antechinus spp	D	C	E	49	
3	Furniture	8/10/2020	0010	Black rat	D	C	E	50-51	
3	Furniture	8/10/2020	0113	Black rat	Pr	C	W	52	
3	Furniture	8/10/2020	2042	SEBtP	D	C	W	53	
3	Furniture	8/10/2020	2107	Black rat	D	C	E	54	
3	Furniture	8/10/2020	2149	Black rat	Pr	I	EXM	55	
3	Furniture	8/10/2020	2235	SEBtP	D	C	W	56	
3	Furniture	9/10/2020	0108	SEBtP	D	C	E	57	
3	Furniture	9/10/2020	2007	Black rat	D	C	E	58	
3	Furniture	9/10/2020	2055	Black rat	D	C	E	60	
3	Furniture	9/10/2020	2125	Black rat	D	C	W	61	
3	Furniture	9/10/2020	2337	SEBtP	Pr	C	E	63	
3	Furniture	10/10/2020	0452	Antechinus spp	D	C	E	64	
3	Furniture	11/10/2020	0039	Antechinus spp	D	C	W	66	
3	Furniture	11/10/2020	0133	SEBtP	D	C	E	67	
3	Furniture	11/10/2020	0429	Antechinus spp	D	C	E	68	
3	Furniture	11/10/2020	2100	SEBtP	D	C	E	70	
3	Furniture	12/10/2020	0411	Antechinus spp	D	C	E	72	
3	Furniture	13/10/2020	1931	Antechinus spp	D	C	E	73	
3	Furniture	13/10/2020	1938	Black rat	D	C	E	74	
3	Furniture	13/10/2020	1955	Black rat	Pr	C	W	75	
3	Furniture	13/10/2020	2034	SEBtP	D	C	W	76	
3	Furniture	13/10/2020	2124	Antechinus spp	D	C	E	77	
3	Furniture	14/10/2020	0337	Antechinus spp	D	C	E	79	
3	Furniture	14/10/2020	1912	SEBtP	D	C	W	80	joey on back
3	Furniture	14/10/2020	2102	Antechinus spp	D	C	W	81	

Site No.	Cam position	Date	Time	Species	Accuracy	Crossing type	Movement direction	Image No's	Comments
3	Furniture	14/10/2020	2213	SEBtP	D	C	W	83	
3	Furniture	14/10/2020	2257	SEBtP	D	C	W	84	
3	Furniture	15/10/2020	0316	Antechinus spp	D	C	E	85	
3	Furniture	15/10/2020	2120	Black rat	D	C	E	87	
3	Furniture	15/10/2020	2125	Black rat	D	C	W	88	
3	Furniture	15/10/2020	2329	SEBtP	D	C	E	89	
3	Furniture	16/10/2020	0131	Antechinus spp	D	C	E	90	
3	Furniture	16/10/2020	0345	Antechinus spp	D	C	E	92	
3	Furniture			Microbat	present			91	
3	Furniture	25/11/2020	2020	BtPoss spp	D	C	E	1	
3	Furniture	26/11/2020	0026	SEBtP	D	C	W	3	
3	Furniture	26/11/2020	0420	Antechinus spp	D	C	E	6	
3	Furniture	26/11/2020	2332	Antechinus spp	D	C	W	7	
3	Furniture	27/11/2020	0006	Antechinus spp	D	C	E	8	
3	Furniture	27/11/2020	0242	Antechinus spp	D	C	E	10	
3	Furniture	27/11/2020	0420	Antechinus spp	D	C	E	12	
3	Furniture	27/11/2020	2249	Antechinus spp	D	C	E	14	
3	Furniture	28/11/2020	0417	Antechinus spp	D	C	E	17	
3	Furniture	29/11/2020	0310	Antechinus spp	D	C	W	18	
3	Furniture	29/11/2020	0330	Antechinus spp	D	C	E	19	
3	Furniture	29/11/2020	2029	Antechinus spp	D	C	E	21	
3	Furniture	30/11/2020	0323	Antechinus spp	D	C	W	23	
3	Furniture	30/11/2020	0350	Antechinus spp	D	C	E	25	
3	Furniture	30/11/2020	2150	SEBtP	Pr	C	E	26	
3	Furniture	1/12/2020	2145	SEBtP	D	C	W	28	
3	Furniture	2/12/2020	0238	Antechinus spp	Pr	C	E	30	
3	Furniture	3/12/2020	2005	SEBtP	Pr	C	E	31	
3	Furniture	4/12/2020	2144	SEBtP	Pr	C	E	32	
3	Furniture	5/12/2020	0323	Antechinus spp	Pr	C	E	34	
3	Furniture	5/12/2020	2128	SEBtP x 2	D	C	W	35	2 x ind.
3	Furniture	8/12/2020	2024	SEBtP x 2	Pr	C	E	37	2 x ind.
3	Furniture	8/12/2020	2140	Antechinus spp	D	C	W	41	
3	Furniture	8/12/2020	2221	Antechinus spp	D	C	E	42	
3	Furniture	8/12/2020	2335	SEBtP	D	C	W	43	
3	Furniture	9/12/2020	0056	Antechinus spp	D	C	E	45	
3	Furniture	9/12/2020	2155	Antechinus spp	D	C	E	47	
3	Furniture	10/12/2020	313	Antechinus spp	D	C	E	49	
3	Furniture	13/12/2020	2008	BtPoss spp	Pr	C	E	51	
3	Furniture	14/10/2020	0210	SEBtP	D	C	W	52	
3	Furniture	15/12/2020	1949	SEBtP	Pr	C	E	54	
3	Furniture	16/12/2020	0002	SEBtP	D	C	W	55	
3	Furniture	16/12/2020	1948	SEBtP	Pr	C	E	58	
3	Furniture	16/12/2020	2032	SEBtP	Pr	C	E	59	
3	Furniture	16/12/2020	2133	SEBtP	Pr	C	E	60	
3	Furniture	16/12/2020	2221	SEBtP	Pr	C	W	61	
3	Furniture	17/12/2020	0057	SEBtP x 2	D	C	W	62-64	2 x ind.
3	Furniture	18/12/2020	0049	Antechinus spp	D	I	EW	66-67	
3	Furniture	18/12/2020	2152	SEBtP	Pr	C	E	68	
3	Furniture	19/12/2020	2010	SEBtP	Pr	C	E	69	
3	Furniture	19/12/2020	2035	SEBtP	Pr	C	E	70	
3	Furniture	20/12/2020	0056	SEBtP	D	C	W	71-73	
3	Furniture	20/12/2020	2137	SEBtP	Pr	C	E	74	
3	Furniture	21/12/2020	0059	SEBtP	D	C	W	75	
4	Floor	19/09/2020	0531	Small mammal	D	I	EXM	1	on camera
4	Floor	21/09/2020	0634	Wallaby spp	D	C	E	4	
4	Floor	22/09/2020	0516	Antechinus spp	D	C	E	5	
4	Floor	22/09/2020	0603	Red-necked wallaby	Pr	C	W	7	
4	Floor	23/09/2020	2308	Red-necked wallaby	Pr	C	W	8	

Site No.	Cam position	Date	Time	Species	Accuracy	Crossing type	Movement direction	Image No's	Comments
4	Floor	24/09/2020	0315	Swamp wallaby	Pr	C	W	10	
4	Floor	27/09/2020	0531	Wallaby spp	D	C	E	16	
4	Floor	28/09/2020	0453	Red necked wallaby	D	C	W	17	
4	Floor	29/09/2020	0521	Antechinus spp	Pr	I	EXM	18	
4	Floor	1/10/2020	0502	Antechinus spp	Pr	C	E	19	
4	Floor	4/10/2020	0641	Swamp wallaby	D	C	W	22	
4	Floor	4/10/2020	0759	Wallaby spp	D	C	E	23	
4	Floor	9/10/2020	0018	Antechinus spp	D	C	W	24	
4	Floor	9/10/2020	0348	Antechinus spp	Pr	C	E	25-6	
4	Floor	12/10/2020	0627	Wallaby spp	D	C	E	28	
4	Floor			microbat spp	present				
4	Furniture	19/09/2020	0513	Antechinus spp	D	C	E	2-3	
4	Furniture	19/09/2020	0536	Antechinus spp	D	C	E	5-6	
4	Furniture	19/09/2020	1802	Antechinus spp	Pr	C	E	8	
4	Furniture	19/09/2020	1814	Antechinus spp	D	C	E	10	
4	Furniture	22/09/2020	0425	Antechinus spp	D	C	W	14	
4	Furniture	22/09/2020	0457	Antechinus spp	D	C	E	15	
4	Furniture	22/09/2020	0624	Antechinus spp	Pr	C	E	17,19	
4	Furniture	26/09/2020	0428	Antechinus spp	Pr	C	E	21	
4	Furniture	29/09/2020	0501	Antechinus spp	D	C	E	24	
4	Furniture	29/09/2020	0513	Antechinus spp	D	C	E	26	
4	Furniture	1/10/2020	0214	Antechinus spp	D	C	E	29	
4	Furniture	1/10/2020	0505	Antechinus spp	D	C	E	31	
4	Furniture	1/10/2020	1858	Antechinus spp	D	C	W	33	
4	Furniture	2/10/2020	2017	Antechinus spp	D	C	E	35	
4	Furniture	5/10/2020	0353	Antechinus spp	D	C	W	36	
4	Furniture	5/10/2020	0409	Antechinus spp	D	C	E	37	
4	Furniture	5/10/2020	0436	Antechinus spp	D	C	E	38-39	
4	Furniture	6/10/2020	2157	Antechinus spp	D	C	E	40	
4	Furniture	7/10/2020	0412	Antechinus spp	D	I	WE	41-42	
4	Furniture	9/10/2020	0008	Antechinus spp	D	C	W	43	
4	Furniture	9/10/2020	0025	Antechinus spp	D	C	E	44	
4	Furniture	9/10/2020	0345	Antechinus spp	D	C	E	46	
4	Furniture	11/10/2020	1911	Antechinus spp	D	I	WE	49-50	
4	Furniture	12/10/2020	0339	Antechinus spp	D	C	W	53	
4	Furniture	12/10/2020	0412	Antechinus spp	D	C	E	54	
4	Furniture	14/10/2020	1825	Antechinus spp	D	I	WE	55-57	
4	Furniture	15/10/2020	0114	Antechinus spp	D	C	E	59-62	
4	Furniture	15/10/2020	0412	Antechinus spp	D	C	E	64	
4	Furniture	24/11/2020	1820	Antechinus spp	D	I	EW	7,11-14	
4	Furniture	24/11/2020	1953	Antechinus spp	D	C	EW	15-17	
4	Furniture	24/11/2020	2143	Antechinus spp	D	C	E	19-23	
4	Furniture	24/11/2020	2215	Antechinus spp	D	C	W	25	
4	Furniture	24/11/2020	2225	Antechinus spp	Pr	C	E	28	With back young
4	Furniture	24/11/2020	2236	Antechinus spp	Pr	C	E	31-32	With back young
4	Furniture	24/11/2020	2248	Antechinus spp	D	C	E	35-39	
4	Furniture	24/11/2020	2307	Antechinus spp	D	I	WE	41-45	
4	Furniture	24/11/2020	2341	Antechinus spp	D	I	WE	47-56	
4	Furniture	25/11/2020	0024	Antechinus spp	D	C	E	57-60	
4	Furniture	25/11/2020	0118	Antechinus spp	D	I	WE	61,63	
4	Furniture	25/11/2020	0250	Antechinus spp	D	C	E	67-68	
4	Furniture	25/11/2020	0342	Antechinus spp	D	I	WE	69-71	
4	Furniture	25/11/2020	0426	Antechinus spp	D	C	E	75	
4	Furniture	25/11/2020	1848	Antechinus spp	D	C	W	77-78	
4	Furniture	25/11/2020	1957	Antechinus spp	D	C	E	79	
4	Furniture	25/11/2020	2258	Antechinus spp	D	C	E	83	
4	Furniture	25/11/2020	2355	Antechinus spp	D	C	E	85-86	
4	Furniture	26/11/2020	0114	Antechinus spp	D	C	E	91	

Site No.	Cam position	Date	Time	Species	Accuracy	Crossing type	Movement direction	Image No's	Comments
4	Furniture	26/11/2020	0245	Antechinus spp	D	C	E	95	
4	Furniture	26/11/2020	0310	Antechinus spp	D	C	W	97	
4	Furniture	26/11/2020	0410	Antechinus spp	D	C	E	99	
4	Furniture	26/11/2020	759	Antechinus spp	D	C	W	100-101	With back young
4	Furniture	26/11/2020	1835	Antechinus spp	D	C	E	103-106	
4	Furniture	26/11/2020	2000	Antechinus spp	D	I	EW	111-113	
4	Furniture	26/11/2020	2135	Antechinus spp	D	I	EW	115-117	
4	Furniture	26/11/2020	2215	Antechinus spp	D	I	EW	119-121	
4	Furniture	26/11/2020	2241	Antechinus spp	D	I	EW	123-124	
4	Furniture	26/11/2020	2342	Antechinus spp	D	I	EW	125-127	
4	Furniture	27/11/2020	0010	Antechinus spp	D	C	E	131	
4	Furniture	27/11/2020	0029	Antechinus spp	D	I	EW	135-136	
4	Furniture	27/11/2020	0108	Antechinus spp	D	I	EW	137-139	
4	Furniture	27/11/2020	0124	Antechinus spp	D	I	EW	141-143	
4	Furniture	27/11/2020	0201	Antechinus spp	D	I	EW	145-149	
4	Furniture	27/11/2020	0339	Antechinus spp	D	I	EW	157-159	
4	Furniture	27/11/2020	0401	Antechinus spp	D	I	EW	161-163	
4	Furniture	27/11/2020	0423	Antechinus spp	D	I	EW	165-167	
4	Furniture	27/11/2020	0649	Antechinus spp	D	I	EW	169-171	
4	Furniture	27/11/2020	0740	Antechinus spp	D	I	EW	173-178	
4	Furniture	27/11/2020	1839	Antechinus spp	D	C	E	179	
4	Furniture	27/11/2020	2000	Antechinus spp	D	I	EW	183-185	
4	Furniture	27/11/2020	2104	Antechinus spp	D	I	EW	187-190	
4	Furniture	27/11/2020	2126	Antechinus spp	D	I	EW	191-194	
4	Furniture	27/11/2020	2249	Antechinus spp	D	I	EW	195-198	
4	Furniture	27/11/20	2319	Antechinus spp	D	I	EW	199-202	
4	Furniture	28/11/2020	0016	Antechinus spp	D	I	EW	203-205	
4	Furniture	28/11/2020	0030	Antechinus spp	D	C	E	206-207	
4	Furniture	28/11/2020	0129	Antechinus spp	D	I	EW	211-212	
4	Furniture	28/11/2020	0227	Antechinus spp	D	I	EW	213-220	
4	Furniture	28/11/2020	0305	Antechinus spp	D	C	E	221-222	
4	Furniture	28/11/2020	0322	Antechinus spp	D	C	W	223	
4	Furniture	28/11/2020	0412	Antechinus spp	D	I	EW	225-227	
4	Furniture	28/11/2020	0559	Antechinus spp	D	I	EW	229-237	
4	Furniture	28/11/2020	0627	Antechinus spp	D	I	EW	239-243	
4	Furniture	28/11/2020	0750	Antechinus spp	D	C	E	245-248	
4	Furniture	28/11/2020	1835	Antechinus spp	D	I	EW	249-251	
4	Furniture	28/11/2020	2004	Antechinus spp	D	I	EW	253-255	
4	Furniture	28/11/2020	2124	Antechinus spp	D	I	EW	257-259	
4	Furniture	28/11/2020	2204	Antechinus spp	D	I	EW	261-263	
4	Furniture	28/11/2020	2228	Antechinus spp	D	I	EW	265-268	
4	Furniture	28/11/2020	2316	Antechinus spp	D	I	EW	269-271	
4	Furniture	29/11/2020	0016	Antechinus spp	D	I	EW	273-275	
4	Furniture	29/11/2020	0124	Antechinus spp	D	I	EW	277-	
4	Furniture	29/11/2020	0159	Antechinus spp	D	I	EW	281-284	
4	Furniture	29/11/2020	0223	Antechinus spp	D	I	EW	285-291	
4	Furniture	29/11/2020	0350	Antechinus spp	D	I	EW	293-300	
4	Furniture	29/11/2020	0616	Antechinus spp	D	I	EW	301-311	
4	Furniture	29/11/2020	1845	Antechinus spp	D	I	EW	313-320	
4	Furniture	29/11/2020	2011	Antechinus spp	D	I	EW	321-323	
4	Furniture	29/11/2020	2117	Antechinus spp	D	I	EW	327-338	
4	Furniture	29/11/2020	2208	Antechinus spp	D	I	EW	339-345	
4	Furniture	29/11/2020	2302	Antechinus spp	D	I	EW	347-349	
4	Furniture	29/11/2020	2353	Antechinus spp	D	I	EW	351-353	
4	Furniture	30/11/2020	0033	Antechinus spp	D	I	EW	355-364	
4	Furniture	30/11/2020	0133	Antechinus spp	D	I	EW	365-372	
4	Furniture	30/11/2020	0214	Antechinus spp	D	I	EW	373-380	
4	Furniture	30/11/2020	0247	Antechinus spp	D	C	E	381	

Site No.	Cam position	Date	Time	Species	Accuracy	Crossing type	Movement direction	Image No's	Comments
4	Furniture	30/11/2020	0412	Antechinus spp	D	I	EW	385-391	
4	Furniture	30/11/2020	0552	Antechinus spp	D	I	EW	393-400	
4	Furniture	30/11/2020	1835	Antechinus spp	D	C	E	401	
4	Furniture	30/11/2020	2021	Antechinus spp	D	I	EW	405-407	
4	Furniture	30/11/2020	2102	Antechinus spp	D	I	EW	409-417	
4	Furniture	30/11/2020	2221	Antechinus spp	D	C	E	419-423	
4	Furniture	30/11/2020	2352	Antechinus spp	D	I	EW	427-428	
4	Furniture	1/12/2020	0044	Antechinus spp	D	I	EW	429-431	
4	Furniture	1/12/2020	0114	Antechinus spp	D	I	EW	433-439	
4	Furniture	1/12/2020	0150	Antechinus spp	D	C	E	441	
4	Furniture	1/12/2020	0311	Antechinus spp	D	C	E	445	
4	Furniture	1/12/2020	0328	Antechinus spp	D	I	EW	447-449	
4	Furniture	1/12/2020	0436	Antechinus spp	D	I	EW	451-453	
4	Furniture	1/12/2020	737	Antechinus spp	D	I	EW	455-457	
4	Furniture	1/12/2020	1843	Antechinus spp	D	I	EW	459-461	
4	Furniture	1/12/2020	2028	Antechinus spp	D	I	EW	463-465	
4	Furniture	1/12/2020	2116	Antechinus spp	D	I	EW	467-473	
4	Furniture	1/12/2020	2249	Antechinus spp	D	I	EW	475-476	
4	Furniture	1/12/2020	2356	Antechinus spp	D	I	EW	477-480	
4	Furniture	2/12/2020	0035	Antechinus spp	D	I	EW	481-484	
4	Furniture	2/12/2020	0056	Antechinus spp	D	I	EW	485-488	
4	Furniture	2/12/2020	0121	Antechinus spp	D	I	EW	489-491	
4	Furniture	2/12/2020	231	Antechinus spp	D	I	EW	493-494	
4	Furniture	2/12/2020	251	Antechinus spp	D	C	E	495	
4	Furniture	2/12/2020	0424	Antechinus spp	D	I	EW	499-502	
4	Furniture	2/12/2020	0548	Antechinus spp	D	C	E	503-508	
4	Furniture	2/12/2020	647	Antechinus spp	D	I	EW	511-514	
4	Furniture	2/12/2020	1943	Antechinus spp	D	I	EW	515-517	
4	Furniture	2/12/2020	2017	Antechinus spp	D	C	E	519	
4	Furniture	2/12/2020	2033	Antechinus spp	D	I	EW	523-5	
4	Furniture	2/12/2020	2130	Antechinus spp	D	I	EW	527-534	
4	Furniture	2/12/2020	2200	Antechinus spp	D	I	EW	535-538	
4	Furniture	2/12/2020	2303	Antechinus spp	D	I	EW	539-541	
4	Furniture	3/12/2020	0014	Antechinus spp	D	I	EW	543-550	
4	Furniture	3/12/2020	0110	Antechinus spp	D	C	E	551-555	
4	Furniture	3/12/2020	0136	Antechinus spp	D	I	EW	557-560	
4	Furniture	3/12/2020	0259	Antechinus spp	D	C	E	561	
4	Furniture	3/12/2020	0323	Antechinus spp	D	I	EW	563-566	
4	Furniture	3/12/2020	0443	Antechinus spp	D	C	E	567	
4	Furniture	3/12/2020	0519	Antechinus spp	D	C	W	569	
4	Furniture	3/12/2020	0612	Antechinus spp	D	C	E	574	
4	Furniture	3/12/2020	0739	Antechinus spp	D	I	EW	575-579	
4	Furniture	3/12/2020	1828	Antechinus spp	D	I	EW	581-588	
4	Furniture	3/12/2020	2027	Antechinus spp	D	I	EW	589-592	
4	Furniture	3/12/2020	2124	Antechinus spp	D	I	EW	593-600	
4	Furniture	3/12/2020	2221	Antechinus spp	D	I	EW	601-608	
4	Furniture	4/12/2020	0125	Antechinus spp	D	C	E	609-610	
4	Furniture	4/12/2020	0309	Antechinus spp	D	C	E	613	
4	Furniture	4/12/2020	0349	Antechinus spp	D	C	E	615	
4	Furniture	4/12/2020	0428	Antechinus spp	D	I	EW	619-621	
4	Furniture	4/12/2020	0559	Antechinus spp	D	I	EW	623-626	
4	Furniture	4/12/2020	0718	Antechinus spp	D	I	EW	627-630	
4	Furniture	4/12/2020	1715	Antechinus spp	D	I	EW	631-633	
4	Furniture	4/12/2020	1820	Antechinus spp	D	I	EW	635-637	
4	Furniture	4/12/2020	2019	Antechinus spp	D	I	EW	639-641	
4	Furniture	4/12/2020	2109	Antechinus spp	D	I	EW	643-649	
4	Furniture	4/12/2020	2151	Antechinus spp	D	I	EW	651-658	
4	Furniture	4/12/2020	2343	Antechinus spp	D	I	EW	659	

Site No.	Cam position	Date	Time	Species	Accuracy	Crossing type	Movement direction	Image No's	Comments
4	Furniture	5/12/2020	0040	Antechinus spp	D	I	EW	661-663	
4	Furniture	5/12/2020	0121	Antechinus spp	D	I	EW	665-667	
4	Furniture	5/12/2020	0429	Antechinus spp	D	I	EW	669-671	
4	Furniture	5/12/2020	0557	Antechinus spp	D	I	EW	673-675	
4	Furniture	5/12/2020	1833	Antechinus spp	D	I	EW	677-679	
4	Furniture	5/12/2020	2028	Antechinus spp	D	I	EW	681-683	
4	Furniture	5/12/2020	2114	Antechinus spp	D	I	EW	685-691	
4	Furniture	5/12/2020	2202	Antechinus spp	D	I	EW	693-703	
4	Furniture	5/12/2020	2232	Antechinus spp	D	I	EW	705-707	
4	Furniture	6/12/2020	0025	Antechinus spp	D	I	EW	709-711	
4	Furniture	6/12/2020	0123	Antechinus spp	D	C	E	713	
4	Furniture	6/12/2020	0152	Antechinus spp	D	C	E	717	
4	Furniture	6/12/2020	0420	Antechinus spp	D	I	EW	721-723	
4	Furniture	6/12/2020	0607	Antechinus spp	D	I	EW	725-730	
4	Furniture	6/12/2020	1839	Antechinus spp	D	C	E	731	
4	Furniture	6/12/2020	2056	Antechinus spp	D	I	EW	735-737	
4	Furniture	6/12/2020	2151	Antechinus spp	D	I	EW	739-741	
4	Furniture	6/12/2020	2239	Antechinus spp	D	I	EW	743-745	
4	Furniture	7/12/2020	0023	Antechinus spp	D	I	EW	747-749	
4	Furniture	7/12/2020	0052	Antechinus spp	D	I	EW	751-756	
4	Furniture	7/12/2020	0134	Antechinus spp	D	I	EW	757-759	
4	Furniture	7/12/2020	0442	Antechinus spp	D	C	E	761	
4	Furniture	7/12/2020	0624	Antechinus spp	D	C	E	763	
4	Furniture	7/12/2020	1849	Antechinus spp	D	C	E	767	
4	Furniture	7/12/2020	2050	Antechinus spp	D	I	EW	771-773	
4	Furniture	7/12/2020	2143	Antechinus spp	D	I	EW	775-777	
4	Furniture	7/12/2020	2229	Antechinus spp	D	I	EW	779-781	
4	Furniture	8/12/2020	0016	Antechinus spp	D	I	EW	783-784	
4	Furniture	8/12/2020	0049	Antechinus spp	D	I	EW	785-787	
4	Furniture	8/12/2020	0110	Antechinus spp	D	I	EW	789-791	
4	Furniture	8/12/2020	0441	Antechinus spp	D	I	EW	793-795	
4	Furniture	8/12/2020	723	Antechinus spp	D	I	EW	797	
4	Furniture	8/12/2020	1712	Antechinus spp	D	C	E	801	
4	Furniture	8/12/2020	1836	Antechinus spp	D	C	E	805-	
4	Furniture	8/12/2020	2053	Antechinus spp	D	I	EW	809-810	
4	Furniture	8/12/2020	2155	Antechinus spp	D	I	EW	811-839	
4	Furniture	8/12/2020	2342	Antechinus spp	D	C	E	841	
4	Furniture	9/12/2020	0114	Antechinus spp	D	C	E	845-847	
4	Furniture								
4	Furniture	9/12/20 0425- 21/12/20 0741		Antechinus spp					
4	Furniture			52 x Incomplete crossings					
4	Furniture			28 x complete east					
4	Furniture			17 x complete west					
5	Floor	18/09/2020	0348	Swamp rat	Po	C	E	3	
5	Floor	19/09/2020	2321	Swamp rat	Po	C	E	4	
5	Floor	20/09/2020	2139	Rodent spp	D	C	E	5	
5	Floor	21/09/2020	0016	Antechinus spp	Pr	C	W	6	
5	Floor	21/09/2020	0429	Antechinus spp	Pr	C	E	9	
5	Floor	27/09/2020	0518	Rodent spp	D	C	E	17	
5	Floor	5/10/2020	1718	Dog	D	C	E	30	
5	Floor	7/10/2020	1943	Bandicoot spp	D	C	E	31	
5	Floor	7/10/2020	2336	Bandicoot spp	D	C	E	33	
5	Floor	10/10/2020	1943	Bandicoot spp	D	C	E	34,36	Juvenile
5	Floor	10/10/2020	2204	SEBtP	D	C	E	38	
5	Floor	11/10/2020	0117	Bandicoot spp	D	C	E	39	
5	Floor	12/10/2020	2045	Bandicoot spp	D	C	E	42	

Site No.	Cam position	Date	Time	Species	Accuracy	Crossing type	Movement direction	Image No's	Comments
5	Floor	13/10/2020	2032	Bandicoot spp	D	C	E	44	
5	Floor	13/10/2020	2221	BtPoss spp	D	C	E	45	
5	Floor	14/10/2020	2045	Bandicoot spp	D	C	E	46	
5	Floor	15/10/2020	2133	Bandicoot spp	D	C	E	50	
5	Floor	17/10/2020	1957	Bandicoot spp	D	C	E	2	
5	Floor	17/10/2020	2319	Cat	D	C	E	4-7	
5	Floor	21/10/2020	2320	BtPoss spp	D	C	E	8	
5	Floor	21/10/2020	2349	SEBtP	Pr	C	E	9-11	
5	Floor	24/10/2020	0209	Bandicoot spp	D	C	E	12	
5	Floor	24/10/2020	1818	Wallaby spp	Pr	C	E	14	
5	Floor	26/10/2020	0324	SEBtP	D	C	W	15	
5	Floor	3/11/2020	2101	Bandicoot spp	D	C	E	16	
5	Floor	10/11/2020	2214	Bandicoot spp	D	C	W	18	
5	Floor	11/11/2020	1916	Wallaby spp	D	C	E	19	
5	Floor	16/11/2020	0044	Wallaby spp	D	C	E	21	
5	Floor	16/11/2020	2317	Bandicoot spp	D	C	E	22	
5	Floor	17/11/2020	0622	Dog	Pr	I	WE	24-25	
5	Floor	19/11/2020	1842	Wallaby spp	D	C	E	26	
5	Floor	20/11/2020	0031	Bandicoot spp	D	C	W	27	
5	Floor	20/11/2020	0134	Bandicoot spp	D	C	E	28	
5	Floor	5/12/2020	0657	Wallaby spp	D	C	E	1	
5	Floor	10/12/2020	1921	Bandicoot spp	D	C	E	2	
5	Floor	12/12/2020	2142	Bandicoot spp	D	C	E	3	
5	Floor	13/12/2020	2209	Bandicoot spp	D	C	E	5	
5	Floor	16/12/2020	0305	Bandicoot spp	D	C	E	6	
5	Floor	17/12/2020	0330	Bandicoot spp	D	C	E	7	
5	Floor	18/12/2020	0244	Bandicoot spp	D	C	E	8	
5	Floor	19/12/2020	2152	Bandicoot spp	D	C	E	10	
5	Floor	19/12/2020	2323	Long-nosed bandicoot	Pr	C	W	11	
5	Floor	20/12/2020	2047	Bandicoot spp	D	C	E	13	
5	Floor			microbat	present				
5	Furniture	25/09/2020	0401	Antechinus spp	D	C	W	3	
5	Furniture	26/09/2020	0117	Antechinus spp	D	C	W	5	
5	Furniture	26/09/2020	0139	Antechinus spp	D	C	E	6-Jul	
5	Furniture	3/10/2020	1913	Antechinus spp	D	C	E	17-18	
5	Furniture	5/10/2020	1948	Antechinus spp	D	C	E	20	
5	Furniture	7/10/2020	1954	Antechinus spp	D	C	E	22	
5	Furniture	14/10/2020	0134	SEBtP	D	C	W	25	
5	Furniture	16/10/2020	0034	Antechinus spp	D	C	E	28	
5	Furniture	18/10/2020	1851	Antechinus spp	D	C	E	3	
5	Furniture	19/10/2020	1853	Antechinus spp	D	C	E	5	
5	Furniture	20/10/2020	1904	Antechinus spp	D	C	E	8	
5	Furniture	21/10/2020	2322	SEBtP	D	I	WE	11-20	
5	Furniture	22/10/2020	0355	Antechinus spp	D	C	E	21	
5	Furniture	22/10/2020	1914	Antechinus spp	D	C	E	23	
5	Furniture	22/10/2020	2209	Antechinus spp	D	C	E	25	
5	Furniture	22/10/2020	2333	Antechinus spp	D	C	E	27	
5	Furniture	23/10/2020	1847	Antechinus spp	D	C	E	30	
5	Furniture	23/10/2020	2204	Antechinus spp	D	C	E	32	
5	Furniture	23/10/2020	2353	Antechinus spp	D	C	E	34	
5	Furniture	24/10/2020	0257	Antechinus spp	D	C	E	36	
5	Furniture	25/10/2020	0257	Antechinus spp	D	I	WE	37-8	
5	Furniture	25/10/2020	1902	Antechinus spp	D	C	E	42	
5	Furniture	25/10/2020	2125	Antechinus spp	D	C	E	44	
5	Furniture	26/10/2020	0112	SEBtP	D	C	E	45	
5	Furniture	26/10/2020	0157	Antechinus spp	D	C	E	47	
5	Furniture	26/10/2020	1934	Antechinus spp	D	C	E	49	
5	Furniture	29/10/2020	2149	SEBtP	Pr	C	E	50	

Site No.	Cam position	Date	Time	Species	Accuracy	Crossing type	Movement direction	Image No's	Comments
5	Furniture	31/10/2020	0034	Antechinus spp	D	C	E	52	
5	Furniture	31/10/2020	0317	SEBtP	D	C	W	53	
5	Furniture	31/10/2020	1937	Antechinus spp	D	I	WE	54-5	
5	Furniture	1/11/2020	1922	Antechinus spp	D	I	WE	56-7	
5	Furniture	1/11/2020	2216	SEBtP	Pr	C	E	58	
5	Furniture	2/11/2020	1918	Antechinus spp	D	C	E	60	
5	Furniture	2/11/2020	1940	Antechinus spp	D	C	E	62	
5	Furniture	3/11/2020	0034	SEBtP	Pr	C	W	63	
5	Furniture	3/11/2020	0313	SEBtP	Pr	C	E	64	
5	Furniture	3/11/2020	1856	BtPoss spp	D	C	E	66	
5	Furniture	4/11/2020	0231	Antechinus spp	D	C	E	68	
5	Furniture	4/11/2020	0405	SEBtP	Pr	C	W	69	
5	Furniture	4/11/2020	1940	Antechinus spp	D	C	E	71	
5	Furniture	4/11/2020	2200	SEBtP	Pr	C	E	72	
5	Furniture	5/11/2020	1903	BtPoss spp	D	C	W	73	
5	Furniture	5/11/2020	1930	Antechinus spp	D	C	E	75	
5	Furniture	6/11/2020	0009	BtPoss spp	D	C	E	76	
5	Furniture	9/11/2020	1954	Antechinus spp	D	C	E	83-4	
5	Furniture	11/11/2020	1953	Antechinus spp	D	C	E	87	
5	Furniture	12/11/2020	1948	Antechinus spp	D	C	E	89	
5	Furniture	15/11/2020	1939	Antechinus spp	D	C	W	92	
5	Furniture	16/11/2020	0057	Antechinus spp	D	C	E	94	
5	Furniture	16/11/2020	1943	Antechinus spp	D	C	E	96	
5	Furniture	16/11/2020	2150	Antechinus spp	D	C	E	98	
5	Furniture	17/11/2020	1932	Antechinus spp	D	C	E	101	
5	Furniture	17/11/2020	2217	Antechinus spp	D	C	E	102	
5	Furniture	18/11/2020	0232	Antechinus spp	D	C	E	104	
5	Furniture	18/11/2020	1951	Antechinus spp	D	C	E	105	
5	Furniture	18/11/2020	2357	Antechinus spp	D	C	E	107-8	
5	Furniture	19/11/2020	2235	Antechinus spp	D	C	W	109	
5	Furniture	19/11/2020	2333	Antechinus spp	D	C	E	110	
5	Furniture	20/11/2020	0123	Antechinus spp	D	C	E	112	
5	Furniture	20/11/2020	1930	Antechinus spp	D	C	E	114	
5	Furniture	20/11/2020	2214	Antechinus spp	D	C	E	116	
5	Furniture	22/11/2020	1920	Antechinus spp	D	C	E	118	
5	Furniture	25/11/20-20/12/20		Antechinus spp					
5	Furniture			26 x Complete East					
5	Furniture			1 x Complete West					
5	Furniture			3 x Incomplete					
5	Furniture			Microbat	Present				
6	Floor	11/10/2020	1745	Cat	Pr	C	E	28	Can't see as flash not working
6	Floor	18/10/2020	1820	Cat	D	C	W	1	
6	Floor	25/10/2020	614	EG kangaroo x 2	Pr	I	EW	2-3	2 x ind.
6	Floor	25/10/2020	1744	Cat	D	C	E	4	
6	Floor	30/10/2020	1746	dog x 2	D	C	E	5	2 x ind.
6	Floor	8/11/2020	0453	EG kangaroo x 2	Pr	C	E	6	3 x ind.
6	Floor	10/11/2020	2220	Fox	D	C	E	8	
6	Floor	13/11/2020	2005	Fox	D	C	E	9	
6	Floor	24/11/2020	0524	Wallaby spp	Pr	C	E	10	
6	Floor	24/11/2020	0536	Wallaby spp	Pr	C	E	12	
6	Floor	28/11/2020	2348	EG kangaroo x 2	Pr	C	E	1	2 x ind.
6	Floor	2/12/2020	2042	Fox	D	C	E	4	
6	Floor	3/12/2020	0516	EG kangaroo x 2	Pr	C	E	5	2 x ind.
6	Floor	3/12/2020	0544	Large macropod	D	C	W	6	
6	Floor	5/12/2020	1920	Fox	D	C	E	7	
6	Floor	7/12/2020	0459	EG kangaroo	Pr	C	E	8	
6	Floor	8/12/2020	2350	Fox	D	C	E	11	

Site No.	Cam position	Date	Time	Species	Accuracy	Crossing type	Movement direction	Image No's	Comments
6	Floor	11/12/2020	2102	Fox	D	C	E	13	
6	Floor	15/12/2020	2227	Fox	D	C	E	15	
6	Floor	15/12/2020	2344	Fox	D	C	W	16	
6	Floor	16/12/2020	0512	Fox	Pr	C	E	17	
6	Floor	16/12/2020	1952	Fox	Pr	C	W	18	
6	Floor	17/12/2020	1922	Fox	Pr	C	W	19	
6	Floor	19/12/2020	0002	Fox	Pr	C	E	20	Mange?
6	Floor	19/12/2020	2340	Fox	Pr	C	E	21	
6	Furniture	12/10/2020	1734	Cat	D	C	W	20	
6	Furniture	12/10/2020	1801	Cat	D	C	E	21-26	
6	Furniture	19/10/2020	2151	BtPoss spp	D	C	E	2	
6	Furniture	25/10/2020	1735	Cat	D	I	WE	4-5	
6	Furniture			microbat	present				
7	Floor	19/09/2020	0015	Antechinus spp	Pr	C	E	1-2	
7	Floor	20/09/2020	2216	Rodent spp	D	C	E	3-4	
7	Floor	24/09/2020	2319	Fox	D	C	E	6	
7	Floor	26/09/2020	2054	Wallaby spp	D	C	E	7	
7	Floor	28/10/2020	1814	Fox	Pr	C	E	2	
7	Floor	12/11/2020	2257	Bandicoot spp	Pr	C	E	4	
7	Floor	3/12/2020	1943	Fox	D	C	W	1	
7	Floor	12/12/2020	0430	Fox	D	C	W	4-9	
7	Furniture	22/09/2020	0228	Antechinus spp	D	C	E	3	
7	Furniture	6/10/2020	1834	Antechinus spp	D	C	W	28	
7	Furniture	8/10/2020	2041	Antechinus spp	D	C	W	29	
7	Furniture	14/10/2020	1930	Antechinus spp	D	C	E	32	
7	Furniture	20/10/2020	0041	Antechinus spp	D	C	E	1	
7	Furniture	28/11/2020	2020	Antechinus spp	D	C	E	3	
7	Furniture			microbat	present				
8	Floor	6/01/2015	1740	Northern brown bandicoot	Pr	C	E	1	
8	Floor	7/01/2015	0319	Lace monitor	D	C	W	2	
8	Floor	7/01/2015	0430	Lace monitor	D	C	E	3	
8	Floor	9/01/2020	0722	Lace monitor	D	I	WE	6-Jul	
8	Floor	11/01/2015	0754	Lace monitor	D	C	E	24	
8	Floor	13/01/2020	0613	Lace monitor	D	C	E	41	
8	Floor	6/01/2020	2005	CBtP	D	C	W	5	
8	Floor	8/01/2020	2357	Bandicoot spp	D	C	E	6	
8	Floor	9/01/2020	0621	Lace monitor	D	C	E	7	
8	Floor	11/01/2020	1851	Bandicoot spp	D	C	E	8	
8	Floor	13/01/2020	1932	CBtP	D	C	W	9	
8	Floor	15/01/2020	0038	Long-nosed bandicoot	Pr	C	E	10	
8	Floor	25/11/2020	2256	Red necked wallaby	Pr	C	W	6	
8	Floor	26/11/2020	0559	Red necked wallaby	Pr	C	E	8	
8	Floor	3/12/2020	2007	Bandicoot spp	D	C	E	13	
8	Floor	9/12/2020	0511	Red necked wallaby	Pr	C	W	18	
8	Floor	10/12/2020	0142	Wallaby spp	D	C	E	19	
8	FF	18/09/2020	231	Antechinus spp	D	C	E	3	
8	FF	18/09/2020	1944	Antechinus spp	D	C	E	5	
8	FF	19/09/2020	412	Antechinus spp	D	C	E	7	
8	FF	21/09/2020	406	Antechinus spp	D	C	E	9	
8	FF	22/09/2020	1807	Antechinus spp	D	C	E	11	
8	FF	23/09/2020	436	Antechinus spp	D	C	E	13	
8	FF	24/09/2020	432	Antechinus spp	D	C	E	20	
8	FF	25/09/2020	413	Antechinus spp	D	C	E	22	
8	FF	27/09/2020	436	Antechinus spp	D	C	E	26	
8	FF	28/09/2020	1853	Antechinus spp	D	C	W	28	
8	FF	29/09/2020	436	Antechinus spp	D	C	E	29	
8	FF	30/09/2020	422	Antechinus spp	D	C	E	30	
8	FF	2/10/2020	1813	Antechinus spp	D	C	E	34	

Site No.	Cam position	Date	Time	Species	Accuracy	Crossing type	Movement direction	Image No's	Comments
8	FF	3/10/2020	417	Antechinus spp	D	C	E	36	
8	FF	5/10/2020	408	Antechinus spp	D	C	E	39	
8	FF	6/10/2020	443	Antechinus spp	D	C	E	45	
8	FF	7/10/2020	433	Antechinus spp	D	C	E	47	
8	FF	8/10/2020	403	Antechinus spp	D	C	E	48	
8	FF	8/10/2020	406	Antechinus spp	D	C	E	50,52-53	
8	FF	8/10/2020	1942	Antechinus spp	D	C	E	54	
8	FF	8/10/2020	2336	Antechinus spp	D	C	E	56	
8	FF	9/10/2020	1946	Antechinus spp	D	C	E	57	
8	FF	10/10/2020	420	Antechinus spp	D	C	E	59	
8	FF	11/10/2020	437	Antechinus spp	D	C	E	63	
8	FF	12/10/2020	408	Antechinus spp	D	C	E	66	
8	FF	17/10/2020	358	Antechinus spp	D	C	E	74	
8	FF	18/10/2020	348	Antechinus spp	D	C	E	76	
8	FF	21/10/2020	2044	Antechinus spp	Pr	C	W	3	
8	FF	22/10/2020	358	Antechinus spp	D	C	E	4	
8	FF	24/10/2020	351	Antechinus spp	D	C	E	5	
8	FF	1/11/2020	1958	CBtP	D	C	W	9	
8	FF	4/11/2020	410	Antechinus spp	D	C	E	14	
8	FF	4/11/2020	2119	Antechinus spp	D	C	E	16	
8	FF	4/11/2020	2206	CBtP	D	C	W	17	
8	FF	5/11/2020	2005	Antechinus spp	D	C	E	19	
8	FF	5/11/2020	2122	Antechinus spp	D	C	E	20	
8	FF	7/11/2020	2333	Antechinus spp	D	C	E	23	
8	FF	8/11/2020	357	Antechinus spp	D	C	E	26	
8	FF	8/11/2020	2133	Antechinus spp	D	C	E	30	
8	FF	9/11/2020	150	Antechinus spp	D	C	E	32	
8	FF	10/11/2020	2200	Antechinus spp	D	C	E	36	
8	FF	10/11/2020	2358	Antechinus spp	D	C	E	38	
8	FF	11/11/2020	158	Antechinus spp	D	C	E	40	
8	FF	13/11/2020	132	Antechinus spp	D	C	E	43	
8	FF	17/11/2020	2244	Antechinus spp	D	C	E	51	
8	FF	18/11/2020	316	Antechinus spp	D	C	E	54	
8	FF	8/12/2020	2259	Antechinus spp	D	C	E	9	
9	Floor	18/09/2020	2355	Northern brown bandicoot	Pr	C	W	1	
9	Floor	21/09/2020	2027	Bandicoot spp	D	C	E	3	
9	Floor	30/09/2020	1934	House mouse	Pr	C	E	6	
9	Floor	2/10/2020	2008	Bandicoot spp	Pr	C	W	8	
9	Floor	2/10/2020	2032	Bandicoot spp	Pr	C	E	9	
9	Floor	3/10/2020	1842	House mouse	Pr	C	E	10	
9	Floor	8/10/2020	1844	Bush rat	Pr	C	W	12	
9	Floor	9/10/2020	2102	Bandicoot spp	Pr	C	W	13	
9	Floor	10/10/2020	1853	Bandicoot spp	D	C	E	14	
9	Floor	12/10/2020	0003	Long-nosed bandicoot	Pr	C	E	15	
9	Floor	13/10/2020	1926	Bandicoot spp	Pr	C	W	17	
9	Floor	17/10/2020	2332	CBtP	Pr	C	E	18	
9	Floor	19/10/2020	0250	Bandicoot spp	Pr	C	E	21	
9	Floor	19/10/2020	2119	Long-nosed bandicoot	Pr	C	E	23	
9	Floor	21/10/2020	0304	Bandicoot spp	D	C	E	29	
9	Floor	21/10/2020	2115	Bandicoot spp	Pr	C	W	2	
9	Floor	22/10/2020	1941	Bandicoot spp	D	C	E	4	
9	Floor	22/10/2020	2246	Bandicoot spp	D	C	W	7	
9	Floor	23/10/2020	1907	Northern brown bandicoot	D	C	E	8	
9	Floor	25/10/2020	0236	Bandicoot spp	D	C	E	11	
9	Floor	25/10/2020	0346	Northern brown bandicoot	D	C	W	8	
9	Floor	26/10/2020	2053	Bandicoot spp	D	C	W	14	
9	Floor	27/10/2020	1852	Bandicoot spp	D	C	E	16	

Site No.	Cam position	Date	Time	Species	Accuracy	Crossing type	Movement direction	Image No's	Comments
9	Floor	27/10/2020	2336	Bandicoot spp	D	C	E	19	
9	Floor	29/10/2020	2025	Bush rat	Pr	C	W	21	
9	Floor	30/10/2020	2001	Northern brown bandicoot	Pr	C	E	26	
9	Floor	1/11/2020	0051	BtPoss spp	Po	C	E	27	
9	Floor	1/11/2020	1940	Bandicoot spp	Pr	C	E	32	
9	Floor	1/11/2020	2022	CBtP	Pr	C	E	33	
9	Floor	1/11/2020	2051	Northern brown bandicoot	Pr	C	W	34-35	
9	Floor	5/11/2020	2037	Bandicoot spp	D	C	E	39	
9	Floor	8/11/2020	2104	Bandicoot spp	D	C	W	49	
9	Floor	9/11/2020	0054	Bandicoot spp	D	C	E	50	
9	Floor	14/11/2020	1939	Bandicoot spp	Pr	C	W	58	
9	Floor	16/11/2020	1907	Bandicoot spp	D	C	W	60	
9	Floor	16/11/2020	2022	Long nosed bandicoot	Pr	I	WE	61	
9	Floor	16/11/2020	2126	Northern brown bandicoot	Pr	C	E	63	
9	Floor	19/11/2020	2246	Bandicoot spp	D	C	W	65	
9	Floor	20/11/2020	1958	Bush rat	D	C	W	66	
9	Floor	23/11/2020	0748	Lace monitor	D	C	E	71	
9	Floor	25/11/2020	2300	Red-necked wallaby	Pr	C	E	2	
9	Floor	26/11/2020	0317	Bush rat	Pr	C	W	4	
9	Floor	26/11/2020	0341	Rodent spp	D	C	E	6	
9	Floor	26/11/2020	0557	Red-necked wallaby	Pr	C	W	7	
9	Floor	2/12/2020	2034	Bandicoot spp	D	C	E	13	
9	Floor	4/12/2020	2238	Bandicoot spp	Pr	C	E	19	
9	Floor	4/12/2020	2251	small mammal	D	C	E	20	
9	Floor	9/12/2020	0515	Wallaby spp	D	C	E	22	
9	Floor	10/12/2020	0043	Red-necked wallaby	Pr	C	W	24-25	
9	Floor	14/12/2020	0033	Bandicoot spp	Pr	C	E	27	
9	Floor	16/12/2020	2217	Bandicoot spp	Pr	C	W	31	
9	Floor	17/12/2020	2017	Bandicoot spp	D	C	E	32	
9	Floor	17/12/2020	2121	Bandicoot spp	D	C	E	33	
9	Floor	18/12/2020	0134	Long-nosed bandicoot	Pr	C	W	37	
9	Floor	18/12/2020	0203	Bandicoot spp	D	C	E	38	
9	Floor	20/12/2020	2040	Bandicoot spp	D	C	E	39	
9	Floor	20/12/2020	2356	Bandicoot spp	D	C	W	40	
9	Furniture	24/09/2020	0448	Antechinus spp	D	C	W	4	
9	Furniture	26/09/2020	0448	Antechinus spp	D	I	WE	18-20	
9	Furniture	1/10/2020	0451	Antechinus spp	D	I	E	18-21	
9	Furniture	5/10/2020	1900	Antechinus spp	D	I	WE	24-25	
9	Furniture	7/10/2020	0453	Antechinus spp	D	C	W	26	
9	Furniture	9/10/2020	2146	CBtP	D	C	W	27	
9	Furniture	10/10/2020	0451	Antechinus spp	D	C	W	31	
9	Furniture	12/10/2020	1857	Antechinus spp	D	C	W	34	
9	Furniture	13/10/2020	1944	Antechinus spp	D	C	E	35	
9	Furniture	13/10/2020	1933	CBtP	D	C	W	36	
9	Furniture	14/10/2020	0420	Antechinus spp	D	I	WE	38-40	
9	Furniture	15/10/2020	0205	CBtP	D	C	E	42	
9	Furniture	16/10/2020	1957	Antechinus spp	D	C	E	49	
9	Furniture	16/10/2020	2129	CBtP	D	C	W	50	
9	Furniture	21/10/2020	1920	CBtP	D	C	W	2	
9	Furniture	23/10/2020	0013	CBtP	D	C	E	5	
9	Furniture	23/10/2020	0029	Antechinus spp	D	C	E	6	
9	Furniture	25/10/2020	0016	CBtP	D	C	W	7	
9	Furniture	25/10/2020	2129	CBtP	D	C	E	9	
9	Furniture	29/10/2020	0129	CBtP	D	C	W	14	
9	Furniture	29/10/2020	1925	CBtP	D	C	W	17	
9	Furniture	30/10/2020	0001	CBtP	D	C	E	18	
9	Furniture	3/11/2020	2032	CBtP	D	C	W	22	

Site No.	Cam position	Date	Time	Species	Accuracy	Crossing type	Movement direction	Image No's	Comments
9	Furniture	3/11/2020	2309	CBtP	D	C	E	23	
9	Furniture	4/11/2020	2040	CBtP	D	C	W	24	
9	Furniture	4/11/2020	2239	CBtP	D	C	E	25	
9	Furniture	7/11/2020	0439	Antechinus spp	D	C	E	27	
9	Furniture								
9	Furniture			microbat	present				
10	Floor	26/09/2020	0918	Lace monitor	D	C	E	6	Actually on FF cam
10	Floor	30/09/2020	2218	Red necked wallaby	D	C	W	4-5	
10	Floor	17/10/2020	0453	Red necked wallaby	D	C	W	9	
10	Floor	30/10/2020	0523	Large macropod	D	C	E	6	
10	Floor	12/11/2020	0443	Cat	D	C	E	12	
10	Floor	28/11/2020	2055	CBtP	Pr	C	E	2	
10	Floor	29/11/2020	2215	CBtP	Pr	C	E	3	
10	Floor	2/12/2020	0420	Cat	Pr	C	E	4	
10	Floor	7/12/2020	0201	Black rat	Pr	C	E	5	
10	Floor	17/12/2020	2247	Black rat	D	C	E	9	
10	FF	4/10/2020	0500	Antechinus spp	D	C	E	15	
10	FF	9/10/2020	2217	Antechinus spp	D	I	EW	26-31	
10	FF	12/10/2020	0101	CBtP	D	I	WE	32-34	
10	FF	12/10/2020	0405	Antechinus spp	D	I	WE	35,38	
10	FF	13/10/2020	1927	Antechinus spp	D	C	WE	44-45	
10	FF	14/10/2020	2056	Antechinus spp	D	I	WE	46-47	
10	FF	17/10/2020	0250	Antechinus spp	D	C	W	57	
10	FF	17/10/2020	0320	Antechinus spp	D	C	E	58	
10	FF	18/10/2020	2053	Antechinus spp	D	C	WE	60-61	
10	FF			microbat	present				
10	FF	22/10/2020	0100	Antechinus spp	D	I	WE	3-4	
10	FF	5/11/2020	2248	Antechinus spp	D	C	E	9	
10	FF	6/11/2020	2140	Antechinus spp	D	I	WE	11-13	
10	FF	9/11/2020	0047	Antechinus spp	D	C	W	14	
10	FF	26/11/2020	0402	Antechinus spp	D	C	W	1	
10	FF	26/11/2020	2210	CBtP	Pr	C	E	2	
10	FF	27/11/2020	0254	CBtP	D	C	W	3	
10	FF	28/11/2020	0119	Antechinus spp	D	C	E	7	
10	FF	29/11/2020	0303	Antechinus spp	D	C	W	10	
10	FF	29/11/2020	0320	CBtP	D	C	W	11	
10	FF	30/11/2020	0007	Antechinus spp	D	I	WE	12-13	
10	FF	30/11/2020	0137	CBtP	D	C	W	14	
10	FF	30/11/2020	0409	Antechinus spp	D	I	WE	16-17	
10	FF	1/12/2020	0404	Antechinus spp	D	I	WE	18-19	
10	FF	2/12/2020	0054	Antechinus spp	D	I	WE	20-22	
10	FF	2/12/2020	0411	Antechinus spp	D	C	E	23	
10	FF	5/12/2020	0230	Antechinus spp	Pr	C	E	25	
10	FF	7/12/2020	0027	Black rat	D	I	EW	26-27	
10	FF	7/12/2020	2308	CBtP	D	C	E	29	
10	FF	19/12/2020	0049	Black rat	D	I	WE	31-32	
11	Floor	27/09/2020	0047	Bettong	Pr	C	E	221	
11	Floor	1/10/2020	0003	Bettong	Pr	C	E	226	
11	Floor	6/10/2020	0733	Lace monitor	D	C	E	230	
11	Floor	19/10/2020	0059	Rodent spp	Pr	C	E	251	
11	Floor	22/10/2020	2036	Bettong	Pr	C	E	259	
11	Floor	22/10/2020	2139	Rattus spp	D	C	E	260	
11	Floor	23/10/2020	2108	Black rat	Pr	C	E	261	
11	Floor	25/10/2020	2155	Black rat x 2	D	I	EXM	263-267	2 x ind.
11	Floor	26/10/2020	0006	Black rat	P	C	W	269	
11	Floor	26/10/2020	2300	Black rat	P	C	E	271	
11	Floor	31/10/2020	0154	Long-nosed bandicoot	D	I	WE	277	Good video
11	Floor	5/11/2020	2241	Bandicoot spp	Pr	C	W	280	

Site No.	Cam position	Date	Time	Species	Accuracy	Crossing type	Movement direction	Image No's	Comments
11	Floor	6/11/2020	2254	Bettong	Pr	C	E	282	
11	Floor	7/11/2020	0719	Lace monitor	D	C	E	287	
11	Floor	10/11/2020	2201	Long-nosed bandicoot	D	C	E	288	
11	Floor	12/11/2020	2025	small mammal	D	C	E	289	
11	Floor	13/11/2020	2317	Bandicoot spp	Pr	C	E	290	
11	Floor	14/11/2020	0223	Long-nosed bandicoot	Pr	I	WE	291-292	
11	Floor	14/11/2020	0742	Lace monitor	D	C	E	293	
11	Floor	14/11/2020	2240	House mouse	Pr	C	E	294	
11	Floor	15/11/2020	2059	Bandicoot spp	D	I	WE	295-8	
11	Floor	19/11/2020	1930	Swamp rat	Po	C	E	303	
11	Floor	23/11/2020	0103	Bandicoot spp	D	C	E	304	
11	Floor	9/01/2020	0057	Lace monitor	D	C	W	1	
11	Floor	9/01/2020	0454	Lace monitor	D	I	WE	210-211	
11	Floor	9/01/2015	536	Lace monitor	D	C	W	214	
11	Floor	19/01/2015	0442	Lace monitor	D	C	E	217	
11	Floor	21/01/2015	1931	Bandicoot spp	D	C	W	221-222	
11	Floor	29/01/2015	0347	Lace monitor	D	C	W	223	
11	Floor	29/01/2015	0422	Lace monitor	D	C	E	224	
11	Floor	29/01/2020	0539	Lace monitor	D	C	W	225	
11	Floor	31/01/2015	0058	Lace monitor	D	C	E	226	
11	Floor			Microbat	present				
11	Furniture	6/10/2020	1919	Antechinus spp	D	C	E	37-41	
11	Furniture	9/10/2020	2332	Antechinus spp	D	I	WE	50-53	
11	Furniture			microbat spp	present				
11	Furniture	14/12/2020	2013	Black rat	D	C	E	14	
11	Furniture	20/12/2020	2254	Black rat	D	C	E	17	
Weast1	North	18/09/2020	2145	Bandicoot spp	Pr	Complete	South	1	
Weast1	North	19/09/2020	0316	BtPoss spp	D	Complete	North	2	
Weast1	North	19/09/2020	2056	Long-nosed bandicoot	Pr	Complete	North	3	
Weast1	North	19/09/2020	2123	Bandicoot spp	D	C	South	4	
Weast1	North	20/09/2020	1848	SEBtP	Pr	C	South	5	
Weast1	North	20/09/2020	1857	SEBtP	Pr	C	South	6	
Weast1	North	20/09/2020	2321	SEBtP	D	I	NDM	7	at entrance
Weast1	North	21/09/2020	0345	SEBtP	D	I	NDM	8	at entrance
Weast1	North	21/09/2020	1938	SEBtP	D	Complete	South	9	2 x ind, one also with pouch young
Weast1	North	22/09/2020	0244	Long-nosed bandicoot	Pr	I	EXM	12-13	at entrance
Weast1	North	22/09/2020	0306	SEBtP	D	C	North	15	2 x ind
Weast1	North	24/09/2020	0257	SEBtP	D	C	North	16	2 x ind
Weast1	North	24/09/2020	1946	SEBtP	D	C	South	17	2 x ind
Weast1	North	25/09/2020	0054	Long-nosed bandicoot	Pr	C	South	18	
Weast1	North	25/09/2020	0255	BtPoss spp	D	C	North	19	
Weast1	North	25/09/2020	1937	SEBtP	D	C	South	20	2 x ind
Weast1	North	26/09/2020	0235	SEBtP	D	C	North	21	
Weast1	North	26/09/2020	0300	SEBtP	D	C	North	22	
Weast1	North	26/09/2020	1904	SEBtP	D	C	South	23	
Weast1	North	27/09/2020	0232	BtPoss spp	D	C	North	26	
Weast1	North	27/09/2020	1851	BtPoss spp	D	C	South	27	
Weast1	North	27/09/2020	1942	SEBtP	D	C	North	28	
Weast1	North	27/09/2020	2224	SEBtP	Pr	C	South	29	
Weast1	North	28/09/2020	2200	SEBtP	D	C	North	30	
Weast1	North	29/09/2020	0107	Long-nosed bandicoot	D	C	North	31	outside
Weast1	North	29/09/2020	257	CRtP	D	C	South	32	
Weast1	North	30/09/2020	225	Long-nosed bandicoot	Pr	C	North	33	outside
Weast1	North	1/10/2020	126	SEBtP	D	C	North	35	Adult with joey in pouch
Weast1	North	1/10/2020	1929	SEBtP	D	C	South	36-37	2 x adults, one adult with joey in pouch
Weast1	North	2/10/2020	401	SEBtP	D	C	North	39	
Weast1	North	2/10/2020	1850	SEBtP	D	C	South	40	

Site No.	Cam position	Date	Time	Species	Accuracy	Crossing type	Movement direction	Image No's	Comments
Weast1	North	3/10/2020	2039	SEBtP	D	C	North	42-43	
Weast1	North	3/10/2020	2209	Long-nosed bandicoot	Pr	I	EXM	44	
Weast1	North	6/10/2020	2147	SEBtP	Pr	C	South	48	
Weast1	North	10/10/2020	2321	SEBtP	D	C	South	54-56	2 x adults, one adult with joey in pouch
Weast1	North	14/10/2020	2218	Long-nosed bandicoot	Pr	C	South	4	
Weast1	North	15/10/2020	1932	Bandicoot spp	D	C	South	6	
Weast1	North	16/10/2020	1943	SEBtP	Pr	C	South	7	
Weast1	North	17/10/2020	9	SEBtP	D	C	North	8	
Weast1	North	17/10/2020	41	Bandicoot spp	D	C	South	9	
Weast1	North	17/10/2020	249	SEBtP	D	C	North	11	
Weast1	North	18/10/2020	1846	Bandicoot spp	Pr	C	South	21	
Weast1	North	18/10/2020	2031	SEBtP	Pr	C	South	45	
Weast1	South	19/09/2020	315	BtPoss spp	D	C	North	1	
Weast1	South	19/09/2020	2057	Long-nosed bandicoot	D	C	North	2	
Weast1	South	19/09/2020	2124	Bandicoot spp	Pr	C	South	3	
Weast1	South	22/09/2020	208	SEBtP	D	C	South	5	
Weast1	South	23/09/2020	155	Bandicoot spp	D	C	North	7	
Weast1	South	24/09/2020	257	SEBtP	D	C	North	8	2 x ind.
Weast1	South	24/09/2020	2312	SEBtP	D	C	North	9	
Weast1	South	25/09/2020	1938	SEBtP	D	C	South	11	2 x ind.
Weast1	South	26/09/2020	234	SEBtP	D	C	North	13	2 x ind.
Weast1	South	26/09/2020	300	SEBtP	D	C	North	14	
Weast1	South	27/09/2020	231	SEBtP	D	C	North	15	
Weast1	South	27/09/2020	1852	SEBtP	D	C	South	16	
Weast1	South	27/09/2020	2214	Rodent	D	I	NDM	18	Outside of fence
Weast1	South	28/09/2020	2201	SEBtP	D	C	North	19	
Weast1	South	29/09/2020	0015	CRtP	D	C	North	20	
Weast1	South	1/10/2020	126	SEBtP	D	C	North	21	
Weast1	South	1/10/2020	1930	SEBtP	D	C	South	23	
Weast1	South	1/10/2020	2257	Rodent	D	I	EXM	24	Outside of fence
Weast1	South	6/10/2020	2124	Long nosed bandicoot	D	C	EXM	29	
Weast1	South	6/10/2020	2148	SEBtP	D	C	South	30	
Weast1	South	7/10/2020	2049	SEBtP	D	C	South	32	Joey in pouch
Weast1	South	10/10/2020	14	SEBtP	D	C	North	33	Joey in pouch
		10/10/2020	217	Bush rat	Pr	I	EXM	34	
		10/10/2020	2321	SEBtP	D	C	North	38	
Weast1	South	14/10/2020	48	SEBtP	Pr	C	North	8	
Weast1	South	14/10/2020	9	Swamp wallaby	D	I	EXM	###	
Weast1	South	14/10/2020	1716	2 x indian peafowl	D	I	EXM	17-20	
Weast1	South	14/10/2020	2221	Long nosed bandicoot	Pr	C	South	21	
Weast1	South	15/10/2020	1921	Long nosed bandicoot x 4	D	C	North	23	1 adults + 3 young
Weast1	South	16/10/2020	1811	Swamp wallaby	D	C	North	24-30	
Weast1	South	18/10/2020	1841	Long-nosed bandicoot	D	C	South	41-43	
Weast1	South	18/10/2020	1928	Northern brown bandicoot	Pr	C	North	44	
Weast1	South	27/10/2020	2336	Long-nosed bandicoot	D	C	South	54	
Weast1	South	31/10/2020	40	SEBtP	D	C	South	57	
Weast1	South	6/11/2020	147	SEBtP	D	C	South	72	
Weast1	South	7/11/2020	502	Indian peafowl	D	C	North	75	
Weast1	South	8/11/2020	27	SEBtP	D	C	South	76	
Weast1	South	10/11/2020	27	Rodent spp	D	C	North	83	
Weast1	South	14/11/2020	359	Northern brown bandicoot	D	C	North	89	
Weast1	South	15/11/2020	54	SEBtP	D	C	South	92	
Weast1	South	15/11/2020	241	SEBtP	Pr	C	North	93	
Weast1	South	17/11/2020	129	Long-nosed bandicoot	Pr	I	EXM	94	
Weast1	South	17/11/2020	2237	BtPoss spp	D	C	North	97	
Weast1	South	17/11/2020	2342	CRtP	D	C	South	98	
Weast1	South	20/11/2020	0	Northern brown	Pr	C	North	100	

Site No.	Cam position	Date	Time	Species	Accuracy	Crossing type	Movement direction	Image No's	Comments
				bandicoot					
Weast1	South	21/11/2020	1809	Indian peafowl	D	I	EXM	104-107	
Weast1	South	22/11/2020	42	Rodent spp	D	I	EXM	108	
Weast1	South	22/11/2020	243	SEBtP	D	C	North	109	
Weast1	South	23/11/2020	349	Swamp wallaby	D	I	EXM	113	
Weast1	South	30/11/2020	219	Echidna	D	I	EXM	141	
Weast1	South	12/12/2020	339	House mouse	Pr	I	EXM	552-553	
Weast1	South	12/12/2020	2103	SEBtP x 2	D	C	South	590	Joey on back
Weast1	South	13/12/2020	106	House mouse	Pr	I	EXM	614	
Weast1	South			microbat	present				
Weast2	North	12/10/2020	2005	Long-nosed bandicoot	Pr	Complete	South	12	
Weast2	North	14/10/2020	2139	Long-nosed bandicoot	D	Complete	North	18-19	
Weast2	North	18/10/2020	1924	Bandicoot spp	Pr	Complete	South	23	
Weast2	North	19/10/2020	1938	SEBtP	D	Complete	South	27	
Weast2	North	20/10/2020	0229	BtPoss spp	D	Complete	North	28	
Weast2	North	20/10/2020	1857	SEBtP	D	Complete	South	29	
Weast2	North	21/10/2020	2038	BtPoss spp	D	Complete	North	33	
Weast2	North	22/10/2020	0001	SEBtP	D	Complete	South	34	
Weast2	North	22/10/2020	2018	SEBtP	D	Complete	South	36	
Weast2	North	24/10/2020	0323	Rodent spp	D	Incomplete	NDM	42	
Weast2	North	26/10/2020	1922	SEBtP	Pr	Complete	South	69	
Weast2	North	3/11/2020	0636	Swamp wallaby	D	Incomplete	NDM	807-809	
Wmid	North	27/09/2020	0351	Koala	D	Complete	South	5	
Wmid	North	28/09/2020	2325	Swamp wallaby	D	Complete	North	10-11	
Wmid	North	29/09/2020	0728	Swamp wallaby	Pr	Complete	South	12	
Wmid	North	6/10/2020	0104	Swamp wallaby	D	Complete	South	20	
Wmid	North	8/10/2020	0341	Swamp wallaby	D	Complete	South	22	
Wmid	North	11/10/2020	2129	Swamp wallaby	Pr	Complete	South	24	
Wmid	North	15/10/2020	0401	House mouse	Pr	Complete	South	21	
Wmid	North	15/10/2020	2002	Swamp wallaby	D	Complete	South	46	
Wmid	North	16/10/2020	2143	House mouse	Pr	Complete	North	49	
Wmid	North	22/10/2020	1954	SEBtP	D	Complete	South	91	
Wmid	North	23/10/2020	2343	Swamp wallaby	D	Complete	North	92	
Wmid	North	25/10/2020	0607	Swamp wallaby	D	Complete	South	98-99	
Wmid	North	29/10/2020	0121	Swamp wallaby	Pr	Complete	South	109	
Wmid	North	29/10/2020	2013	SEBtP	D	Complete	South	112	
Wmid	North	31/10/2020	0000	Cat	D	Complete	South	114	
Wmid	North	1/11/2020	2204	SEBtP	D	Complete	South	121	
Weast2	South	14/10/2020	103	Swamp wallaby	D	Incomplete	NDM	7-9	
Weast2	South	14/10/2020	1716	Indian peafowl x 2	D	Incomplete	NDM	10-19	
Weast2	South	16/10/2020	1802	Swamp wallaby	D	Complete	North	24	
Weast2	South	17/10/2020	1944	SEBtP	D	Complete	South	25	
Weast2	South	18/10/2020	345	Swamp wallaby	D	Incomplete	EXM	26-38	
Weast2	South	18/10/2020	1837	Northern brown bandicoot	Pr	Complete	North	39	
Weast2	South	18/10/2020	1923	Bandicoot spp	Pr	Complete	South	42	
Weast2	South	19/10/2020	1938	SEBtP	Pr	Complete	South	45	
Weast2	South	20/10/2020	227	SEBtP	D	Complete	North	47	
Weast2	South	21/10/2020	2036	SEBtP	D	Complete	North	50	
Weast2	South	22/10/2020	259	SEBtP	D	Complete	North	51	
Weast2	South	22/10/2020	2017	SEBtP	D	Complete	South	53	
Weast2	South	24/10/2020	131	SEBtP	D	Complete	North	54	
Weast2	South	26/10/2020	1922	SEBtP	Pr	Complete	South	57	
Weast2	South	29/10/2020	2109	Bandicoot spp	Po	Complete	North	61	
Weast2	South	1/11/2020	1941	BtPoss spp	D	Complete	North	66	
Weast2	South	2/11/2020	1911	BtPoss spp	D	Complete	South	76	
Weast2	South	3/11/2020	632	Swamp wallaby	D	Complete	North	82	
Weast2	South	3/11/2020	2216	Swamp wallaby	D	Incomplete	EXM	84-5	
Weast2	South	4/11/2020	56	BtPoss spp	D	Complete	North	86	

Site No.	Cam position	Date	Time	Species	Accuracy	Crossing type	Movement direction	Image No's	Comments
Weast2	South	5/11/2020	1927	BtPoss spp	D	Complete	South	95	
Weast2	South	5/11/2020	2108	Bandicoot spp	D	Incomplete	EXM	96	
Weast2	South	6/11/2020	1945	SEBtP	D	Incomplete	EXM	101-2	
Weast2	South	7/11/2020	2117	BtPoss spp	D	Complete	North	104	
Weast2	South	8/11/2020	2009	SEBtP	Pr	Incomplete	NDM	106	
Weast2	South	9/11/2020	2300	Bandicoot spp	Pr	Complete	North	114	
Weast2	South	10/11/2020	18	BtPoss spp	D	Complete	North	116	
Weast2	South	11/11/2020	223	Rodent spp	D	Incomplete	EXM	117	
Weast2	South	12/11/2020	131	SEBtP	Pr	Complete	North	481	
Wmid	South	15/10/2020	2118	Echidna	D	Complete	North	3	
Wmid	South	16/10/2020	455	Fox	D	Complete	North	5	
Wmid	South	17/10/2020	6	Northern brown bandicoot	Pr	Complete	North	7	
Wmid	South	17/10/2020	2020	BtPoss spp	D	Complete	South	8	
Wmid	South	18/10/2020	249	SEBtP	D	Complete	North	9	
Wmid	South	20/10/2020	2233	SEBtP	D	Complete	South	10	
Wmid	South	21/10/2020	414	SEBtP	D	Complete	North	11	
Wmid	South	21/10/2020	2110	SEBtP	D	Complete	South	14	
Wmid	South	22/10/2020	325	SEBtP	D	Complete	North	15	
Wmid	South	23/10/2020	2344	Swamp wallaby	D	Complete	North	21	
Wmid	South	24/10/2020	2259	SEBtP	D	Complete	South	26	
Wmid	South	25/10/2020	400	SEBtP	D	Complete	North	27	
Wmid	South	25/10/2020	0609	Swamp wallaby	D	Complete	South	28	
Wmid	South	25/10/2020	1932	SEBtP	D	Complete	South	29	
Wmid	South	26/10/2020	416	SEBtP	D	Complete	North	30	
Wmid	South	26/10/2020	2017	SEBtP	D	Complete	South	31	
Wmid	South	26/10/2020	2147	Swamp wallaby	D	Complete	North	32	
Wmid	South	27/10/2020	401	SEBtP	D	Complete	North	34	
Wmid	South	27/10/2020	1946	SEBtP	D	Complete	South	35	
Wmid	South	28/10/2020	408	SEBtP	D	Complete	North	36	
Wmid	South	29/10/2020	351	SEBtP	D	Complete	North	39	
Wmid	South	29/10/2020	2015	SEBtP	D	Complete	South	40	
Wmid	South	30/10/2020	359	SEBtP	D	Complete	North	41	
Wmid	South	31/01/2020	1	Cat	D	Complete	South	44	
Wmid	South	31/01/2020	342	SEBtP	D	Complete	North	45	
Wmid	South	31/01/2020	2116	SEBtP	D	Complete	South	46	
Wmid	South	1/02/2020	350	SEBtP	D	Complete	North	47	
Wmid	South	6/11/2020	2344	Swamp wallaby	D	Complete	North	56-57	
Wmid	South	10/11/2020	2104	SEBtP	D	Complete	South	60	
Wmid	South	12/11/2020	2231	Swamp wallaby	D	Complete	South	67-69	
Wmid	South	15/11/2020	2101	Swamp wallaby	D	Complete	North	71-72	
Wmid	South	18/11/2020	310	Bandicoot spp	D	Complete	North	73	
Wmid	South	18/11/2020	2153	SEBtP	D	Complete	South	76	
Wmid	South	23/11/2020	11	Swamp wallaby	D	Complete	North	79	
Wmid	South	23/11/2020	406	Fox	D	Complete	South	80	
Wmid	South	23/11/2020	506	Fox	D	Complete	North	81	
Wmid	South	24/11/2020	453	Fox	D	Complete	North	82	
Wmid	South	26/11/2020	2240	Swamp wallaby	D	Complete	South	83	
Wmid	South	26/11/2020	2321	Fox	D	Complete	South	84	
Wmid	South	27/11/2020	150	Swamp wallaby	D	Complete	South	85	
Wmid	South	27/11/2020	2128	Swamp wallaby	D	Complete	North	93	
Wmid	South	28/11/2020	153	Fox	D	Complete	South	94	
Wmid	South	28/11/2020	2015	Fox	D	Complete	South	121	
Wmid	South	29/11/2020	444	Swamp wallaby	D	Complete	North	124	
Wmid	South	1/12/2020	1932	Fox	D	Complete	North	130	
Wmid	South	2/12/2020	452	Fox	D	Complete	North	131	
Wmid	South	2/12/2020	2347	Fox	D	Complete	North	132	
Wmid	South	4/12/2020	422	Fox	D	Complete	North	136	
Wmid	South	4/12/2020	2328	SEBtP	D	Complete	North	137	

Site No.	Cam position	Date	Time	Species	Accuracy	Crossing type	Movement direction	Image No's	Comments
Wmid	South	5/12/2020	153	Fox	D	Complete	North	138	
Wmid	South	6/12/2020	2038	Fox	D	Complete	South	139	
Wmid	South	6/12/2020	2340	Swamp wallaby	D	Complete	North	140	
Wmid	South	7/12/2020	1955	Fox	D	Complete	North	141	
Wmid	South	9/12/2020	41	SEBtP	D	Complete	North	143	
Wmid	South	9/12/2020	2058	Fox	D	Complete	South	144	
Wmid	South	10/12/2020	2134	SEBtP	D	Complete	South	147	
Wmid	South	15/12/2020	218	Fox	D	Complete	North	151	
Wmid	South	15/12/2020	2120	SEBtP	D	Complete	North	152	
Wmid	South	18/12/2020	510	Fox	D	Complete	North	154	
Wmid	South	20/12/2020	111	Bandicoot spp	D	Complete	North	155	
Wmid	South	21/12/2020	118	Fox	D	Complete	North	157	
Wmid	South	21/12/2020	1945	Swamp wallaby	D	Complete	North	158	

Appendix D: Road mortality surveys

Table D1: Details of road mortality surveys adjacent koala culverts monitored on W2B sections 1 & 2 and a segment of Wardell Road and Old Pacific Highway, Wardell, 2020.

Road	Date	Spr/Sum survey no.	Observer	Start	End	Carriage way	Species recorded	Age	Easting	Northing	Cleared off Rd	Live fauna	Location on road	Notes	Weather	Comments	Fence conditions
S1/2	9/07/2020	1	LA & NM	1345	1500	NB	Medium mammal	>7days	517704	6678360	No	nil	Shoulder	50S corindi ck bridge			
S1/2		1	LA & NM			SB	Fox	>7days	506466	6691379	Part of	nil	Shoulder	500m s luthers rd			
S1/2		1	LA & NM			SB	European hare	>7days	512250	6686252	Part of	nil	Shoulder	Mchillips rd			
S1/2		1	LA & NM			SB	NB bandicoot	<7days	514469	6682265	No	nil	Shoulder	1200M s range road e			
S1/2		1	LA & NM			SB	Dog	<7days	515200	6681967	No	nil	Shoulder	1650M n mclaughlin rd			
S1/2		1	LA & NM			SB	Bandicoot spp	>7days	517892	6678027	No	nil	Shoulder	470M n kangaroo trail rd			
S1/2	16/10/20	2	NM & BT	1420	1530	SB	Laughing kookaburra	<7days	509392	6688190	Yes	nil	Shoulder	Near servo			
S1/2		2	NM & BT			SB	Cat	>7days	510391	6687391	Yes	nil	Shoulder	Near servo			
S1/2		2	NM & BT			NB	Bandicoot spp	>7days	517645	6678501	No	nil	Shoulder	Corindi ck bridge			
S1/2		2	NM & BT			NB	Eastern grey kangaroo	>7days	506546	6690606	No	nil	Shoulder	Halfway ck bridge			
Wardell Rd	10/07/2020	1	NM & SR	0940	0950	Nil									Fine		
Wardell Rd	12/10/2020	2	NM	805	815	Nil									Fine, 17.5deg,RH 92		
Old pacific hwy	10/07/2020	1	NM & SR	925	940	NB	Prob echidna	>7days	546370	6800175	Nil	nil	NB	300M s coolgardie rd	Fine		
Old pacific hwy	12/10/20	2	NM	745	800	NB	BtPoss spp	>7days	546428	6800721	Nil	nil	NB	Near kays lane	Fine, 17.5deg,RH 92		