



Squirrel Glider Monitoring 2022

Oxley Highway to Kempsey, Pacific Highway Upgrade

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Cover photograph: Sugar/Squirrel Glider (left) and baited arboreal trap (right) in Maria River State Forest.

Executive summary

Context

This report documents findings for the 2022 monitoring period, the third and final, for the Squirrel Glider (*Petaurus norfolcensis*), as required for the Oxley Highway to Kempsey (OH2K) Pacific Highway upgrade project (the Project) and specified in the Oxley Highway to Kempsey (OH2K) Ecological Monitoring Program (EMP, TfNSW 2022). Transport for NSW (TfNSW) is required to manage and monitor the effectiveness of biodiversity mitigation measures implemented as part of the Project. The Squirrel Glider is one of the threatened species identified as requiring monitoring during the operational phase of the Oxley Highway to Kempsey (OH2K) Pacific Highway Upgrade.

Aim

The aim of the Squirrel Glider monitoring program is to determine whether the Project is meeting the performance indicators for the species, and provide corrective actions where required.

Method

Monitoring sites were established in four broad areas. Each site consisted of an impact site with a paired control site. Surveys were undertaken in accordance with the EMP and involved arboreal trapping for four consecutive nights using 20 Elliot B traps deployed at each control and impact site over approximately two hectares of habitat. Traps were baited with a mixture of oats, honey and peanut butter.

Key results

No Squirrel Gliders were recorded during the 2022 monitoring. Species recorded included the native Brown Antechinus (*Antechinus stuartii*), Brush-tailed Phascogale (*Phascogale tapoatafa*), Common Brushtail Possum (*Trichosurus vulpecula*) and the introduced Black Rat (*Rattus rattus*).

Squirrel Gliders were not recorded during baseline, 2018, 2020 or 2022 monitoring surveys.

Conclusion

Performance measures relating to monitoring requirements have been met.

The performance measure relating to the presence of Squirrel Gliders within habitat adjacent to the Project has been met through observations of individuals in nest boxes as part of broader nest box monitoring for the Project. Squirrel Glider records have not been confirmed for aerial crossings or use of the widened median.

Management implications

While Squirrel Gliders were not recorded during 2018, 2020 and 2022 targeted Squirrel Glider monitoring, the species has been recorded occupying nest boxes within 75 metres (m) of the Project Corridor within the Cairncross State Forest and Maria River State Forest monitoring areas. As per the performance measure, this suggests that the home ranges of the local population includes habitat immediately adjacent to the Project.

Given that no Squirrel Gliders were recorded prior to the 2017 nest box monitoring, and records exist demonstrating use of adjacent habitat by the species, contingency measures are not considered relevant.

As such, adaptive management actions or further monitoring beyond Year 8 (2022/2023) are not recommended.

Table of Contents

Executive summary	ii
1. Introduction	1
1.1 Context.....	1
1.2 Performance Measures.....	2
1.3 Monitoring Timing	2
1.4 Reporting.....	2
2. Methodology.....	3
2.1 Monitoring Sites	3
2.2 Survey Method	3
2.3 Analysis	3
3. Results.....	9
3.1 Timing and Conditions	9
3.2 2022 Trapping Results	9
3.3 Cumulative Results	10
3.4 Summary.....	11
4. Discussion.....	12
4.1 Performance Measures.....	12
5. Recommendations	13
5.1 Contingency Measures/Recommendations.....	13
References	14

List of Figures

Figure 1: Overview of Monitoring Sites	4
Figure 2: Cairncross Sate Forest: Site 1 trap locations.....	5
Figure 3: Ballengarra State Forest South: Site 2 trap locations.....	6
Figure 4: Ballengarra State Forest North: Site 3 trap locations.....	7
Figure 5: Maria River State Forest: Site 4 trap locations	8

List of Tables

Table 1: Weather conditions 2022	9
Table 2: 2022 arboreal trapping results.....	9
Table 3: Cumulative results for 2018, 2020 and 2022 monitoring events.....	10
Table 4: Summary of additional monitoring data records.....	11
Table 5: Summary of performance measures for the 2022 monitoring period.....	12

1. Introduction

1.1 Context

The Oxley Highway to Kempsey (OH2K) section of the Pacific Highway Upgrade Project (the Project) was approved in 2012 subject to various Ministers Conditions of Approval (MCoA) and a Statement of Commitments (SoC). A subsequent approval with additional conditions of consent (CoA) was granted in 2014 by the Commonwealth Department of Climate Change, Energy, the Environment and Water (DCCEEW, previously the Department of Environment (DoE)) for Matters of National Environmental Significance (MNES) listed under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1995* (EPBC Act). The Ecological Monitoring Program (hereafter referred to as the EMP) (TfNSW 2022) combines these approval conditions and defines the mitigation and offsetting requirements for threatened species and ecological communities impacted by the Project. The Squirrel Glider (*Petaurus norfolcensis*) was one threatened species identified as requiring monitoring following the completion of the Project's construction, during the operational phase.

1.1.1 Legal status

The Squirrel Glider is listed as vulnerable under the New South Wales *Biodiversity Conservation Act 2016* (BC Act). Monitoring of the species is required under the Project's approval.

1.1.2 Monitoring framework

The survey design, methodology and performance indicators that define the Squirrel Glider monitoring program are specified in the EMP. The EMP requires monitoring of the Squirrel Glider on three occasions: between April and August in Years 4, 6 and 8, after the completion of construction. This represents the third and last of the monitoring periods – Year 8, winter 2022. Baseline surveys (not required by the EMP) were undertaken by Niche in autumn 2014.

To date, these monitoring events have been undertaken and reported as follows:

- Baseline monitoring: Niche (2015)
- Operational phase monitoring:
 - Year 4 (2018): Niche (2018a)
 - Year 6 (2020): Niche (2021)
 - Year 8 (2022): current report.

1.1.3 Baseline data

While the EMP notes that the Squirrel Glider has not been identified within the Project area, the environmental assessment considered the species as highly likely to occur in the area (GHD 2010, GHD 2011). Baseline surveys (not required by the EMP) were undertaken by Niche in autumn 2014 (Niche 2015). No Squirrel Gliders were recorded during those baseline surveys.

1.1.4 Purpose of this report

This report details the findings obtained from the third and last monitoring period for the Squirrel Glider. The aims of this report are to summarise the methods and results of the 2022 monitoring and determine if performance measures have been met, as per the EMP.

1.2 Performance Measures

The EMP specifies the following performance measures for the Squirrel Glider:

- Monitoring is undertaken after construction of the upgrade.
- Monitoring is undertaken at Impact and Control sites.
- There is no statistically significant difference in presence of Squirrel Glider between Impact and Control sites during the operation monitoring phase of the Project.
 - Where statistical analysis is not possible due to low trapping success, detection of the Squirrel Glider using aerial crossings and/or the widened median.
 - Where statistical analysis is not possible due to low trapping success, detection of the Squirrel Glider within 75 metres (m) (assuming conservative minimum home range size of 2 ha) of the Project corridor, so that it may be inferred that the local population may be incorporating habitat immediately adjacent to the Project within their home ranges.

1.3 Monitoring Timing

Monitoring is to occur annually between April and August, ideally in gaps in flowering resource availability.

1.4 Reporting

As per the EMP, the annual reporting of monitoring results will include:

- Detailed description of monitoring methodology employed.
- Results of the monitoring period.
- Discussion of results, including how the results compare against performance measures, if any modifications to timing or frequency of monitoring periods or monitoring methodology are required and any other recommendations.
- If contingency measures should be implemented.

All reports prepared under the EMP will be submitted to the NSW Department of Planning and Environment (DPE) and the NSW Environment Protection Authority (EPA).

2. Methodology

2.1 Monitoring Sites

Monitoring sites were established within four broad areas containing Moist Slopes Forest and Dry Ridgetop Forest habitat, where the species was considered likely to occur (GHD 2010, GHD 2011). They included:

- Cairncross State Forest: Site 1
- Ballengarra State Forest South: Site 2
- Ballengarra State Forest North: Site 3
- Maria River State Forest: Site 4

Each site consists of an impact site and a paired control site. Control sites were located a minimum of 500 m to one kilometre (km), where access permitted, from the paired impact site within continuous vegetation. Trap locations are shown in Figure 1 - Figure 5.

2.2 Survey Method

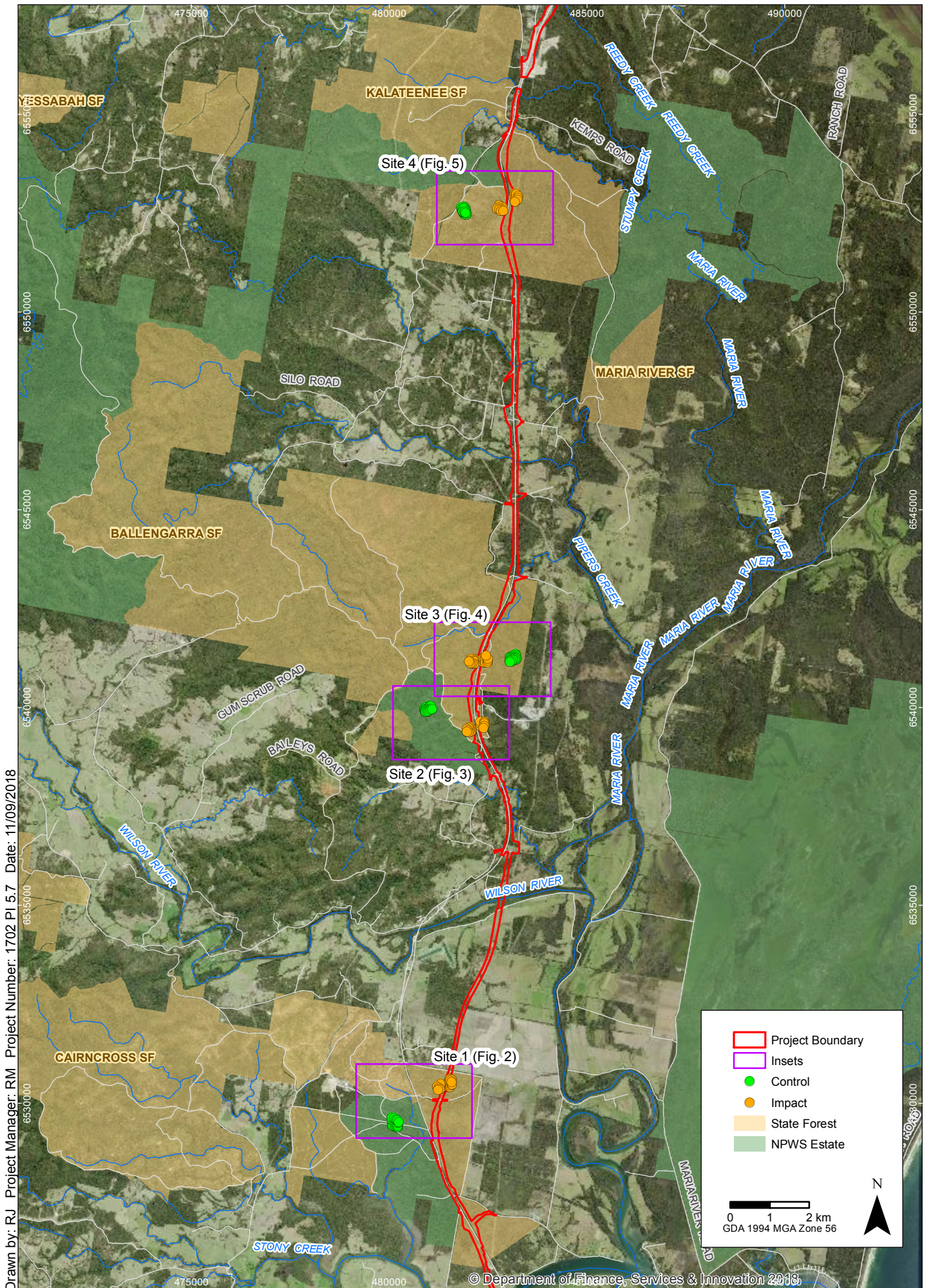
In accordance with the EMP, arboreal trapping was undertaken using a grid configuration of 20 tree-mounted Elliot B traps distributed over approximately two hectares of habitat for four consecutive nights at each control and each impact site. At impact sites, 10 traps were deployed on either side of the carriageway. Traps were positioned on brackets and installed approximately two to three metres above the ground on a range of mature canopy species and baited with a mixture of oats, peanut butter and honey. The host tree was sprayed with a mixture of honey water above the trap as an additional attractant. Traps were checked each morning and bait was replaced as necessary.

The following details were recorded for any captured fauna where this could be determined with minimal animal handling:

- Trap location
- Sex
- Age class
- Mass
- Breeding condition.

2.3 Analysis

Monitoring results were analysed in accordance with the performance indicators specified within the EMP. However, undertaking statistical analysis of trapping results to determine a statistically significant difference between control and impact sites requires a relatively high trapping success rate to achieve reasonable sample sizes and sufficient statistical power. Trapping success was not sufficient during the current surveys to allow for such analysis. As such, trapping results are presented as capture numbers in this instance.

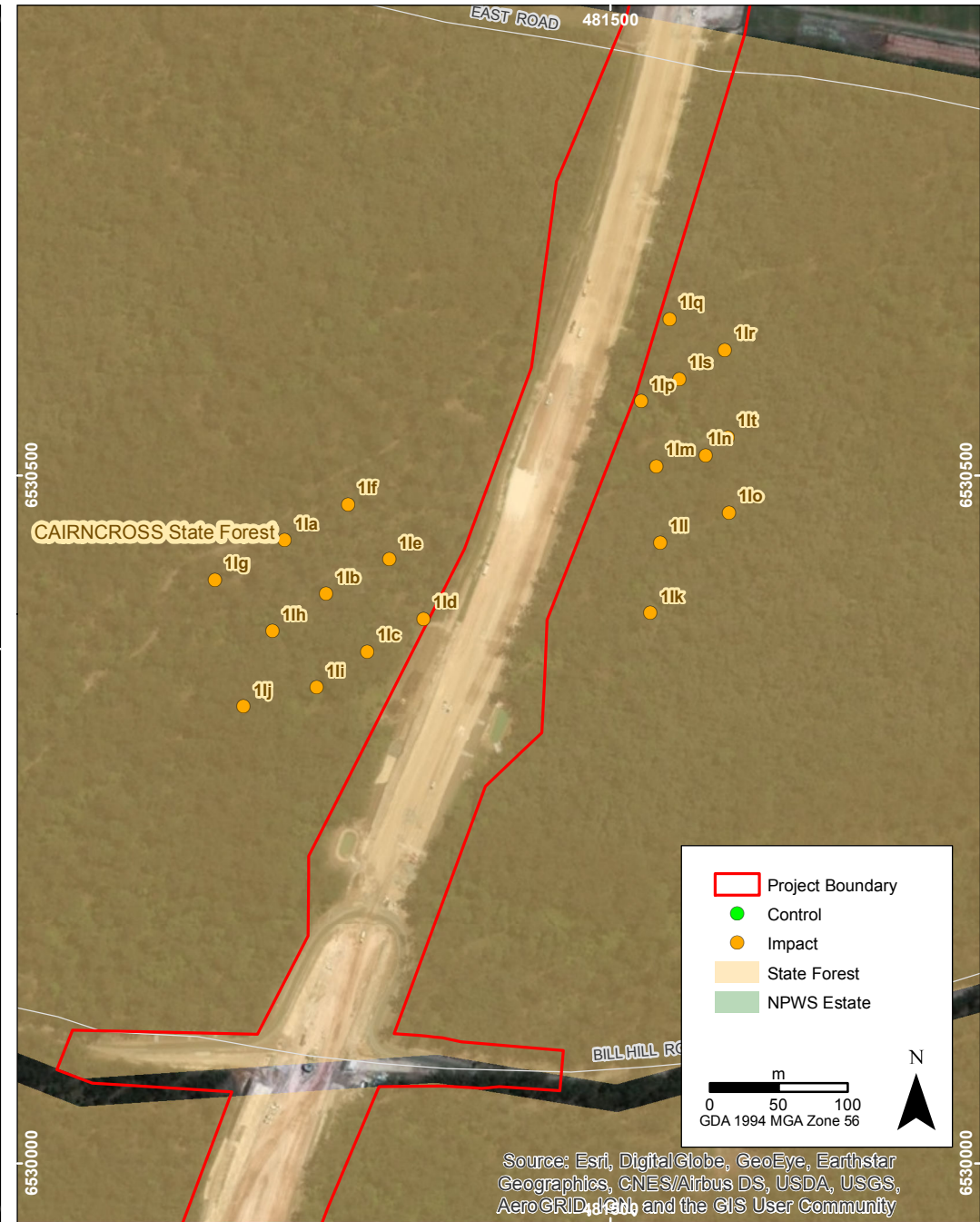


Overview of monitoring sites

Squirrel Glider Monitoring: Pacific Highway Upgrade – Oxley Highway to Kempsey

FIGURE 1

Imagery: (c) LPI 2014-6-10

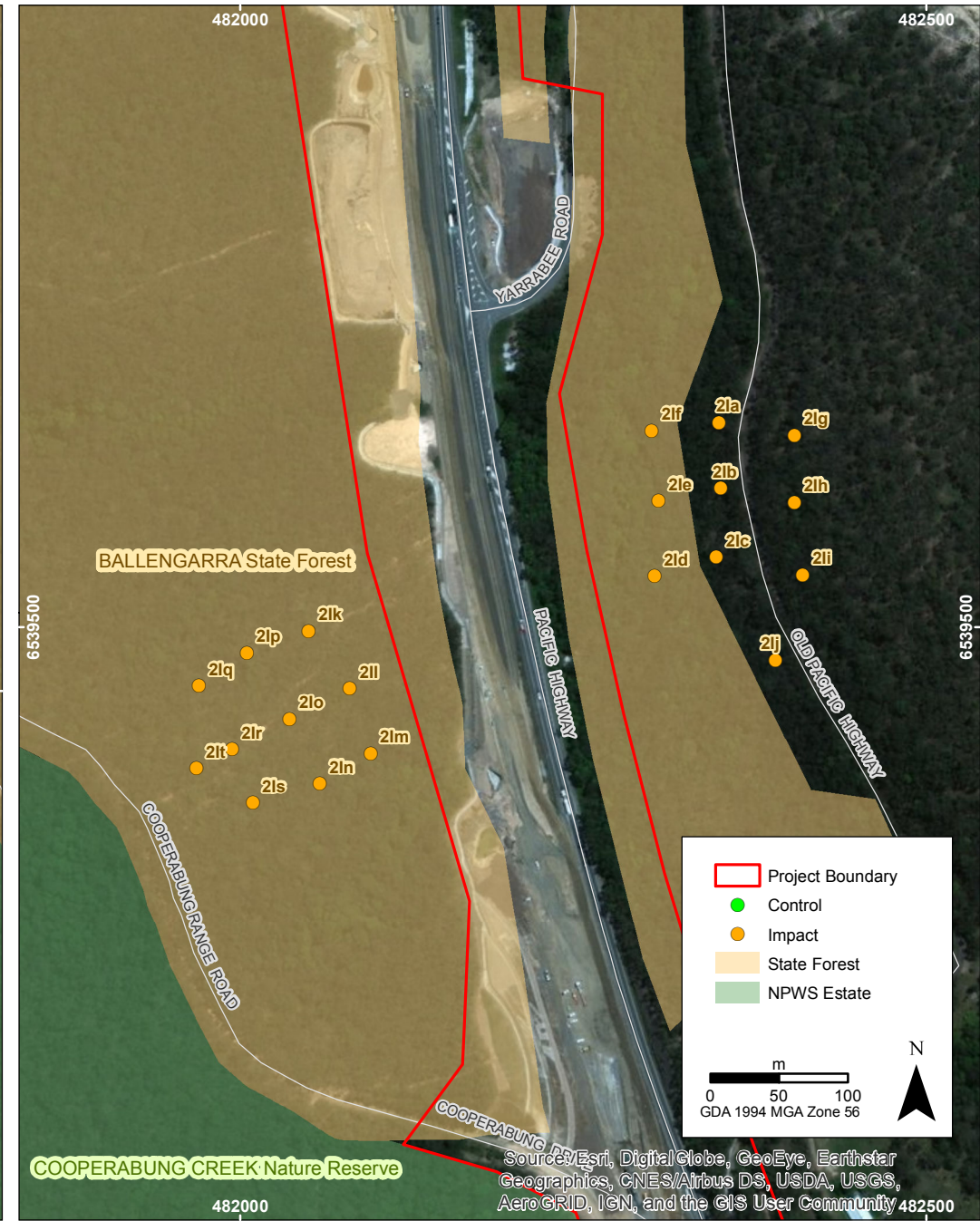


Cairncross State Forest: Site 1 trap locations
Squirrel Glider Monitoring: Pacific Highway Upgrade – Oxley Highway to Kempsey

FIGURE 2

Imagery: (c) DigitalGlobe 2015-11-25

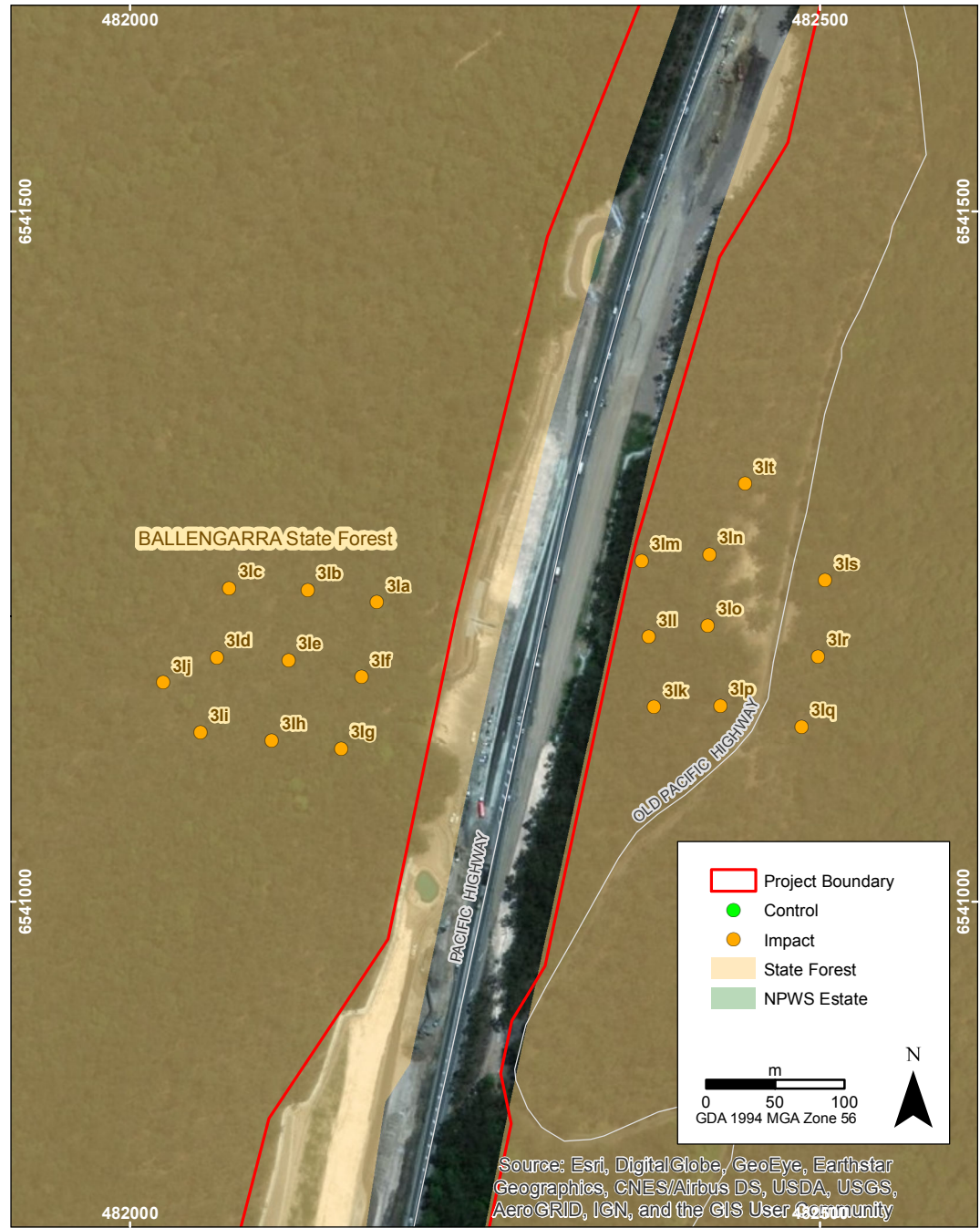
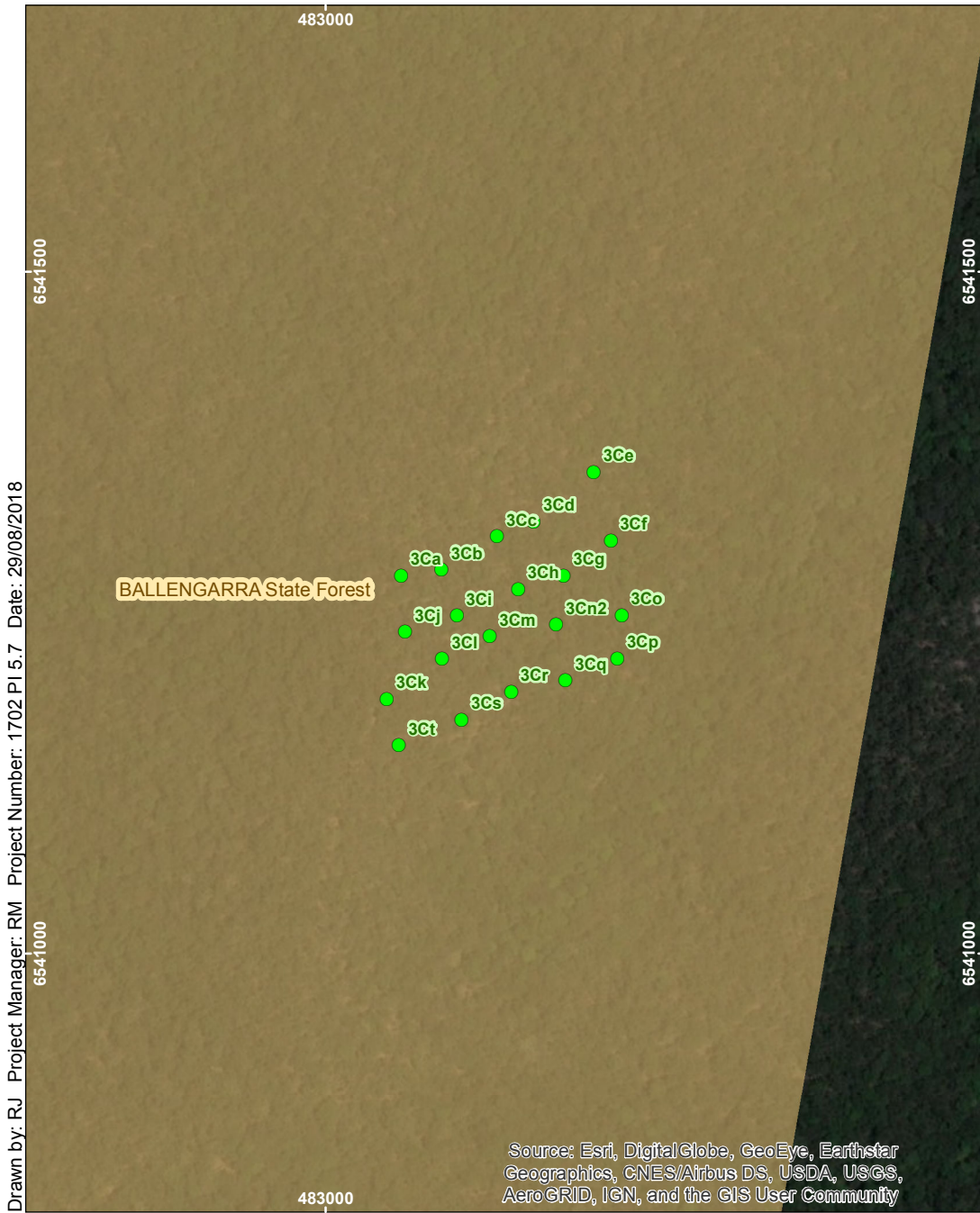
Drawn by: RJ Project Manager: RM Project Number: 1702.PI.5.7 Date: 29/08/2018



Ballegarra State Forest South: Site 2 trap locations
Squirrel Glider Monitoring: Pacific Highway Upgrade – Oxley Highway to Kempsey

FIGURE 3

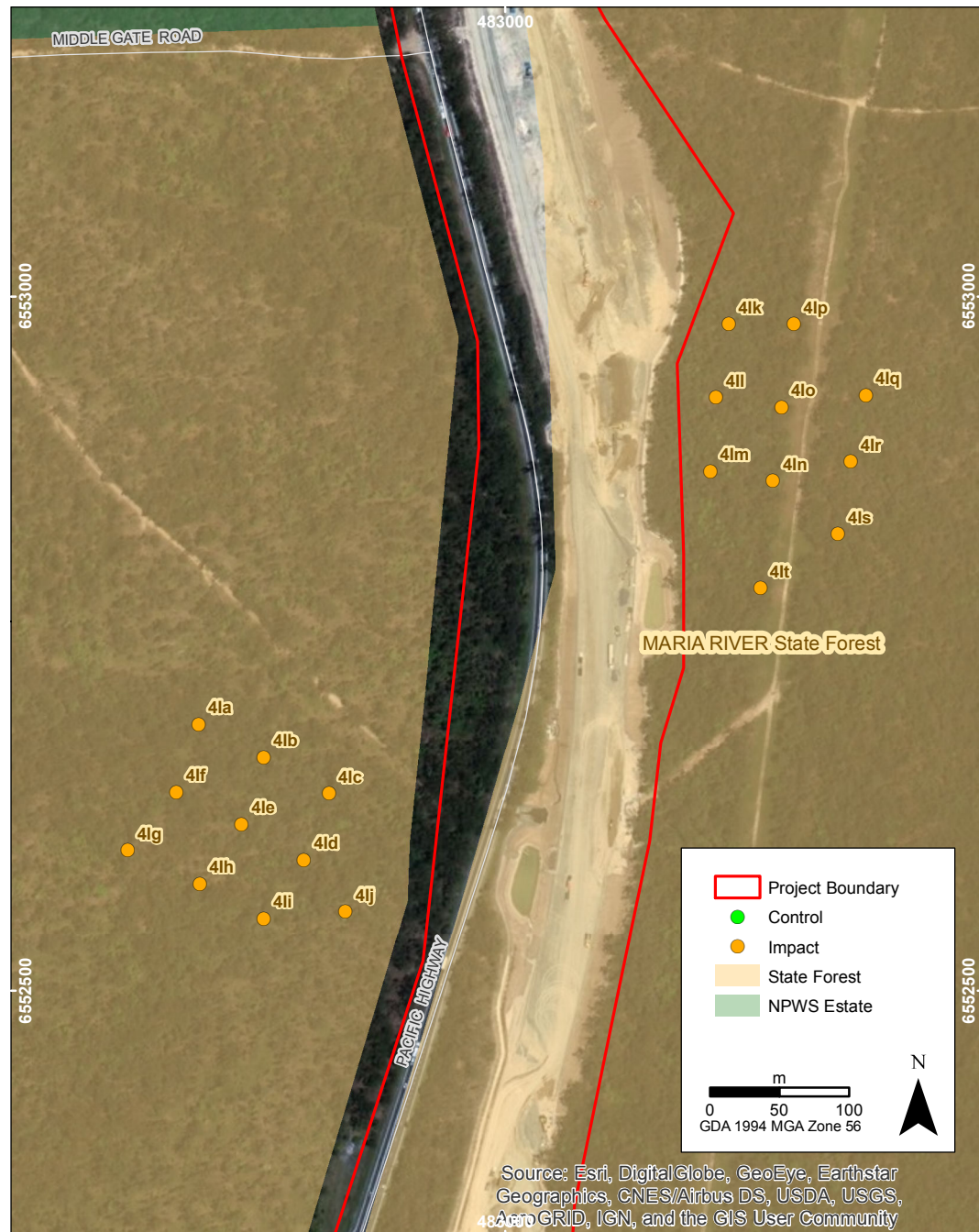
Imagery: (c) DigitalGlobe 2015-11-25



Ballegarra State Forest North: Site 3 trap locations
 Squirrel Glider Monitoring: Pacific Highway Upgrade – Oxley Highway to Kempsey

FIGURE 4

Imagery: (c) DigitalGlobe 2015-11-25



Maria River State Forest: Site 4 trap locations
 Squirrel Glider Monitoring: Pacific Highway Upgrade – Oxley Highway to Kempsey

3. Results

3.1 Timing and Conditions

Trapping was undertaken from 1-5 August 2022 for Sites 1 and 2 and from 11-15 July 2022 for Sites 3 and 4. Table 1 shows the weather conditions recorded at Port Macquarie Airport (station ID 060168) for these periods.

Table 1: Weather conditions 2022

Date range	Min temp (°C)	Max temp (°C)	Rainfall (mm)
1/08/22 – 5/08/22	6.5	22.3	3.8
11/07/22 – 15/07/22	6.6	18.1	52.8

3.2 2022 Trapping Results

Results of the trapping are presented in Table 2.

No Squirrel Gliders were captured during the 2022 monitoring period. Four species were recorded, including the native Brown Antechinus (*Antechinus stuartii*), Brush-tailed Phascogale (*Phascogale tapoatafa*), Common Brushtail Possum (*Trichosurus vulpecula*) and the introduced Black Rat (*Rattus rattus*).

Site 1 impact had the highest number of captures (six) consisting of one species, the Brown Antechinus. Similarly, captures at Site 2 and Site 3 consisted of three different species including, the Brush-tailed Phascogale, Common Brushtail Possum, Black Rat and Brown Antechinus. There were no captures at Site 4.

Table 2: 2022 arboreal trapping results

Site	Date	Site type	SOC	Trap ID	Species	Sex	Age
1	5/08/2022	Control	W	S	Brown Antechinus	Unk	adult
1	2/08/2022	Impact	E	R	Brown Antechinus	Unk	adult
1	3/08/2022	Impact	E	C	Brown Antechinus	Unk	adult
1	5/08/2022	Impact	E	R	Brown Antechinus	Unk	adult
1	5/08/2022	Impact	E	S	Brown Antechinus	Unk	adult
1	5/08/2022	Impact	E	P	Brown Antechinus	Unk	adult
1	5/08/2022	Impact	E	M	Brown Antechinus	Unk	adult
2	4/08/2022	Control	W	R	Brush-tailed Phascogale	F	adult
2	3/08/2022	Impact	E	E	Black Rat	Unk	adult
2	4/08/2022	Impact	E	E	Brown Antechinus	Unk	adult
2	5/08/2022	Impact	E	F	Brown Antechinus	Unk	adult
2	5/08/2022	Impact	E	E	Brown Antechinus	Unk	adult
3	13/07/2022	Control	E	L	Common Brushtail Possum	Unk	adult
3	14/07/2022	Control	E	H	Brown Antechinus	Unk	adult
3	15/07/2022	Control	E	H	Brown Antechinus	Unk	adult
3	15/07/2022	Control	E	T	Black Rat	Unk	adult

SOC = side of carriageway; E = east of carriageway; W = west of carriageway; M = male; F = female, unk = unknown

3.3 Cumulative Results

3.3.1 Trapping data

As for the baseline, 2018 and 2020 surveys, the Squirrel Glider was not recorded at any of the monitoring sites during the 2022 monitoring. Table 3 summarises the species recorded during the 2018, 2020 and 2022 monitoring events.

Table 3: Cumulative results for 2018, 2020 and 2022 monitoring events

Species	Site 1 Impact	Site 1 Control	Site 2 Impact	Site 2 Control	Site 3 Impact	Site 3 Control	Site 4 Impact	Site 4 Control
Brown Antechinus (<i>Antechinus stuartii</i>)	Y (26)	Y (5)	Y (8)	Y (1)	Y (3)	Y (6)		
Black Rat (<i>Rattus rattus</i>)	Y (5)		Y (3)			Y (1)		Y (1)
Bush Rat (<i>Rattus fuscipes</i>)					Y (1)	Y (1)		
Brush-tail Possum (<i>Trichosurus</i> sp.)	Y*	Y*	Y*	Y*	Y*	Y*	Y*	Y*
Common Brush-tail Possum (<i>Trichosurus vulpecula</i>)						Y (1)		
Brush-tailed Phascogale (<i>Phascogale tapoatafa</i>)				Y (1)	Y (1)			
House Mouse (<i>Mus musculus</i>)							Y*	

Y = yes recorded, (#) = number of records of species at each site, * species recorded by hair tube traps in association with Brush-tailed Phascogale monitoring.

3.3.2 Additional monitoring data

Hair tubes

As part of the Project's monitoring requirements for the Brush-tailed Phascogale and the widened median, hair tube surveys were undertaken at the same sites during the 2018, 2020 and 2022 monitoring periods and within the widened median in 2018 and 2020. Hair tube results have not produced Squirrel Glider records to date (Niche, unpublished data).

Nest boxes

Squirrel Gliders have been recorded during inspections of installed nest boxes in 2017 (Niche 2018b) and 2018 (Niche 2018c). Squirrel Gliders were observed occupying nest boxes in the Maria River State Forest area, approximately 700 m south of Site 4; in Cairncross State Forest area, approximately one kilometre south of Site 1; and in the Fernbank Creek area, approximately seven kilometres south of Site 1. The occupied nest boxes (NEW ZONE NBT96 (possum box), G3 NBT209 (scansorial box) and C2 NBT219 (small glider box) occur within 60, 20 and 110 m, respectively, of the Project corridor.

Spotlighting

As part of the Project's monitoring requirements for the widened median and Yellow-bellied Glider/Koala monitoring, spotlighting surveys were undertaken within and adjacent to the widened median and within the broad Squirrel Glider monitoring areas, respectively. A number of possible Squirrel Glider records have been noted during spotlighting within the widened median and vegetation immediately adjacent, however, the accurate identification of Squirrel Gliders during spotlighting surveys was not always possible due to distinguishing features being hidden from view, distance from which observations were made and rapid movement of individuals.

Widened Median

As part of the Project’s monitoring requirements for the widened median monitoring, arboreal camera monitoring was undertaken within and adjacent to the widened median. A number of possible Squirrel Glider records have been noted during camera monitoring within the widened median and vegetation immediately adjacent, however, the accurate identification of Squirrel Gliders was not always possible due to distinguishing features being hidden from view and rapid movement of individuals.

Aerial crossings

As part of the Project’s monitoring requirements for the aerial crossing structures, three rope bridges (RB1, RB2 and RB3) and three glider pole (GP1, GP2 and GP3) crossings in the northern Kundabung to Kempsey (Ku2K) section of the Project were monitored. There have been no confirmed Squirrel Gliders recorded as a part of the aerial crossing monitoring to date.

3.4 Summary

A summary of Squirrel Glider records to date in relation to the broad monitoring areas is provided in Table 4.

Table 4: Summary of additional monitoring data records

Site	Monitoring area	Baseline trapping records	All Years trapping records	Hair tube records	Nest box records	Spotlighting records	Widened median records	Aerial crossing records
1	Cairncross State Forest	0	0	0	Yes, at 1 km from site (20 m from Project corridor)	Possible (widened median)	Possible (widened median)	0
2	Ballengarra State Forest South	0	0	0	0	0		0
3	Ballengarra State Forest North	0	0	0	0	0		0
4	Maria River State Forest	0	0	0	Yes, within 700 m from site (60 m from Project corridor)	0		0

4. Discussion

4.1 Performance Measures

A summary of the 2022 survey results in relation to the performance measures are provided in Table 5.

Table 5: Summary of performance measures for the 2022 monitoring period

Performance measure	Discussion
Monitoring is undertaken after construction of the upgrade.	<p>This performance measure has been met.</p> <p>The final stage of the Project became operational on 29 March 2018. Three rounds of operational monitoring have been undertaken as per the EMP in 2018, 2020 and 2022.</p>
Monitoring is undertaken at Impact and Control sites.	<p>This performance measure has been met.</p> <p>Three rounds of operational monitoring have been undertaken as per the EMP in 2018, 2020 and 2022.</p>
<p>There is no statistically significant difference in presence of Squirrel Glider between Impact and Control sites during the operation phase of the project.</p> <ul style="list-style-type: none"> Where statistical analysis is not possible due to low trapping success, detection of the Squirrel Glider using aerial crossings and/or the widened median. Where statistical analysis is not possible due to low trapping success, detection of the Squirrel Glider within 75 m (assuming conservative minimum home range size of 2 ha) of the Project corridor, so that it may be inferred that the local population may be incorporating habitat immediately adjacent to the Project within their home ranges. 	<p>This performance measure has been met for use of adjacent habitat.</p> <p>No Squirrel Gliders were recorded at either the control or impact sites in 2018, 2020 or 2022, therefore there is no apparent difference between impact and control sites at this stage.</p> <p>Use of aerial crossings and/or widened median: Squirrel Gliders have not been detected using aerial crossings. Possible Squirrel Glider records have been noted during widened median spotlighting surveys and arboreal camera monitoring.</p> <p>Detection of the Squirrel Glider within 75 m of the Project corridor: Squirrel Gliders have been recorded occupying nest boxes within 60, 20 and 110 m of the Project corridor.</p>

5. Recommendations

5.1 Contingency Measures/Recommendations

The EMP lists potential problems and contingency measures for various components of the monitoring program, however specific contingency measures for the Squirrel Glider have not been provided within the EMP. While Squirrel Gliders were not recorded during 2018, 2020 and 2022 targeted Squirrel Glider monitoring events, the species has been recorded occupying nest boxes within 75 m of the Project Corridor within the Cairncross State Forest and Maria River State Forest monitoring areas, inferring, as per the performance measure, that the home ranges of the local population includes habitat immediately adjacent to the Project.

Given that no Squirrel Gliders were recorded prior to 2017 nest box monitoring, and records exist demonstrating use of adjacent habitat by the species, contingency measures are not considered relevant.

As such, adaptive management actions or further monitoring beyond Year 8 (2022/2023) are not recommended .

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