



Transport for  
New South Wales

# Warrell Creek to Nambucca Heads Pacific Highway Upgrade

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

Transport for New South Wales | March 2024



# Pacific Highway Upgrade: Warrell Creek to Nambucca Heads (WC2NH)

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



SANDPIPER  
ECOLOGICAL  
SURVEYS

Final Report  
March 2024

# Document Distribution

Date	Version	Status	Sent to	Represent	Delivered Format	Dispatched By
20/2/2024	A	Draft	L. Andrews & D. Rohweder	Sandpiper	MSW	N. Steel
28/2/2024	1	Draft	J. Sheehan	TfNSW	MSW	L. Andrews
1/3/2024	2	Final	J. Sheehan	TfNSW	MSW	L. Andrews

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**Cover Photo:** Koala recorded on the western side of the alignment during nest box monitoring in spring 2022.

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# 1 Introduction

In 2015, Transport for New South Wales (TfNSW), in conjunction with Acciona Ferrovia Joint Venture (AFJV), commenced the upgrade of the Pacific Highway between Warrell Creek and Nambucca Heads (WC2NH). The WC2NH project was opened to traffic in two stages: stage 2a - 13.5km section from Lower Warrell Creek Bridge to Nambucca Heads opened on 18 December 2017; and stage 2b 6.25km section from the southern end of the project to the Lower Warrell Creek bridge opened in late June 2018.

Approvals for the WC2NH upgrade required monitoring of several species and mitigation measures during the operational phase. Species and mitigation measures targeted include koala, yellow-bellied glider, giant barred frog, green-thighed frog breeding ponds, underpasses, vegetated median, roadkill, exclusion fence, and threatened flora. Sandpiper Ecological Surveys (SES) has been contracted by TfNSW to deliver the WC2NH operational ecological and water quality monitoring program.

The following report details the results pertaining to koala in year four and five of operational monitoring, which extends from August 2021 to August 2023. The report summarises results obtained from three monitoring tasks: koala population surveys; monitoring of underpasses and adjacent habitats and opportunistic records obtained during yellow-bellied glider population monitoring in Nambucca State Forest. The aim of koala monitoring is to identify changes in resident koala activity (abundance, home range and movements) in response to construction of the WC2NH upgrade and assess the effectiveness of koala habitat connectivity mitigation measures (i.e. fauna underpasses and exclusion fencing).

## 1.1 Background

The impact of the upgrade on koala (*Phascolarctos cinereus*) was assessed in the Project Environmental Assessment (Sinclair Knight Merz [SKM] 2010a, SKM 2010b), and following its listing on the *Environment Protection and Biodiversity Conservation Act 1999*, a supplementary assessment in accordance with the *EPBC Act Policy Statement 1.1 Significant Impact Guidelines* (Geolink 2016). The supplementary assessment found that the project would have negative impacts on koalas utilising the Nambucca State Forest/ Old Coast Road area, mainly through habitat removal and fragmentation. The Project, with effective implementation of proposed mitigation measures, was found to be unlikely to result in a significant impact to the local koala population. Notwithstanding, as the Project adversely affected habitat that satisfied the SEWPaC (2012) definition of 'habitat critical to the survival of the species' (including direct removal of approximately 86.5 ha of vegetation that satisfies this criteria) it was considered to constitute a significant impact on the koala as per the DSEWPaC (2012) and DoE (2013a) guidelines.

Measures implemented to minimise impacts on koalas include:

- Ecological monitoring to determine the effectiveness of mitigation measures undertaken as part of the Project.
- Installation of fauna crossings, and fauna exclusion fencing to allow for safe passage of fauna (including the koala) crossing the Pacific Highway.
- Installation of 'floppy-top' fauna exclusion fencing to minimise road strike.

Prior to construction, a koala monitoring methodology was developed to establish a pre-construction baseline. This involved conducting initial surveys during the autumn and spring of 2014 to assess the koala population and habitat conditions (SKM 2014). Subsequent monitoring efforts were carried out during the construction

phase, with surveys conducted in the spring of 2015 (year 1 of construction) and 2017 (year 3 of construction) (Geolink 2017). As per the operational phase monitoring requirements, surveys were also conducted in the spring of 2018 (year 1 of operation) and 2020 (year 3 of operation), by Sandpiper Ecological (2018, 2021).

The following report describes the methods and results of the final year (Year 5) of koala population monitoring during the operational phase of the WC2NH project. It also evaluates the effectiveness of habitat connectivity measures, such as underpasses and exclusion fencing, in enabling koala movement and preserving habitat integrity. The report covers the targeted koala surveys conducted in spring 2022 and compiles all recorded koala data from baseline, construction, and operational monitoring phases. It examines koala movement patterns and underpass use, and assesses any changes in habitat use and the success of the mitigation strategies based on the following outcomes:

- The koala population near Nambucca State Forest/Old Coast Road has remained stable in abundance and distribution.
- The underpasses are used by koalas at a sufficient frequency to sustain the population.
- There have been no or few koala vehicle collisions in the area, indicating effective road risk mitigation.
- The fauna exclusion fencing has remained intact, with no breaches found, and the vegetation management has maintained a clear buffer zone to ensure the fencing effectiveness.

## 1.2 Study area

The WC2NH project covers a total length of 19.75km and extends from Warrell Creek in the south to Nambucca Heads in the north (Figure 1). The alignment bypasses the town of Macksville and the northern section traverses Nambucca State Forest. Koala population monitoring surveys occur within Nambucca State Forest at the northern end of the upgrade.



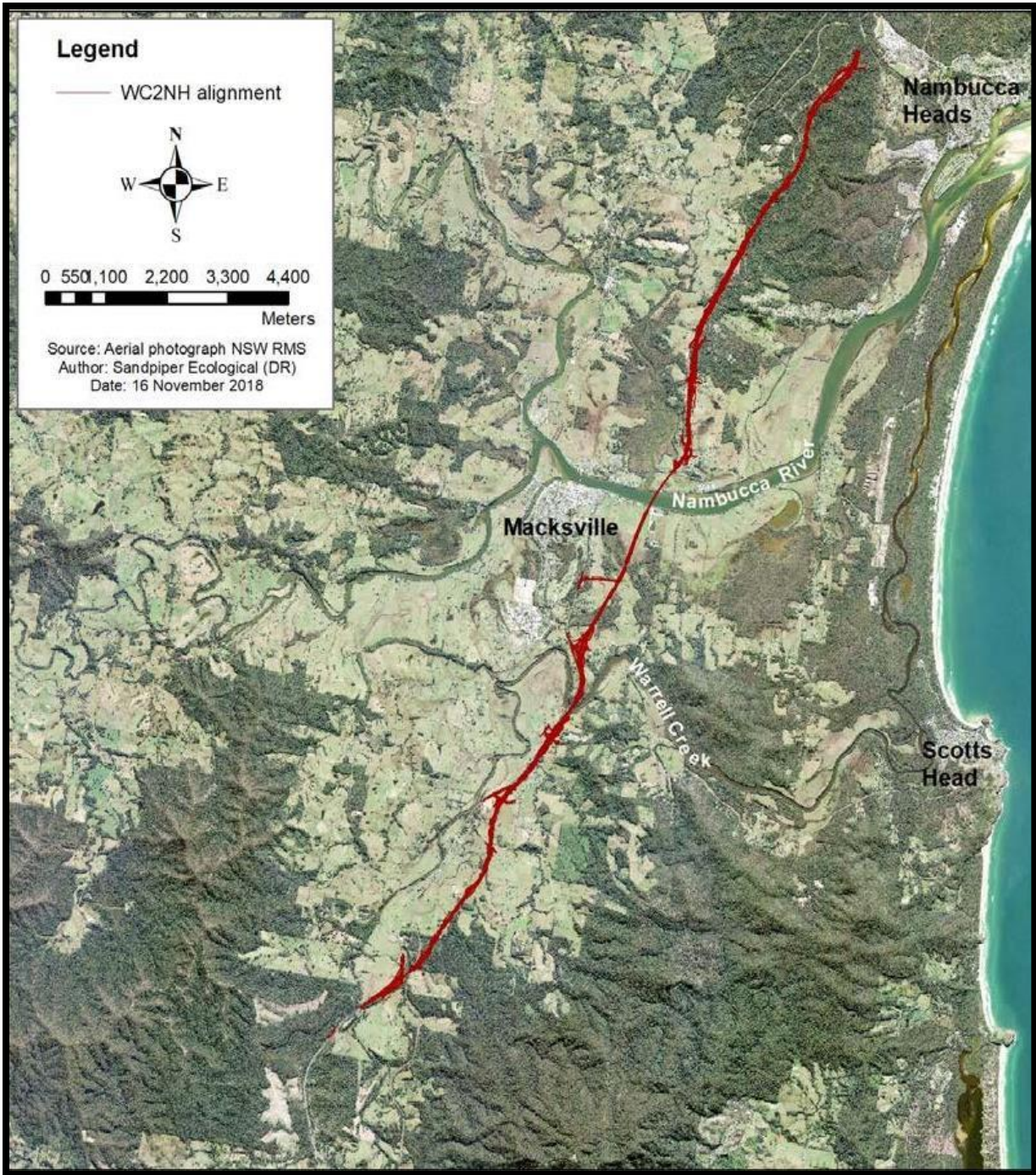


Figure 1: Footprint of the WC2NH Pacific Highway upgrade.

## 2 Methods

Methods used to sample koalas are summarised in the year five operational phase interim koala population monitoring report (Sandpiper 2022a), year five operational phase interim underpass monitoring report (Sandpiper 2023a) and year four operational phase yellow-bellied glider population monitoring report (Sandpiper 2023b). In this biennial report, data includes koala observations from year four and five underpass monitoring and spotlighting efforts, along with song meter recordings from yellow-bellied glider population surveys conducted during year four and six of operation.



## 3 Results

### 3.1 Spring 2022 transect surveys

Two koalas were recorded while completing transect surveys during the spring 2022 sample event (Table 1; Figure 2). Both individuals were healthy and were recorded during night surveys (Table 1). One male koala was recorded on the eastern side of the alignment on transect E13 foraging on a small-fruited grey gum (*Eucalyptus propinqua*) on 28 September 2022 (Table 1). The second individual could not be sexed and was found resting in a black sheoak (*Allocasuarina littoralis*) on the western side of the alignment on transect W10 (Table 1). Koala scats were also recorded beneath a tallowwood (*Eucalyptus microcorys*) on transect E14, and beneath a small-fruited grey gum (*Eucalyptus propinqua*) on transect W10 (Table 2).

Based on the location of koala and scat records during the summer 2022 survey, koala use of adjoining forest was largely evident on ridges and mid-slope within Open Blackbutt Forest located between the central transects 10 and 14 (Figure 1). The combination of scat and koala records confirms the species presence on both sides of the highway.

**Table 1:** Details of koalas recorded during the spring 2022 survey. M = male. A. littoralis = *Allocasuarina littoralis*. Uk= unknown. OBF = Open Blackbutt Forest.

Date	Easting	Northing	Time	Closest transect & distance (m)	Habitat type	Sex	Behaviour	Health	Side of alignment
28/9/22	496638	6609355	Night	E13; 3m	OBF	M	Foraging in <i>E. propinqua</i>	Healthy	East
29/9/22	496603	6609565	Night	W10; 5m	OBF	Uk	Resting in <i>A. littoralis</i>	Healthy	West

**Table 2:** Location of koala scats recorded during spring 2022 transect and track/easement surveys. Datum – GDA 94.

Transect	Evidence	Distance from alignment (m)	Easting	Northing	Date
<b>E14</b>	Old scat beneath tallowwood	70	496879	660881	29/9/22
<b>W10</b>	Fresh scat beneath grey gum	45	497131	6609905	28/9/22

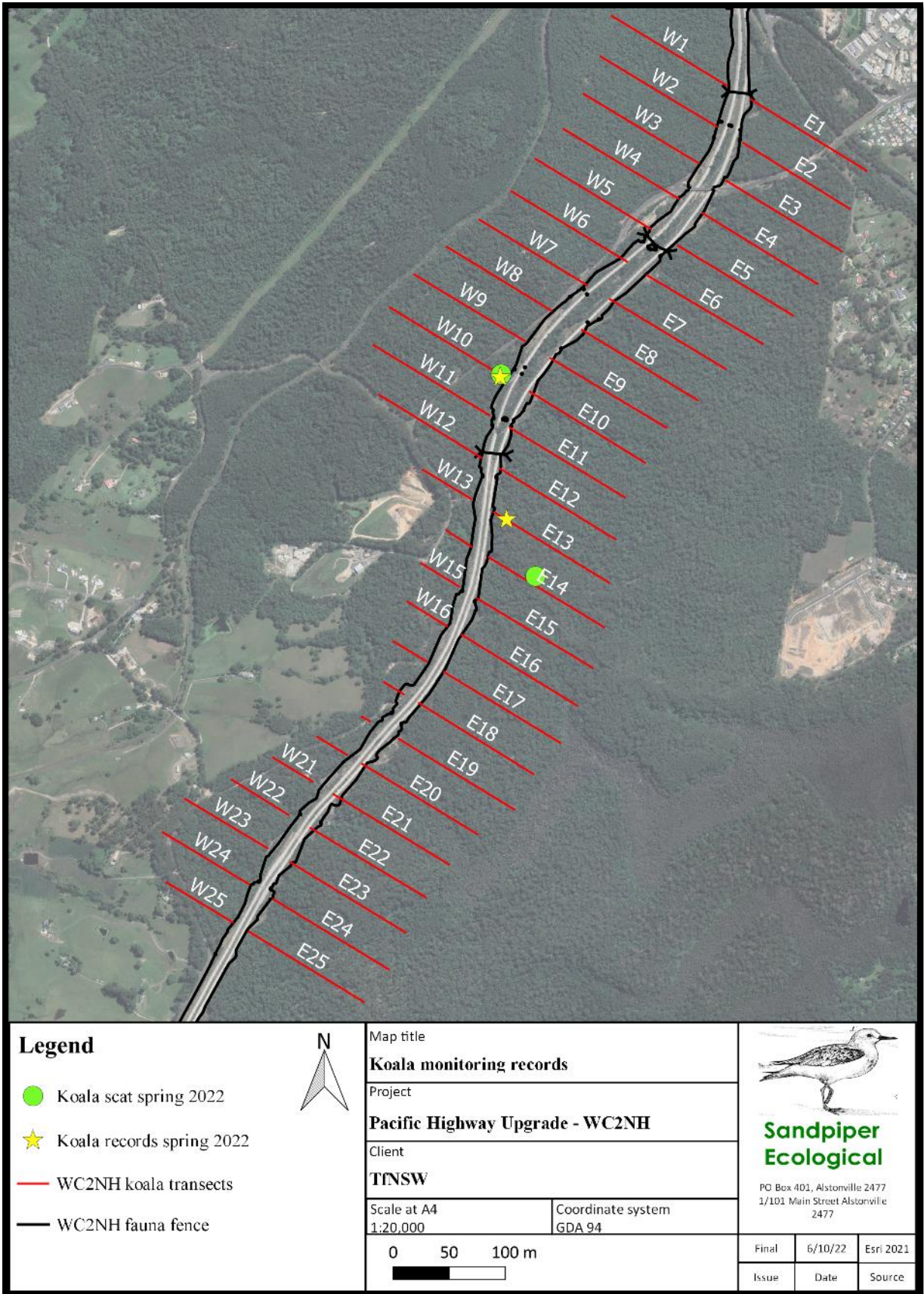


Figure 2: Location of koala records during spring 2022 monitoring at WC2NH.

### 3.2 Underpass monitoring

Koalas were recorded using underpasses to make complete crossings beneath the highway in both years four and five. In year four spring/summer, a koala was recorded via infra-red camera at site 4, and scat was recorded during adjacent habitat diurnal surveys at sites 7 and 8 (Table 3, Fig 3). During winter 2022, four underpasses were used by koalas to make complete crossings, including sites 2 (one occasion), 4 (one occasion) and 11/12 (two occasions) (Table 3, Figures 3 & 4). Scat was also detected in adjacent habitat diurnal surveys during winter 2022 at site 4 (Table 3). In spring year five, one koala was photographed at site 4, and in winter, koalas were detected making complete crossings at sites 9/10 and 11/12 (Plate 1) (Table 3, Figure 3). Adjacent habitat nocturnal surveys in year five spring/summer detected one healthy female on the east side of the alignment at site 9/10, and in winter, one individual was recorded on the west side of the alignment approximately 30 m from the entrance to site 7 (Table 3, Figure 3). Scat was detected in winter during adjacent habitat diurnal surveys underneath a tallowwood (*Eucalyptus microcorys*) on the east side of the alignment at site 11/12 (Table 3, Figure 3).

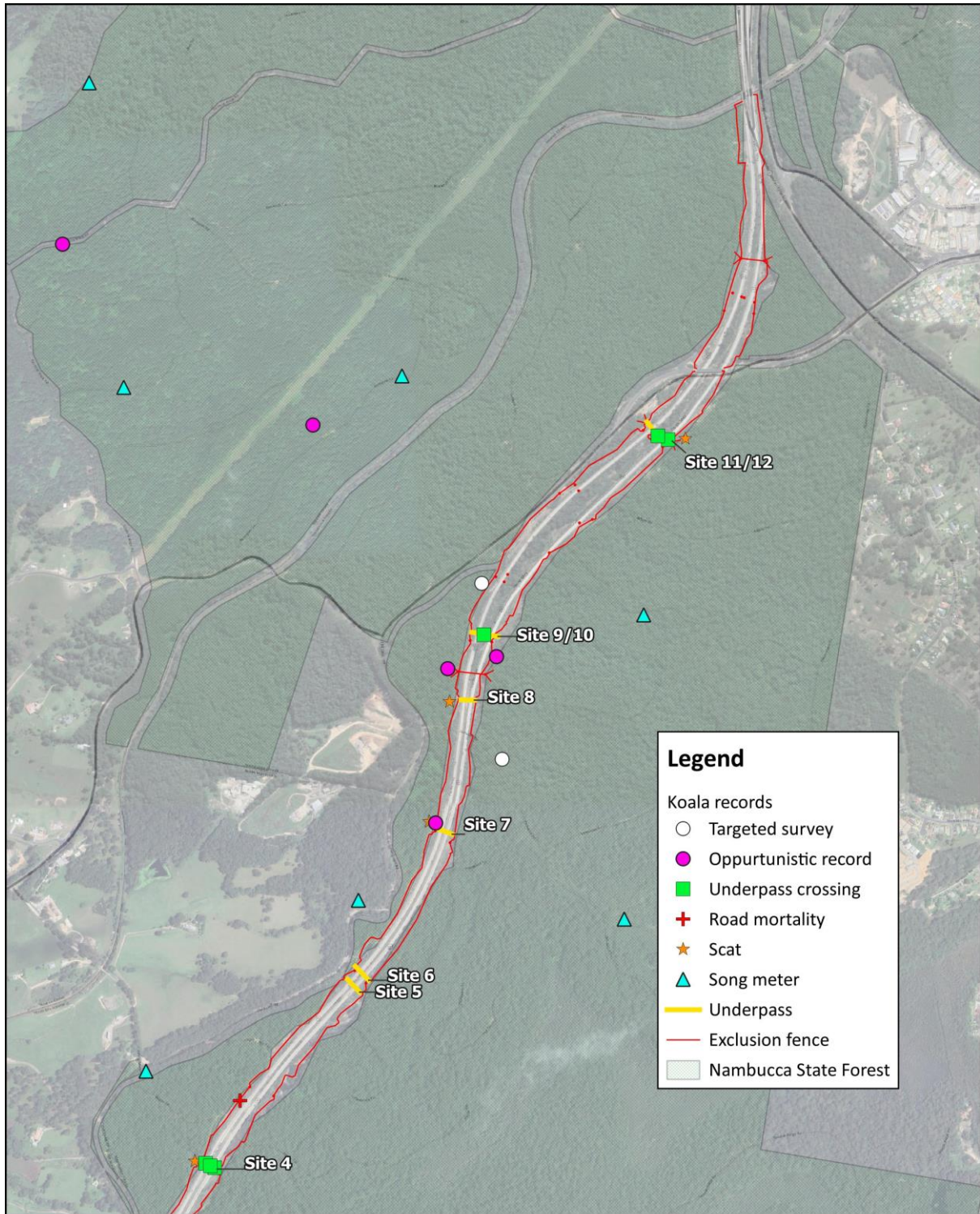


**Plate 1:** Koala recorded moving east through site 12 (L) and 11 (R) on 25 August during winter 2023 monitoring.

**Table 3:** Koalas recorded during underpass monitoring in year four and five operational phase monitoring for the WC2NH upgrade. \* = scat, spr = spring, sum = summer, win = winter.

Survey type	Site			
	Spr/sum 21/22	Win 2022	Spr/sum 22/23	Win 2023
Infra-red camera	4	2, 4, 11/12	4	9/10, 11/12
Adjacent habitat diurnal surveys	7*, 8*	4*		11/12*
Adjacent habitat nocturnal surveys			9/10	7





**Figure: Evidence of koalas recorded during Year 4 and 5 of operational monitoring at WC2NH (Northern extent).**

Project: Warrell Creek to Nambucca Heads (WC2NH)  
 Client: Transport for New South Wales

CRS: GDA94 / MGA zone 56  
 Scale: 1:15000  
 Date: 16/02/2024  
 Acknowledgements: ESRI Satellite Imagery (2020)

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**Figure 3:** Location of koala records during year four and five monitoring at WC2NH (northern extent).





**Figure 4:** Location of koala records during year four and five monitoring at WC2NH (southern extent).



### 3.3 Roadkill records

Two road-killed koalas were recorded along the WC2NH alignment during year four and five monitoring. This included an incidental record on the northbound carriageway at 495821, 6607892 on 9 November 2022, approximately 2.8 km south of the Old Coast Road overpass, and one male during the winter road-kill survey at 494499, 6605063 on 3 July 2023, 290 meters north of the Mattick Road overpass on the southbound roadside verge (Figures 3 & 4).

In response to the koala record on 9 November 2022, an initial fence inspection was undertaken by Sandpiper 200m north and south of the record. A follow up fauna fence inspection was conducted 500m either side of the road-kill location on 10 November 2022 by TfNSW maintenance team to identify any obvious breach locations. Multiple potential points of entry were identified during both inspections, including vegetation against fauna fencing, gap in access gate and two missing panels in fauna fence. Repair work commenced in the week of 21 November 2022 to rectify and eliminate these possible breach causes.

Immediately following the koala road-kill on 3 July 2023, a search was conducted 200 m either side of the incident. The search identified a eucalyptus tree with a diameter of approximately 150mm growing through the fence on the west side, just south of the Site 2 underpass. A follow up inspection was carried out by the TfNSW maintenance team on 7 July 2023 and a small tree with possible koala claw markings over 500 metres north of the incident site was identified and removed. Additionally, heavy vegetation growth was noted and scheduled for mulching, including the tree identified as part of the fence inspection immediately following the koala road-kill.

### 3.4 Opportunistic records

Opportunistic records of koalas were collected whilst conducting spotlight and song meter surveys for yellow-bellied glider and nest-box surveys. Song-meters detected koala at eight sites (S1, 5-7, 9-12) during spring/summer 2021/2022. Calls were recorded on both sides of the highway and extended from song meter #5 near Jacks Ridge Mountain Bike Park in the south to song meter #9 near Gordons Knob Road in the north (Figures 3 & 4). One koala was recorded during yellow-bellied glider spotlight surveys on the west side of the highway on 21/8/2023 along Rosegum Trail (496057, 6610077) (Figure 3). Additionally, during nest-box surveys on 27 July 2022, a koala was recorded approximately 100 metres north-west of underpass 8 (496493, 6609289) (Figure 3).

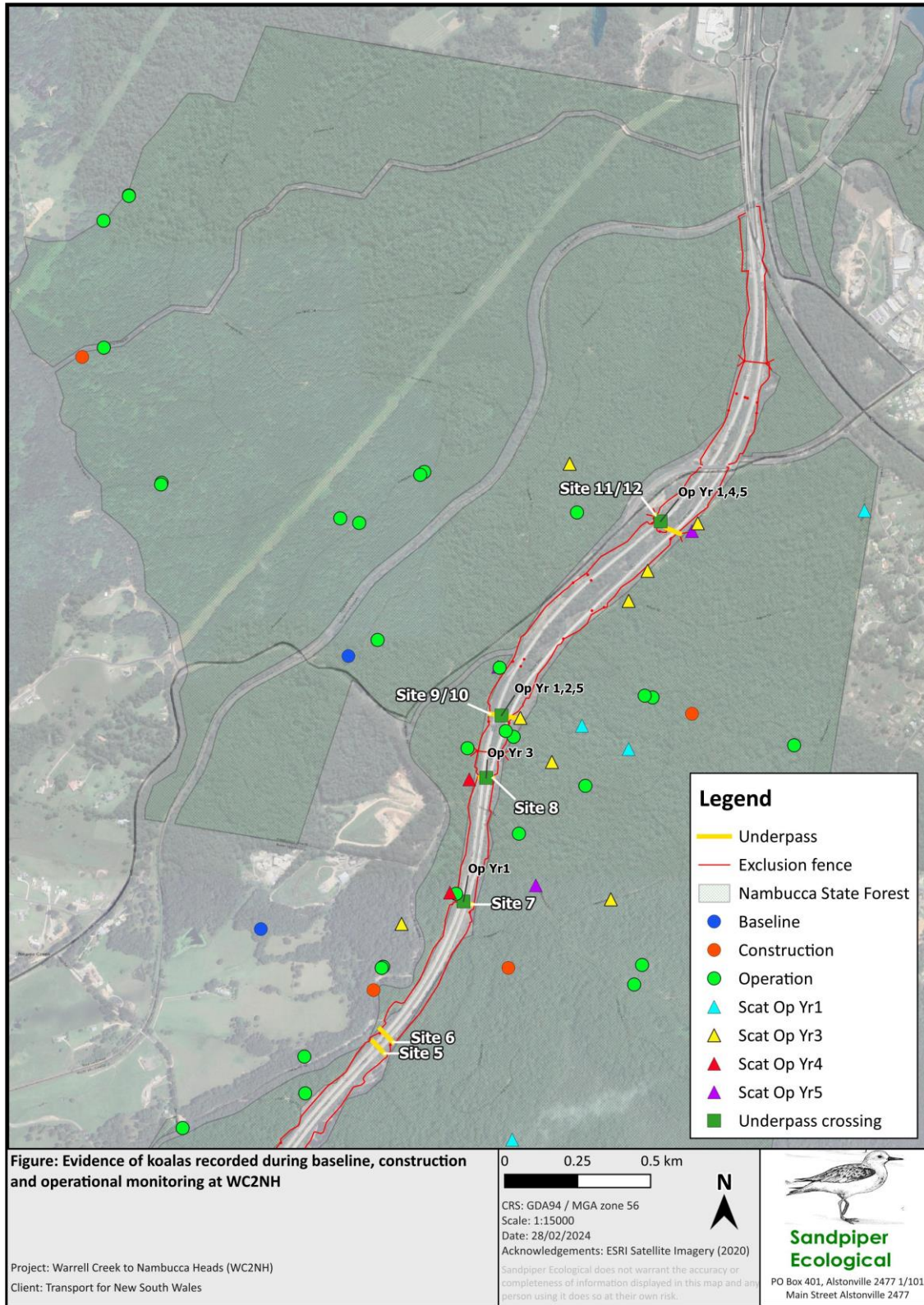
### 3.5 Habitat use and distribution

Throughout monitoring, koalas have been recorded using both Open Blackbutt Forest on ridges and mid slope, and Flooded Gum Moist Open Forest in gullies. Occupied tree species during spring 2022 transect surveys included small fruited grey gum (*Eucalyptus propinqua*) and black sheoak (*Allocasuarina littoralis*), with scats recorded beneath tallowwood (*Eucalyptus microcorys*) and *E. propinqua*.

In 2022, targeted koala records occurred towards the centre of the study area (Figure 5). Year five koala and scat records were in a similar area to the records near sites 7, 8 and 9/10 in baseline, construction year three and operational years one and three (Figure 5).

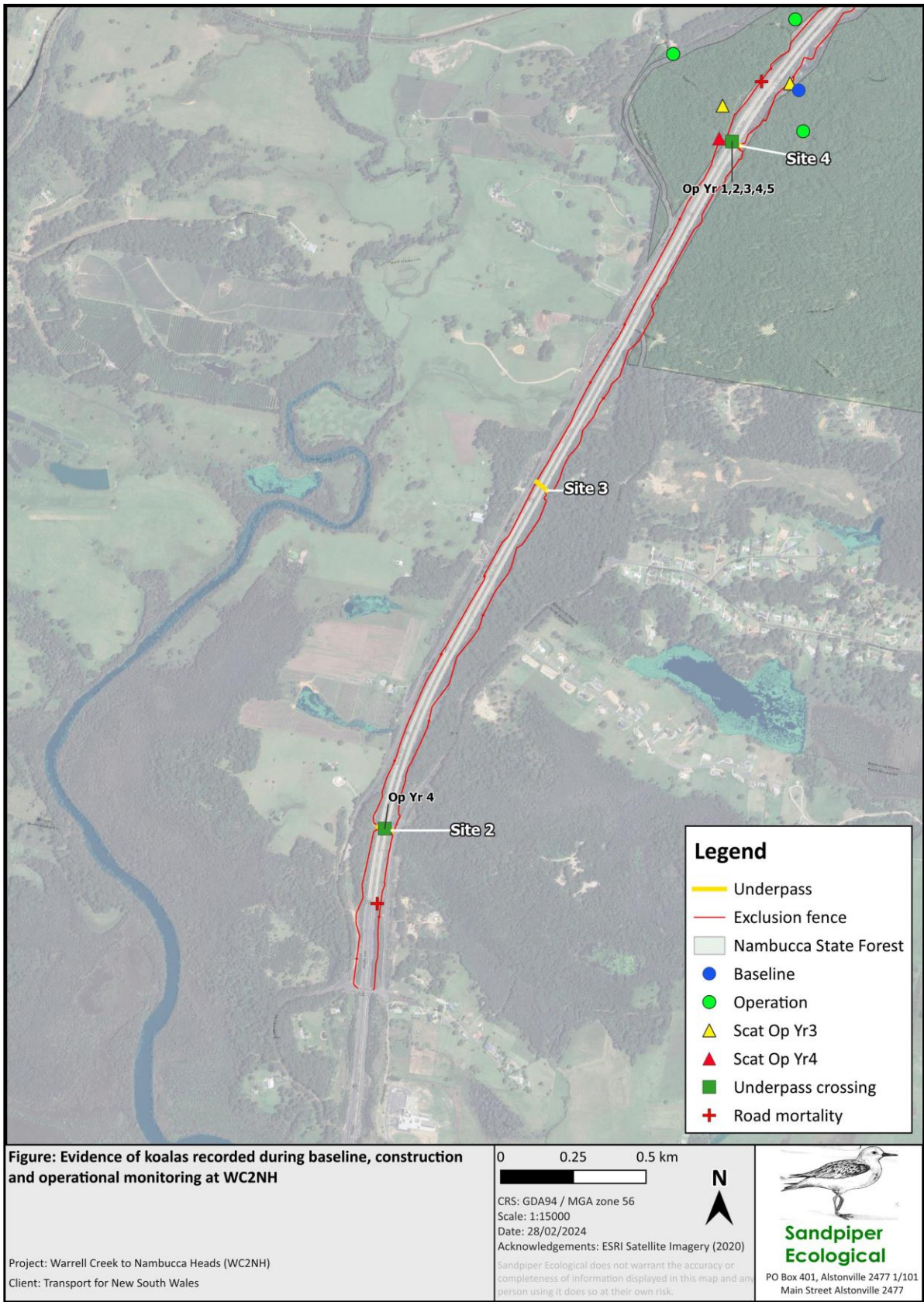
Koala records show that the species continues to use habitat on both sides of the carriageway and records obtained from underpass monitoring show that individuals have utilised dedicated underpasses to move across the carriageway. Throughout operational monitoring, koalas have been recorded using site 4 during all years, sites 9/10 during years 1, 2 and 5, site 11/12 during years 1, 4 and 5, site 8 during year 3 and site 2 during year 4 (Figures 5 & 6).

Opportunistic records including song meter records show that koalas continue to be widely distributed in Nambucca State Forest, with records at song meter 1, 7 and 9-12 throughout both 2020/21 and 2022/23, S2, 3 and 8 during 2020/21 and S5 and 6 during 2022/23. Importantly, the song meter records are opportunistic and a more targeted monitoring program would likely result in additional records.



**Figure 5:** Evidence of koalas recorded during baseline, construction and operational monitoring at WC2NH (northern extent). Dots indicate koalas recorded during targeted surveys, spotlight surveys, song meters and opportunistically.





**Figure 6:** Evidence of koalas recorded during baseline, construction and operational monitoring at WC2NH (southern extent).

## 4 Discussion

### 4.1 Koala population

The two koalas recorded on transect E13 and W10 was the highest number of transect records to date (Table 3). Nonetheless, fewer koalas were recorded during current surveys (2 individual) compared to spring 2018 and spring 2017 surveys (3 individuals; Table 3). Further, no individuals were recorded on tracks and easements where most koalas have been recorded previously (Table 3 refer to previous reports).

Inconsistencies in survey method, particularly the effort expended on tracks and easements where most koalas have been recorded, precludes a robust assessment of possible changes in koala abundance and whether this is associated with the WC2NH upgrade.

**Table 3:** Comparison of koala records during the baseline, construction, and operational phases of the WC2NH upgrade. \* individual recorded on four occasions.

Phase & year	Transect Surveys (diurnal & nocturnal)		Track & Easement Surveys (nocturnal)	Total koalas recorded
	Koalas observed	Koala evidence (scats)	Koalas observed	
Baseline autumn 2014	0	0	1	1
Baseline spring 2014	0	0	1	1
Construction spring 2015	1	1	1	1*
Construction spring 2017	0	2	3	3
Operation spring 2018	1	3	2	3
Operation spring 2020	0	6	1	1
Operation spring 2022	2	2	0	2

Results of 2017 construction phase surveys and 2018 operation phase showed that at least three koalas were residing within the transect survey area, estimated to be approximately 104 ha (Sandpiper Ecological 2021). Home range areas of koalas residing in moderate to high quality habitat on the north coast is reportedly in the range of 23-37 ha (see Lassau *et al.* 2008; Goldingay & Dobner 2014). Koala density in the lower Richmond River range from 0.047 to 0.084 individuals/ha<sup>-1</sup> (Sandpiper Ecological 2024). Home range areas of koalas residing in Nambucca State Forest (NSF) would likely be larger than these estimates due to the lower habitat quality and NSF's forest management history. As such, the study area probably supports few resident individuals.

Despite fewer koala observations during 2022 targeted surveys compared to 2017 and 2018, the presence of several other records suggests that there are most likely more than two koalas residing in the study area. Additional koala records obtained during the year 5 survey period included opportunistic detection of two individuals, scats at six spatially separated locations, detection of koala calls at eight sites, camera records in six underpasses and detection of two individuals during adjacent habitat nocturnal surveys. The presence of calling males at eight sites and the broad distribution of records (see Figures 5 & 6) indicates that the area of NSF east and west of the highway supports a viable koala population.

The impact of clearing for the upgrade on the local koala population is difficult to ascertain. As discussed above, clearing impacts are both compounded and confounded by several exogenous factors acting concurrently on the local koala population. Positive signs of koala persistence include the broad distribution of koala calls and scats across the study area, especially adjacent to the upgrade corridor.

Two road-kill koalas were observed along the WC2NH alignment during year four and five monitoring, including one adjoining NSF near underpass 4. Due to the small population of koalas, these records are significant, and highlight the importance of ongoing fence maintenance to reduce the likelihood of koalas accessing the road corridor.

## 4.2 Habitat use and distribution

Individuals recorded in the recent 2022 surveys were located near underpasses 8 and 9/10 amongst open blackbutt forest on ridgelines, which has previously been noted as a preferred habitat type for koalas at WC2NH, particularly when tallowwood is also present (Sandpiper Ecological 2021).

Koala sightings, call records and scats east and west of the highway corridor combined with numerous complete crossings of six underpasses shows that the WC2NH Pacific Highway Upgrade is not a barrier to movement. The frequency of underpass records strongly suggests that the upgrade has been successful in maintaining habitat connectivity for koalas and the patterns of underpass use indicates use by resident, dispersing and breeding individuals. For example, a (likely) resident koala has used the site 4 underpass to cross the highway 30 times over the five-year survey period. This contrasts with the occasional winter dispersal or spring/summer breeding movements recorded at other underpasses. The ability to move beneath the highway is particularly important to ensure viability of the local population and enable koalas to cope with stochastic events such as drought and bushfires.

Since underpass monitoring commenced in 2018/19, koalas have been recorded using seven of the 12 structures monitored. Operational monitoring during years three and four suggested evidence of a slight temporal decline, however, monitoring in years four and five do not support this.

## 5 Conclusion and recommendations

The WC2NH upgrade has complied with all goals of the Koala Management Plan (KMP; Table 4). Monitoring has shown that connectivity has been maintained with koalas making complete crossings at six underpasses and moving both east and west during operational phase monitoring. Limitations of the koala monitoring method means that a robust temporal comparison of koala abundance is not possible and the only conclusion that can be drawn from the targeted survey data is that numbers recorded in year 5 were slightly higher than baseline. Importantly, results show that koalas continue to occur at a low-moderate density throughout NSF. The two road-kill koalas recorded in years 4 and 5 monitoring are significant and ongoing fence inspections and maintenance is essential to reduce the likelihood of koalas accessing the road corridor (Table 5). Landscape plantings are slowly becoming established and are supporting movement of koalas beneath the highway.

**Table 4:** Compliance with Table 6.1 from the Koala Management Plan.

Main goal	Performance criteria	Has performance criteria been satisfied	Corrective action required
Maintain connectivity for koalas potentially occurring either side of the upgrade.	No change to densities, distribution, habitat use and movement patterns compared to baseline Koala population data.	<b>Yes.</b> Koala abundance in year five is greater than baseline. Koalas continue to occur on both sides of the highway and regular movement beneath the highway has been confirmed.	No corrective action required.
Minimise road-kill of koala during operation of the WC2NH Project.	All fauna fencing is installed at the minimum number of locations identified in the	<b>Yes.</b> However, two road-kill koalas were recorded in years four and five monitoring and breaches were found	No corrective action is required.



	EPBC approval prior to the operational phase of the WC2NH Upgrade.	in the fencing, highlighting the importance of ongoing fence inspections and maintenance to reduce access to the road corridor.	
Maintain habitat rehabilitation areas.	Self-sufficient areas of rehabilitated habitat for Koalas within all nominated areas.	<b>Yes.</b> Plantings are more established and seem to be supporting underpass use by koalas.	No corrective action is required.

**Table 5:** Recommendations based on findings of the year five koala monitoring.

Number	Recommendation	Transport for NSW Response
1.	Vegetation management and ongoing maintenance around the exclusion fence is warranted to minimise the risk of koalas accessing the alignment	Agree.

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