

Woolgoolga to Ballina Pacific
Highway Upgrade, section 10:
Koala Health Assessment -
Law's Point to Wardell Road



Sandpiper Ecological

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Cover Photo: Female koala (Rana) observed at Law's Point during phased resource reduction surveys.

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1. Introduction

1.1 Background

Phased Resource Reduction (PRR) for koalas was conducted at two koala 'hotspots' within Section 10 of the Woolgoolga to Ballina (W2B) Pacific Highway Upgrade. Hotspots were identified from baseline koala surveys (Ecosure & Biolink 2015), and the procedure for PRR specified in the W2B Koala Management Plan (RMS 2016). Koala hotspots were located at Law's Point and Wardell Road, approximately 2km north of Broadwater and 3km north-west of Wardell respectively. Substantive mainline clearing of the Section 10 alignment was completed in late January 2018.

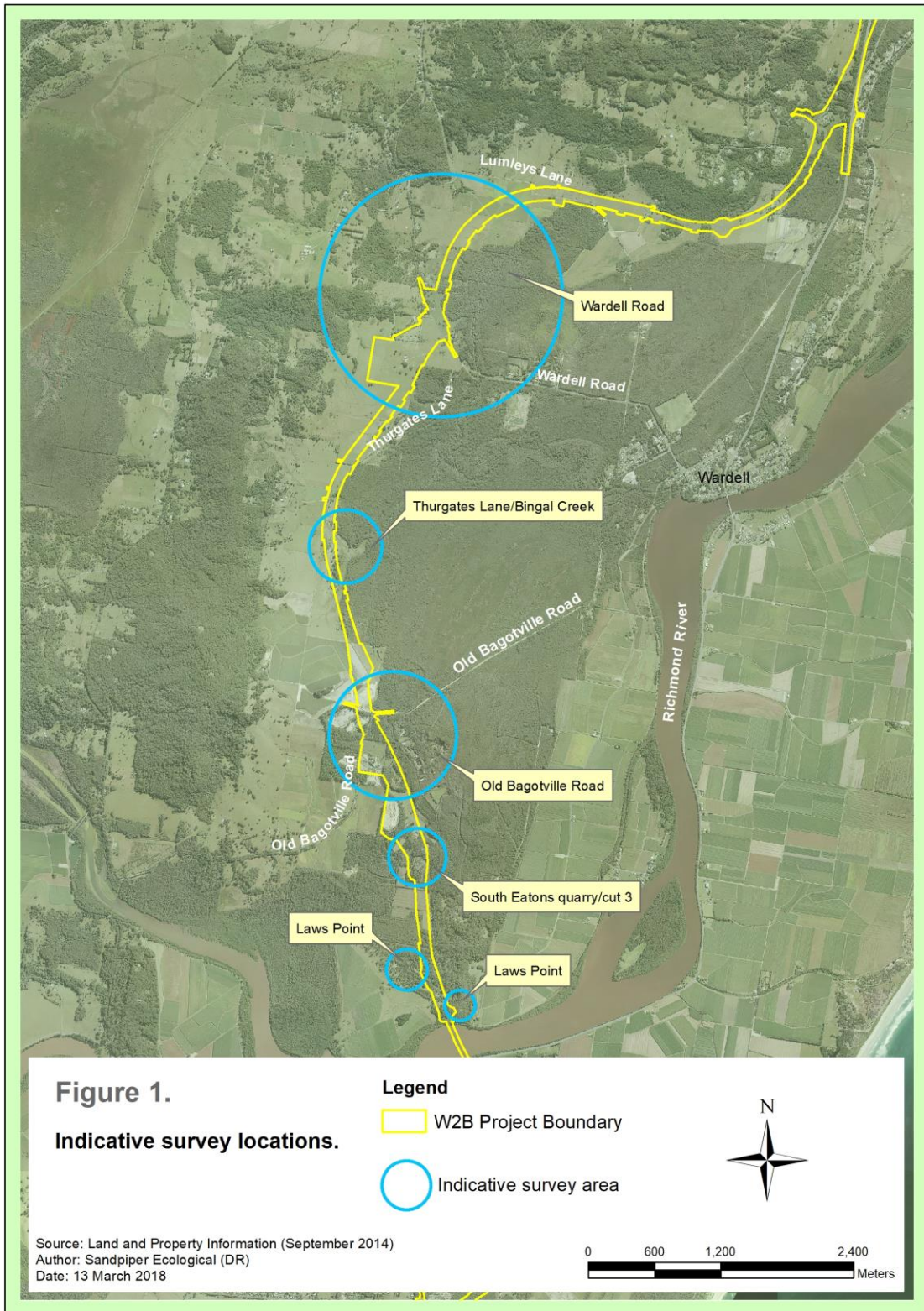
The final phase of the PRR program identified possible changes in koala distribution and occurrence at both sample sites (Sandpiper Ecological 2018 & in prep). In addition, Lismore Friends of the Koala (FOK) suggested that targeted surveys be undertaken following clearing to gather additional information on koala distribution and health in vicinity of the upgrade. Sandpiper Ecological (2018) recommended a targeted survey to assess the distribution and health of koalas at key locations adjoining the W2B upgrade.

Sandpiper Ecological Surveys (SES) was subsequently contracted by Pacific Complete to undertake targeted surveys for koalas at three locations within and/or adjoining Section 10 of the W2B upgrade. The aim of the surveys was to supplement the PRR koala population surveys, with a specific emphasis on the health of koalas adjoining the alignment.

The author acknowledges the assistance of private land owners and the Jali Local Aboriginal Land Council who provided access to their properties for koala surveys.

1.2 Study area

Surveys were undertaken at three locations adjoining Section 10 of the W2B upgrade, Law's Point, Old Bagotville Road (OBR), and Wardell Road (Figure 1). Survey coverage of sample sites was dictated by access permission from land owners. Access to targeted sample sites was achieved at Law's Point and Old Bagotville Road but not at Wardell Road. Surveys at Wardell Road were restricted to public land (Road Reserves and RMS owned land), the Ngunya Jargoan Indigenous Protected Area (IPA) and two private properties.



2. Methodology

2.1 Koala detection dog

Diurnal surveys were completed by one ecologist (SES) and one detection dog and handler (TATE Animal Training) at key locations within the study area between 26 and 29 March 2018 (Appendix A). These locations were pre-determined on the basis of historical koala records, local knowledge of the existing koala population and individual koala movements and the occurrence of potential koala habitat (i.e. areas with a high density of primary feed trees). Each survey location was traversed on foot to allow searches for koala faecal pellets (scats) to be undertaken by the ecologist and koala detection dog. The location of scats was recorded (GPS) along with tree details under which the scat was found and approximate age of the scat. Ageing scats is inherently difficult and was more challenging in this instance due to persistent showers prior to and during the detection dog surveys. Intensive searches for koalas were completed in the immediate area that scats were detected, particularly where they were determined to be fresh or recent scats.

2.2 Spotlighting and diurnal surveys

Spotlight and diurnal (Law's Point only) surveys were completed by two ecologists at 14 transects between 20 March and 5 April 2018. Transect length ranged from approximately 100m to 1500m depending on the extent of potential/suitable koala habitat at each transect location. Surveys were conducted using Led Lenser (max 800 lumen) hand-held spotlights and binoculars. At Law's Point, surveys were concentrated in areas of known koala habitat on the eastern and western sides of the PRR study area. These areas were sampled on two non-consecutive nights and days. At Wardell Road, six transects were sampled on one occasion. Sample sites were distributed north, south and east of the W2B alignment (Figure 1). At Old Bagotville Road, six transects were sampled, five once and one twice. Data collected during spotlight surveys included start and end time, personnel, temperature range, cloud cover, wind speed, and rainfall (Appendix A).

2.3 Koala health assessment

Data collected on koalas recorded during field surveys included: sex, age category, name/code (if recorded previously), tree species used, tree diameter at breast height, breeding status, and health. Health criteria were based on information provided by Lismore Friends of the Koala (FoK). The FoK criteria include a comprehensive list of field-based health assessment criteria. To avoid undue disturbance of individuals at night, through prolonged use of spotlights, a summarised version of the FoK criteria was adopted. This included:

- clarity and brightness of eye shine;
- evidence of closed, partially closed, or “weepy” eyes;
- alertness and posture;
- body condition, pelage colour and sheen; and
- colour of bottom fur and presence of a wet tail.

Where fresh scat was available, details were also recorded on scat formation (e.g. whether they were well formed, malformed or watery). Fresh scats were collected for cortisol analysis. Scats from each sample were immediately placed in a paper bag and into a freezer within 2hrs of collection.

3. Results

3.1 Detection dog surveys

The detection dog identified koala scats at 18 sites (Table 1; Figures 2, 3 & 4). However, no koalas were recorded during the detection dog surveys. Scats were recorded at nine sites around Wardell Road, including two sites north of the alignment, one west of the alignment and six east of the alignment (Figure 4). The number of sites with scats broadly corresponds to the size of the area sampled. No scats were recorded in forest red gums immediately east of the alignment. The age of scats at Wardell Road ranged from fresh (<2 days) to old (>2 weeks). The majority of scats detected east of the alignment were <2 weeks old. In contrast, scats north and east of the alignment were greater than 2 weeks old.

Scats were recorded at four sites around Old Bagotville Road, three north and one south (Figure 3). Fresh scats (<2 weeks old) were recorded on both sides of OBR including one immediately adjacent to each of the northern and southern koala exclusion fences (i.e. on habitat side of fence). Jali quarry is situated west of the alignment and also adjoins Old Bagotville Road. The detection dog found scats at five sites at Jali quarry. Four samples were classified as older than two weeks and one sample as <2 weeks old. No koala scats were recorded south of Eaton's Quarry/OBR.

Table 1: Details of koala scats located by detection dog.

Site	Date	Approx. age of scat	Tree species	DBH (mm)	Easting	Northing	Notes
Wardell rd	26.3.18	Fresh <2 days	Swamp mahogany	540	543281	6798363	Second fresh scat found by Taylor nearby same tree
		Recent <2 weeks	Swamp mahogany	500	543047	6798345	
		Recent <10 days	Swamp mahogany	600	543037	6798378	
		Recent <10 days	Broad-leaved paperbark	360	543035	6798434	Swamp mahogany nearby
		Recent <10 days	Camphor laurel	80	543059	6798486	Swamp mahogany nearby
		Old >2 weeks	Tallowwood	750	542887	6798015	
Jali Quarry	27.3.08	Recent <2 weeks.	Tallowwood	280	541809	6794673	Second fresh scat found by Taylor nearby same tree
		>2 weeks	Brush box	340	541785	6794654	Scats wet, difficult to determine age
		>2 weeks	Tallowwood	220	541763	6794670	
		>2 weeks	Iron bark	270	541793	6794796	
		>2 weeks	Tallowwood	180	541855	6794773	Scat e.g. press seal
OBR north	27.3.08	Recent <2 weeks	Broad-leaved paperbark	450	542132	6795245	
		>2 weeks	Swamp Mahogany	510	542130	6795223	
		Fresh, <1 week	Broad-leaved paperbark	330	542176	6795158	
OBR south	27.3.08	Recent <2 weeks	Forest red gum	240	542460	6795172	Scat e.g. press seal
Tilsleys	29.3.08	>2 weeks	Camphor laurel	2000+	542475	6799352	
		>2 weeks	Tallowwood	290	542473	6799394	
A. Steele	29.3.08	>2 weeks	Tallowwood	310	541402	6798530	Old scats under adj. grey gums

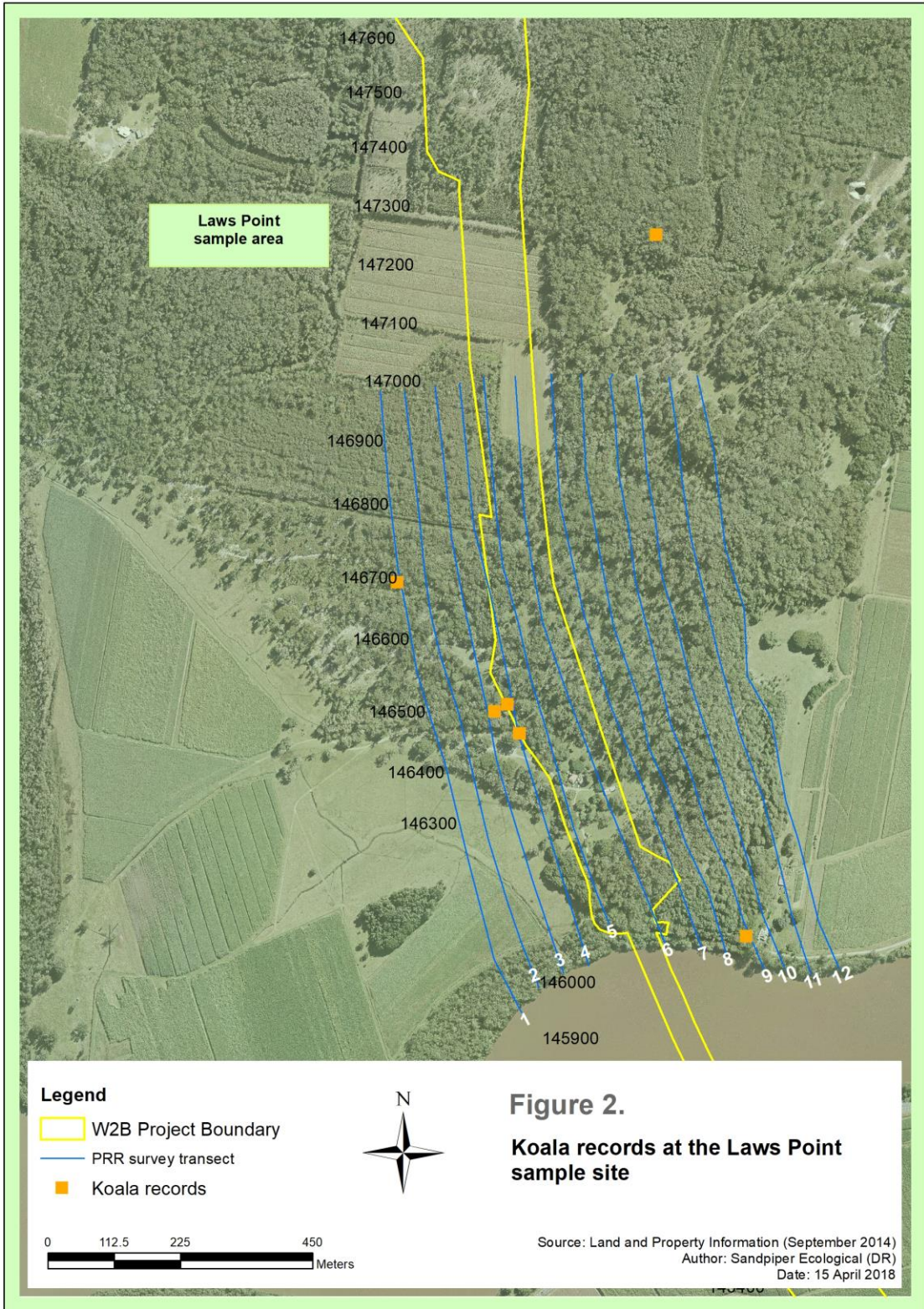
3.2 Spotlight and diurnal surveys

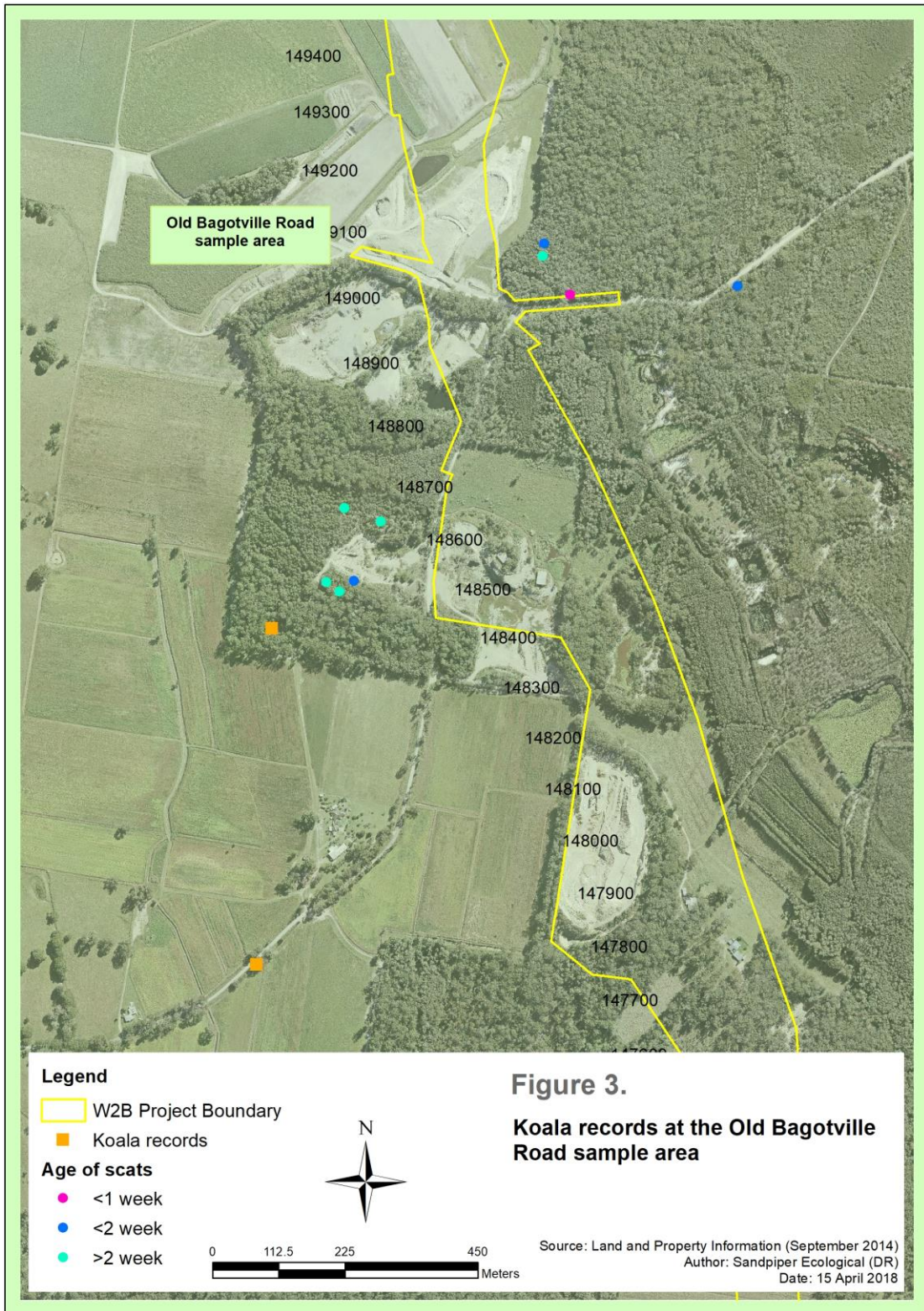
Nine koalas were recorded during spotlight and diurnal surveys, four at Law's Point, two at Wardell Road, two at OBR, and one south of Eaton's quarry (Table 2, Figures 2, 3 & 4). At Law's Point one adult male, two adult females and one sub-adult male were recorded (Figure 2). Three individuals (adult male, sub-adult female and adult female) were recorded west of the alignment, and one adult female was recorded east of the alignment. The sub-adult male was recorded in the same tree on four occasions during the Koala Health surveys.

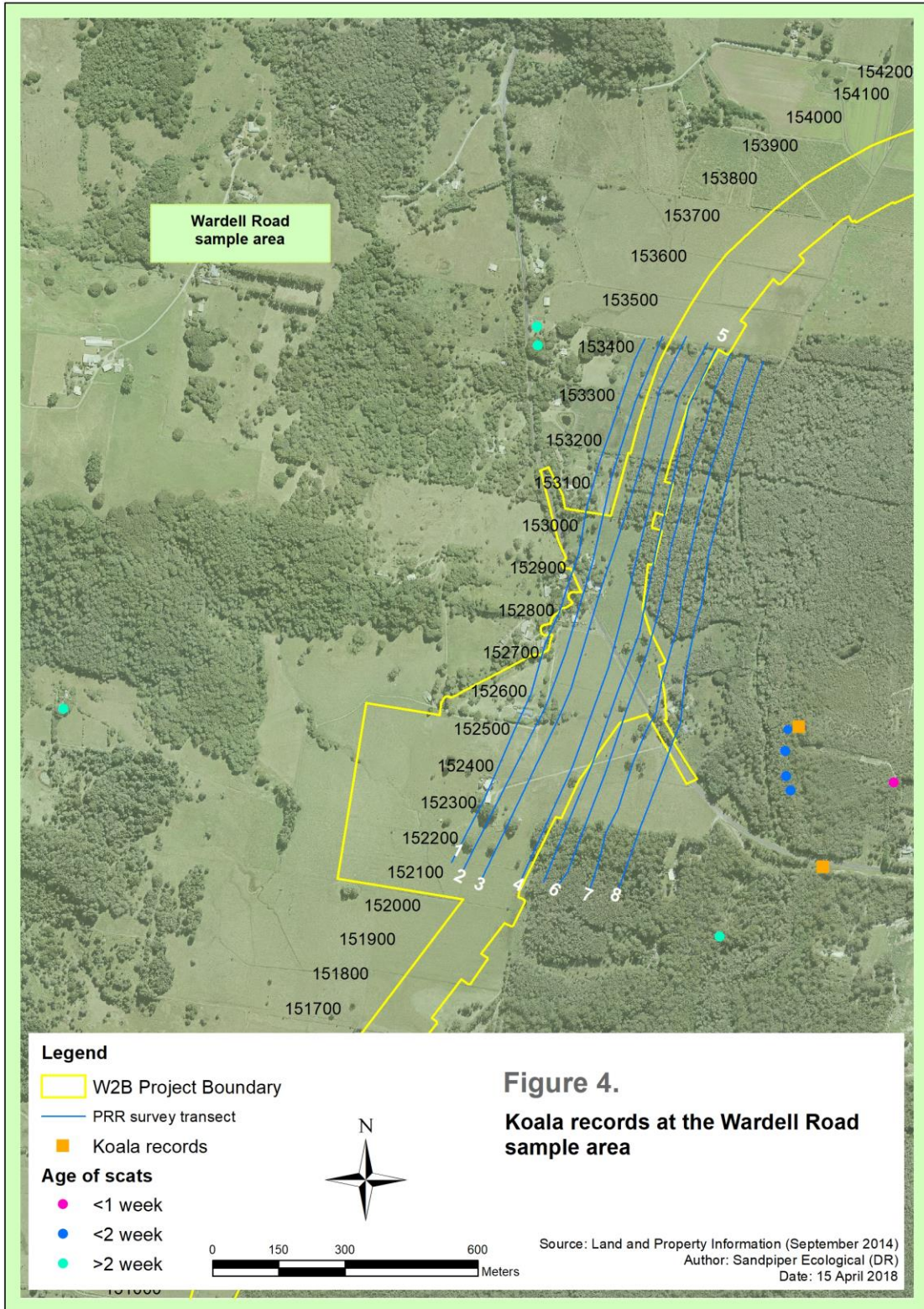
Two koalas were recorded at OBR, an adult female in the Jali quarry, immediately west of the alignment, and an adult male in the road reserve further along OBR, approximately 500m west of the alignment (Figure 3). A sub-adult male was recorded east of the alignment at Cut 3, south of Eaton's Quarry (Figure 2). At Wardell Road, a probable sub-adult male and adult female were recorded north and south of Wardell Road east of the alignment (Figure 4). No koalas were recorded in forest red gums on the immediate eastern side of the alignment at Wardell Road.

Table 2: Details of koalas recorded during spotlight and diurnal surveys.

Date	Record No.	Same individual as	Sex	Tree species	DBH (mm)	Time	Easting	Northing
20.3.18	KH1	Brown back	Male	<i>Eucalyptus robusta</i>	95	2044	542344	6792945
20.3.18	KH2	Rana	Female	<i>Eucalyptus tereticornis</i>	900	2200	542937	6792344
21.3.18	KH3	Jug	Sub-adult male	<i>Eucalyptus tereticornis</i>	680	0950	542552	6792689
23.3.18	KH3	Jug	Sub-adult male	<i>Eucalyptus tereticornis</i>	680	0905	542552	6792689
28.3.18	KH4	Bellamina	Female	<i>Eucalyptus robusta</i>	700	1015	542509	6792726
28.3.18	KH3	Jug	Sub-adult male	<i>Eucalyptus tereticornis</i>	680	0905	542552	6792689
3.4.18	KH5	N/A	Female (pr)	<i>Eucalyptus robusta</i>	300	1840	543120	6798172
3.4.18	KH6	N/A	Sub-adult male (pr)	<i>Eucalyptus robusta</i>	275	1910	543065	6798489
4.4.18	KH7	N/A	Male	<i>Eucalyptus resinifera</i>	850	1900	541644	6794022
4.4.18	KH8	N/A	Female (pr)	<i>Eucalyptus microcorys</i>	175	1930	541670	6794592
4.4.18	KH9	N/A	Sub-adult male	<i>Corymbia intermedia</i>	250	2135	542784	6793536
5.4.18	KH3	Jug	Sub-adult male	<i>Eucalyptus tereticornis</i>	680	1900	542552	6792689
5.4.18	KH4	Bellamina	Female	<i>Eucalyptus patentinervis</i>	650	1905	542531	6792738







3.3 Koala health

All koalas observed during the surveys displayed good body condition, alertness and dry rump (Table 3). No missing or matted fur, asymmetry, obvious breathing, coughing or abnormal behaviour was observed, although two (probable) adult females (KH5 & KH8) displayed evidence of past injuries or ill health. Two koalas were observed in non-primary feed trees but there were no incidences of koalas feeding on non-primary feed trees. Fresh scats were located on the ground beneath four of the nine koalas assessed. These scats were collected for cortisol analysis (Table 4). All scats collected were well formed and no watery or malformed scats were observed.

Table 3: Visual assessment of health of koalas recorded during spotlight and diurnal surveys.

Physical signs	KH1	KH2	KH3	KH4	KH5	KH6	KH7	KH8	KH9
Eyes									
Clear eyes	x	High in canopy, difficult to observe	x	High in canopy partly hidden	Observed from Wardell Road	x	No clear view of eyes	x	x
Clear bright eye shine	x	x	x	x	Left eye closed/missing. Eye shine from right eye clear and bright	x		x	x
Body/disposition									
Condition	Robust	Robust	Good	Good	Robust	Good	Robust	Good	Good
Alert	x	x	x	x	x	x	x	x	x
Rump									
White markings			x						
Yellow to brown staining	Slight			x		Slight	Slight	Distinct brown	
Wet/dry	Dry		Dry	Dry	Dry	Dry	Dry	Dry	Dry
Fur									
Thick grey	x		x	x	x	x	x		x
White markings	x		x	x					x
Brown markings	x						x		
Dry	x		x	x	x	x	x	x	x
Matted						Clean coat	Clean coat		Clean coat
Scats									
Well formed	N/A	N/A	x	x	N/A	N/A	x	x	x numerous

Two (probable) adult female koalas displayed some evidence of (previous) ill health. One individual (KH5) was missing an eye, potentially a past injury from fighting, or the eye was completely closed due to chemosis associated with chlamydial keratoconjunctivitis (Obendorf 1983; Wan *et al.* 2011). That koala was observed on land with access restrictions and observations could only be made from a distance of >50m. The second probable female (KH8) had distinct brown staining of the rump. The level and colour of brown staining observed is generally an indication of clinical urogenital tract

disease associated with chlamydial infection and resulting urinary incontinence (Obendorf 1983; Jackson *et al.* 1999; Wan *et al.* 2011). However, the absence of wet fur around the rump suggests that the staining may be associated with a previous infection that has since been naturally suppressed or an inactive urogenital tract disease (Jackson *et al.* 1999; Wan *et al.* 2011).

Table 4: Scats collected from near the S10/11 alignment and at a control site during the koala health assessment. SM = swamp mahogany; FRG = forest red gum.

Date	Record No.	D/N	Time	Easting	Northing	Tree sp.	DBH	Health
4/4/18	KH7	N	1900	541644	6794022	Red mahogany	850	Dry bottom slight brown stain.
4/4/18	KH8	N	1930	541670	6794592	Tallowwood	175	Very brown bottom, dry. Clear eye shine
4/4/18	KH9	N	2135	542784	6793536	Pink bloodwood	250	Very healthy
5/4/18	KH4 (Bellamina)	N	1905	542531	6792738	SM/FRG hybrid	650	Slight stain bum, dry.
23/5/18	KHC1	D	0800	529830	6800122	Forest red gum	300	Healthy
23/5/18	KHC2	D	0830	528915	6800272	Forest red gum	400	Healthy
23/5/18	KHC3	D	0900	529742	6800148	Forest red gum	750	Brown tail
23/5/18	KHC4	D	0930	531200	6801689	Forest red gum	450	Brown tail, wet

4. Discussion

A total of nine koalas were detected within the study area during the koala health surveys. This included four koalas that have previously been recorded (as part of PRR surveys) and five additional koalas that had not previously been recorded. It is possible that the sub-adult male (KH9) recorded east of the alignment, south of Eaton's Quarry, is the offspring of Rana (KH2) given its current size and location. Rana and her offspring were regularly observed together during phases 1-4 of the PRR surveys until the offspring presumably dispersed in late 2017. The sub-adult was recorded approximately 1km to the north of where Rana and her offspring were previously observed.

Eight koalas were recorded in the Laws Point hotspot study area during phase 5 of the Phased Resource Reduction (PRR) program, with one additional individual (F2) recorded after phase 5 (Table 5). The additional individual F2 may have been the same as F1, which was recorded once during the first phase 5 survey (Sandpiper Ecological 2018). One adult female (Yahzi) was euthanased due to ill health prior to completion of phase 5 (Sandpiper Ecological 2018). At completion of phase 5, five koalas were known to occur in the Laws Point study area. These were Rana, J1, Aubrey, Bellamina, and Jug. F1 (female) and M1 (male) were present during the early part of phase 5 only. During the koala health assessment surveys four of the five individuals present in phase 5 were recorded, Rana, Aubrey, Bellamina, and Jug. Rana's joey (J1) was the only individual, based on phase 5 results, that was expected to occur but was not recorded. Based on its age J1 should be independent of Rana but likely to occur in a nearby tree.

On 17 May 2018, during autumn koala population surveys, four koalas were recorded opportunistically in a *Eucalyptus patentinervis* west of the alignment at Laws Point (S. Fitzgibbon pers comm). Those individuals included an adult female (possibly Bellamina), sub-adult male (possibly Jug) and an adult male (possibly M1). The fourth individual was not identified. The (identified) adult male was not Aubrey based on absence of distinctive brown markings on the belly and flank.

The occurrence of two koalas, including a sub-adult, east of the alignment, and scats west and north of the alignment, at Wardell Road proves that koalas remain in that area. Scats recorded adjacent to Wardell Road north of the alignment are consistent with a koala sighted crossing Wardell Road on 22 March 2018. The spatial extent of surveys at Wardell Road was limited by access to private property. Surveys on private properties immediately west of Wardell Road, where koalas were recorded during the PRR program would be beneficial. The number of koalas recorded in the vicinity of Wardell Road was consistent with results obtained during the PRR monitoring program.

Table 5: Koalas recorded during phase 5 of the PRR and during the KHA. * = Individual euthanased by vet following capture and health assessment by FoK; ** = potentially same individual as F1.

Name or Code	Sex	Occurrence during PRR	Recorded during KHA
Rana	Female	Phase 1 to 5	Yes
J1	Unknown (Rana's joey)	Phase 4 & 5	
F1	Female	Phase 5	
Aubrey	Male	Phase 1 to 5	Yes
Yahzi*	Female	Phase 1 to 5	
Bellamina	Female	Phase 1 to 5	Yes
Jug	Male (Bellamina's joey)	Phase 5	Yes
M1	Male	Phase 5	
F2**	Female	Post PRR	

The results of the Koala Health Assessment reveal positive signs for the local koala population in that all koalas recorded were observed to be relatively healthy, with most individuals showing no confirmed visible signs of disease or poor condition. This is particularly encouraging with regard to koalas recorded around Wardell Road, as a relatively high incidence of disease was observed in individuals occurring in that area during previous studies (Sandpiper Ecological 2017; Ecosure *et al.* 2016).

Results should be interpreted in the context of the assessment methodology and limitations relating to the spatial and temporal coverage of the assessment considered. In addition, the majority of koalas were detected at night, which not only presents difficulties in observing certain signs and symptoms of disease, but also requires a more rapid assessment to ensure individual koalas are not subjected to excessive disturbance from prolonged spotlight use. Visibility was also hindered when individuals were positioned high in the tree canopy or hidden by foliage. Furthermore, a visual assessment of health does not rule out the possibility of subclinical illnesses that lack detectable signs and symptoms (Jackson *et al.* 1999; Wan *et al.* 2011). Additional monitoring and assessment would be required to more conclusively infer the absence of disease in individual koalas occurring in the study area.

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Appendix A – Field Survey Data

Table A1: Survey effort and weather variables.

Date	Survey location	Survey No.	Observers	Start	End	Temp. range	Cloud cover %	Wind	Weather/rain
20.3.18	Law's Point	1N	MJ, BT	1930	2220	23-24	0	MSB	Fine
21.3.18	Law's Point	1D	MJ, BT	0935	1210	23-26	75	MLB	Fine
23.3.18	Law's Point	2D	MJ, BT	0810	1040	21	90	MLB	Windy, showers
26.3.18	Wardell rd east of alignment (south along rd edge, north along drain, behind Karly's house and adjacent to pond) and thurgates In north	1D	MJ, Claire & Taylor	0900	1430	25-29	20	MSB	Fine
27.3.18	Jali Quarry west & OBR N&S	1D	BT, Claire & Taylor	1300	1730	25-23	90	MSB	Showers
28.3.18	Law's Point	3D	BT, Claire & Taylor	0700	1130	22-24	40	MSB	Fine
29.3.18	Wardell rd west of alignment (Lumleys, Tillsley, Steele) & thurgates In behind old house	1D	BT, Claire & Taylor	0700	1120	23-24	25	MSB	Fine
3.4.18	Buckombil mt rd, Lumleys In, Wardell rd east/thurgates In north, south, behind old house, and near compo habitat, bingal ck/OBR N&S roadside	1N	MJ, NP	1800	2315	22-23	0	MSB	Fine
4.4.18	OBR habitat to north, Jali Quarry west, OBR west of alignment, east of quarry pond, Cut 3 west (track) and east (north of PRR transects)	1N	MJ, NP	1715	2245	24-22	5	MSB	Fine
5.4.18	Law's Point and north of PRR transects	2N	MJ, NP	1830	2045	23-21	5	MSB	Showers