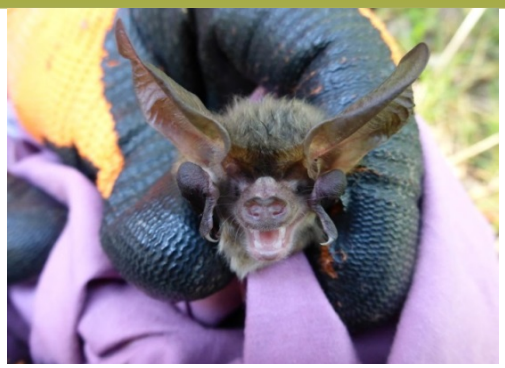
Ecological Monitoring Annual Report (2016/2017)

Warrell Creek to Nambucca Heads Pacific Highway Upgrade



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UPR	*Description*	*Date Issued*	*Issued By*
2378-1330	First issue	09/03/2017	JOL
2378-1350	Second issue	13/03/2017	DGH
2378-1351	Third issue	19/04/2017	JOL
2378-1355	Fourth issue	26/04/2017	JOL

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1. Introduction

1.1 Introduction

The Pacific Highway Upgrade Program is a joint commitment by the Australian and New South Wales governments to improve the standard and safety of the Pacific Highway between Hexham and the Queensland border. The NSW Minister for Planning approved the Warrell Creek to Urunga (WC2U) Pacific Highway Upgrade Project (the Project) under Part 3A (now repealed) of the Environmental Planning and Assessment Act 1979 (EP&A Act) on 19 July 2011, subject to the Minister's Conditions of Approval (CoA) being met.

The WC2U Project comprises approximately 42 kilometres of dual carriageway road that would bypass the towns of Warrell Creek, Macksville, Nambucca Heads and Urunga on the Mid North Coast of NSW. The Project has been divided into two stages with Stage 1 consisting of approximately 22.5 kilometres from Nambucca Heads to Urunga (NH2U) and Stage 2 consisting of the remaining 19.5 kilometres of dual carriageway between Warrell Creek and Nambucca Heads (WC2NH). This report relates to Stage 2 (WC2NH) as 'the Project'.

As part of WC2NH an ecological monitoring program has been prepared to satisfy the Minister's Condition of Approval (MCoA) B10, which requires preconstruction, construction and post construction phase monitoring (Benchmark 2014). The monitoring program incorporates all threatened species monitoring developed as part of individual species management plans (refer to the CEMP). This annual report (the second completed for the project) provides the results of the ecological monitoring program undertaken in 2016/2017 in relation to the following:

- Pre-clearing and clearing procedures.
- Flying-fox population.
- Threatened Microbats.
- Nest boxes.
- Yellow-bellied Glider.
- Roadkill monitoring.
- In Situ threatened flora.
- Threatened flora translocation area.
- Landscape rehabilitation monitoring.

The following sections provide a summary of ecological monitoring tasks undertaken in the second year of construction.

Note: The project construction year anniversary is 8 February so the annual monitoring period encompasses all site assessments between 8 February 2016 and 8 February 2017. Further details of ecological monitoring are provided in separate monitoring reports appended to this report.

2. Pre-clearing and Clearing Procedures

The Conditions of Approval and species management plans which form part of the Flora and Fauna Management Plan for the project requires a number of pre-clearing surveys to be undertaken. A summary of pre-clearing surveys undertaken on the project is provided in the sections below.

A habitat tree register and register of fauna capture/ relocations is provided in **Appendix A**. A more detailed description of pre-clearing survey results will be provided as part of the post-clearing report upon completion of clearing activities. Mainline clearing is now complete, however minor clearing is planned as part of subsequent approvals or later staged works.

2.1 Pre-clearing Surveys

2.1.1 Green-thighed Frog

Pre-clearing surveys targeting the Green-thighed Frog (GTF) were conducted within all areas of nominated GTF habitat on the project. These involved active searches of suitable microhabitat either the night before or immediately prior (within two hours) of clearing operations commencing. Active searches involved turning rocks and logs, raking of debris and peeling of decorticating bark. A small area within GTF habitat was cleared north of Old Coast Road during February 2016.

No GTFs were recorded within clearing areas during the pre-clearing surveys.

2.1.2 Giant Barred Frog

Nocturnal pre-clearing surveys of all areas of Giant Barred Frog (GBF) habitat have been undertaken as required where adjustments to the frog exclusion fence has been required post rainfall events where the frog fencing was breached or intentionally moved to allow high flows to move through the Lower Warrell Creek system. Two non-consecutive nights survey were undertaken within the work zone to capture and relocate any GBF potentially located on the work side of the fence. No GBF were located on the work side of the fence during these nocturnal surveys.

In addition to the above, active searches of all areas of GBF habitat were undertaken either the night prior to or immediately prior (less than two hours) to the commencement of works or clearing. No GBFs were detected during such surveys.

2.1.3 Koala and Spotted-tailed Quoll

Pre-clearing surveys for koalas were undertaken the night prior to clearing any areas of koala habitat on the project involving spotlighting within areas of suitable habitat on the night prior to clearing operations. Diurnal visual searches were also conducted in areas of suitable habitat immediately prior to commencement of clearing operations to detect any koalas that may have entered the area overnight. No koalas or evidence of recent presence were detected during clearing operations in year 2.

Pre-clearing surveys for the Spotted-tailed Quoll (STQ) were conducted immediately prior to commencement of clearing and included searches of potential denning habitat, including large hollow logs and rock piles. No STQ or evidence of recent presence was detected during clearing operations in year 2.

2.1.4 Searches for Fauna Immediately Prior to Clearing

A final pre-clearing visual search was undertaken by an ecologist immediately prior (i.e. less than two hours) to commencement of clearing operations to ensure that the areas to be cleared are as free of fauna as possible. This survey was often successful in flushing mobile fauna from the works area including birds, macropods and reptiles before the commencement of clearing. Fauna encountered during these surveys are captured within **Appendix A**.

2.2 Clearing Supervision

Following the completion of the pre-clearing surveys described in **Section 2.1**, tree removal was undertaken in a staged manner, with non-habitat trees being removed first, then the potential habitat trees being removed with a swivel head harvester at least 48 hours later to enable resident hollow-dependent fauna time to evacuate the tree prior to felling. A suitably qualified, licensed and experienced ecologist and/ or a suitably licensed and experienced wildlife carer from GeoLINK was present to observe the removal of each potential habitat tree.

A habitat tree register and register of fauna capture/ relocations is provided in **Appendix A**.

Ecologist clearing supervision was also undertaken for mapped GBF habitat. No GBF were observed during clearing supervision undertaken in such areas.

3. Flying-fox Population Monitoring

3.1 Introduction

Population monitoring at the Macksville Grey-headed Flying-fox camp (north of Bald Hill Road) has been undertaken on at least a monthly basis since July 2013 to confirm flying-fox presence and determine patterns of occupation, species composition, demographic composition, key behaviours, and habitat characteristics. The sampling methodology and timing has been undertaken in accordance with the approved flying-fox management plan (Gorecki *et al*. 2016).

Population monitoring commenced in the winter of 2013 to provide a baseline of population condition prior to road construction, which will provide a point of comparison to assess the impacts of the road on the population of flying-foxes and monitor the effectiveness of mitigation measures (Gorecki *et al*. 2016). Population monitoring will continue to be undertaken monthly throughout the pre-construction phase, construction phase and first year of the operational phase of the project. The monthly field monitoring program would continue through construction of the Project during the period when flying-foxes are expected to be in the camp (i.e. from 1 August until monitoring confirms the camp is vacated). The monitoring program would be reviewed regularly and refined if considered appropriate.

A summary monitoring report up to January 2017 is provided in **Appendix B**.

3.2 Summary of Results

The results of the January 2017 flying-fox monitoring indicate that excluding a brief stopover at the site observed in mid-January 2015, flying-foxes have been absent from the site now for approximately two and a half years (since mid-April 2014). The nearby Macksville Cemetery camp (detected in February 2015) has recently been re-occupied by flying-foxes following an absence over the winter period, and the numbers of flying-foxes have been variable ranging from 500 to 30,000 individuals. Currently the number is estimated at 11,500 individuals, with a substantial proportion being made of Black Flying-foxes (*Pteropus alecto*).

The small number of flying-foxes recently camped at Bowraville have now departed, while numbers at Bellingen Island and Gordon Park have remained relatively stable. Male flying-foxes dominated the demographic composition of the Macksville Cemetery camp, where only low levels of dependent young flying-fox were recorded. In contrast, dependent young flying-foxes are still present at a moderate level at the Bellingen Island and Gordon Park camps, despite the death of a substantial number of young recently in relation to resource shortage. Summer flowering of trees that are key diet species has begun recently in the region, including Pink Bloodwood (*Corymbia intermedia*) however major flowering of any species is yet to occur.

4. Threatened Microbats

The following sections provide a summary of monitoring activities completed for threatened microbats. Microbat monitoring reports covering the second year of construction are provided in **Appendix C**.

4.1.1 Microbat Habitat (Flyway) Monitoring

No Microbat habitat (flyway) monitoring was undertaken during the reporting period as per the requirements of the Ecological Monitoring Program. To date no detrimental impacts to flyways off site have been detected, although substantial changes have occurred on site due to construction proceeding.

4.1.2 Microbat Roost Box Monitoring

Microbat roost boxes were installed by RMS prior to construction commencing. Roost boxes were inspected quarterly to determine species presence/ absence and estimate numbers and breeding activity. Bat box inspections commenced six months after installation and will continue seasonally until the construction phase is complete. One monitoring event will be undertaken post-construction.

The monitoring results have indicated a medium uptake/ usage rate in the second year of construction with between 10 and 19 microbats recorded occupying boxes in 2016 compared to two microbats during the 2015/ 2016 monitoring period.

Up to five roost boxes were occupied by microbats in 2016 compared to two boxes in 2015/ 2016.

The total diversity of bat species observed using roost boxes has increased from one species in 2015/ 2016 to at least three species recorded in 2016.

4.1.3 Microbat Persistence and Behaviour Monitoring

The Microbat Management Strategy requires monitoring during construction to examine bat behaviour and roost persistence. This monitoring is to focus on Crouches Creek Bridge during construction to evaluate the response of microbats to a range of construction activities. A methodology for completing this monitoring was prepared by GeoLINK and approved by EPA and involves quarterly monitoring of this known roost site for the first two years of construction. Quarterly surveys are to be undertaken so any variations between summer and winter roost occupancy are captured.

During each monitoring session an ecologist (experienced in microbat survey/ identification) physically inspected Crouches Creek Bridge and recorded the following:

- Evidence of microbats (guano and/or staining).
- Number of microbats present.
- Identification of species.
- Indications of breeding activity.
- Date and time of inspection.
- Location of microbats within the bridge.
- Record of rainfall during monitoring period.

To date, monitoring has indicated the ongoing use of the roost site despite construction activities occurring in proximity. To date, no microbats have been observed leaving the roost diurnally as a result of activities related to the highway upgrade.

This annual report presents the final monitoring results for the Crouches Creek Bridge site. The monitoring requirements as outlined within the Project Ecological Monitoring Program have now been met for monitoring of microbat persistence and behaviour. Monitoring was required to be undertaken seasonally throughout years 1 and 2 of the construction phase.

4.1.4 Microbat Overwintering Habitat Surveys

A total of 30 structures representing potential microbat roost sites were inspected in June 2016. For the current reporting period, structures which were previously identified as potential microbat habitat were inspected in addition to newly constructed structures such as culverts at Butchers and Stoney Creek. Fauna underpasses (concrete box culverts) throughout CC04 and CC05 areas were also inspected.

Microbat occupation was recorded at 10 culverts and one bridge with a total count of approximately 1045 individuals, including five of the 10 newly constructed culverts (e.g. Butchers Creek, Stoney Creek and the Box Culvert near the Sheather Property). These large box culverts are either still partially under construction (mainly finishing works at the entry/exit points) or have works within 100 metres from the structure at the time of occupation by microbats. Monitoring of these structures has been undertaken during construction by the contractor's environmental team and project ecologist.

5. Nest Box Monitoring

5.1 Introduction

GeoLINK was engaged to undertake the installation and seasonal monitoring of 143 nest boxes in accordance with the *WC2NH Nest Box Management Plan*. The installation of 60% of nest boxes was required prior to vegetation clearing operations commencing, with the aim to provide temporary refuge for hollow dependent fauna displaced during clearing operations. The remaining 40% of nest boxes were installed post mainline clearing. All nest boxes were installed between November 2014 and December 2016.

The Nest Box Management Plan requires monitoring to be undertaken during summer and winter of years 3 and 4 of construction and during summer and winter of years 6 and 8. Maintenance of nest boxes will be undertaken in line with the monitoring regime.

A report documenting the results of the first two monitoring events (winter 2016 and summer 2017) is provided in **Appendix D**.

5.2 Summary of Results

Two nest box monitoring events have been undertaken, for winter 2016 and summer 2017. The results indicate that occupation rates of the nest boxes decreased slightly in the summer 2017 (15% occupied) when compared against winter monitoring results where 20% of boxes were recorded as occupied. Signs of box use by fauna (evidenced by the presence of drey or nesting material, chewings etc.) increased substantially (from 44% to 57%) from winter to summer. For both events, the Sugar Glider was the most commonly recorded species and no threatened species were recorded. It should also be noted that the number of European bee hives recorded has increased, with two hives recorded for winter 2016 in comparison with six hives recorded for the summer 2017 event. Species diversity recorded within the boxes has decreased from winter (seven species) to summer (six species).

6. Yellow-bellied Glider Monitoring

6.1 Introduction

Monitoring has been undertaken in accordance with the approved yellow bellied glider management plan as approved for the Warrell Creek to Nambucca Heads (WC2NH) section of the overall Warrell Creek to Urunga approved Pacific Highway Upgrade project.

Ecological monitoring of the yellow-bellied glider populations in the surrounding state forests nature reserved and national parks adjacent to the WC2NH section has been undertaken during the second year of substantive construction commencing in accordance with the approved plan. Substantive constriction commenced in February 2015 and spring monitoring pursuant to the approved plan and ecological monitoring program table 3.1 commenced in spring of 2016 thus within year 2 of the commencement of construction.

The spring monitoring involved the survey of transects and the installation of ten song metres,

At the time of writing this report, field work for the monitoring was completed in late spring 2016 and the song meters were still present within the prescribed six month recording period with down load of data scheduled in late May 2017 and thus the report is not expected to be finalised until mid June 2017. This report will be tendered to DPE/DoE separately.

6.2 Summary of monitoring undertaken

The summary of findings from field surveys and spotlighting undertaken during November December 2016 is:

- YBG detection was marginally lower across all sites in comparison to the base line surveys.
- The No of transect that YBG were detected in the 2016 year 2 construction survey compared to the 2014 survey (pre-construction in parenthesis) is:
    - Nambucca State forest = 4/40 transect (5/40)
    - Ngaamba nature reserve = 8/32 transects (9/32)
    - Yarribinni Nature reserve = 5/20 transects (7/20).

Monitoring was undertaken during the night time when no construction activity was active.

The final monitoring report prepare d in June will be issued to stakeholders as required in mid to late July within one month of the receipt of the report in compliance with the approvals requirements to make such reports available to stakeholders.

7. Roadkill Monitoring

7.1 Introduction

Daily roadkill monitoring has been undertaken during the second year of construction in accordance with the requirements of the roadkill monitoring strategy prepared for the project.

Reports documenting the results of the second year of monitoring are provided in **Appendix E**.

7.2 Summary of Results

Twenty one fauna road mortalities have been recorded during the second year of monitoring. Fauna roadkills have increased in the second year compared to year one of monitoring which recorded 15 fauna road mortalities. Both native and introduced species has been recorded within the roadkill data. No threatened fauna species were recorded as roadkill during the year 2 monitoring period.

8. In-situ Threatened Flora Monitoring

8.1 Introduction

In accordance with the project Threatened Flora Management Plan (TFMP), monitoring of threatened flora species retained in-situ as part of the WC2NH project has been undertaken by GeoLINK. All in-situ threatened flora were located and tagged prior to clearing activities commencing, with no-go fencing and signage installed as required and the location of threatened plants shown on project Sensitive Area Plans (SAPs). Monitoring of the health of in-situ threatened flora was undertaken prior to clearing commencing and six months after this.

The in-situ threatened flora monitoring report for 2016 is provided in **Appendix F**.

8.2 Summary of Results

Key points arising from the second year of monitoring are as follows:

- All Tall Knotweed (*Persicaria elatior*) plants within the monitoring area died back prior to the autumn 2015 monitoring surveys. A reference population of Tall Knotweed located in the Maclean locality (far north coast of NSW) was surveyed at the same time and was also found to have experienced complete die back during this period.
- New Tall Knotweed plants were identified within the monitoring area in autumn 2016 and were again recorded during spring 2016. This finding appears to support previous observations of the species, suggesting it may have an annual lifecycle. The subject population of this species is currently persisting in a healthy manner within the monitoring area.
- Favourable growing conditions for Maundia (*Maundia triglochinoides*) (indicated by generally high rainfall) were present prior to and during construction in 2015. During this period large areas of Maundia were recorded adjacent to the project footprint in the Nambucca floodplain area. This population has remained generally similar (as evidenced by health and abundance) throughout monitoring to date. Recent surveys detected a decrease in cover of Maundia within the Nambucca floodplain area, most likely linked to drier conditions experienced in the lead up to these surveys. During this time decreased surface water was detected across areas of Maundia floodplain habitat. Similar reference populations in the Woodburn locality (far north coast of NSW) showed similar seasonal decreases in abundance.
- The population of Maundia within Crouches Creek was removed as part of the diversion of the creek in this location. Although translocation of this species was not prescribed as part of the WC2NH Threatened Flora Management Plan, salvage translocation was attempted within the new alignment of Crouches Creek. This translocation has been successful; the Maundia plants translocated to the creek bed have established and appear in good health.
- The in-situ Spider Orchid (*Dendrobium melaleucaphilum*) specimen remains in a healthy condition with recruitment of an additional individual occurring immediately below this plant on the same tree. The number of pseudobulbs (storage organs) on this plant has increased substantially during recent monitoring events.
- In-situ Rusty Plum (*Niemeyera whitei*) in the Cockburns Lane locality remain generally healthy and in good condition, the one exception to this being plant NW56. This plant continues to show signs of discolouration which are likely due to edge effects associated with its now exposed location. Remediation measures to protect this plant from edge effects have been initiated by the contractor.

- Slender Marsdenia (*Marsdenia longiloba*) plants at monitoring locations remain healthy with evidence of new growth. Evidence of regular die back of stems and plants has been a common observation with this species, with the origin of stems being difficult due to sharing common rhizomes in some instances. This has made the tracking of individual plants over time problematic. Notwithstanding this, the monitoring to date has demonstrated the perseverance of Slender Marsdenia plants at all monitoring locations. A number of additional plants have recently been translocated as part of the approved WC2NH North-facing Ramps project.

9. Threatened Flora Translocation Areas

9.1 Introduction

The overall aim of the translocation project is to establish viable populations of the impacted threatened flora species in habitat adjacent to the highway corridor. To achieve this aim the translocation program has three components:

- Salvage transplanting of impacted individuals from the construction footprint.
- Population enhancement by introduction of additional plants propagated from locally collected seed, to increase the initial population size and promote establishment of a viable long-term population.
- Restoration of good quality habitat in the receiver sites where required.

Monitoring of translocation areas was undertaken in accordance with the requirements of the Threatened Flora Management Plan in order to evaluate the success of translocations undertaken for threatened flora. A report detailing the second year of translocation area monitoring is provided in **Appendix G**.

9.2 Summary of Results

Two years after translocation, all species had a survival rate greater than 80% with the exception of Koala Bells (*Artanema fimbriatum*). The overall survival rate of Slender Marsdenia, the main species requiring translocation was 82% (173 individuals translocated) and was slightly down from the 90.7% survival rate recorded in year 1 (169 individuals translocated). This survival rate is higher than achieved for Slender Marsdenia after two years on NH2U project (71.2%). The single Spider Orchid flowered in spring in year 1 and 2 but no seed pods formed. Koala Bells started to flower a month after transplanting and set seed, then declined in year 2 apparently due to its short life cycle. Nearly all Floyds Grass (*Alexfloydia repens*) clumps survived (95%+) and produced substantial growth in year's 1 and 2.

Assessment of the translocation outcomes (after two years) against the performance criteria in Appendix 11 of the WC2U Threatened Flora Management Plan (Ver. 4 24/12/2014) found that all performance criteria had been met.

10. Landscape Rehabilitation Monitoring

10.1 Introduction

The landscape rehabilitation monitoring methodology was developed based on the requirements of the Urban Design Landscape Plan in accordance with the requirements of the Project Ecological Monitoring Program. The monitoring methodology was utilised for this assessment and was the same as for the baseline assessment completed in spring 2016. A report documenting the results of the first two monitoring events (spring 2016 and summer 2017) is provided in **Appendix H**.

10.2 Summary of Results

Based on the monitoring results, most landscaping sites appear to be establishing well and indicate a high degree of native establishment and persistence, although dominance by Pigeon Grass (*Setaria sphacelata*) appears to be a problem at some sites (e.g. sites 1, 2 and 3). Riparian sites were in a lower condition and will require attention to ensure plants survive and persist, with site 12 requiring significant replacement of dead plants. Aftercare of all landscaped sites should continue as per requirements, with weed control a priority at affected sites. Pigeon Grass is a locally prevalent pastoral grass within the southern zone, which can establish prolifically and has potential to outcompete native species. Control of this species maybe required if results over time indicate reduced success of native species regeneration, in comparison with landscape treatment areas not supporting high percentages of Pigeon Grass.

11. Conclusion

The monitoring and reporting requirements of the second year of construction have been completed in accordance with the Project Ecological Monitoring Program and the Flora and Fauna management sub-plans. **Table 11.1** summarises the ecological monitoring undertaken for the Project to date and the upcoming monitoring requirements for the remaining years of the construction phase.

A summary of the Key Performance Indicators which inform the ecological monitoring program has been completed (refer to **Table 11.2**) and indicates all monitoring complies with KPIs (or relevant objectives) where relevant.

Year 3 monitoring will be undertaken during the period from February 2017 to February 2018.

Table 11.1 Ecological Monitoring Timeline

Giant Barred Frog	*Microbat Roost Box*	*Microbat 22 Structures - Overwintering*	*Microbat Habitat Monitoring*	*Microbat Persistence and Behaviour Monitoring*	*Yellow-bellied Glider*	*Koala Population*	*Nest Box Monitoring*	*Landscape Rehabilitation Photo Points*	*Landscape Rehabilitation Monitoring*	*In situ Threatened Flora Population*	*Translocation Areas*	*Wetland Rehabilitation Monitoring*	*Weed Photo Points*
Year 1 - Autumn 2015	Year 1 - Summer 2015	Year 2 - Winter 2016	Apr-15	Year 1 - Summer 2015	Year 2 - Winter/ Spring 2016	Year 1 - Spring 2015	Year 2 - Winter 2016	Nov-16	Year 2 - Spring 2016	Year 1 - Autumn 2015	Year 1 - Autumn 2015	Year 1 - Autumn 2015	Apr-15
Year 1 - Spring 2015	*Year 1 - Autumn 2015	Year 3 - Winter 2017	May-15	Year 1 - Autumn 2015		Year 3 - Spring 2017	Year 2 - Summer 2016	Dec-16		Year 1 - Spring 2015	Year 1 - Spring 2015	Year 1 - Winter 2015	May-15
Year 1 - Summer 2015/16	Year 1 - Winter 2015		Jun-15	Year 1 - Winter 2015			Year 3 - Winter 2017	Jan-17		Year 2 - Autumn 2016	Year 2 - Spring 2016	Year 1 - Spring 2015	Jun-15
Year 3 - Autumn 2017	Year 1 - Spring 2015		Jul-15	Year 1 - Spring 2015			Year 3 - Summer 2017	Feb-17	Year 2 - Summer 2016	Year 2 - Spring 2016	Year 3 - Spring 2017	Year 2 - Summer 2016	Jul-15
Year 3 - Spring 2017	Year 2 - Summer 2016		Aug-15	Year 2 - Summer 2016			Year 4 - Winter 2018	Mar-17		Year 3 - Spring 2017	Year 4 - Spring 2018	Construction Phase monitoring now complete	Aug-15
Year 3 - Summer 2017/18	Year 2 - Autumn 2016		Sep-15	Year 2 - Autumn 2016			Year 4 - Summer 2018	Apr-17		Year 4 - Spring 2018			Sep-15
	Year 2 - Winter 2016		Oct-15	Year 2 - Winter 2016				May-17	Year 3 - Autumn 2017				Oct-15
	Year 2 - Spring 2016		Nov-15	Year 2 - Spring 2016				Jun-17					Nov-15
	Year 3 - Summer 2017		Dec-15	Construction Phase monitoring now complete				Jul-17					Dec-15
	Year 3 - Autumn 2017		Jan-16					Aug-17	Year 3 - Winter 2017				Jan-16
	Year 3 - Winter 2017		Feb-16					Sep-17					Feb-16
	Year 3 - Spring 2017		To be continued monthly in year 3 and 4 (recommence in Feb 2017)					Oct-17					Mar-16
	Year 4 - Summer 2018		Feb-17					Nov-17	Year 3 - Spring 2017				Apr-16
	Year 4 - Autumn 2018		Mar-17					Dec-17					May-16
	Year 4 - Winter 2018		Apr-17					Jan-18					Jun-16
	Year 4 - Spring 2018		May-17					Feb-18	Year 3 - Summer 2017				Jul-16
			Jun-17					Mar-18					Aug-16
			Jul-17					Apr-18					Sep-16
			Aug-17					May-18	Year 4 - Autumn 2018				Oct-16
			Sep-17					Jun-18					Nov-16
			Oct-17					Jul-18					Dec-16

Giant Barred Frog	*Microbat Roost Box*	*Microbat 22 Structures - Overwintering*	*Microbat Habitat Monitoring*	*Microbat Persistence and Behaviour Monitoring*	*Yellow-bellied Glider*	*Koala Population*	*Nest Box Monitoring*	*Landscape Rehabilitation Photo Points*	*Landscape Rehabilitation Monitoring*	*In situ Threatened Flora Population*	*Translocation Areas*	*Wetland Rehabilitation Monitoring*	*Weed Photo Points*
			Nov-17					Aug-18	Year 4 - Winter 2018				Now 6 monthly monitoring
			Dec-17										Year 3 - June 2017
			Jan-18										Year 3 - December 2017
			July 2017 produce a 6 monthly summary report										
			Jan 2018 produce annual monitoring report										

Legend:

Year 1 - Winter 2015	Non-compliance
Completed	monitoring event completed
Upcoming	next seasons required monitoring
Construction Phase monitoring now complete	No monitoring required for construction phase

Table 11.2 Summary of Key Performance Criteria for Ecological Monitoring

Relevant Management Plan	*Key Performance Indictors (KPIs)*	*KPIs met?*	*Contingency if KPI Not Met*
Grey-headed Flying-fox	**Vegetation Clearing** ▪ More than one dead/ foetus or more than one injured Grey-headed Flying-fox is found which, in the opinion of the ecologist experienced with flying-foxes, are likely to have been killed or injured by the disturbance activities. **During Construction** ▪ Significant reduction in reproductive output (measured as mean percentage of females with young in target trees) relative to control site. ▪ Zero flying-fox mortality within 300 metres of the camp footprint. ▪ Should the annual road kill monitoring reports identify a significant difference between the roadkill numbers of the different treatments (transect types).	▪ Yes – no Grey-headed Flying-fox have been injured or killed as a result of project clearing activities. ▪ Yes – no significant reduction in reproductive output has been recorded as attributable to the project construction activities. ▪ Yes – no Flying-fox mortalities have been recorded within 300 m of the camp footprint due to construction activities. The camp self-relocated from the project alignment to the Macksville cemetery prior to clearing commencing. ▪ Yes – no significant difference has been recorded between roadkill numbers.	No action currently required.
Microbat overwintering	No key performance indicators are specifically listed in relation to this section of the plan.	N/A	N/A
Microbat Roost Box	Roost boxes installed are being utilised by a range of microbats.	▪ Yes – the uptake of roost boxes by microbats has increased in 2016 when compared to 2015 results. ▪ Yes – the species diversity of microbats using the boxes has increased in 2016 when compared to 2015 results. ▪ No – some roost boxes have never recorded occupancy.	**Recommend relocating boxes which have never recorded use by microbats to achieve increased uptake.**

Relevant Management Plan	*Key Performance Indictors (KPIs)*	*KPIs met?*	*Contingency if KPI Not Met*
Nest Box	Use of nest boxes by a wide range of native fauna: ▪ Use of nest boxes designed for specific species by those species (i.e. Brush-tailed Phascogale nest box being used by this species). ▪ Low rates of exotic fauna using nest boxes. ▪ Reduced maintenance requirements.	▪ Yes – low to moderate diversity was recorded during year 2 monitoring events (winter and summer) the combined number of native species recorded was seven fauna species and one native invertebrate (stingless bee). ▪ Yes – two Common Brush tailed possums were recorded using possum boxes ▪ Yes – sugar gliders used a range of box types including small glider, scansoral mammal, large glider, possum and microbat boxes. ▪ Yes – only two exotic species have been recorded using the nest boxes (Black Rat and European Bees). However six nest boxes have recorded occupation by active bee hives during the summer 2017 monitoring event (corrective actions have been implemented). ▪ Yes – low maintenance requirements have been experienced to date. Only one box was needed to be replaced due to damage. Minor maintenance was required for several boxes.	Buffalo ear tags have been affixed to nest boxes which have recorded European bee hive uptake with the intention that the bees will abandon the hive and leave the nest box.
Roadkill	Number of roadkill of EPBC listed fauna species resulting from the Project.	▪ Yes - No EPBC listed fauna have been recorded as road fatalities as a result of the Project.	No action currently required.

Relevant Management Plan	*Key Performance Indictors (KPIs)*	*KPIs met?*	*Contingency if KPI Not Met*
In-situ Threatened Flora: In-situ Roadside	The following performance indicators are to be used to evaluate the success of protective measures for in-situ threatened flora: a) The survival rate of in-situ threatened flora at the finish of clearing is 100%. No accidental damage occurs during clearing. b) The survival rate of in-situ threatened flora at the end of years 1-3 of the monitoring program is at least 80% and at least 70% at the end of years 4-8. c) Of plants surviving at the end of each year, at least 75% are in good condition i.e. they have healthy foliage, no sign of die-back or disease and exhibit new shoot growth (Condition Class 3 or >).	a) Yes – no in-situ threatened flora plants have died due to clearing or constructions operations. Natural die back of annual species has been recorded. b) Not yet applicable as only currently at the end of year 2. c) Yes – no construction related impacts have been recorded as affecting the health of the retained threatened flora. For those species not experiencing natural season dieback new growth and recruitment is evident amongst the retained plants. The exception is one Rusty Plum (NW56) which has experienced edge effects as a result of mainline clearing.	Installation of shade cloth has been recommended as well as additional watering and placement of mulch to the base of the Rusty Plum (NW56) to minimise impacts from over-exposure to sun and wind until protective revegetation becomes established.
In-situ Threatened Flora: Wools Tylophora and Slender Marsdenia Habitat	The following performance indicators are to be used to evaluate changes in habitat condition a) Plot crown-cover of exotic species is no more than 15% (overlapping and/or summed) at the end of Year-1 and no more than 25% at the end of Years-2 to 8. b) Baseline vegetation structure (height and crown cover) remains the same or increases in height and crown cover at the end of year compared to the previous year. c) There is no increase in the microclimate exposure class (e.g. 1 to 2, or 4 to 5) compared to the previous year.	a) Yes – no increase above 25% crown cover of exotic species has been recorded at the end of year 2 monitoring events. b) Yes – no reduction to baseline vegetation structure has been recorded when compared to the previous years monitoring. c) Yes – no increase to the microclimate exposure class has been recorded when compared to the previous year.	No corrective action is currently required.

Relevant Management Plan	*Key Performance Indictors (KPIs)*	*KPIs met?*	*Contingency if KPI Not Met*
Threatened Flora Translocation	The following performance indicators are to be used to evaluate the success of the threatened species translocations (salvage translocation and population enhancement): a) All directly impacted individuals of threatened species were salvaged and relocated to the receival site(s). b) At least 60% of transplant and enhancement individuals are surviving after the first year, 50% after five years and 40% after eight years. c) At the end of the monitoring program (8 years), at least 50% of surviving individuals have a Condition Class of 3 or higher.	a) Yes – all impacted individuals of threatened species have been translocated. b) Yes – survival rate greater than 60%. c) Not yet applicable until the end of the monitoring program.	No corrective action is currently required.
Landscape Rehabilitation	No performance indicators have been prescribed as part of the scope of works for landscape rehabilitation monitoring provided by Pacifico.	N/A	N/A

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Appendix A

Habitat Tree Register and Fauna Capture/ Relocation Records

Table A1 WC2NH Fauna Register February 2015 to March 2017

Common name	Scientific Name	Number of Individuals	Date	Fate	Location	Chainage	Comments	Observer
February 2015								
GBF	*Mixophyes iteratus*	2	19/02/2015	Released on non-works side of frog fence	Lower Warrell Creek	42500	Observed during GBF monitoring (night time)	DH,FM, JOL
March 2015								
Sugar Glider	*Petaurus breviceps*	4	4/03/2015	Released, Unharmed	State forest off Old Coast Road	55200	Nest box attached to tree was removed. 4 x sugar gliders occupying nest box. Nest box Relocated into bush, reattached to tree on same chainage outside clearing limits	JOL
Pink-tounge Skink	*Cyclodomorphus gerrardii*	1	16/03/2015	Released, Unharmed	Cockburns Lane	42980	Found within fallen stag, released in bush on same chainage outside clearing limits	DH,FM
Yellow Bellied Glider	*Petaurus australis*	4	16/03/2015	Died in falling stag	Cockburns Lane	42980	Discovered in fallen stag. Three dead on arrival one euthanised by Macksville vet	DH,FM
Brushtail Possum	*Trichosurus vulpecula*	5	16/03/2015	Escaped falling stag	Cockburns Lane	42980	Observed escaping fallen stag. Appeared to be unharmed	DH,FM
Ringtail Possum	*Pseudocheirus peregrinus*	2	23/03/2015	Self-relocated	NE siding Lane	58150	Observed during pre-dawn survey	DH,FM
Red-backed Toadlet	*Pseudophryne coriacea*	1	23/03/2015	Self-relocated	NE siding Lane	58150	Observed during pre-dawn survey	DH,FM
Sugar Glider	*Petaurus breviceps*	1	25/03/2015	Self-relocated	NE siding Lane	58150	Observed during pre-dawn survey	DH,FM
Carpet Python	*Morelia spilota*	1	30/03/2015	Died on site, possible machinery strike	NE siding Lane	58150	Observed during site visit	DH,FM
Fawn-footed Melomys	*Melomys cervinipes*	1	30/03/2015	Released, Unharmed	NE siding Lane	58150	Observed habitat tree removal	DH,FM
Southern Dwarf-crowned Snake	*Cacophis krefftii*	1	27/03/2015	Released outside of clearing limits	NE siding Lane	58150	Observed habitat tree removal	DH,FM

Common name	Scientific Name	Number of Individuals	Date	Fate	Location	Chainage	Comments	Observer
GBF	*Mixophyes iteratus*	3	11/03/2015	Released on non-works side of frog fence	Lower Warrell Creek	42500	Observed during GBF monitoring (night time)	DH,FM,JH
April 2015								
Sugar Glider	*Petaurus breviceps*	1	1/04/2015	Released outside of clearing limits	Above quarry on Pacific Hwy	47750	Observed in HBT held during the day then released after dark	DH,FM
Sugar Glider	*Petaurus breviceps*	3	8/04/2015	Self-relocated	Old coast Road	59300	Found in habitat tree when dropped	FM
Sugar Glider	*Petaurus breviceps*	1	8/04/2015	Wires	Old Coast Road	59300	Found in habitat tree when dropped	FM
Blind snake	*Ramphtyphlops nigrescens*	1	9/04/2015		Bald hill Road	49300	Found in habitat tree when dropped	FM
Green Tree Snake	*Dendrelaphis punctulata*	1	15/04/2015	Relocated outside of project area	Bald hill Road	48500	Salvaged from debris after habitat tree felling	FM,GJM
Carpet Python	*Morelia spilota*	1	23/04/2015	Relocated outside of project area	Lower Warrell Creek	48100	Collected from the south side of lower Warrell Creek	DH,EW
May 2015								
White-headed Pigeon	*Columba leucomela*	1	4/05/2015	Taken to Macksville vet	North Bald Hill	49300		
Carpet Python	*Morelia spilota*	1	14/05/2015	wires	Cockburns Lane	42800		
Carpet Python	*Morelia spilota*	1	15/05/2015	Relocated outside of project area	Butchers Creek	43200		
Pacific Black Duck	*Anas superciliosa*	15	29/05/2015	Relocated outside of project area	Dam wall	44500	Mother duck plus 14 ducklings, shooed from dam wall into neighbouring water body (outside of alignment)	
Carpet Python	*Morelia spilota*	1	29/05/2015	Relocated outside of project area	South of Butchers creek	42700		
June 2015								
Swamp Wallaby	*Wallabia bicolor*	1+1	5/06/2015	Mother hit by car, joey survived	Intersection of Scotts head Road	48100	Wires carer to rehabilitate	FM,EW
Lace Monitor	*Varanus varius*	1	11/06/2015	Relocated to nearby bush land, unharmed	North of Sheathers driveway	56200	Encountered during clearing	FM

Common name	Scientific Name	Number of Individuals	Date	Fate	Location	Chainage	Comments	Observer
Carpet Python	*Morelia spilota*	1	11/06/2015	Relocated to nearby bush land, unharmed	North of Sheathers driveway	56200	Encountered during clearing	FM
Feathertail Glider	*Acrobates pygmaeus*	2	16/06/2015	Relocated to nearby bush land ,unharmed	Adjacent Jacks ridge	57000	Placed in nest box with dry leafy material	DH,FM
Little Forest Bat	*Vespadelus sp*	4	16/06/2015	3 deceased, 1 Relocated after sun down	Adjacent Jacks ridge	57000	Encountered during clearing	DH,FM
Eastern Water Dragon	*Itellagama lesueurii*	6	16/06/2015	5 Relocated outside of project area, 1 euthanised	Culvert, near quarry access	47500	Encountered during clearing	DH,FM
Sugar Glider	*Petaurus breviceps*	1	18/06/2015	Relocated to nearby bush land, unharmed	Jacks Ridge	57050	Encountered during clearing	FM
Southern Dwarf-crowned Snake	*Cacophis krefftii*	1	22/06/2015	Self-relocated	South Bald Hil	48900	Encountered during clearing	DH
Carpet Python	*Morelia spilota*	1	23/06/2015	Relocated to nearby bush land, unharmed	Poplar trail, OCR	58200	Encountered during clearing	FM
Red-bellied Black Snake	*Pseudechis porphyriacus*	1	24/06/2015	Relocated to nearby bush land, unharmed	Old Mill, Sheathers	56100	Encountered during clearing	FM
Echidna	*Tachyglossus aculeatus*	1	25/06/2015	Relocated to nearby bush land, unharmed	Poplar trail, OCR	58200	Encountered during clearing	FM,JOL,JL
Kookaburra	*Dacelo novaeguineae*	1	25/06/2015	Died after being struck by stick in mulcher	Poplar trail, OCR	58200	Encountered during clearing	DH
July 2015								
Brushtail Possum	*Trichosurus vulpecula*	1	1/07/2015	Relocated outside of project boundary	Old Coast Road	N/A	possibly with young	FM
Eastern Small-eyed Snake	*Cryptophis nigrescens*	1	8/07/2015	Relocated outside of project boundary	Old Coast Road	N/A	Encountered during clearing	FM

Common name	Scientific Name	Number of Individuals	Date	Fate	Location	Chainage	Comments	Observer
Lace Monitor	*Varanus varius*	1	15/07/2015	Injured in clearing and grubbing, taken to Macksville vet	Old Coast Road	N/A	Successfully rehabilitated and will be release back to state forest once fauna fencing has been installed and connected.	FM
Eastern water dragon	*Itellagama lesueurii*	1	15/07/2015	Relocated outside of project boundary	Old Coast Road and pacific hwy	52900	Found in rubbish pile	FM
Blind Snake	*Ramphtyphlops nigrescens*	1	15/07/2015	Relocated outside of project boundary	Old Coast Road	N/A	Encountered during clearing	FM
Echidna	*Tachyglossus aculeatus*	1	16/07/2015	Relocated outside of project boundary	Stoney creek	45600	Encountered during clearing	FM
Sugar Glider	*Petaurus breviceps*	2	17/07/2015	Found in nest box that required moving outside of clearing limits	Old Coast Road	N/A	Encountered in preparation for clearing	FM
Blue-tongue Lizard	*Tiliqua scincoides.*	1	21/07/2015	Found during top soil stripping, Relocated unharmed	North of southern compound	46100	Encountered during topsoil strip	FM
Swamp Wallaby	*Wallabia bicolor*	2	24/07/2015	Hit by vehicle (OCR) Mother died at scene, joey un injured being cared for by wires	Old Coast Road	N/A	Vehicle strike	FM
Feathertail Glider	*Acrobates pygmaeus*	1	27/07/2015	Found in HBT whilst clearing, Relocated to nearby bush land, unharmed	Gate 18, Old Coast Road	60900	Encountered during clearing	FM
August 2015								
No Records for August								
September 2015								
Great Barred Frog	*Mixophyes fasciolatus*	2	7/09/2015	Moved off site, found during GBF	Butchers Creek	43300	Moved off site, found during GBF pre clearing	DH

Common name	Scientific Name	Number of Individuals	Date	Fate	Location	Chainage	Comments	Observer
				pre clearing survey			survey	
Striped Rocket Frog	*Litoria nasuta*	2	9/09/2015	Moved off site, found during GBF pre clearing survey	Butchers Creek	43300	Moved off site, found during GBF pre clearing survey	FM
Red-backed Toadlet	*Pseudophryne coriacea*	1	9/09/2015	Moved off site, found during GBF pre clearing survey	Butchers Creek	43300	Moved off site, found during GBF pre clearing survey	FM
Eastern Dwarf Frog	*Litoria fallax*	1	10/09/2015	Moved off site, found during GBF pre clearing survey	Butchers Creek	43300	Moved off site, found during GBF pre clearing survey	FM
Dwarf-crowned Snake	*Cacophis krefftii*	1	11/09/2015	Moved off site, found during GBF pre clearing survey	Butchers Creek	43300	Moved off site, found during GBF pre clearing survey	FM
Great Barred Frog	*Mixophyes faciolatus*	1	17/09/2015	Moved off site, found during GBF pre clearing survey	Butchers Creek	43300	Moved off site, found during GBF pre clearing survey	DH
Blind Snake	*Ramphtyphlops nigrescens*	1	24/09/2015	Relocated off site unharmed	OC15	59200	Found under Geofabric in cleanwater drain	JOL
October 2015								
Marsh Snake	*Hemiapsis signata*	1	2/10/2015	Relocated outside of project boundary	Gate OC14 Nambucca State Forest	59000	Identified by work crew	JOL
Brown Snake	*Pseudonaja textilis*	1	6/10/2015	Relocated outside of project boundary	Albert Drive interchange	46150	Identified by work crew	JOL
Carpet Python	*Morelia spilota*	1	8/10/2015	taken to the vet for medical attention, now in care with WIRES	122 Old Coast Road house demolition, pre-demo survey was undertaken but the snake was not detected	54100	Identified during house demolition by work crew	JOL

Common name	Scientific Name	Number of Individuals	Date	Fate	Location	Chainage	Comments	Observer
Eastern Rosella	*Platycercus eximius*	1	15/10/2015	taken to care for WIRES	Fill 12 south of Lower Warrell Creek	48000		JOL
November 2015								
Great Barred Frog	*Mixophyes fasciolatus*	1	19/11/2015	during frog surveys, Relocated offsite, Butchers Creek	Butchers Creek	43300	Encountered during nocturnal frog surveys	FM,JOL
Pink-tounge Skink	*Cyclodomorphus gerraroadii*	1	19/11/2015	during frog surveys, Relocated offsite, Butchers Creek	Butchers Creek	43300	Encountered during nocturnal frog surveys	FM,JOL
Brown Falcon	*Falco berigora*	1	28/11/2015	Taken to vet, found under plant in the morning, cut 10	Cut 10	47700	Identified by work crew	Enviro Crew
Koala	*Phascolarctos cinereus*	1	24/11/2015	Found during Koala surveys	Near Tip Road > 70m west of the project alignment		Encountered during koala surveys	FM,GMcL
December 2015								
Brown Snake	*Pseudonaja textilis*	1	8/12/2016	Relocated outside of project boundary	OC6 drainage excavation	55200	Identified by work crew	JOL
January 2016								
Striped Marsh Frog	*Limnodynates peronii*	1	14/01/2016	Relocated outside of Project alignment to the east	Fill 19 near South Mattick Road	54400	Identified by work crew	JOL
Red-bellied Black Snake	*Pseudechis porphyriacus*	1	20/01/2016	Euthanised at vet missing tail above the cloaca	Rosewood Creek	44900		JOL
Eastern Long Neck Turtle	*Chelodina longicollis*	1	22/01/2016	Relocated outside of Project alignment to the east	Fill 19 near South Mattick Road in sediment trap	54400	Identified by work crew	JOL
Kookaburra	*Dacelo novaeguineae*	1	27/01/2016	Hit by traffic on Old Coast Road - euthanised at vet	Old Coast Road	N/A	PV brought in to ecologists	FM

Common name	Scientific Name	Number of Individuals	Date	Fate	Location	Chainage	Comments	Observer
February 2016								
Grey-headed Flying-fox	*Pteropus poliocephalus*	1	16/02/2016	Found in structure pile casing, taken to vet then given to experienced WIRES carer	Nambucca River Bridge - Gumma Road	52050	Structures staff called ecologist to capture the animal	FM,JOL
Yellow-bellied Glider	*Petaurus australis*	3	18/02/2016	Observed on HBT at OC18 - additional monitoring and supervision of tree felling. No YBGs in the habitat tree while felling	OC18 HBT	60950	Observed on HBT at OC18 1 animal observed 2 additional animals heard calling within 100 m of the HBT. This HBT was monitored over a series of nights before felling of this tree. No YBGs in the habitat tree when felled.	JOL
Sugar Glider	*Petaurus breviceps*	2	29/02/2016	found within hollows of the OC18 HBT - safely released at night	OC18 HBT	60950	Captured during supervised felling of the HBT	DH,FM, JOL
March 2016								
Swamp Wallaby	*Wallabia bicolor*	1	2/03/2016	Found attacked by dogs - taken to vet for treatment in care with WIRES	Cut 24 OC14	58800	Attacked by 2 dogs captured by foreman and given to ecologists	JOL
Tawny Frogmouth	*Podargus strigoides*	1	7/03/2016	Collision with delivery truck on route to PCY - euthanised due to missing wing	PCY	54100	Delivery driver called Enviros	JOL
Perons Tree Frog	*Litoria peronii*	1	8/03/2016	Captured during HBT felling - Relocated offsite	Stoney Creek	45500	Ecologist capture/relocate	FM
Rainbow Lorikeet	*Trichoglossus moluccanus*	1	9/03/2016	Retrieved from a hollow nest taken to wires for care	Albert Drive HBTs	42600	Taken to wires for care raised and later released in Scotts Head	JOL

Common name	Scientific Name	Number of Individuals	Date	Fate	Location	Chainage	Comments	Observer
Galah	*Eolophus roseicapilla*	1	9/03/2016	located in hollow nest but already deceased for a number of days	Albert Drive HBTs	42600	Deceased for a number of days likely water exposure as the hollow was inundated with water	JOL
Eastern Rosella nest	*Platycercus eximius*	2 eggs	9/03/2016	Two eggs in hollow nest - eggs destroyed	Albert Drive HBTs	42600	Two eggs in hollow nest - eggs destroyed by ecologist	JOL
Red-bellied Black Snake	*Pseudechis porphyriacus*	1	14/03/2016	escaped capture, minor laceration	Rosewood creek	44550	Injured by machinery, escaped ecologist	JOL
April 2016								
Swamp Wallaby	*Wallabia bicolor*	1	14/04/2016	Euthanised	OCR and Mattick Road	54600	Discovered early morning, possible vehicle strike	A Dwyer
May 2016								
Great Barred Frog	*Mixophyes fasciolatus*	1	9/05/2016	Relocated unharmed	Butchers Creek	43350	found during nocturnal survey	FM
June 2016								
Common Froglet	*Crinia signifera*	1	26-Jun	Relocated offsite safely	Butchers Creek	43350	N/A	FM
Eastern Dwarf Frog	*Littoria fallax*	1	26-Jun	Relocated offsite safely	Butchers Creek	43350	N/A	FM
Carpet Python	*Morelia spilota*	1	2-Jun	Self relocated unharmed	Butchers Creek	43350	N/A	E Wright
Echidna	*Tachyglossus aculeatus*	1	10-Jun	Self relocated unharmed	gate 5	46880	N/A	FM
July 2016								
Australian White Ibis	*Threskiornis moluccus*	1	18/07/2016	Euthanised by vet	Old Coast Road	59500	Discovered early morning by Enviro Coordinator on OCR	A Dwyer
Black Flying-fox	*Pteropus alecto*		26/07/2016	Deceased - likely vehicle strike	Gate 5 - Albert Drive	46880	Deceased - likely vehicle strike	E Wright
Tawny Frogmouth	*Podargus strigoides*	1	25/07/2016	Taken into care by WIRES released shortly after	Letitia drive	53300	Found at Letitia drive early morning	A Dwyer
August 2016								
Black Flying-fox	*Pteropus alecto*	1	26/08/2016	Found at gate 5 (deceased) likely vehicle strike	Albert drive North	46880	Likely vehicle strike	E Wright

Common name	Scientific Name	Number of Individuals	Date	Fate	Location	Chainage	Comments	Observer
September 2016								
Blue-tongue Lizard	*Tiliqua scincoides*	1	9/09/2016	Relocated to nearby vegetation by Pacifico south zone enviro team	Butchers Creek	43350	Encountered while working in Butchers Creek	AFJV enviro crew
Carpet Python	*Morelia spilota*	1	13/09/2016	Sunning itself on fuel cart – self relocated once the truck was driven close to vegetation	North Zone QB area	57900	Observed on Watercart	J Henderson
Swamp Wallaby	*Wallabia bicolor*	1	14/09/2016	Rescued from sediment basin at OC19 – released in nearby vegetation	OC19	61200	Wallaby hopped into sediment basin and became trapped in silt mud retrieved using snatch strap and tadpole dip net.	JOL
Brown Snake	*Pseudonaja textilis*	1	29/09/2016	Take to WIRES for care	Fill 6	44700	Stuck in spray seal rescued by wires and cleaned by WIRES volunteer	E Wright
October 2016								
Green Tree Snake	*Dendrelaphis punctulatus*	1	6/10/2016	Deceased	Fill 19	54650	N/A	AFJV
Pretty-faced Wallaby	*Macropus parryi*	1	10/10/2016	Deceased - Roadkill	Fill 24	57700	N/A	AFJV
Rabbit	*Oryctolagus cuniculus*	1	11/10/2016	Deceased - Roadkill	Fill 24	57700	N/A	AFJV
Sugar Gliders	*Petaurus breviceps*	2	24/10/2016	Observed only - during NFRs pre-clearing surveys	Old Coast Road - east	53800	Observed entering a nest box at dawn (not within the clearing footprint).	JOL
Feathertail Glider	*Acrobates pygmaeus*	1	25/10/2016	Observed only - during NFRs pre-clearing surveys	Old Coast Road - east	53720	Observed in a tree not within the clearing footprint.	DJH
Ringtail Possum	*Pseudocheirus peregrinus*	1	25/10/2016	Observed only - during NFRs pre-clearing surveys	Old Coast Road - east	53780	Observed in a tree within the clearing footprint - tree not cleared until confirmed possum had self-Relocated.	DJH

Common name	Scientific Name	Number of Individuals	Date	Fate	Location	Chainage	Comments	Observer
Red-bellied Black Snake		1	28/10/216	Self-Relocated from machine	Location not supplied	N/A	Self-Relocated from machine	J Henderson
Magpie chicks	*Cracticus tibicen*	2	31/10/2016	1 taken to Vet and WIRES for care 1 fatally injured during clearing	Woods Property access	53260	Occupied nest in a tall marked HBT was difficult to control the fall of this tree when felling.	JOL
November 2016								
Masked Lapwing Chick	*Vanellus miles*	1	9/11/2016	Chick without parents taken to WIRES for care	Mattick Road	54550	Steel fixers caught the chick and gave to Enviro Coordinator	J Henderson
Green Tree Snake	*Dendrelaphis punctulatus*	1	22/11/2016	Likely roadkill	Mattick Road	54550	Collected by ecologist for ID purposes	JOL
Golden-crowned Snake	*Cacophis squamulosus*	1	31/11/2016	Relocated, unharmed	Upper Warrell Creek	42650	Captured from shallow excavation and Relocated unharmed	JOL
December 2016								
Microbat	*Miniopterus sp.*	1	12/12/2016	Observed within box culvert scupper - no action required	Nth Albert Drive - Cattle underpass	46450	Observed within box culvert scupper - no action required	JOL
January 2017								
Red-bellied Black Snake	*Pseudechis porphyriacus*	1	23/01/2017	Observation only	Upper Warrell Creek	1km south of CH48100	Observed Swimming in Upper Warrell Creek during Microbat Roost Box Monitoring event	JOL
Green Tree Snake	*Dendrelaphis punctulatus*	1	23/01/2017	Relocated unharmed	Rosewood Road Bridge abutment	45280	Captured from bag of rio bar at the bridge abutment	JOL
February 2017								
Carpet Python	*Morelia spilota*	1	13/02/2017	Captured from within tracks of excavator. Released unharmed	Brown's Crossing Road	41950	Spotter observed the snake when clearing lantana and topsoil	JOL

Table A2 WC2NH Hollow Bearing Tree Register March 2015 to March 2017

Ref	Easting	Northing	Location	Species	Surrounding Vegetation	Habitat Type	Dead or Alive	DBH (cm)	Tree Height (m)	Date Felled	Actual Functional Hollows (Predicted)	Trunk - Small (<5cm)	Trunk - Medium (5-15cm)	Trunk - Large (>15cm)	Limb - Small (<5cm)	Limb - Medium (5-15cm)	Limb - Large (>15cm)	Fissure - Small (<5cm)	Fissure - Medium (5-15cm)	Fissure - Large (>15cm)	Base - Small (<5cm)	Base - Medium (5-15cm)	Base - Large (>15cm)
G10	495998	6608055	58300-58000	Stag	Blackbutt dry open forest	Hollow-bearing tree	Dead	90	16	26/03/2015		0	1	0	2	0	0						
G11	495997	6608097	58300-58000	Blackbutt	Blackbutt dry open forest	Hollow-bearing tree	Alive	80	14	27/03/2015		0	0	0	0	0	0						
G12	495955	6608064	58300-58000	Blackbutt	Blackbutt dry open forest	Hollow-bearing tree	Alive	110	15	27/03/2015		0	0	0	3	0	0						
G13	495995	6608026	58300-58000	Blackbutt	Blackbutt dry open forest	Hollow-bearing tree	Alive	110	16	27/03/2015		0	0	0	0	0	0						
G14	495987	6608094	58300-58000	White Mahogany	Blackbutt dry open forest	Hollow-bearing tree	Alive	80	14	27/03/2015		0	0	0	2	0	0						
G15	495961	6607980	58300-58000	Tallowwood	Blackbutt dry open forest	Hollow-bearing tree	Alive	80	14	27/03/2015		0	1	4	2	3	1					1	1
G16	496044	6608102	58300-58000	Stag	Blackbutt dry open forest	Hollow-bearing tree	Dead	40	10	30/03/2015		0	0	0	0	0	0						
G17	496056	6608091	58300-58000	Stag	Blackbutt dry open forest	Hollow-bearing tree	Dead	80	14	30/03/2015		4	3	2	0	3	0						
G18	496181	6608281	58570-58700	Turpentine	Blackbutt dry open forest	Hollow-bearing tree	Alive	50	12	9/04/2015		0	2	0	4	0	0			1			
G19	492427	6599830	49100	Red ash	Moist Open Forest- White mahogany/ Grey Gum	Bird habitat	Alive	40	15	13/04/2015		0	0	0	0	0	0						
G2	495126	6606610	57000-57500	Mahogany	Blackbutt dry open forest	Hollow-bearing tree	Alive	50	10	13/03/2015		2	0	0	0	1	0						
G20	496429	6608592	58950-59100	Blackbutt	Blackbutt dry open forest	Hollow-bearing tree	Alive	120	24	11/04/2015		0	0	0	0	0	0						
G21	496393	6608612	58950-59100	Tallowwood	Blackbutt dry open forest	Hollow-bearing tree	Alive	80	12	11/04/2015		0	0	0	0	0	0						
G22	496239	6608302	58950-59100	White Mahogany	Blackbutt dry open forest	Hollow-bearing tree	Alive	50	10	11/04/2015		0	0	2	1	3	6						
G23	492400	6600025	49300	Tallowwood	Paddock trees, farmland	Hollow-bearing tree	Alive	130	22	9/04/2015		0	0	5	4	0	0						
G24	492351	6600069	49300	Grey gum	Paddock trees, farmland	Hollow-bearing tree	Alive	230	30	9/04/2015		0	0	1	2	0	0						
G25	492404	6599119	48280-49000	Tallowwood	Moist Open Forest- White mahogany Grey Gum	Hollow-bearing tree	Alive	60	16	14/04/2015		0	0	0	0	0	0						
G26	492402	6599173	48280-49000	Tallowwood	Moist Open Forest- White mahogany/ Grey Gum	Hollow-bearing tree	Alive	80	18	14/04/2015		2	0	1	4	0	0						

Ref	Easting	Northing	Location	Species	Surrounding Vegetation	Habitat Type	Dead or Alive	DBH (cm)	Tree Height (m)	Date Felled	Actual Functional Hollows (Predicted)	Trunk - Small (<5cm)	Trunk - Medium (5-15cm)	Trunk - Large (>15cm)	Limb - Small (<5cm)	Limb - Medium (5-15cm)	Limb - Large (>15cm)	Fissure - Small (<5cm)	Fissure - Medium (5-15cm)	Fissure - Large (>15cm)	Base - Small (<5cm)	Base - Medium (5-15cm)	Base - Large (>15cm)
G27	497194	6610135	60900-60600	Stag	Blackbutt dry open forest	Hollow-bearing tree	Dead	72	14	17/04/2015		0	0	2	5	4	0						
G27a	497213	6610163	60900-60600	Tallowwood	Blackbutt dry open forest	Hollow-bearing tree	Alive	80	16	17/04/2015		0	0	0	0	0	0						
G28	489468	6594427	42700-42750	Blackbutt	Moist Open Forest-Flooded Gum	Hollow-bearing tree	Alive	70	15	23/04/2015		0	0	0	0	2	0						
G29	497190	6610020	60300-60600	Blackbutt	Blackbutt dry open forest	Potential hollow-bearing tree	Alive	80	16	29/04/2015		0	0	0	0	0	0						
G3	495067	6606410	56550-56350	Blackbutt	Paddock trees, farmland	Hollow-bearing tree	Alive	130	25	19/03/2015		0	0	0	0	0	0						
G30	489961	6595160	43350-45300	Stag	Moist Open Forest-Flooded Gum	Hollow-bearing tree	Dead	70	22	13/05/2015		0	3	0	4	5	0						
G31	490130	6595312	43350-45300	Turpentine	Moist Open Forest-Flooded Gum	bird habitat	Alive	12	30	13/05/2015		0	0	0	0	0	0						
G32	490152	6595348	43350-45300	Tallowwood	Moist Open Forest-Flooded Gum	Hollow-bearing tree	Alive	15	30	20/05/2015		0	0	0	2	0	0						
G33	494901	6606330	55900-56400	Bloodwood	Moist Open Forest-Flooded Gum	bird habitat	Alive	15	40	3/06/2015		0	0	0	0	0	0						
G34	494908	6606308	56100-56400	Bloodwood	Moist Open Forest-Flooded Gum	Hollow-bearing tree	Alive	65	18	10/06/2015		0	0	0	1	2	0					1	
G35	494892	6606332	56100-56400	Bloodwood	Moist Open Forest-Flooded Gum	Hollow-bearing tree	Alive	70	22	10/06/2015		0	0	0	0	2	0						
G36	495024	6606356	56100-56400	Tallowwood	Moist Open Forest-Flooded Gum	Hollow-bearing tree	Alive	45	12	11/06/2015		0	0	0	0	4	0						
G37	494945	6606330	56100-56400	Blackbutt	Moist Open Forest-Flooded Gum	Hollow-bearing tree	Alive	50	12	11/06/2015		0	0	0	0	2	0						
G38	494952	6606346	56100-56400	Bloodwood	Moist Open Forest-Flooded Gum	Hollow-bearing tree	Alive	90	18	11/06/2015		0	0	0	0	3	0						
G39	494964	6606382	56100-56400	Blackbutt	Moist Open Forest-Flooded Gum	Hollow-bearing tree	Alive	100	18	11/06/2015		0	0	0	0	2	0						
G4	495059	6606380	56550-56350	Blackbutt	Paddock trees, farmland	Hollow-bearing tree	Alive	90	18	19/03/2015		2	0	0	0	0	0						
G40	494994	6606408	56100-56400	Paperbark	Blackbutt dry open forest	Hollow-bearing tree	Alive	140	25	11/06/2015		0	0	0	0	1	0						
G41	495000	6606430	56100-56400	Bloodwood	Blackbutt dry open forest	Hollow-bearing tree	Alive	80	16	11/06/2015		0	0	3	4	1	0						1
G42	495007	6606437	56100-56400	Bloodwood	Blackbutt dry open forest	Hollow-bearing tree	Alive	60	12	11/06/2015		0	0	0	0	0	0						

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G43	495031	6606453	56980-57900	Paperbark	Blackbutt dry open forest	Hollow-bearing tree	Alive	45	12	16/06/2015		0	0	0	0	0	0						
G44	495058	6606488	56980-57900	Turpentine	Blackbutt dry open forest	Hollow-bearing tree	Alive	50	10	16/06/2015		2	0	0	0	0	0						
G45	495074	6606525	56980-57900	Bloodwood	Blackbutt dry open forest	Hollow-bearing tree	Alive	90	17	16/06/2015		3	0	0	3	0	0						
G46	495560	6607360	57100-57500	Stag	Blackbutt dry open forest	Hollow-bearing tree	Dead	60	15	18/06/2015		0	2	0	3	0	0						
G47	495614	6607515	57450-57800	Stag	Blackbutt dry open forest	Hollow-bearing tree	Dead	95	20	22/06/2015		0	2	0	4	0	0						
G48	496540	6608919	58700-59450	Blackbutt	Blackbutt dry open forest	Hollow-bearing tree	Alive	90	25	29/06/2015		2	1	0	3	0	0						
G49	496182	6608285	57900 - 58500	Blackbutt	Blackbutt dry open forest	Hollow-bearing tree	Alive	120	25	29/06/2015		3	0	0	0	0	0						
G5	491620	6598053	47050	Paperbark	Moist Open Forest- White mahogany /Grey Gum	Hollow-bearing tree	Alive	110	15	30/03/2015		0	0	4	0	0	0						
G50	496296	6608415	58400 - 58800	Mahogany	Blackbutt dry open forest	Hollow-bearing tree	Alive	140	25	2/07/2015		0	2	0	0	0	0						
G51	496216	6608375	58600 - 58900	Blackbutt	Blackbutt dry open forest	Hollow-bearing tree	Alive	80	16	1/07/2015		0	0	0	3	1	0						
G52	496234	6608375	58600 - 58900	Blackbutt	Blackbutt dry open forest	Hollow-bearing tree	Alive	70	22	1/07/2015		1	0	0	0	1	0						
G53	496259	6608375	58600 - 58900	Mahogany	Blackbutt dry open forest	Hollow-bearing tree	Alive	45	12	1/07/2015		1	0	0	0	1	0						1
G54	496310	6608403	58600 - 58900	Mahogany	Blackbutt dry open forest	Hollow-bearing tree	Alive	50	12	1/07/2015		1	0	0	0	0	0						
G55	496325	6608435	58600 - 58900	Blackbutt	Blackbutt dry open forest	Hollow-bearing tree	Alive	90	18	1/07/2015		1	2	0	0	0	0						
G56	496523	6609033	59000 - 59450	Blackbutt	Blackbutt dry open forest	Hollow-bearing tree	Alive	120	25	10/07/2015		1	0	0	1	0	0						
G57	496521	6609077	59000 - 59450	Blackbutt	Blackbutt dry open forest	Hollow-bearing tree	Alive	60	12	10/07/2015		1	2	0	1	0	0						
G58	496524	6609105	59000 - 59450	Blackbutt	Blackbutt dry open forest	Hollow-bearing tree	Alive	100	18	10/07/2015		2	0	0	0	0	0						
G59	497190	6610030	60400 - 60600	Stag	Blackbutt dry open forest	Hollow-bearing tree	Alive	120	22	20/07/2015		0	0	0	2	0	0						
G6	492085	6598703	47800	Stag	Moist Open Forest- White mahogany /Grey Gum	Hollow-bearing tree	Dead	50	14	7/04/2015		0	2	0	4	0	0						

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G60	497382	6610405	60900 - 61250	Blackbutt	Blackbutt dry open forest	Hollow-bearing tree	Alive	100	18	27/07/2015		1	0	1	1	0	0						
G61	497396	6610456	60900 - 61250	Blackbutt	Blackbutt dry open forest	Hollow-bearing tree	Alive	120	22	27/07/2015		1	0	0	0	0	0						
G62	497421	6610547	60900 - 61250	Casurina	Blackbutt dry open forest	Hollow-bearing tree	Alive	155	18	27/07/2015		1	0	0	1	0	0						
G63	497456	6610607	60900 - 61250	Blackbutt	Blackbutt dry open forest	Hollow-bearing tree	Alive	80	22	27/07/2015		1	0	0	2	0	0						
G64	490673	6596062	Rose wood Ck	Ficus sp.	Paddock	Hollow-bearing tree	Alive	20	12	3/08/2015		2	0	0	0	1	0						
G65	497388	6610414	60951 - 61280	Blackbutt	Open Forest-Blackbutt	Hollow-bearing tree	Alive	120	25	23/07/2015		0	0	0	2	2	0						
G66	497367	6610376	60950 - 61280	Blackbutt	Open Forest-Blackbutt	Hollow-bearing tree	Alive	60	12	23/07/2015		0	0	0	2	0	0						
G67	494370	6604038	53250 - 54300	Blackbutt	Moist Open Forest-White Mahogany	Hollow-bearing tree	Alive	100	18	5/08/2015		0	0	0	1	0	0						
G68	494375	6604033	53250 - 54300	Blackbutt	Moist Open Forest-White Mahogany	Hollow-bearing tree	Alive	120	22	5/08/2015		0	1	0	0	0	0						
G69	494272	6603655	53250 - 54300	Stag	Moist Open Forest-White Mahogany	Hollow-bearing tree	Dead	155	18	5/08/2015		0	0	0	1	0	0						
G7	495890	6607913	58300-58000	Blackbutt	Blackbutt dry open forest	Hollow-bearing tree	Alive	80	18	25/03/2015		0	1	0	0	0	0			1			
G70	494270	6603667	53250 - 54300	Blackbutt	Moist Open Forest-White Mahogany	Hollow-bearing tree	Alive	120	22	5/08/2015		0	1	0	0	0	0						
G71	494282	6603665	53250 - 54300	Blackbutt	Moist Open Forest-White Mahogany	Hollow-bearing tree	Alive	55	18	5/08/2015		0	1	0	1	0	0						
G72	494282	6603654	53250 - 54300	Stag	Moist Open Forest-White Mahogany	Hollow-bearing tree	Dead	135	20	5/08/2015		0	1	0	0	0	0						
G73	497119	6610042	Oc17	Blackbutt	Open Forest-Blackbutt	Potential hollow-bearing tree	Alive	120	20	7/10/2015		0	0	0	0	0	0						
G74	492086	6598490	Cut 10	Ficus sp.	Paddock, Quarry	Potential hollow-bearing tree	Alive	250	12	28/10/2015		0	0	0	0	0	0						
G82	497271	6610278	OC19	Blackbutt	Open Forest-Blackbutt	Potential hollow-bearing tree	Alive	105	20	18/02/2016		0	0	0	0	0	0						
G75	489570	6594557	42750-42850	flooded gum	Moist Open Forest-Flooded Gum	Hollow-bearing tree	Alive	65	12	12/05/2015		0	0	0	0	2	0						
G76	497275	6610275	OC19	Blackbutt	Open Forest-Blackbutt	Potential hollow-bearing tree	Alive	140	25	18/02/2016		0	0	0	0	0	0						

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G77	497167	6610233	OcC18	Stag	Open Forest-Blackbutt	Potential hollow-bearing tree	Dead	80	16	18/02/2016		0	0	0	0	0	0						
G78	497453	6610261	Top of OCR	Bloodwood	Open Forest-Blackbutt	Hollow-bearing tree	Alive	70	22	29/02/2016		0	2	0	1	2	2						
G79	497465	6610258	Top of OCR	Stag	Open Forest-Blackbutt	Hollow-bearing tree	Dead	45	12	29/02/2016		0	0	0	1	0	0						
G8	495919	6607947	58300-58000	Tallowwood	Blackbutt dry open forest	Potential hollow-bearing tree	Alive	50	12	25/06/2015		0	0	0	0	0	0						
G80	497520	6610273	Top of OCR	Stag	Open Forest-Blackbutt	Potential hollow-bearing tree	Dead	50	12	29/02/2016		0	0	0	2	0	0						
G81	490852	6596754	Stoney Ck	Blue gum	Cleared creek line	Potential hollow-bearing tree	Alive	90	18	8/03/2016		0	0	0	0	0	0						
G9	495939	6607980	58300-58000	Stag	Blackbutt dry open forest	Potential hollow-bearing tree	Dead	130	18	26/03/2015		0	0	0	0	0	0						
H100	497311	6610242	North OCR	Stag	Blackbutt dry open forest	Hollow-bearing tree	Dead	80	16	28/07/2015		0	1	0	1	0	0						
H101	497405	6610271	60890	Blackbutt	Blackbutt dry open forest	Hollow-bearing tree	Alive	115	24	15/04/2015		0	0	0	3	1	0						
H102	497447	6610424	60900 - 61250	Blackbutt	Blackbutt dry open forest	Hollow-bearing tree	Alive	110	26	3/07/2015		0	0	0	2	0	0						
H103	497460	6610464	60900 - 61250	Blackbutt	Blackbutt dry open forest	Hollow-bearing tree	Alive	100	18	27/07/2015		2	1	0	1	0	0						
H104	497501	6610514	60900 - 61250	Blackbutt	Blackbutt dry open forest	Hollow-bearing tree	Alive	140	25	27/07/2015		0	2	0	0	0	0						
H105	497364	6610342	60900 - 61250	Blackbutt	Blackbutt dry open forest	Hollow-bearing tree	Alive	105	20	3/07/2015		0	2	0	0	0	0						
H16	490697	6596192	Rose wood ck	Flooded gum	Camphor Laurel Forest	Hollow-bearing tree	Alive	90	25	3/08/2015		2	0	0	0	2	0						
H18	491110	6597352	46200 Albert Drv	Stag	Cleared pasture land	Hollow-bearing tree	Dead	120	22	8/03/2016		0	0	0	5	3	0						
H19	491122	6597339	46200 Albert Drv	Blackbutt	Cleared pasture land	Hollow-bearing tree	Alive	120	24	8/03/2016		0	0	0	3	0	0						
H2	489482	6594420	42700-42750	Stag	Moist Open Forest-Flooded Gum	Hollow-bearing tree	Alive	130	10	23/04/2015		0	0	0	0	2	0						
H20	491126	6597338	46200 Albert Drv	Blackbutt	Cleared pasture land	Hollow-bearing tree	Alive	130	17	8/03/2016		0	1	0	2	1	0						

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H21	491129	6597345	46200 Albert Drv	Blackbutt	Cleared pasture land	Hollow-bearing tree	Alive	120	22	8/03/2016		0	0	0	3	2	1						
H22	491142	6597345	46200 Albert Drv	Stag	Cleared pasture land	Hollow-bearing tree	Dead	60	24	8/03/2016		0	0	0	3	2	0						
H23	491147	6597334	46200 Albert Drv	Blackbutt	Cleared pasture land	Hollow-bearing tree	Alive	170	20	8/03/2016		0	1	1	3	2	0		1				
H24	492347	6600078	49300	Blackbutt	Paddock trees, farmland	Hollow-bearing tree	Alive	70	20	9/04/2015		6	0	2	2	0	0						
H25	491148	6597340	46200 Albert Drv	Blackbutt	Cleared pasture land	Hollow-bearing tree	Alive	120	22	9/03/2016		0	0	0	5	5	2						
H26	491160	6597334	46000-46880	White mahogany	Paddock trees, farmland	Hollow-bearing tree	Alive	70	18	24/03/2015		0	1	0	0	0	0						
H27	491163	6597337	46150	Tallowwood	Paddock trees, farmland	Hollow-bearing tree	Alive	90	22	19/03/2015		0	0	1	0	0	0						
H28	491173	6597334	46200 Albert Drv	Blackbutt	Cleared pasture land	Hollow-bearing tree	Alive	140	20	9/03/2016		0	0	2	3	0	0						
H29	491197	6597332	46200 Albert Drv	Blackbutt	Cleared pasture land	Hollow-bearing tree	Alive	100	19	9/03/2016		0	0	0	3	3	0						
H3	489589	6594531	43150-42850	Stag	Hardwood platation	Hollow-bearing tree	Dead	230	30	16/03/2015		0	10	0	0	0	0						
H30	491219	6597329	46200 Albert Drv	Blackbutt	Cleared pasture land	Hollow-bearing tree	Alive	120	24	9/03/2016		0	0	0	2	1	0						
H32	492100	6598598	48150-47050	White mahogany	Moist Open Forest- White mahogany /Grey Gum	Hollow-bearing tree	Alive	60	12	1/04/2015		0	0	0	2	4	0						
H33	496182	6608280	56600-57000	Bloodwood	Blackbutt dry open forest	Potential hollow-bearing tree	Alive	80	22	8/05/2015		0	0	0	0	0	0						
H34	492320	6599039	48280-47000	Tallowwood	Moist Open Forest- Flooded Gum	Hollow-bearing tree	Alive	95	16	17/04/2015		0	0	0	0	0	0						
H35	492302	6599044	48280-47000	Tallowwood	Moist Open Forest- Flooded Gum	Hollow-bearing tree	Alive	60	17	17/04/2015		0	0	0	0	0	0						
H36	492309	6599063	48280-47000	Mahogany	Moist Open Forest- Flooded Gum	Hollow-bearing tree	Alive	100	18	17/04/2015		4	2	0	5	7	0						
H37	492462	6599311	48280-49000	Grey Ironbark	Moist Open Forest- White mahogany /Grey Gum	Hollow-bearing tree	Alive	75	14	16/04/2015		0	0	2	2	0	0						
H38	492470	6599294	56980-57900	Blackbutt	Blackbutt dry open forest	Hollow-bearing tree	Alive	115	22	16/06/2015		2	0	0	0	0	0						
H39	492508	6599449	56980-57900	Blackbutt	Blackbutt dry open forest	Hollow-bearing tree	Alive	135	20	16/06/2015		4	0	1	1	0	1						

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H40	492419	6600018	49300	Flooded gum	Paddock trees, farmland	Hollow-bearing tree	Alive	55	22	9/04/2015		0	0	3	3	0	0						
H41	492429	6600010	49300	Flooded gum	Paddock trees, farmland	Hollow-bearing tree	Alive	80	18	9/04/2015		0	0	4	1	0	0						
H42	492348	6600079	56980-57900	Blackbutt	Blackbutt dry open forest	Hollow-bearing tree	Alive	150	8	16/06/2015		2	0	0	0	0	0						
H43	495410	6607047	56980-57900	Blackbutt	Blackbutt dry open forest	Hollow-bearing tree	Alive	40	14	16/06/2015		2	0	0	1	0	0						
H44	495406	6607054	56980-57900	Blackbutt	Blackbutt dry open forest	Hollow-bearing tree	Alive	200	19	16/06/2015		3	0	1	2	0	1						
H45	495410	6607049	56980-57900	Blackbutt	Blackbutt dry open forest	Hollow-bearing tree	Alive	60	17	16/06/2015		2	0	0	0	0	0						
H46	495388	6607014	56980-57900	Blackbutt	Blackbutt dry open forest	Hollow-bearing tree	Alive	110	18	16/06/2015		2	0	0	0	3	0						
H531	494424	6605254	54550-55400	Blackbutt	Moist Open Forest-Flooded Gum	Hollow-bearing tree	Alive	90	18	29/05/2015		0	5	0	0	0	0						
H533	494431	6605290	55500	Stag	Blackbutt dry open forest	Hollow-bearing tree	Dead	70	16	2/03/2015		1	0	0	3	0	0						
H55	495392	6607100	57100-57500	Blackbutt	Blackbutt dry open forest	Potential hollow-bearing tree	Alive	85	22	18/06/2015		0	0	0	0	0	0						
H56	495395	6607106	57100-57500	Blackbutt	Blackbutt dry open forest	Hollow-bearing tree	Alive	110	22	18/06/2015		0	0	1	3	1	0						
H57	495600	6607465	57100-57500	Stag	Blackbutt dry open forest	Hollow-bearing tree	Dead	110	20	18/06/2015		1	0	0	3	1	2		2				
H58	495614	6607505	57100-57500	Stag	Blackbutt dry open forest	Hollow-bearing tree	Dead	80	14	18/06/2015		1	1	0	2	0	0		3				
H62	496179	6608282	58570-58700	Brushbox	Blackbutt dry open forest	Hollow-bearing tree	Alive	40	16	9/04/2015		0	0	0	0	0	0						
H63	496195	6608316	58400 - 58800	Stag	Blackbutt dry open forest	Hollow-bearing tree	Alive	100	12	2/07/2015		0	1	0	3	0	0						
H66	496543	6608949	59300	Blackbutt	Blackbutt dry open forest	Hollow-bearing tree	Alive	120	28	8/04/2015		1	4	0	6	2	0						
H67	496540	6608909	59300	Blackbutt	Blackbutt dry open forest	Hollow-bearing tree	Alive	125	28	8/04/2015		1	0	0	1	0	0						
H73	496600	6609419	59750-60050	Red mahogany	Moist Open Forest-Flooded Gum	Potential hollow-bearing tree	Alive	120	22	8/05/2015		0	0	0	0	0	0						
H74	496668	6609455	496668-6609455	Flooded gum	Moist Open Forest-Flooded Gum	Hollow-bearing tree	Alive	120	26	1/05/2015		0	0	0	3	3	0						

Ref	Easting	Northing	Location	Species	Surrounding Vegetation	Habitat Type	Dead or Alive	DBH (cm)	Tree Height (m)	Date Felled	Actual Functional Hollows (Predicted)	Trunk - Small (<5cm)	Trunk - Medium (5-15cm)	Trunk - Large (>15cm)	Limb - Small (<5cm)	Limb - Medium (5-15cm)	Limb - Large (>15cm)	Fissure - Small (<5cm)	Fissure - Medium (5-15cm)	Fissure - Large (>15cm)	Base - Small (<5cm)	Base - Medium (5-15cm)	Base - Large (>15cm)
H75	496647	6609457	496646-6609457	Flooded gum	Moist Open Forest- Flooded Gum	Hollow-bearing tree	Alive	12	20	13/07/2015		3	0	0	0	0	0						
H76	496740	6609603	59650 - 60200	Blackbutt	Moist Open Forest- Flooded Gum	Potential hollow-bearing tree	Alive	85	24	15/07/2015		0	0	0	0	0	0						
H77	496709	6609634	59650 - 60200	Blackbutt	Moist Open Forest- Flooded Gum	Potential hollow-bearing tree	Alive	100	26	15/07/2015		0	0	0	0	0	0						
H79	496664	6609613	59650 - 60200	Blackbutt	Moist Open Forest- Flooded Gum	Potential hollow-bearing tree	Alive	120	28	15/07/2015		0	0	0	0	0	0						
H80	496730	6609731	60080	Blackbutt	Blackbutt dry open forest	Hollow-bearing tree	Alive	130	24	14/05/2015		0	0	3	0	2	0						
H86	496954	6609900	60300 - 60950	Stag	Blackbutt dry open forest	Hollow-bearing tree	Dead	100	26	16/07/2015		1	0	0	0	2	0						
H88	496954	6609900	48280-49000	Blackbutt	Moist Open Forest- White mahogany /Grey Gum	Hollow-bearing tree	Alive	120	26	15/04/2015		0	0	1	3	0	0						
H89	497091	6609977	60400-60500	White mahogany	Blackbutt dry open forest	Hollow-bearing tree	Alive	40	16	27/04/2015		2	1	1	0	2	0						
H90	497128	6609976	60300 - 60950	Blackbutt	Blackbutt dry open forest	Hollow-bearing tree	Alive	120	26	16/07/2015		2	0	0	0	1	0						
H91	497082	6609969	60300 - 60950	Blackbutt	Blackbutt dry open forest	Hollow-bearing tree	Alive	120	26	16/07/2015		1	0	0	0	1	0						
H92	497002	6610015	60300 - 60950	Blackbutt	Blackbutt dry open forest	Hollow-bearing tree	Alive	105	20	16/07/2015		2	0	0	0	1	2						
H93	497002	6610010	60400 - 60600	Blackbutt	Blackbutt dry open forest	Hollow-bearing tree	Alive	140	25	20/07/2015		0	0	0	2	0	0						
H95	497154	6610100	North OCR	Blackbutt	Blackbutt dry open forest	Hollow-bearing tree	Alive	90	18	28/07/2015		0	0	1	1	0	0						
H96	497230	6610193	60750-60800	Stag	Blackbutt dry open forest	Hollow-bearing tree	Dead	120	28	9/03/2015		0	0	0	0	0	0						
H97	497274	6610215	North OCR	Blackbutt	Blackbutt dry open forest	Hollow-bearing tree	Alive	45	12	28/07/2015		0	1	0	1	0	0						
H98	497279	6610216	North OCR	Blackbutt	Blackbutt dry open forest	Hollow-bearing tree	Alive	50	12	28/07/2015		0	1	0	1	0	0						
H99	497264	6610227	North OCR	Blackbutt	Blackbutt dry open forest	Hollow-bearing tree	Alive	70	22	28/07/2015		0	1	0	1	0	0						
HB1	494348	6603808	53400 - 54100		Blackbutt dry open forest	Hollow-bearing tree	Alive	100	35	24/10/2015		0	1	0	1	2	0						
HB10	494360	6604054	53400 - 54100	Blackbutt	Blackbutt dry open forest	Hollow-bearing tree	Alive	110	28	25/10/2015		0	0	0	0	1	0						1

Ref	Easting	Northing	Location	Species	Surrounding Vegetation	Habitat Type	Dead or Alive	DBH (cm)	Tree Height (m)	Date Felled	Actual Functional Hollows (Predicted)	Trunk - Small (<5cm)	Trunk - Medium (5-15cm)	Trunk - Large (>15cm)	Limb - Small (<5cm)	Limb - Medium (5-15cm)	Limb - Large (>15cm)	Fissure - Small (<5cm)	Fissure - Medium (5-15cm)	Fissure - Large (>15cm)	Base - Small (<5cm)	Base - Medium (5-15cm)	Base - Large (>15cm)
HB11	494348	6604083	53400 - 54100	Blackbutt	Blackbutt dry open forest	Hollow-bearing tree	Alive	120	35	25/10/2015		0	1	0	0	0	0						
HB12	494336	6604082	53400 - 54100	Tallowwood	Blackbutt dry open forest	Hollow-bearing tree	Alive	115	30	25/10/2015		1	0	0	2	0	0						
HB13	494353	6604098	53400 - 54100	Tallowwood	Blackbutt dry open forest	Hollow-bearing tree	Alive	70	22	25/10/2015		0	0	0	2	3	0					1	
HB14	494354	6604108	53400 - 54100	Blackbutt	Blackbutt dry open forest	Hollow-bearing tree	Alive	100	30	25/10/2015		1	0	0	0	1	0						
HB15	494346	6604117	53400 - 54100	Blackbutt	Blackbutt dry open forest	Hollow-bearing tree	Alive	90	25	25/10/2015		1	0	0	0	0	0						1
HB16	494361	6604206	53400 - 54100	Grey gum	Blackbutt dry open forest	Hollow-bearing tree	Alive	45	20	25/10/2015		0	1	0	0	0	0						
HB17	494342	6604147	53400 - 54100	Grey gum	Blackbutt dry open forest	Hollow-bearing tree	Alive	80	25	25/10/2015		0	1	0	0	0	0						1
HB18	494344	6604151	53400 - 54100	Blackbutt	Blackbutt dry open forest	Hollow-bearing tree	Alive	100	30	25/10/2015		1	0	0	1	1	0						
HB2	494341	6603822	53400 - 54100		Blackbutt dry open forest	Hollow-bearing tree	Alive	80	28	24/10/2015		1	0	0	1	0	0				1		
HB3	494339	6603845	53400 - 54100		Blackbutt dry open forest	Hollow-bearing tree	Alive	45	22	24/10/2015		0	0	0	2	2	0						
HB4	494339	6603865	53400 - 54100		Blackbutt dry open forest	Hollow-bearing tree	Alive	120	35	24/10/2015		2	0	0	0	0	0		1				1
HB5	494353	6604009	53400 - 54100		Blackbutt dry open forest	Hollow-bearing tree	Alive	115	35	24/10/2015		0	1	0	0	2	0					1	
HB6	494342	6604025	53400 - 54100		Blackbutt dry open forest	Hollow-bearing tree	Alive	80	25	24/10/2015		1	0	0	2	0	0						
HB7	494345	6604032	53400 - 54100		Blackbutt dry open forest	Hollow-bearing tree	Alive	70	20	24/10/2015		0	0	0	0	1	0			1		1	
HB8	494356	6604032	53400 - 54100	Blackbutt	Blackbutt dry open forest	Hollow-bearing tree	Alive	110	32	24/10/2015		0	2	0	0	0	0						
HB9	494373	6604033	53400 - 54100	Stag	Blackbutt dry open forest	Hollow-bearing tree	Alive	85	28	24/10/2015		1	0	0	1	1	0						
G83	494277	6603403	53150	Tallowwood	Planted trees along property access	Hollow-bearing tree	Alive	130	25	31/11/2016		1	1										
H78	496702	6609613	60000	Blackbutt	Blackbutt dry open forest	Hollow-bearing tree	Alive	90	35	24/10/2015						1							
G84	497533	6610238	60950	Blackbutt	Blackbutt dry open forest	Hollow-bearing tree	Alive	120	35	11/11/2016				1		1							

Appendix B

Flying-fox Monthly Report (January 2017)

Flying-fox Monitoring
January 2017

Warrell Creek to Nambucca Heads
Pacific Highway Upgrade

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Prepared for: Roads and Maritime Services

UPR	*Description*	*Date Issued*	*Issued By*
2692-1036	First issue	30/01/2017	David Andrighetto

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1. Introduction

1.1 Introduction

NSW Roads and Maritime Services have been monitoring a Grey-headed Flying-fox (*Pteropus poliocephalus*) (GHFF) camp that was intermittently present within the approved alignment of the Warrell Creek to Nambucca Heads (WC2NH) Pacific Highway upgrade project near Macksville. The camp is located in a patch of swamp sclerophyll forest north of Bald Hill Road (henceforth referred to as 'the site').

GeoLINK has undertaken monitoring at the site on at least a monthly basis since July 2013. Prior to this, irregular monitoring of flying-foxes at the site has been undertaken since the initial establishment of the camp in December 2011 (Eby 2012).

This report details the January 2017 flying-fox monitoring results.

2. Flying-fox Survey

2.1 Methodology

The following GeoLINK personnel undertook fieldwork for the January 2017 flying-fox monitoring:

- Tom Pollard (ecologist).
- Jessica O'Leary (ecologist).
- Kale Hardie-Porter (environmental scientist).

Grey-headed Flying-fox expert Dr Peggy Eby also joined GeoLINK for fieldwork this monitoring event to coincide with her annual monitoring of flying-fox camps in the region.

Fieldwork followed the methodology developed by Dr Eby for the project. Refer to Eby (2013) for full details of the methodology. A summary of the main procedures used for the monitoring is provided below.

On 13 January 2017, the presence of flying-foxes at the site was assessed by undertaking a traverse of the area previously known to support flying-foxes in conjunction with a few sharp handclaps aimed at eliciting a vocal response from any flying-foxes roosting at the site.

When flying-foxes are present at the site, the following data is collected:

- The area of the roost footprint (mapped by GPS).
- Species composition.
- Demographics.
- Reproductive status.
- Behaviour.

When the site is unoccupied and flying-foxes are present at the nearby seasonally-occupied flying-fox camp within two kilometres of the site adjacent to Macksville Cemetery, the above-mentioned data is collected here instead. This data provides relevant information on the status of flying-foxes that are camped in the Macksville area.

The water level at the site was measured at GPS location 492866, 6600756 (UTM coordinates, GDA 94, Zone 56) on 13 January 2017. The water level at this location is representative of the average level at the site and is tracked over time to provide information on water level fluctuations that occur at the site.

A dusk exit count survey was undertaken at both the site and the Macksville Cemetery camp on the evening of 13 January 2017 to confirm the presence/ absence of flying-foxes and to provide an estimate of the current population at each camp.

Two observers were strategically located for the exit count on a northern and a southern ridge overlooking the site. Specifically, the two observers were located at the following vantage points:

- In a paddock to the north of the swamp sclerophyll forest (off Wedgewood Drive).
- On a prominent ridge to the south (at 41 Bald Hill Road).

Two observers were also strategically located adjacent to the Macksville Cemetery camp. Specifically, the two observers were located at the following vantage points:

- At the Macksville Cemetery gate off Wallace Street (west of the camp).
- Adjacent to the Macksville Golf Course next to the Pacific Highway (east of the camp).

The exit counts extended over approximately 45 minutes from sunset until dark (approximately 7:45 pm to 8:30 pm).

Other regional flying-fox camps at Gordon Park, Nambucca Heads (approximately 12 kilometres north-east of the site), Bowraville (approximately 10.5 kilometres north-west of the site), Bellingen Wheatley Street Camp (approximately 30 kilometres north of the site) and Bellingen Island (approximately 31 kilometres north of the site) were also visited on 13 January 2017 and observational comments made. Refer to **Illustration 2.1** for the location of the subject regional camps.

2.2 Results

2.2.1 Roost Footprint

No flying-foxes were recorded roosting at the site in the traverse. Flying-foxes were also absent from and Wheatley Street camp in Bellingen and Bowraville.

Flying-foxes were observed to be roosting at the Macksville Cemetery camp. The extent of the roost covered approximately 2.28 hectares and is shown in **Illustration 2.2**.

Regionally, flying-foxes were observed to be roosting at Bellingen Island and Gordon Park (Nambucca Heads). The extent of the roost footprint at Bellingen Island was consistent with that recorded in the previous monitoring event. The Gordon Park camp now only occupies the eastern section of the rainforest vegetation, as was recorded in the previous monitoring event.

2.2.2 Population Estimates

2.2.2.1 Exit Count

No flying-foxes were observed flying from the site during the exit count.

The exit count conducted for the Macksville Cemetery camp indicated that an estimated 11,500 flying-foxes were roosting at the site. Most of these individuals exited the camp in a westerly stream while approximately one third exited in a south to south-easterly direction.

Information shown is for illustrative purposes only

Drawn by: KHP Checked by: FM Reviewed by: VJS Date: 17/01/2017
Source of base data: Roads and Maritime Services

0 4 km

North

Location of Regional Flying-fox Camps

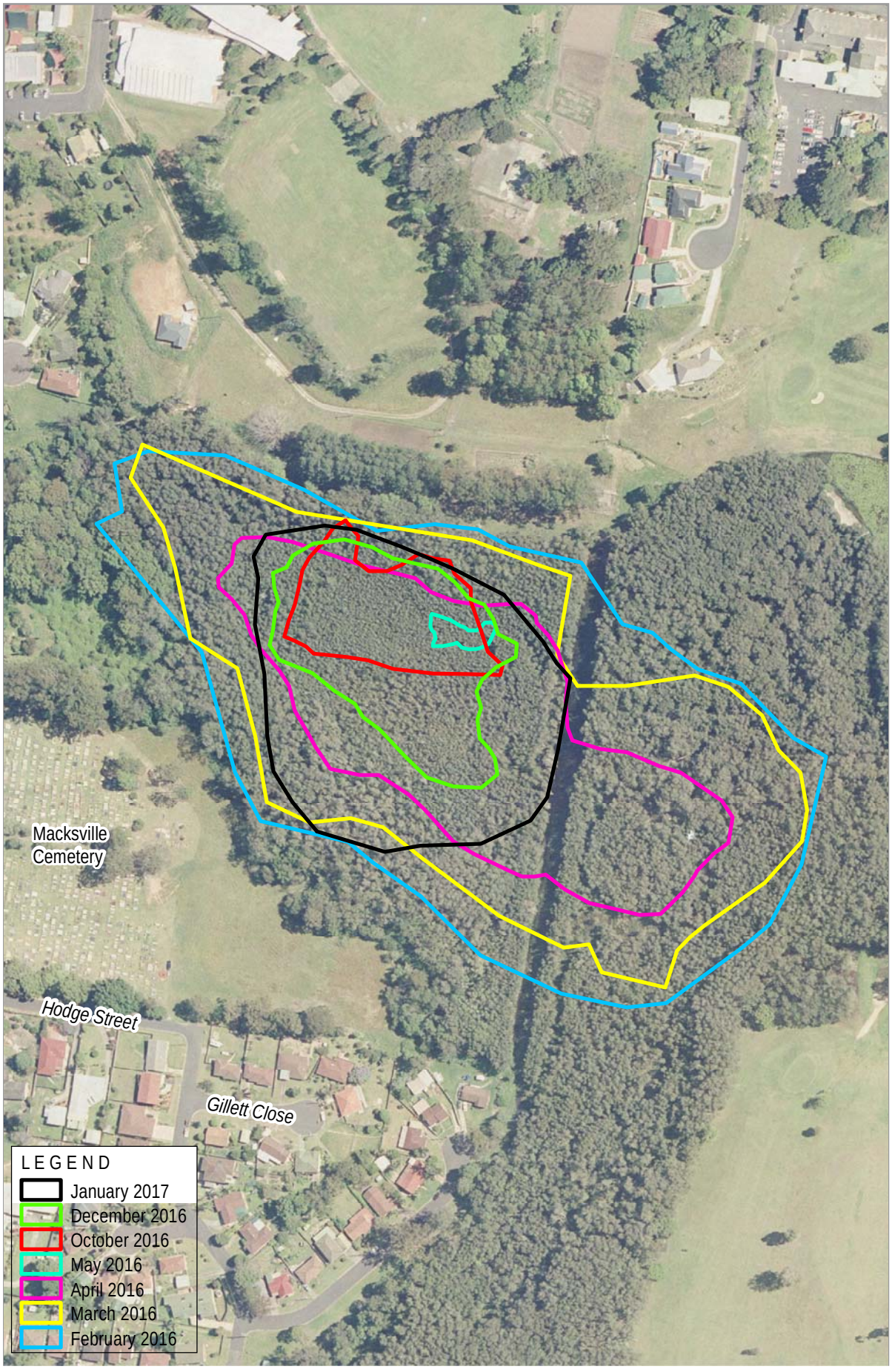
GeoLINK environmental management and design

Flying-fox Monitoring January 2017 - Warrell Creek to Nambucca Heads
Pacific Highway Upgrade
2692-1008

Illustration 2.1

Information shown is for illustrative purposes only

Drawn by: AB Checked by: RE Reviewed by: DSA Date: 30/01/2017
Source of base data: Roads and Maritime Services



0 60

North

Macksville Cemetery Flying-fox Roost Footprint

GeoLINK environmental management and design

Flying-fox Monitoring January 2017 - Warrell Creek to Nambucca Heads
Pacific Highway Upgrade
2692-1038

Illustration 2.2

2.2.2.2 Direct Counts

With the exception of the Macksville Cemetery camp, no exit counts were conducted at any of the remaining regional camps. However, rough population estimates for these camps based on extrapolation of counts in individual trees and the roost footprint are as follows:

- Gordon Park: approximately 10,000 individuals.
- Bellingen Island: approximately 15,000 individuals.
- Wheatley Street, Bellingen: no individuals recorded.
- Bowraville: no individuals recorded.

2.2.3 Detailed Data

2.2.3.1 Species Composition

The species composition and proportions observed at occupied camps were as follows:

- Macksville Cemetery: 70-80% GHFF and 20-30% Black Flying-fox.
- Bellingen Island: 90% GHFF and 10% Black Flying-fox.
- Gordon Park: 80% GHFF and 20% Black Flying-fox.

2.2.3.2 Habitat Characteristics and Demographic Composition

As flying-foxes were not recorded at the site in the current monitoring event, detailed demographic composition data was not collected. This has been the case since April 2014 (excluding a brief return in January 2015) and during this period of absence Macksville Cemetery camp has been the alternative site for collection of this data.

Data collected in demographic point counts at the Macksville Cemetery camp indicated that the proportion of female GHFF present was very low. Most counts consisted of exclusively 'bachelor trees' with only male flying-foxes present, while the remainder of counts were male-dominated, but also included a few female flying-foxes. The proportion of female GHFF present was between 0% and 10%. Only one female GHFF with dependant young was recorded in the counts. Black Flying-fox were also present, and included a much higher proportion of females with dependent young than was recorded for the GHFF (refer to **Table 2.1**).

Table 2.1 Demographic Data of GHFF at the Macksville Cemetery Camp

Tree Code	*GPS Location (UTM coordinates GDA94, Zone 56)*	*Tree Species*	*Height (m)*	*DBH (cm)*	*Demographic Ratio (female:male)*	*Presence of Dependant Young (yes/no)*	*% Females with Dependant Young*
MC1	492035, 6601757	Broad-leaved Paperbark	12	20	(bachelor tree – males only)	No	n/a
MC2	492036, 6601763	Broad-leaved Paperbark	12	20	(bachelor tree – males only)	No	n/a
MC3	492033, 6601771	Broad-leaved Paperbark	12	20	10:17	No	n/a
MC4	492035, 6601779	Broad-leaved Paperbark	15	30	(bachelor tree – males only)	No	n/a
MC5	492032, 6601785	Broad-leaved Paperbark	12	20	(bachelor tree – males only)	No	n/a
MC6	492030, 6601802	Broad-leaved Paperbark	12	20	4:10	No (however, 1 Black FF female with young was present)	n/a
MC7	492026, 6601812	Broad-leaved Paperbark	15	30	(bachelor tree – males only)	No	n/a
MC8	492027, 6601827	Broad-leaved Paperbark	12	20	1:9 (predominantly males only)	Yes	10
MC9	492026, 6601833	Broad-leaved Paperbark	12	20	1:1	No (however, 6 Black FF females with young were present)	n/a
MC10	492025, 6601840	Broad-leaved Paperbark	12	20	3:4	No (however, 4 Black FF females with young were present)	n/a

Data collected in demographic point counts at the Bellingen Island camp indicated that the proportion of female GHFF present was between 50% and 67% of all individuals. The proportion of female GHFF with dependant young was variable and ranged between 30% and 90% (average 53%) (refer to **Table 2.2**).

Table 2.2 Demographic Data of GHFF at the Bellingen Island Camp

Tree Code	*GPS Location (UTM coordinates GDA94, Zone 56)*	*Tree Species*	*Height (m)*	*DBH (cm)*	*Demographic Ratio (female:male)*	*Presence of Dependant Young (yes/no)*	*% Females with Dependant Young*
BI1	489958, 6631605	Creek Sandpaper Fig	8	40	10:6	Yes	40
BI2	489949, 6631610	Creek Sandpaper Fig	9	30	10:6	Yes	50
BI3	489943, 6631615	Creek Sandpaper Fig	10	30	10:5	Yes	50
BI4	489939, 6631627	Giant Stinging Tree	12	40	10:5	Yes	30
BI5	489974, 6631605	Giant Stinging Tree	10	50	10:10	Yes	50
BI6	489986, 6631577	Giant Stinging Tree	12	30/20 (multiple trunks)	10:5	Yes	50
BI7	490016, 6631584	Giant Stinging Tree	10	40	10:6	Yes	30
BI8	490028, 6631595	Creek Sandpaper Fig	10	30	10:5	Yes	60
BI9	490041, 6631582	Creek Sandpaper Fig	12	40	10:9	Yes	80
BI10	490048, 6631626	Moreton Bay Fig	12	60	10:7	Yes	90

General observations of the GHFF currently roosting at the Gordon Park camp indicated that both females and males were present. Dependant young GHFF were also recorded at the Gordon Park camp, making up a similar proportion of all individuals as was recorded at Bellingen Island.

2.2.3.3 Water Level at the Site

Water level at the site measured at the representative measurement location had decreased again this month, and measured 10 cm in depth as shown in **Figure 2.1**. This represents a 7 cm decrease reflecting the ongoing relatively dry summer conditions being experienced.

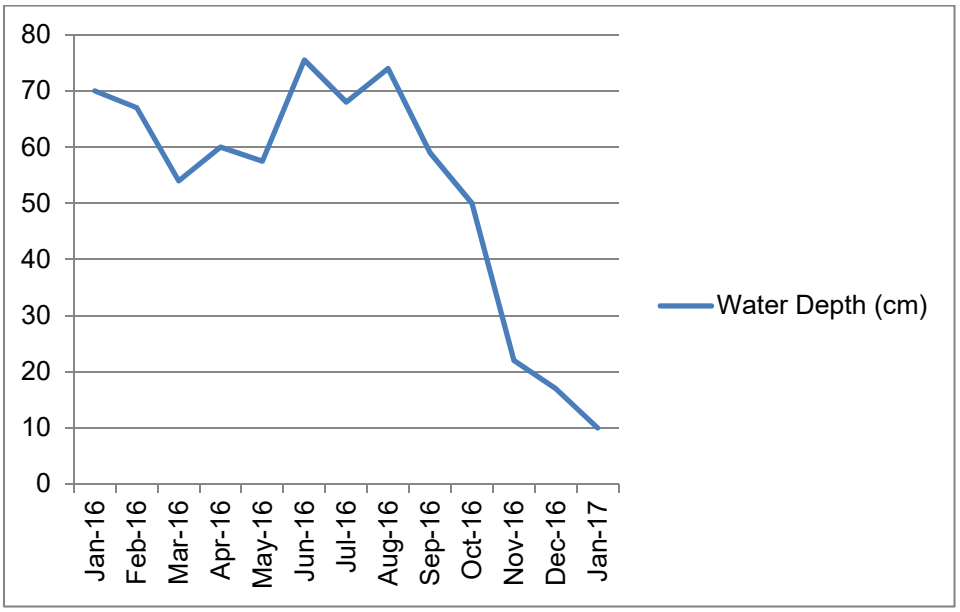


Figure 2.1 Water level measurements at the site

2.3 Discussion

2.3.1 Population Estimates

No flying-foxes were observed to be roosting at the site during the roost traverse. Flying-foxes have not occupied the site (excluding a brief return in January 2015) since mid-April 2014.

The trend in flying-fox numbers over the last 12-month period at the site and other monitored regional flying-fox camps is shown in **Figure 2.2**.

The number of flying-foxes presently roosting at the Macksville Cemetery camp has continued to rise and had reached approximately 11,500 individuals in the current monitoring event. In January 2016, this camp was supporting a much larger number of flying-foxes, estimated to be at least 40,000 individuals.

After returning to the Bowraville camp in low numbers in the last few months, flying-foxes were once again absent in the current monitoring event. Prior to this the number of flying-foxes at Bowraville has been less than 1,000 individuals.

The number of flying-foxes presently roosting at the Bellingen Island camp has remained steady at around 15,000 individuals over the last four months, following a period of relatively low numbers over winter. In January 2016, the Bellingen Island camp was estimated to be supporting a substantially larger number of flying-foxes than were recorded in the current monitoring event, numbering approximately 25,000 individuals. The Bellingen Wheatley Street camp, which supported small numbers of flying-foxes mainly when Bellingen Island was vacant, remains unoccupied.

The population level at Gordon Park has remained variable over the last four months, ranging between 7,500 and 15,000 individuals. As was observed in the previous two monthly monitoring events, the roost area recorded in the current monitoring event has also reduced and now only occupies the eastern section of the rainforest vegetation. This may be linked to the poor health of the rainforest canopy at Gordon Park at present as a result of flying-fox activity, and may indicate this area is the most suitable section of the rainforest in terms of microclimate for roosting.

2.3.2 Species Composition and Demographic Data

At occupied camps, GHFF dominated the species composition, with Black Flying-fox accounting for between 5% and 30% of all individuals present. The proportion of Black Flying-fox was highest at the Macksville Cemetery camp as was also the case in the previous monthly monitoring event. The proportion of Black Flying-fox at occupied camps in January 2016 was lower than that recorded in the current monitoring event at only <5-10% of all individuals present (GeoLINK 2015).

Despite the recent food resource shortage, dependent young GHFF were nonetheless recorded at a moderate level at both the Bellingen Island camp and Gordon Park camp in the current monitoring event. However, numbers of GHFF young were comparatively low at the Macksville Cemetery camp (although the number of dependent young was substantially higher for Black Flying-fox). For comparison, the proportion of females with dependent young recoded at Bellingen Island in the January 2016 monitoring event was much higher with 90-100% of females supporting dependent young.

2.3.3 Phenology of Trees in the Region

January flowering of a number of highly productive nectar source trees in the upper North Coast region of NSW includes the following key GHFF diet species: various *Corymbia* spp. (Bloodwoods and Spotted Gums), New England Blackbutt (*Eucalyptus andrewsii*), River Red Gum (*E. camaldulensis*), Coastal Blackbutt (*E. pilularis* – foothills and ranges), Grey Ironbark (*siderophloia* – foothills and ranges), Forest Red Gum (*E. tereticornis* – high altitude) and Black Bean (*Castanospermum australe*) (Eby 2012; Eby and Law 2008).

Observations when travelling between regional flying-fox camps recorded minor flowering of Pink Bloodwood (*Corymbia intermedia*) is currently occurring in the region. No other key diet species were flowering.

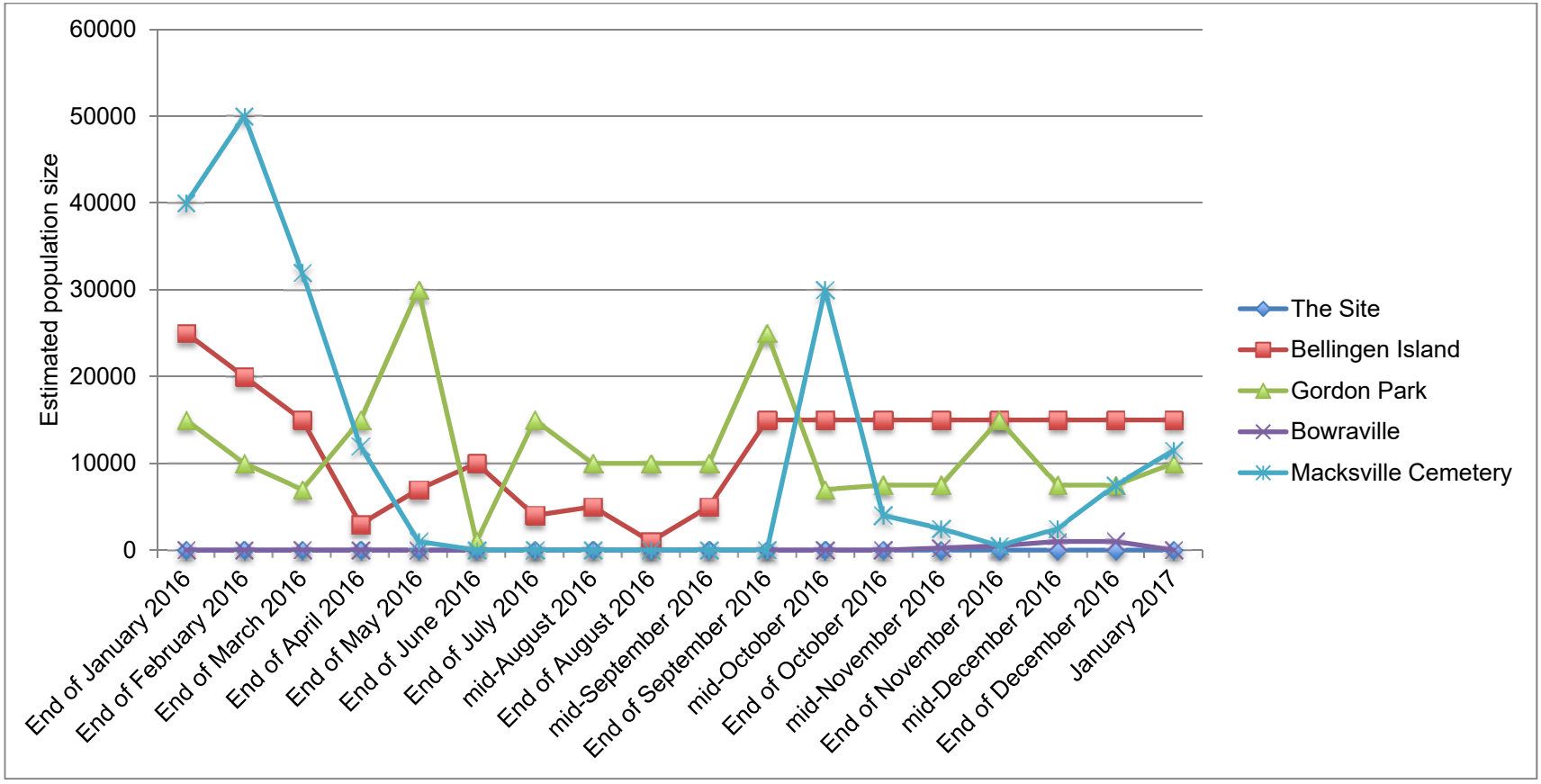


Figure 2.2 Population trends at the site and regional camps over past 12 months

2.4 Conclusion

The results of the January 2017 flying-fox monitoring indicate that excluding a brief stopover at the site observed in mid-January 2015, flying-foxes have been absent from the site now for approximately two and a half years.

The nearby Macksville Cemetery camp (detected in February 2015) has recently been re-occupied by flying-foxes following an absence over the winter period, and the numbers of flying-foxes have been variable ranging from 500 to 30,000 individuals. Currently the number is estimated at 11,500 individuals, with a substantial proportion being made of Black Flying-foxes. The small number of flying-foxes recently camped at Bowraville have now departed, while numbers at Bellingen Island and Gordon Park have remained relatively stable.

Male flying-foxes dominated the demographic composition of the Macksville Cemetery camp, where only low levels of dependent young flying-fox were recorded. In contrast, dependent young flying-foxes are still present at a moderate level at the Bellingen Island and Gordon Park camps, despite the death of a substantial number of young recently in relation to resource shortage.

Summer flowering of trees that are key diet species has begun recently in the region, including Pink Bloodwood, however major flowering of any species is yet to occur.

David Andrighetto
Senior Ecologist

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Eby, P. (2012). *An Assessment of the Flying-fox Camp at Macksville*. Unpublished report to NSW Roads and Maritime Services.

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GeoLINK. (2016). *Flying-fox Monitoring January 2016: Warrell Creek to Nambucca Heads Pacific Highway Upgrade*. Unpublished report to NSW Roads and Maritime Services.

Appendix C

Threatened Microbat Monitoring Reports

ABN 79 896 839 729
ACN 101 084 557

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LENNOX HEAD
NSW 2478

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9 March 2017
Ref No.: 2378-1345

Pacifico
124 Albert Drive
DONNELLYVILLE NSW 2447

Attention: Noelene Rutherford

WC2NH Microbat Roost Box – Annual Report – Annual Report 2016

Introduction

GeoLINK has been engaged by Pacifico to undertake microbat roost box monitoring for the Warrell Creek to Nambucca Heads (WC2NH) Pacific Highway upgrade. A total of 24 microbat roost boxes were installed to provide compensatory roost habitat for hollow-bearing trees removed during clearing for the highway upgrade alignment. Monitoring of microbat roost boxes is to be undertaken seasonally for four years as outlined in the *Warrell Creek to Urunga Microchiropteran Bat Management Strategy* (Lewis 2014). This annual report summarises the results of monitoring undertaken between summer 2016 and spring 2016.

Objectives

Lewis (2014) notes that long term monitoring of bat boxes:

"….would commence 6 months after their installation, followed by quarterly inspections for 2 years before addressing corrective actions. Monitoring of the boxes would continue up until Year 6 (i.e. 4 surveys per year for 5 years) with the boxes inspected to determine species presence/absence, an estimate or count of numbers of microbats and breeding activity. Information would also be collected as to the roost identification number, date and time of the inspection".

Monitoring Events

Roost boxes were inspected for microbats or evidence of use by microbats using an ecologist and tree climber on four occasions (quarterly) during year 2 of the construction phase as per the required monitoring. Monitoring dates are as follows:

- Summer 2016 (17/02/2016).
- Autumn 2016 (3/05/2016).
- Winter 2016 (22/07/2016).
- Spring 2016 (24/10/2016).

Results

The results from the four microbat roost box monitoring events during 2016 are summarised in **Table 1**.

Table 1 Summary of 2016 Microbat Roost Box Monitoring Results

Monitoring Event	*Number of Microbats Observed*	*Species Observed*	*Number of Boxes Occupied*	*Number of Boxes with Evidence of Use*	*Repairs Undertaken*	*Invertebrate Pests Observed*	*Comments*
Summer 2016	11	1 x *Miniopterus* sp. 4 x likely *Myotis.* 6 x unidentified sp.	3	5	▪ No maintenance or adjustments to any bat boxes were required	Invertebrate pests (bees, wasps, ants etc.) were not an issue at the time of survey. Spider webs were removed from the entrance or interior of some bat boxes	N/A
Autumn 2016	11	4 x *Nyctophilus* sp., 7 x unidentified species.	5	7	▪ Two bat boxes (18, 21) were relocated to a higher branch to prevent flood waters impacting the bat box ▪ Box 4 was replaced as it had washed away during a previous flood ▪ Adjustment to several of the cable systems affixing bat boxes to trees		This survey observed greater occupation of bat boxes than all monitoring undertaken to date
Winter 2016	10	7 x *Nyctophilus* sp. 1 x *Miniopterus* sp. 2 x unidentified species.	4	6	▪ Adjustment of several of the cable systems affixing bat boxes to trees ▪ Clearing of debris from box 9		N/A
Spring 2016	19	18 x *Nyctophilus* sp. 1 x *Miniopterus* sp.	3	6	▪ No maintenance or adjustments to any bat boxes were required		This survey recorded the largest number of microbats than all monitoring undertaken during 2016

Table 2 provides a summary of the bat boxes that have been frequently occupied during each monitoring period.

Table 2 Bat Box Usage 2015-2016

Bat Box No.	*2015 Summer*	*2015 Autumn*	*2015 Spring*	*2016 Summer*	*2016 Autumn*	*2016 Winter*	*2016 Spring*
1							
2				4 x likely *Myotis* sp.	4 x unidentified microbats		
3	1 x microbat + guano	Guano		Guano	Guano		Guano
4							
5		Guano					
6							
7		Guano			Guano		
8		Guano					
9							
10						1 x unidentified microbat	10 x *Nyctophilus* sp.
11							
12			1 x *Myotis macropus*	1 x *Miniopterus* sp.	3 x microbats	1 x *Miniopterus* sp.	1 x *Miniopterus* sp.
13							
14							
15							
16							Guano
17					1 x *Nyctophilus* sp.		
18							
19	Guano	Guano	Guano	Guano	2 x *Nyctophilus* sp.	1 x unidentified microbat	Guano
20	Guano	Guano	Guano	6 x unidentified microbats	1 x *Nyctophilus* sp.	7 x *Nyctophilus* sp.	
21							8 x *Nyctophilus* sp.
22							
23							
24							
Total Bats	**1**	**0**	**1**	**11**	**11**	**10**	**19**
No. of boxes showing evidence of use	**3**	**6**	**3**	**5**	**7**	**4**	**6**

Discussion

The highest numbers of microbats were recorded during the spring 2016 monitoring event (19 microbats), compared to summer and autumn 2016 (11 microbats at each event) and winter 2016 (ten microbats). Only one microbat was recorded in spring 2015 and summer 2015. Based on the data to date, the numbers of microbats using roost boxes is increasing over time, an encouraging finding.

Five roost boxes were occupied in autumn 2016, four boxes in winter 2016, and three boxes each in spring 2016 and summer 2016. Only two boxes were occupied during the previous monitoring in 2015.

The boxes with the greatest frequency of observed occupation since monitoring commenced in autumn 2015 are as follows:

- Box 12 (5 occupation events).
- Box 10 (2 occupation events).
- Box 19 (2 occupation events).
- Box 20 (3 occupation events).

The boxes with the greatest frequency of observed occupation or use (guano) since monitoring commenced in autumn 2015 are as follows:

- Box 19 (7 events).
- Box 3 (5 events).
- Box 20 (6 events).
- Box 12 (5 events).

There has been an increase in the total diversity of bat species observed using boxes from one species recorded during the 2015 monitoring period (Southern Myotis) to at least three (and possibly more) species recorded in the 2016 monitoring period (Southern Myotis, Bentwing-bat species, and Long-eared Bat species).

The increase in total microbat numbers observed over the 2016 monitoring period may be attributed to:

- Seasonal factors in total bat numbers and activity levels within locality (i.e. some species are more active in summer, some species may use different types of roosts during different seasons including for example deep vs shallow, warm vs cold, artificial vs natural).
- Length of time that the bat boxes have been installed and increased familiarity.
- Increased number of bats in the roosting group due to a successful breeding event producing young.
- Increased number of bats in the roosting group due to influx of bats from other areas / groups rather than due to breeding within existing roost group.

Future monitoring will provide further data on roost box usage and occupation to add to the baseline monitoring to date which may allow better interpretation of results and determination of any trends. It is recommended that consideration be given to relocating the boxes that have never been occupied in an attempt to provide a more suitable location and increase uptake.

Conclusion

Overall there has been an increase of total numbers of bats observed using the bat boxes since monitoring commenced in summer (February) 2015 while total numbers of boxes used appears to fluctuate between three and seven boxes. Total diversity of bat species observed also appears to be gradually increasing over time.

Future monitoring events will be undertaken during summer, autumn, winter and spring of 2017.

Please feel free to contact me if you require any additional information.

Yours sincerely
GeoLINK

Jessica O'Leary
Ecologist

References

Lewis, B (2014). *Warrell Creek to Urunga Microchiropteran Bat Management Strategy*. Unpublished report to Roads and Maritime Service, NSW.

Churchill, S. (2008). *Australian Bats (Second Edition)*. Allen & Unwin, NSW.

UPR	*Description*	*Date Issued*	*Issued By*
2378-1345	First issue	09/03/2017	Jessica O'Leary

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9 March 2017
Ref No.: 2378-1348

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Attention: Ms Noelene Rutherford

WC2NH Microbat Persistence and Behaviour Monitoring (Crouches Creek) – Annual Compliance Report 2016

1. Introduction

Lewis Ecological Surveys (LES) was contracted by Roads and Maritime Services (RMS) to prepare the *Warrell Creek to Urunga Microchiropteran Bat Management Strategy* following the discovery of microchiropteran bats (microbats) utilising bridge and culvert structures associated with the Warrell Creek to Nambucca Heads (WC2NH) Pacific Highway upgrade. As the Project Ecologist GeoLINK were engaged by Pacifico to prepare a monitoring methodology and undertake bat behaviour and roost persistence monitoring during years 1 and 2 of the construction phase to assess how this microbat colony respond to construction related disturbances. This was developed in accordance with the *Microchiropteran Bat Management Strategy*.

Southern Myotis (*Myotis macropus*) and Gould's Wattled Bat (*Chalinolobus gouldii*) were detected at Crouches Creek Bridge by LES in 2014 during targeted microbat surveys. LES (2014) noted that the bridge structure would also provide potential habitat for the Little Bentwing-bat (*Miniopterus australis*) and Eastern Horseshoe Bat (*Rhinolophus megaphyllus*). Crouches Creek Bridge recorded the largest microbat roost of the pre-construction summer field surveys undertaken by LES. Based on the above, this structure has been assigned a "high conservation status" within the Microbat Management Strategy. The bridge is therefore a suitable monitoring point to determine potential ongoing impacts to microbats from the adjacent WC2NH project.

Monitoring focuses on Crouches Creek Bridge during construction years 1 and 2 to evaluate the response of microbats to a range of construction activities. Quarterly surveys enable variations between summer and winter roost occupancy to be captured. Microbat persistence monitoring was required to be undertaken quarterly from summer 2015 until spring of year 2016. This is the final report for monitoring of the Crouches Creek Bridge microbat roost.

2. Methodology

During each monitoring session an ecologist (experienced in microbat survey/ identification) physically inspected Crouches Creek Bridge and recorded the following:

- Evidence of microbats (guano and/or staining);
- Number of microbats present;
- Identification of species;

- Indications of breeding activity;
- Date and time of inspection;
- Location of microbats within the bridge; and
- Record of rainfall during monitoring period.

Dates of monitoring surveys (including rainfall records) are included in **Table 2.1** below.

Table 2.1 Survey Details

Monitoring Period	*Month*	*Date*	*Time*	**Rainfall (mm) During Monitoring Period (season)*
Summer 2015	February	2	19:00	771.3
Autumn 2015	May	27	16:45	411.5
Winter 2015	June	15	16:30	74
Spring 2015	October	12	18:30	247
Summer 2016	February	16	15:30	82.4
Autumn 2016	May	26	14:00	4.4
Winter 2016	July	22	14:00	32
Spring 2016	October	24	15:00	29.4

**Data Source: Bureau of Meteorology – Bellwood (Nambucca Heads Station).*

3. Results

A summary of the survey results is shown in **Table 3.1**. Photographs are shown at **Plates 1.1** and **1.2**. Since the commencement of construction adjacent to the bridge the following works have been performed:

- Clearing and grubbing;
- Hauling of cut/ fill material;
- Earthworks;
- Rock hammering with pneumatic tool;
- Creek realignment works associated with Crouches Creek; and
- New bridge construction and landing of bridge beams.

Despite the above works, microbats continue to utilise the bridge. Based on our observations of microbat colonies occurring elsewhere adjacent to earthworks/ roadworks, we believe that impacts on this colony will be relatively minor unless works are required on or in close proximity to roosting bats.

To date there have been no observations of microbats leaving the bridge diurnally which is usually indicative of a stress induced response. Numbers of bats occupying the bridge have remained relatively stable with the exception of summer 2015 monitoring where no microbats were recorded roosting within the structure. It is likely that the microbats which roost in the Crouches Creek Bridge are tolerant to noise and vibration from the heavily trafficked Pacific Highway above the bridge deck and so are not negatively impacted by the construction works occurring adjacent to the roost site.

This report presents the complete set of monitoring results to date. No further seasonal monitoring is scheduled for this microbat colony unless works are to be undertaken in close proximity to, or on the bridge in which case the mitigations measures as described within the Microchiropteran Management Strategy should be employed. Pacifico has been advised to ensure that the project ecologist is

engaged to review works methodologies in relation to minimizing impacts on microbats and undertake monitoring during the commencement of such works in order to detect any changes in behavior that may be related to stress.

Table 3.2 Survey Results

Survey Period	*Evidence of Microbats*	*Number*	*Identification*	*Indications of Breeding*	*Location*
Summer 2015	Old guano stains present	0	NA	NA	NA
Autumn 2015	Three solitary identified microbats in gaps between concrete bridge deck. Moderately large fresh guano deposits under bridge and guano staining on parts of the concrete bridge decking	3	Most appear to be Southern Myotis	No	North-west outer edge, north-eastern edge and south-eastern edge
Winter 2015	Scattered individuals and a small group (3) located in gaps between concrete bridge decks	8	Likely Little Bentwing-bat and Southern Myotis	No	Outer-most gaps between bridge decks
Spring 2015	Large group occupying gap between bridge deck	Approx. 30	Most appear to be Southern Myotis	No (but likely to be a maternity colony for Southern Myotis)	Centre of bridge
Summer 2016	Scattered groups occupying three separate gaps in the bridge decking	15	Most appear to be Southern Myotis	One (1) small group may indicate Myotis breeding colony	Outer-most gaps between bridge decks
Autumn 2016	Scattered groups occupying the outer most gaps in the bridge decking	26	Most appear to be Southern Myotis	One group of 15 bats may indicate Myotis breeding colony	Outer-most gaps between bridge decks.
Winter 2016	Predominantly dispersed throughout the northern third of the bridge decking with one larger grouping of ten microbats in the centre span.	26	Likely Little Bentwing-bats and Southern Myotis	One group of 10 bats may indicate Myotis breeding colony.	All three spans but predominantly the northern third
Spring 2016	All groups were located in the eastern most gap of the bridge decking	21	Likely Myotis	One group of 15 bats may indicate Myotis breeding colony.	Northern and southern span eastern most gap

Plate 1.1 Staining indicating common location of one of the larger groups (spring 2016 survey)

Plate 1.2 Group of microbats within gap between concrete (summer 2016 survey)

Yours sincerely

GeoLINK

Jessica O'Leary
Ecologist

UPR	*Description*	*Date Issued*	*Issued By*
2378-1348	First issue	09/03/2017	Jessica O'Leary

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30 June 2016
Ref No: 2378-1244

Pacifico
Albert Avenue Site Office
Donnellyville NSW 2447

Attention: Noelene Rutherford

Dear Noelene,

WC2NH Microbat Overwintering Habitat Surveys Rev2

As required within the Warrell Creek to Nambucca Heads (WC2NH) Microbat Management Plan an assessment of culverts and bridges associated with the WC2NH project is required to identify microbat overwintering habitat and inform management of such areas. A survey of all bridges/ culverts associated with the project was undertaken in order to identify structures representing potential overwintering habitat for microbat species. Based on the findings of the surveys and in accordance with the Microbat Management Plan (Lewis, 2014), structures were classified at three scales of conservation value as follows:

- High Conservation Value
- Moderate Conservation Value
- Low Conservation Value

A total of 30 structures (culverts and bridges) associated with the WC2NH project were inspected by Ecologists Frank Makin and Jessica O'Leary on 23, 29 & 30 of June 2016. Structures which were previously identified as potential microbat habitat were inspected along with newly constructed structures such as culverts at Butchers and Stoney Creek. Fauna underpasses (concrete box culverts) throughout CC04 and CC05 areas were also inspected.

The methods of inspection included:

- Ground based inspections with the aid of inspection camera or binoculars, depending on the height or size of the roost space. Culverts were entered for inspection with details captured regarding location of microbats within the structure such as scupper or segment location and number.
- Observations for other signs of use such as the presence of guano or staining were also noted if observed.
- It is noted that smaller culverts (<1m diameter) were not surveyed due to safety issues with accessing such structures.

The results of the overwintering habitat surveys are provided in **Appendix A**. A total of 28 culverts and two bridges were surveyed during June 2016. Ten culverts and one bridge recorded microbat occupation with a total approximate count of 1045 individuals. Five of the ten newly constructed culverts such as Butchers Creek, Stoney Creek and the Box Culvert near the Sheather Property recorded presence of roosting microbats. These large box culverts are either still partially under construction (mainly finishing works at the entry/exit points) or have works within 100m from the structure at the time of occupation by microbats.

Photos of selected roosts within culverts are provided in **Plates 1.1, 1.2, 1.3 and 1.4**

Plate 1.1 Culvert 599205 - Deadman's Gully. Approx. 1000 *M. australis* in segment gaps.

Plate 1.2 Culvert 599205 - Deadman's Gully. *M. australis* individual.

Plate 1.3 Culvert 599228 - Bald Hill Rd *Nyctophilus sp*. roosting together in a lifting point.

Plate 1.4 Culvert 599222 - Donnellyville. *M. australis* present in scuppers.

Yours sincerely
GeoLINK

Jessica O'Leary
Ecologist

Appendix A

Overwintering Microbat Habitat Results

Appendix A WC2NH Overwintering Habitat Monitoring

Structure/ ID	*Location*	*Microbats Present*	*Conservation Value as Overwintering Microbat Habitat*	*Occurring within 200m of the Project*	*Mitigation Required for high value overwintering roost sites for works occurring within 100m (Lewis, 2014)*
Bridges					
Williamson Creek	Williamson Creek	Approx **14** *Miniopterus australis* roosting in 5 locations between the bridge decking.	Moderate	√	▪ Qualified ecologist to perform pre-clearing surveys to assess if bats are using the structure before planned works within 100m of structure. These surveys are considered to have been completed as part of ongoing spring and winter surveys of all culverts. ▪ Microbat roost monitoring will be undertaken during construction to evaluate the response of microbats to a range of construction activities. This will involve ongoing surveys of all structures in early spring and winter each year during construction to update the status of each structure as microbat habitat. ▪ In the event that microbats are observed leaving the roost site during the day, works are to cease and the project ecologist to attend site and provide advice. ▪ The contractor would manage the integrity of drainage lines and associated riparian vegetation so as not to constrict microbat flyways. ▪ The contractor would manage water quality and velocity of the adjoining waterways to be maintained in accordance with the EPL issued for the project. ▪ If works are required on the structure itself, seasonal limitation of construction works are required for specific construction activities including clearing, dumping of oversize rock at bridge abutments, piling or any activity deemed as inappropriate by the Project Ecologist. Should works be required on the structure itself, the project ecologist must be consulted.
1871	Lower Warrell Creek Bridge	Nil - limitations to surveying the center of the bridge due to limited accessibility.	Low	√	
Culverts					
CH59550*	Nth Bellwood Rd	Nil	Low	√	
CH58570*	Gate 13 Fauna Underpass	Nil	Low	√	

CH58510*	Gate 13 Drainage culvert	Nil	Low	√	
CH56410*	Sheather Box Culvert	**4** *M. australis* roosting together in a segment space.	Low	√	▪ Microbat roost monitoring will be undertaken during construction to evaluate the response of microbats to a range of construction activities. This will involve ongoing surveys of all structures in early spring and winter each year during construction to update the status of each structure as microbat habitat. ▪ In the event that microbats are observed leaving the roost site during the day, works are to cease and the project ecologist to attend site and provide advice. ▪ The contractor would manage the integrity of drainage lines and associated riparian vegetation so as not to constrict microbat flyways. ▪ The contractor would manage water quality and velocity of the adjoining waterways to be maintained in accordance with the EPL issued for the project.
CH55860*	Nth of Hartmens Pipe culvert	Nil	Low		
CH55100*	Nth Mattick Fauna Underpass	Nil	Low	√	
599237	Nursery Rd - south	Nil	Low	√	
599238	Old Coast Rd/ Pacific Hwy intersection	Dense over hanging vegetation obstructing the entrance to culvert.	Low	√	
599240	Old Coast Rd/ Pacific Hwy intersection	Nil	Low	√	
599229	Upper Warrell Ck Rd	Nil	Low	√	

599228	Bald Hill Rd	**3** *Nyctophilus sp.* roosting together in a lifting point.	Low	√	▪ Microbat roost monitoring will be undertaken during construction to evaluate the response of microbats to a range of construction activities. This will involve ongoing surveys of all structures in early spring and winter each year during construction to update the status of each structure as microbat habitat. ▪ In the event that microbats are observed leaving the roost site during the day, works are to cease and the project ecologist to attend site and provide advice. ▪ The contractor would manage the integrity of drainage lines and associated riparian vegetation so as not to constrict microbat flyways. ▪ The contractor would manage water quality and velocity of the adjoining waterways to be maintained in accordance with the EPL issued for the project.
599227	Lower Warrell Creek	Nil	Low	√	
599226 (NB Mitigation for this culvert is not specified within the MMP. Mitigation proposed is based on that required for other high conservation value roost sites for Myotis e.g 599205)	Lower Warrell Creek	**33** M. australis across 7 locations (3 groupings of >7) scattered singles and pairs in further lift points throughout culvert. Absence of water in the base of culvert.	High	√	▪ Qualified ecologist to perform pre-clearing surveys to assess if bats are using the structure before planned works within 100m of structure. These surveys are considered to have been completed as part of ongoing spring and winter surveys of all culverts. ▪ Microbat roost monitoring will be undertaken during construction to evaluate the response of microbats to a range of construction activities. This will involve ongoing surveys of all structures in early spring and winter each year during construction to update the status of each structure as microbat habitat. ▪ In the event that microbats are observed leaving the roost site during the day, works are to cease and the project ecologist to attend site and provide advice. ▪ The contractor would manage the integrity of drainage lines and associated riparian vegetation so as not to constrict microbat flyways. ▪ The contractor would manage water quality and velocity of the adjoining waterways to be maintained in accordance with the EPL issued for the project. ▪ If works are required on the structure itself, seasonal limitation of construction works are required for specific construction activities including clearing, dumping of oversize rock at bridge abutments, piling or any activity deemed as inappropriate by the Project Ecologist. Should works be required on the structure itself, the project ecologist must be consulted.
599225	Scotts Head Rd	Nil	Low	√	

599224	Scotts Head Rd	**10** *M. australis* present. Four individuals in separate segment gaps and six grouped together in a single lifting point.	Moderate	√	▪ Qualified ecologist to perform pre-clearing surveys to assess if bats are using the structure before planned works within 100m of structure. These surveys are considered to have been completed as part of ongoing spring and winter surveys of all culverts. ▪ Microbat roost monitoring will be undertaken during construction to evaluate the response of microbats to a range of construction activities. This will involve ongoing surveys of all structures in early spring and winter each year during construction to update the status of each structure as microbat habitat. ▪ In the event that microbats are observed leaving the roost site during the day, works are to cease and the project ecologist to attend site and provide advice. ▪ The contractor would manage the integrity of drainage lines and associated riparian vegetation so as not to constrict microbat flyways. ▪ The contractor would manage water quality and velocity of the adjoining waterways to be maintained in accordance with the EPL issued for the project. ▪ Note: If works are required on the structure itself, seasonal limitation of construction works are required for specific construction activities including clearing, dumping of oversize rock at bridge abutments, piling or any activity deemed as inappropriate by the Project Ecologist. Should works be required on the structure itself, the project ecologist must be consulted.
599223	Donnellyville	Nil	Low	√	
599222	Donnellyville	**2** *M. australis* present, individually roosting in scuppers.	Low	√	▪ Microbat roost monitoring will be undertaken during construction to evaluate the response of microbats to a range of construction activities. This will involve ongoing surveys of all structures in early spring and winter each year during construction to update the status of each structure as microbat habitat. ▪ In the event that microbats are observed leaving the roost site during the day, works are to cease and the project ecologist to attend site and provide advice. ▪ The contractor would manage the integrity of drainage lines and associated riparian vegetation so as not to constrict microbat flyways. ▪ The contractor would manage water quality and velocity of the adjoining waterways to be maintained in accordance with the EPL issued for the project.
599221	Donnellyville	Nil	Low	√	

CH45600*	Stoney Creek 5 Cell Culvert	**3** *M. australis* present within newly constructed 5 cell box culvert. All 3 animals grouped together.	Low	√	▪ Microbat roost monitoring will be undertaken during construction to evaluate the response of microbats to a range of construction activities. This will involve ongoing surveys of all structures in early spring and winter each year during construction to update the status of each structure as microbat habitat. ▪ In the event that microbats are observed leaving the roost site during the day, works are to cease and the project ecologist to attend site and provide advice. ▪ The contractor would manage the integrity of drainage lines and associated riparian vegetation so as not to constrict microbat flyways. ▪ The contractor would manage water quality and velocity of the adjoining waterways to be maintained in accordance with the EPL issued for the project.
CH44900*	Rosewood Creek Box culvert	**1** *M. australis* present within newly constructed single cell box culvert 1 individual in a segment gap.	Low	√	
CH44480*	Rosewood Tributary	**4** *M. australis* present within newly constructed 3 cell pipe culvert 4 grouped together in segment gap.	Low	√	
CH43340*	Butchers Creek 5 Cell Culvert	**4** *M. australis* present within newly constructed 5 cell box culvert. All 4 animals roosting individually.	Low	√	
599220	Donnellyville	Nil	Low	√	
599210	Upper Warrell Creek	Nil	Low	√	
599209	Upper Warrell Creek	Nil	Low	√	
599208	Browns Crossing Rd	Nil	Low	√	
599207	Browns Crossing Rd	Nil	Low	√	

599205	Deadman's Gully	Approx. **1000** *M. australis* in segment gaps ranging between 2-4cm. 120 was the largest estimate of group number in the same gap.	High	√	▪ Qualified ecologist to perform pre-clearing surveys to assess if bats are using the structure before planned works within 100m of structure. These surveys are considered to have been completed as part of ongoing spring and winter surveys of all culverts. ▪ Microbat roost monitoring will be undertaken during construction to evaluate the response of microbats to a range of construction activities. This will involve ongoing surveys of all structures in early spring and winter each year during construction to update the status of each structure as microbat habitat. ▪ In the event that microbats are observed leaving the roost site during the day, works are to cease and the project ecologist to attend site and provide advice. ▪ The contractor would manage the integrity of drainage lines and associated riparian vegetation so as not to constrict microbat flyways. ▪ The contractor would manage water quality and velocity of the adjoining waterways to be maintained in accordance with the EPL issued for the project. ▪ Note: If works are required on the structure itself, seasonal limitation of construction works are required for specific construction activities including clearing, dumping of oversize rock at bridge abutments, piling or any activity deemed as inappropriate by the Project Ecologist. Should works be required on the structure itself, the project ecologist must be consulted.

*Denotes newly constructed culverts, using the chainage numbers used on the current WC2NH project mapping.

Appendix D

Nest Box Monitoring Report Summer 2017 and Annual Results Comparison

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6 March 2017
Ref No.: 2378-1346

PACIFICO
124 Albert Drive
DONNELLYVILLE NSW 2447

Attention: Noelene Rutherford

Dear Noelene

Nest Box Monitoring Report, Summer 2017 and Annual Results Comparison - Warrell Creek to Nambucca Heads Pacific Highway Upgrade

1. Introduction

GeoLINK has been engaged by PACIFICO to undertake nest box (NB) monitoring as part of the Warrell Creek to Nambucca Heads (WC2NH) Pacific Highway Upgrade. This report provides the results of the second NB monitoring event undertaken between 23 – 25 January and 30 January - 1 February 2017 by GeoLINK ecologist Jessica O'Leary. Three bi-annual (winter/ summer) monitoring events are required in total in accordance with the *WC2U Nest Box Management Plan* (Lewis 2014).

2. Background

GeoLINK was engaged by PACIFICO to undertake the installation of 60 per cent of the nominated NBs required for the WC2NH Pacific Highway Upgrade. The *Nest Box Management Plan* (NBMP) requires that 92 of a total of 152 NBs (60 per cent) are installed prior to or during vegetation clearing operations in order to provide temporary refuge for hollow-dependent fauna displaced during clearing operations.

The installation of the initial 60 per cent of NBs was undertaken over six days between 26 November and 11 December 2014. GeoLINK supervised the installation of the NBs, undertaken by experienced tree climbers from George's Tree Services. Each NB was assigned a specific code depending on box type and the number of boxes required. For example, SF1.1 denotes box type 1, designed for scansorial mammals and .1 denotes 1 of 11 SF boxes allocated for installation. Refer to GeoLINK's *WC2NH Pre-Clearing Nest Box Installation Report* (ref. 2378-1085) for details of pre-clearing NB installation.

All mainline clearing including the area for the north facing ramps (NFRs) has now been completed.

In addition to the 135 NBs installed for pre and post clearing, as per the initial NB calculations and number required (Lewis, 2014), an additional eight NBs were installed in December 2016 to capture the final clearing quantities and habitat trees removed for the NFRs and other small areas of clearing. These boxes were placed in both the existing or new Nest Box replacement Zones (NBRZs) in compliance

with the NBMP. Details were provided to Pacifico (20/12/2016) in the WC2NH – Final Nest Box Installation Report: Final Calculations (Geolink, 2016).

This brings the total NBs inspected during the summer 2017 monitoring event to 143 boxes.

The locations of the NBs are displayed in **Illustrations 1.1** and **2.1**.

3. Methods

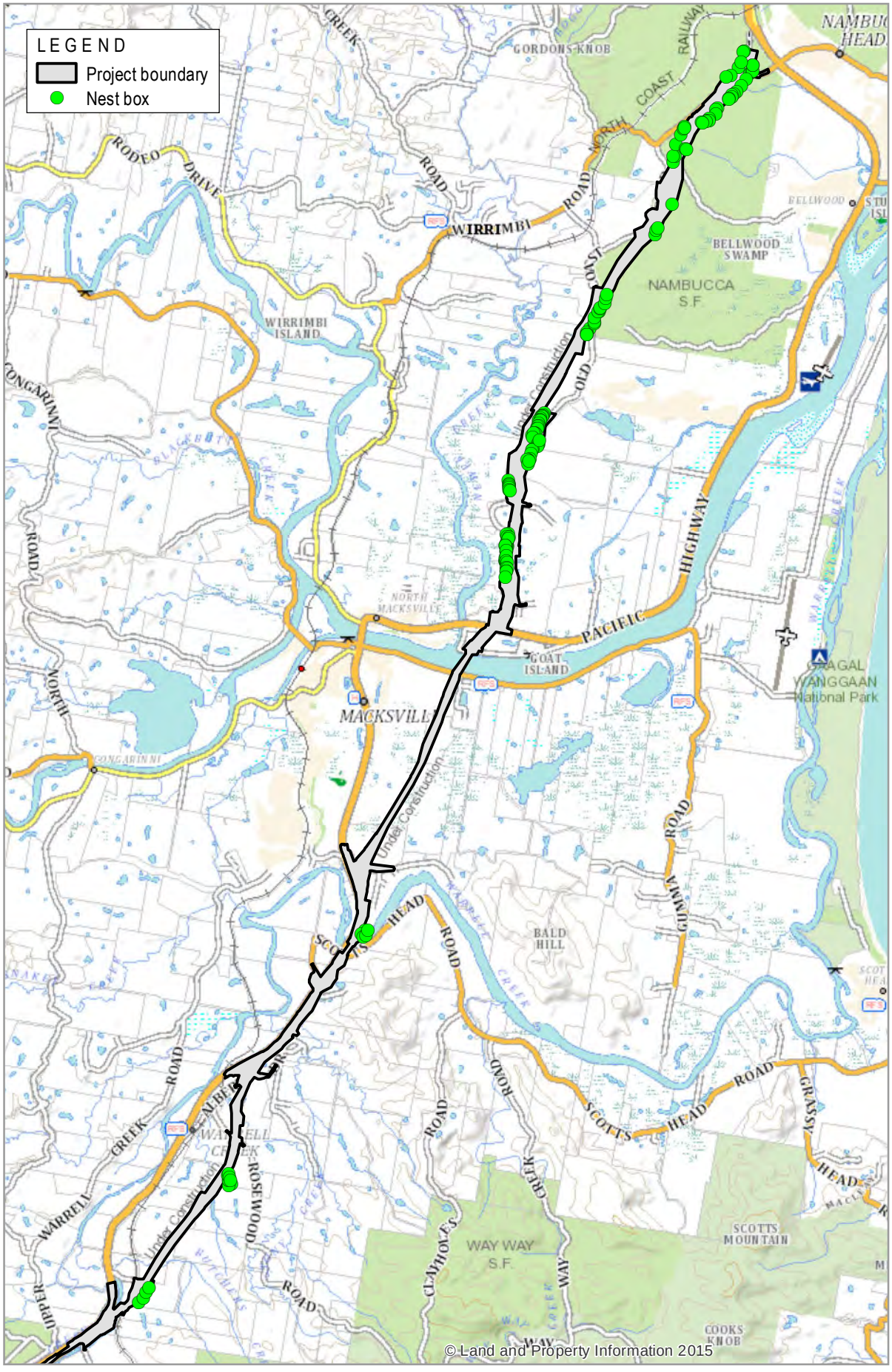
The methods of NB inspection included:

- Direct observations by professional tree climbers: This was the predominant method of inspection due to the high position of NBs as per the NBMP (Lewis 2014). All nest boxes are positioned between 5-12 metres above ground level. Therefore tree climbers looked directly into the boxes, took a photograph and passed the camera to the ecologist for assessment. Once NBs were determined to be empty, closer observations were made of the NB lid and interior of the boxes to search for potential signs of fauna occupancy. If the box was occupied and maintenance or handling of fauna was required the boxes were lowered to the ground, checked and then reinstated.
- The following data was collected, or checked to be correct, at each NB:
  - NB replacement zone
  - Box code
  - Global Positioning System waypoints
  - Installation and inspection date
  - Weather conditions (rain, wind, cloud cover percentage, ambient temperature)
  - Box occupied? (Y/N)
  - Species of fauna present
  - Number of individuals, adult or juvenile (if discernible)
  - Evidence of use if not occupied (chewings, drey, fur, feathers, and scats)
  - Evidence of pest species (European bees, Common Myna *Acridotheres tristis*, Starlings *Sturnus vulgaris*, ants)
  - Is maintenance/ replacement required? (Y/N)
  - What maintenance was undertaken?
  - Has the surrounding landscape changed? (Clearing/ partial clearing)
  - Could the box be relocated to a better position or area?
  - Does the box hold water? Is leaking from the lid occurring?
  - Additional comments.
  - Photo identification number

General maintenance (e.g. tightening of cables/ adjusting for stability, tightening of fixtures, emptying of pooled water and removal of pest invertebrate fauna) was also undertaken when required.

Information shown is for illustrative purposes only

Drawn by: RE Checked by: RE Reviewed by: JOL Date: 9/02/2017
Source of base data: SIX Maps and AFJV



0 1.5 km

North

Site Context

GeoLINK environmental management and design

WC2NH Nest Box Monitoring Report – Summer 2017
2378-1328

Illustration 1.1

Information shown is for illustrative purposes only

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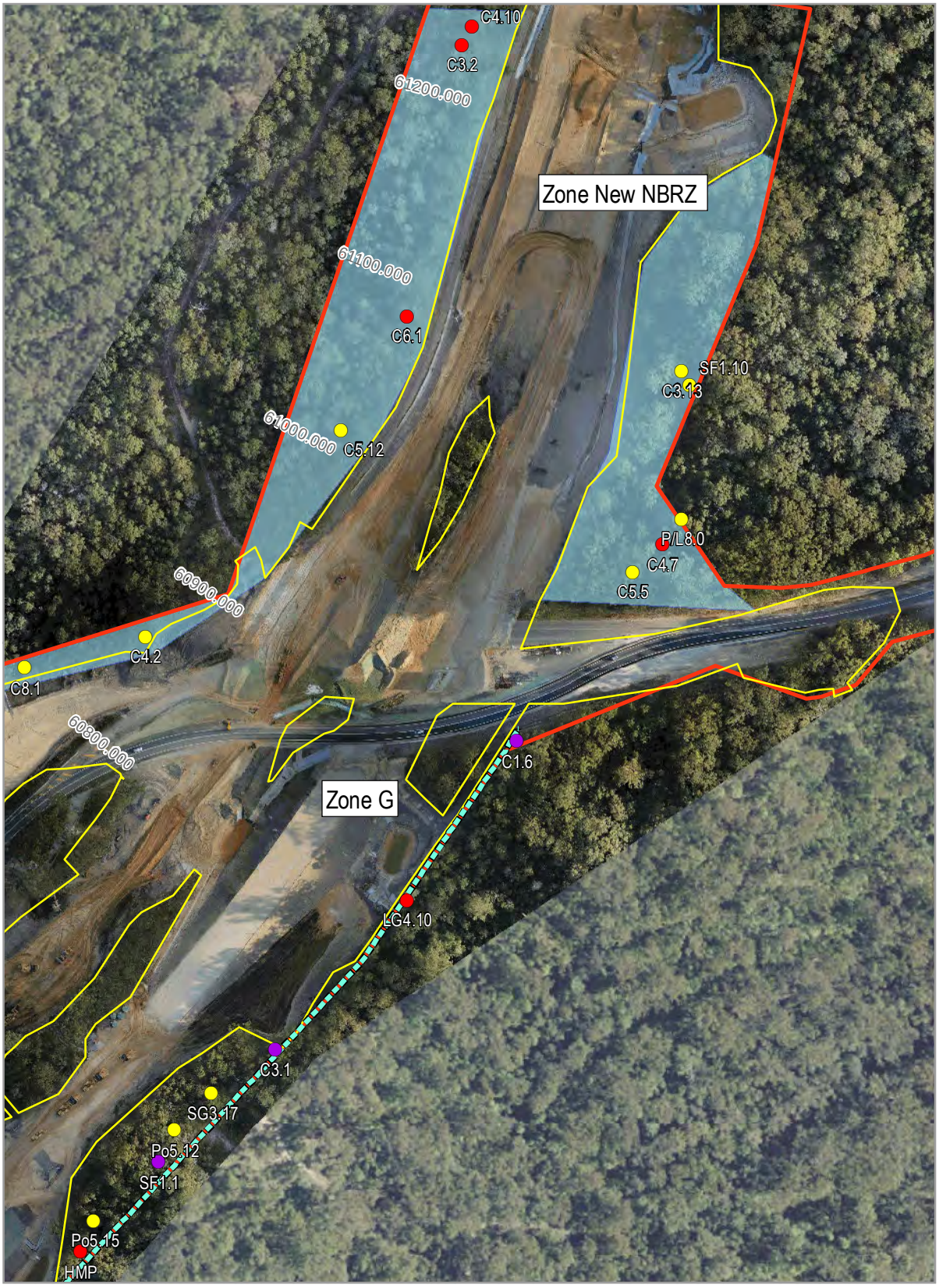
Source of base data: SIX Maps and AFJV



LEGEND

- Project boundary
- Clearing limit
- Nest box replacement zone line
- Nest box replacement zone

Nest Box

- Not occupied, no evidence of use
- Not occupied, evidence of use
- Occupied, evidence of use

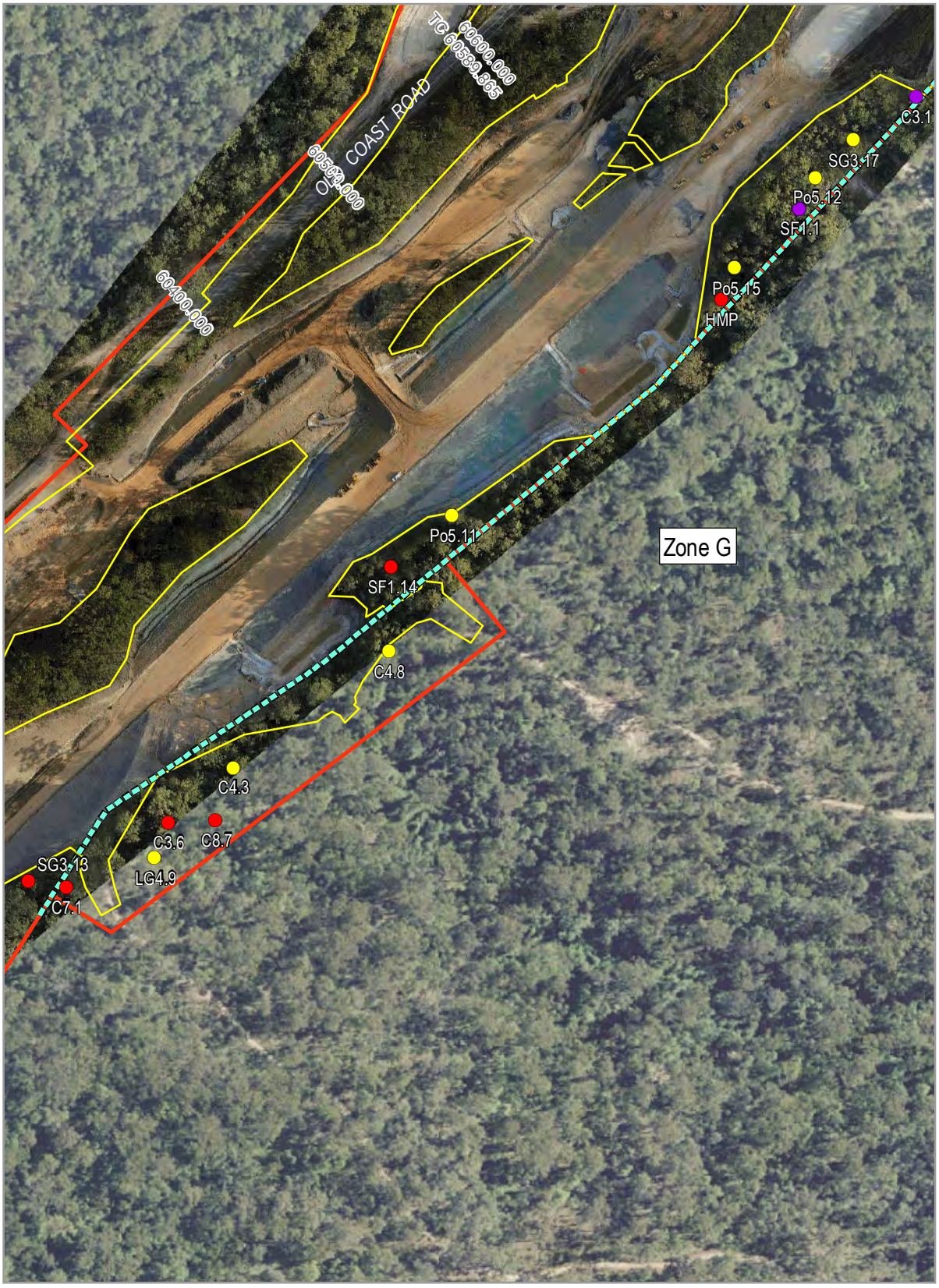
0 60

North

Nest Box Locations and Usage

Information shown is for illustrative purposes only

Drawn by: RE Checked by: RE Reviewed by: JOL Date: 9/02/2017
Source of base data: SIX Maps and AFJV



LEGEND

Project boundary
Clearing limit
Nest box replacement zone line

Nest Box

Not occupied, no evidence of use
Not occupied, evidence of use
Occupied, evidence of use

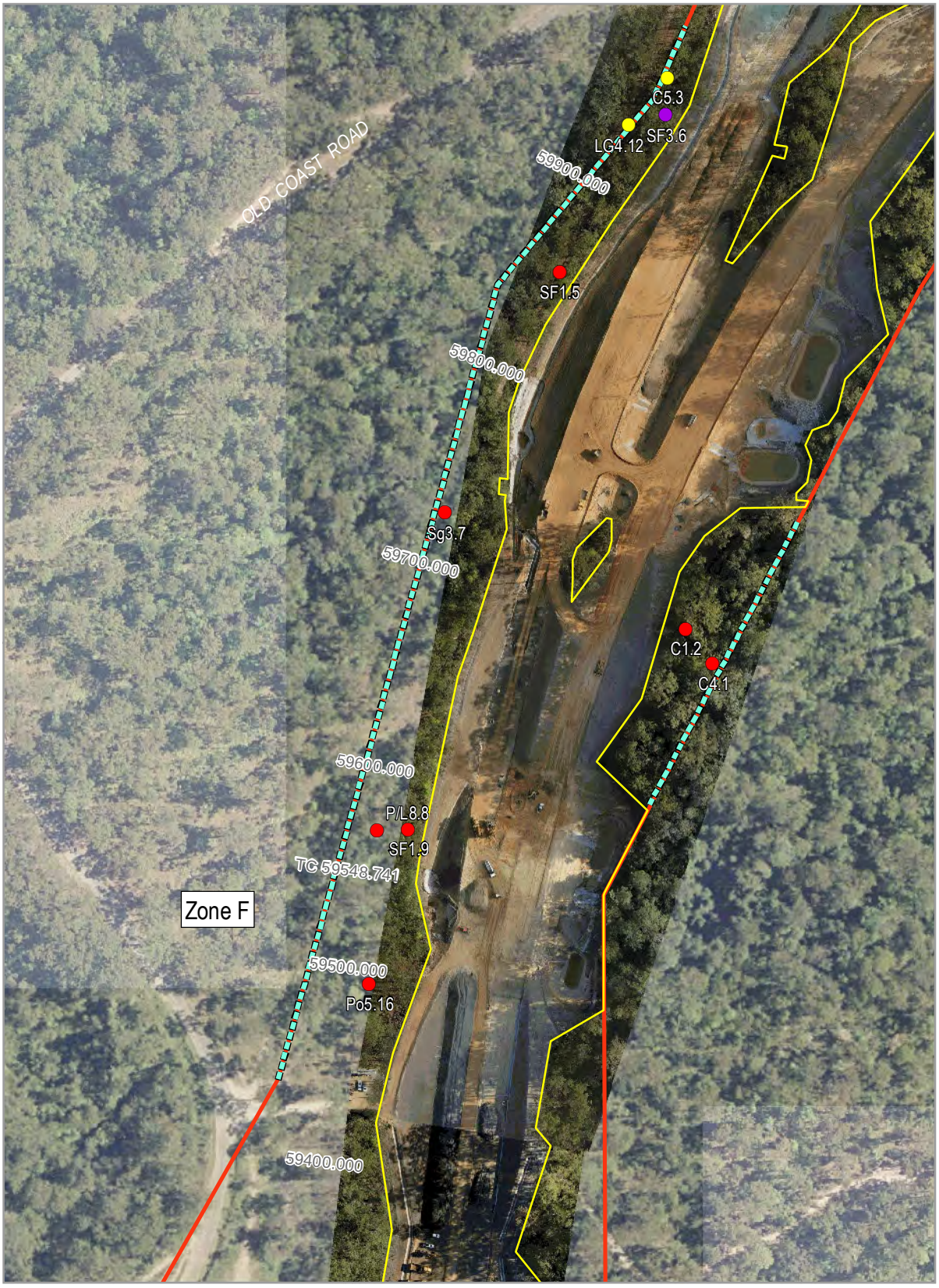
0 60

North

Nest Box Locations and Usage

Information shown is for illustrative purposes only

Drawn by: RE Checked by: RE Reviewed by: JOL Date: 9/02/2017
Source of base data: SIX Maps and AFJV



LEGEND

- Project boundary
- Clearing limit
- Nest box replacement zone line

Nest Box

- Not occupied, no evidence of use
- Not occupied, evidence of use
- Occupied, evidence of use

0 60

North

Nest Box Locations and Usage

Information shown is for illustrative purposes only

Drawn by: RE Checked by: RE Reviewed by: JOL Date: 9/02/2017
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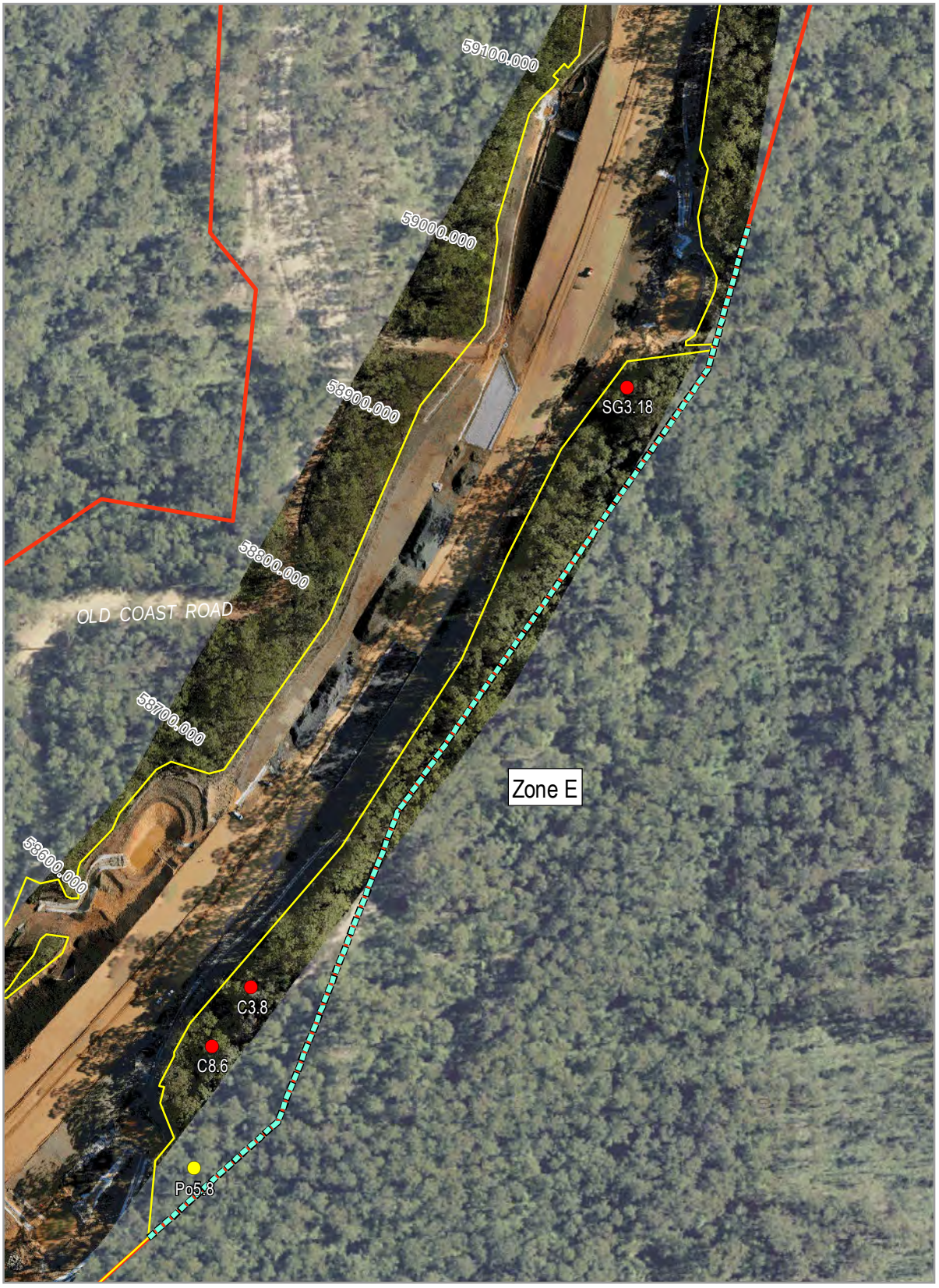


LEGEND

- Project boundary
- Clearing limit
- Nest box replacement zone line

Nest Box

- Not occupied, no evidence of use
- Not occupied, evidence of use

0 60

North

Nest Box Locations and Usage

GeoLINK environmental management and design

Information shown is for illustrative purposes only

Drawn by: RE Checked by: RE Reviewed by: JOL Date: 9/02/2017
Source of base data: SIX Maps and AFJV

LEGEND

Project boundary
Clearing limit
Nest box replacement zone line

Nest Box
Not occupied, no evidence of use
Not occupied, evidence of use
Occupied, evidence of use

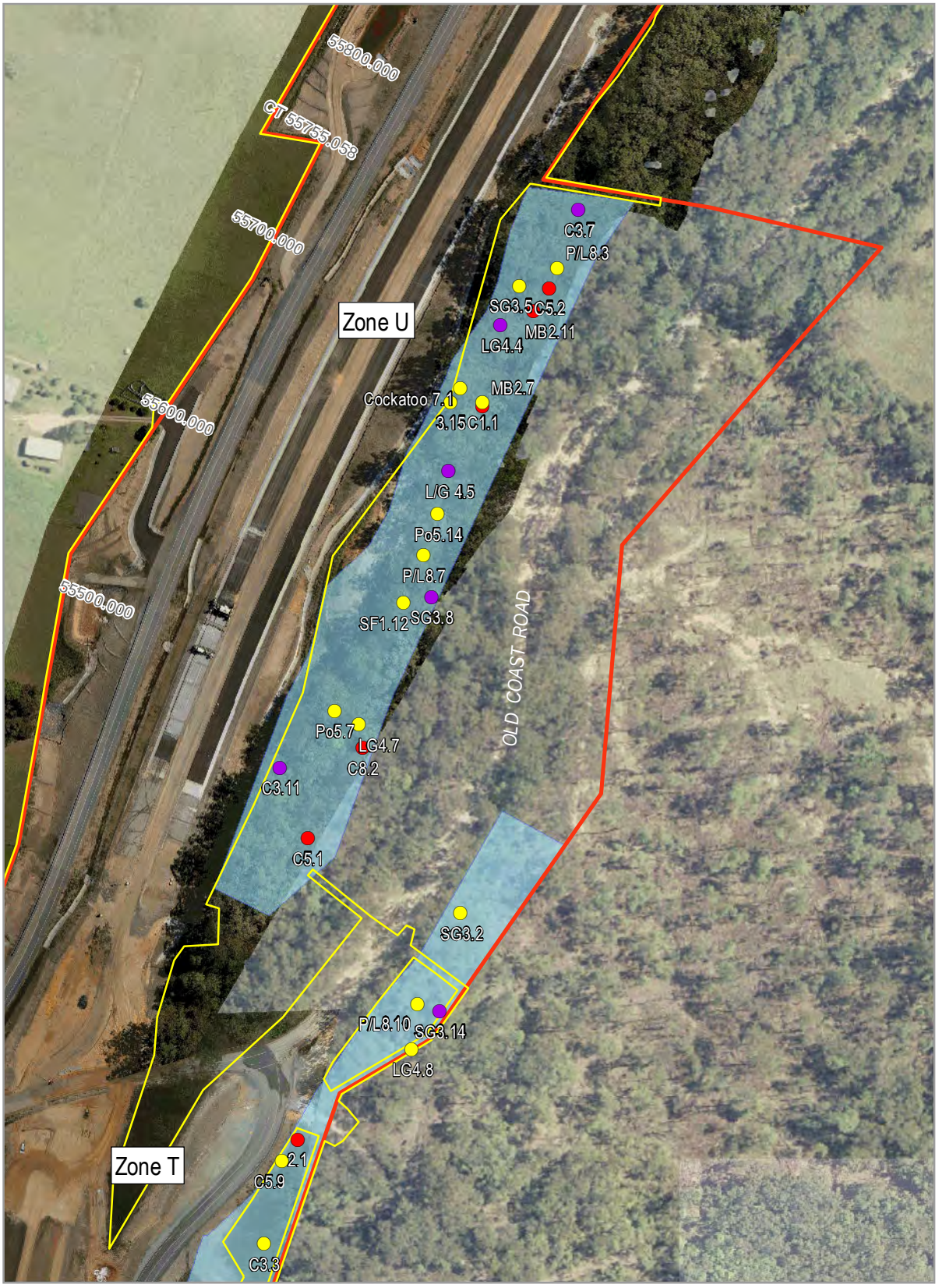
0 60

North

Nest Box Locations and Usage

Information shown is for illustrative purposes only

Drawn by: RE Checked by: RE Reviewed by: JOL Date: 9/02/2017
Source of base data: SIX Maps and AFJV



LEGEND

- Project boundary
- Clearing limit
- Nest box replacement zone

Nest Box

- Not occupied, no evidence of use
- Not occupied, evidence of use
- Occupied, evidence of use

0 60

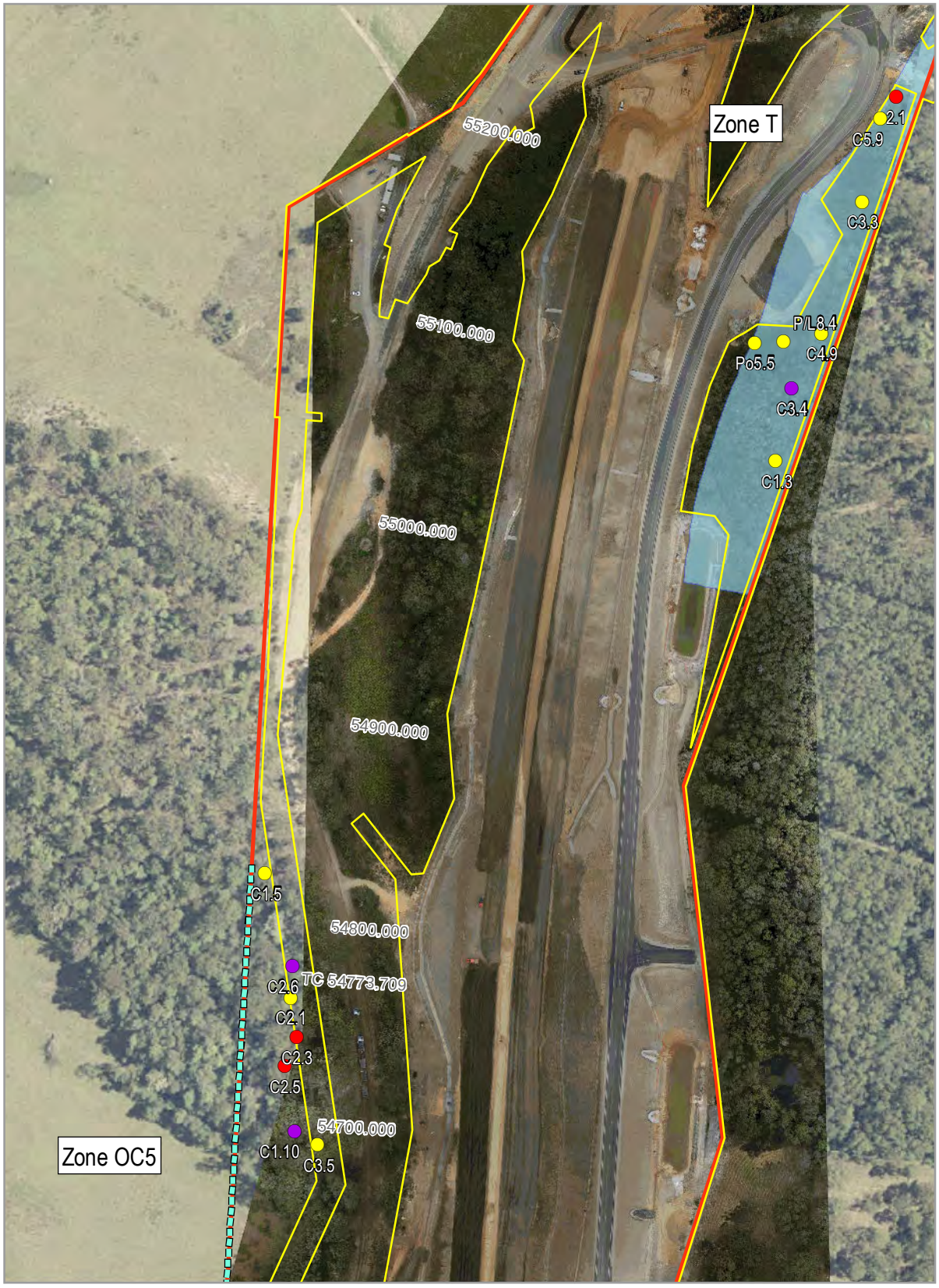
North

Nest Box Locations and Usage

GeoLINK environmental management and design

Information shown is for illustrative purposes only

Drawn by: RE Checked by: RE Reviewed by: JOL Date: 9/02/2017
Source of base data: SIX Maps and AFJV



LEGEND

- Project boundary
- Clearing limit
- Nest box replacement zone line
- Nest box replacement zone

Nest Box

- Not occupied, no evidence of use
- Not occupied, evidence of use
- Occupied, evidence of use

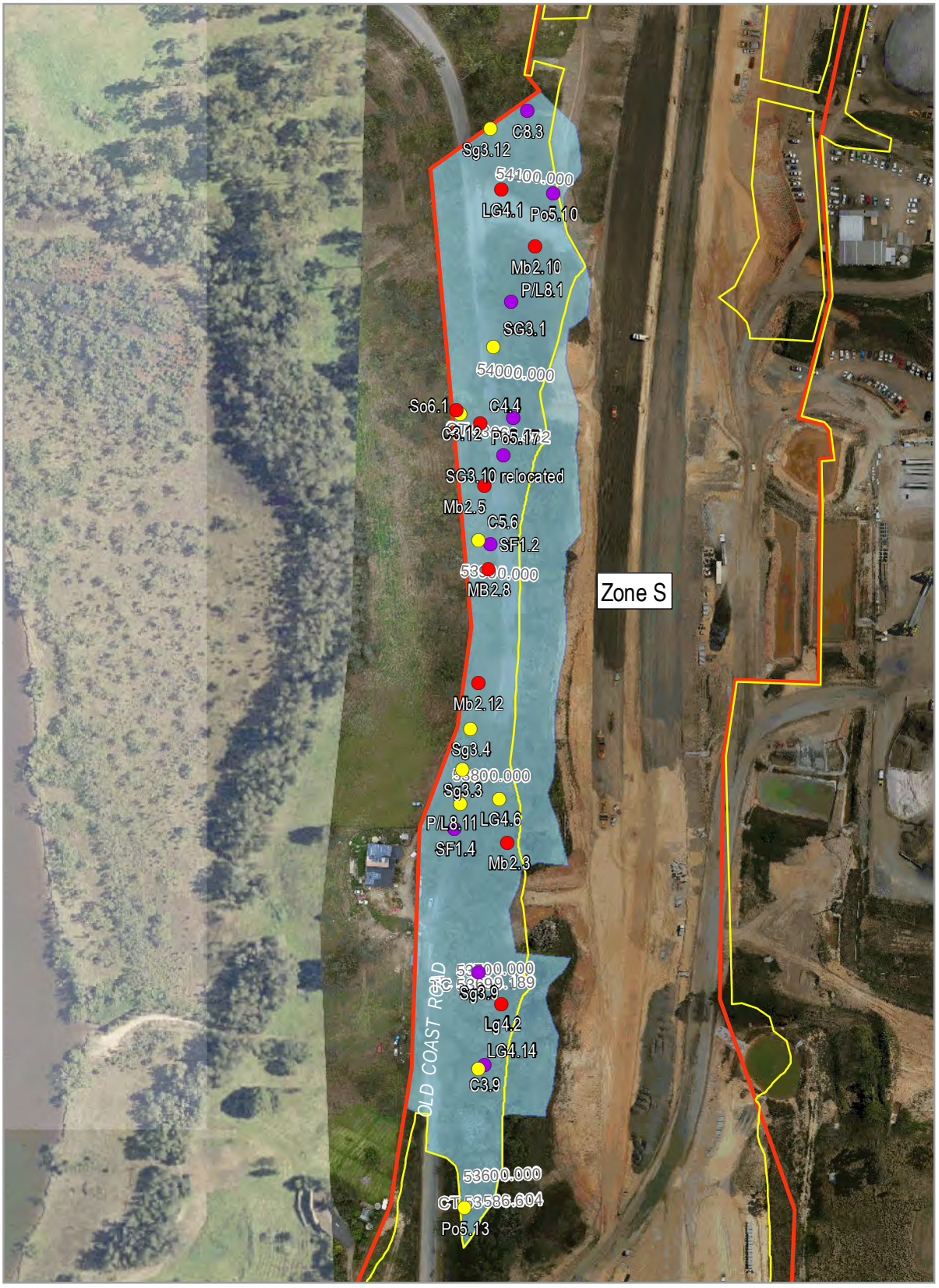
0 60

North

Nest Box Locations and Usage

Information shown is for illustrative purposes only

Drawn by: RE Checked by: RE Reviewed by: JOL Date: 9/02/2017
Source of base data: SIX Maps and AFJV



LEGEND

- Project boundary
- Clearing limit
- Nest box replacement zone

Nest Box

- Not occupied, no evidence of use
- Not occupied, evidence of use
- Occupied, evidence of use

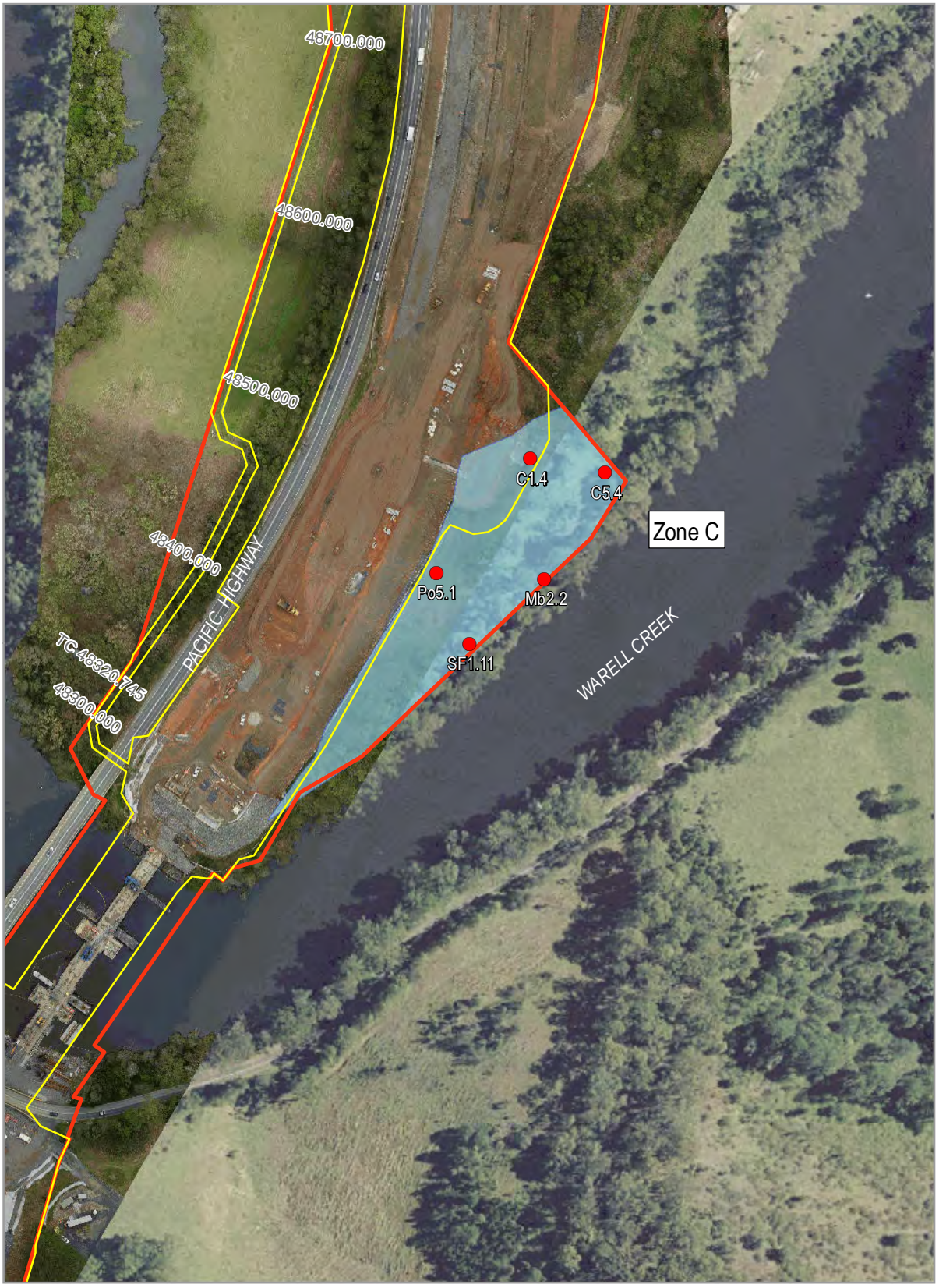
0 60

North

Nest Box Locations and Usage

Information shown is for illustrative purposes only

Drawn by: RE Checked by: RE Reviewed by: JOL Date: 9/02/2017
Source of base data: SIX Maps and AFJV



LEGEND

Project boundary
Clearing limit
Nest box replacement zone

Nest Box
Not occupied, no evidence of use

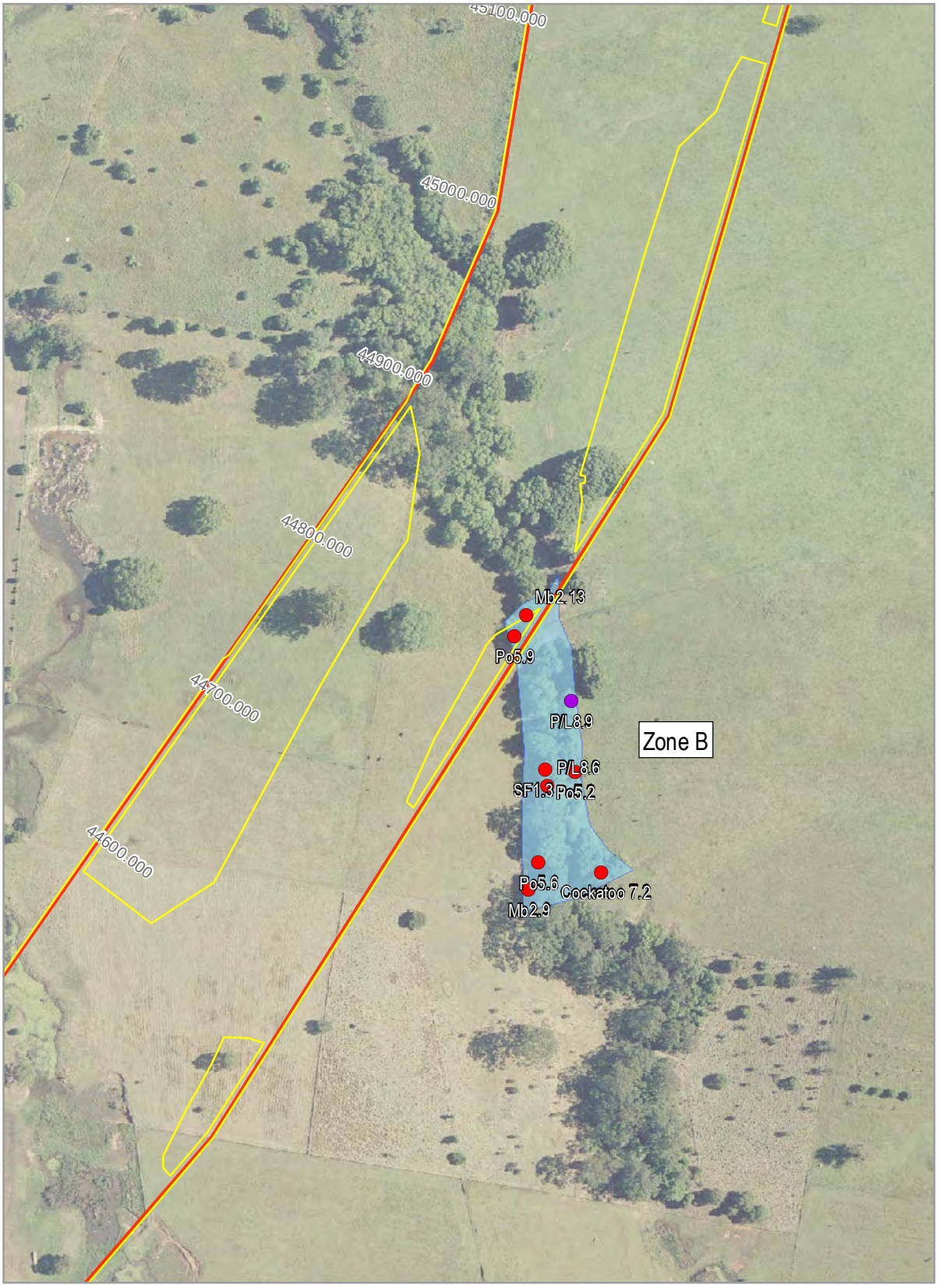
0 60

North

Nest Box Locations and Usage

Information shown is for illustrative purposes only

Drawn by: RE Checked by: RE Reviewed by: JOL Date: 9/02/2017
Source of base data: SIX Maps and AFJV



LEGEND

Project boundary
Clearing limit
Nest box replacement zone

Nest Box
Not occupied, no evidence of use
Occupied, evidence of use

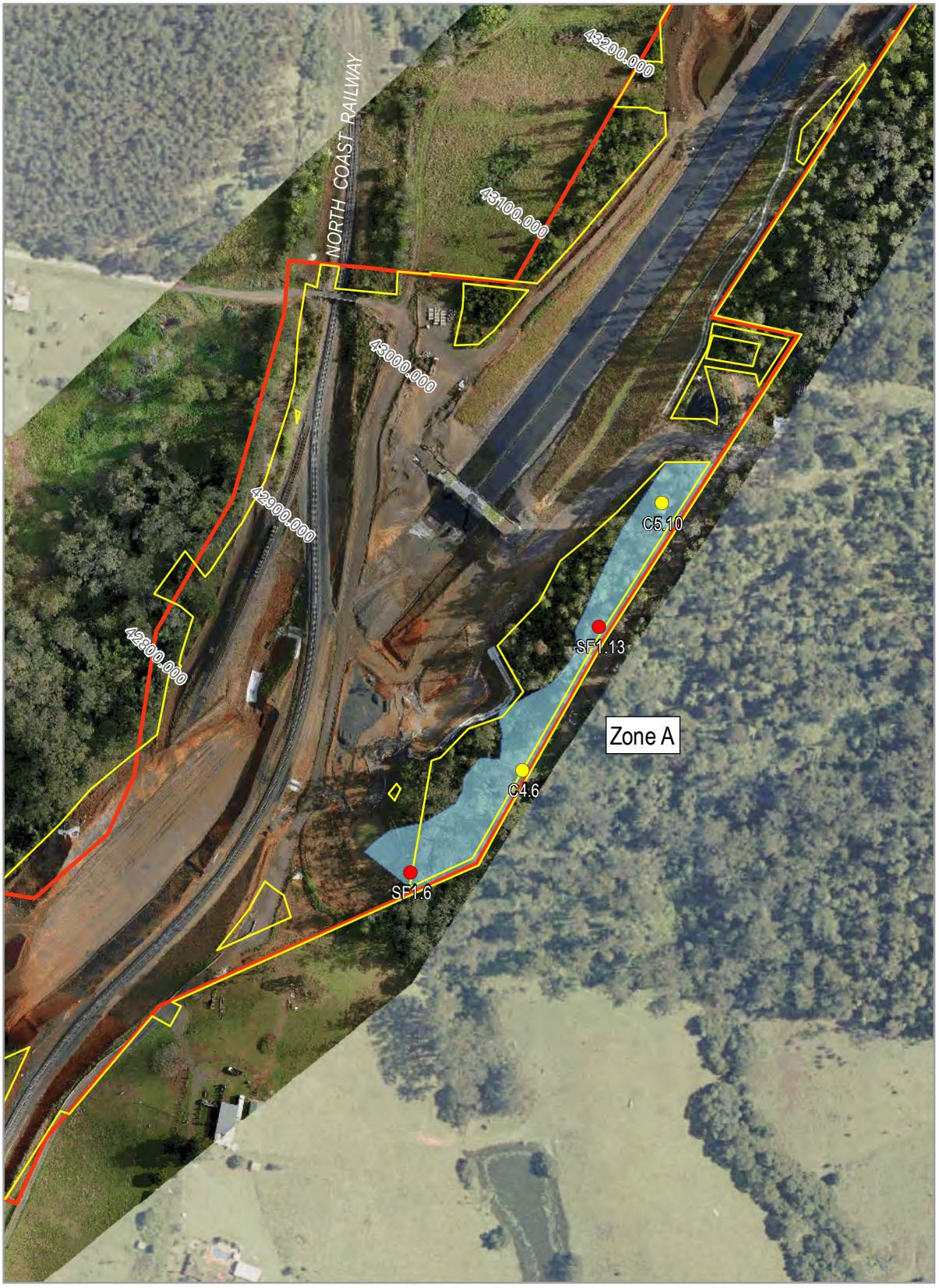
North

0 60

Nest Box Locations and Usage

Information shown is for illustrative purposes only

Drawn by: RE Checked by: RE Reviewed by: JOL Date: 9/02/2017
Source of base data: SIX Maps and AFJV



LEGEND

- Project boundary
- Clearing limit
- Nest box replacement zone

Nest Box

- Not occupied, no evidence of use
- Not occupied, evidence of use

0 60

North

Nest Box Locations and Usage

GeoLINK environmental management and design

4. Results and Discussion

The results from the second NB monitoring event (i.e. summer 2017) are provided in **Attachment A** and summarised below.

4.1 Native Fauna Occupancy

A total of 22 NBs (approximately15% of total) were occupied by fauna at the time of monitoring. This is a decrease from the 20% of NBs occupied during the winter 2016 monitoring (27 of a total of 135 NBs).

Fauna recorded occupying the NBs during the summer 2017 monitoring are listed below. **Plates 1.1** to **1.10** show NB contents or evidence of use by fauna.

- Two mature Common Brushtail Possums (*Trichosurus vulpecula*) were recorded in two NBs
- One Owlet Night-jar (*Aegotheles cristatus*) was recorded in NB Po5.18
- The introduced Black Rat (*Rattus rattus*) (one individual) was recorded in NB P/L8.9
- Active native stingless bee hives (*Tetragonula* or *Austroplebeia* species) were recorded in NBs LG4.4, SF1.4 and SG3.14. SG3.14 was recorded as containing a hive during winter 2016.
- A minimum of 46 Sugar Gliders (*Petaurus breviceps*) from seventeen separate boxes (refer to**.** The Sugar Glider was the most abundant species observed in occupied boxes with 17 (77% of 22 occupied) NBs containing this species. This represents a minor increase from the 70% of NBs this species was observed in during the winter 2016 monitoring. At least four boxes were occupied by a least one Sugar Glider, however most boxes (10) supported two to three individuals per box. One box each had four individuals, five individuals and seven individuals respectively. It is likely that additional animals were present in some of the occupied boxes, however avoided detection due to their location within the box or as pouch young. Four individual dead gliders were recorded in 4 separate boxes. Two of these boxes had living gliders also inside. Sixty-nine NBs (84% of 82) which showed some indication of previous fauna use (dreys, nesting material etc.) showed some evidence of use by a glider species via leaf nest material (dreys).

A total of 82 NBs (57 per cent of 143) were recorded as having evidence of use by fauna indicated by the presence of animals (22 NBs), dreys (67 NBs), nesting material (1 NB), scats (1 NB), scratches (4 NBs), fur (1 NB), feathers (2 NBs), bird excrement (4 NBs) or chew marks (4 NBs) around the entry hole of the box or a combination of these indicators. These results indicate an increase from 44 % use in winter 2016 to 57% use in summer 2017.

No threatened fauna or signs of NB occupancy by threatened species were recorded. There is potential for threatened species to use the boxes as the home range of confirmed populations of hollow obligated threatened fauna are known to overlap with the nominated NBRZs. For example there are known populations of Yellow-bellied Gliders (*Petaurus australis)* in Nambucca State Forest and in the Cockburn Lane area.

It was not possible to determine whether the NBs showing evidence of glider usage was from activity of the threatened Squirrel Glider (*Petaurus norfolcensis*) (listed as Vulnerable under the *Threatened Species Conservation Act 1995*), or of the common Sugar Glider (*P. breviceps*). Only Sugar Gliders have been recorded in the study area and are therefore the likely species to have used these NBs.

The results show a moderate diversity of five recorded species utilising the NBs (two native mammal, one native bird, one native invertebrate and one introduced mammal species). The majority of boxes which housed Sugar Gliders (the most commonly recorded species) were Small Glider type 3 (SG3)

boxes (9 NBs) and scansorial mammals type 1 (SF1) boxes (6 NBs), both of which have the smallest entry holes. This is known to be a preference when small gliders select nesting hollows, as smaller entry holes serve to exclude larger predators from gaining access to the hollow and reduce competition for hollows with larger animals (refer to Beyer, Goldingay & Sharpe 2008). Specifically Sugar Gliders also prefer to select narrow entry hollows as this also aids in reducing competition for hollows with the larger Squirrel Glider where these species co-exist (Beyer and Goldingay 2006). Possum and large glider boxes were also occupied by Sugar Gliders and/or contained drey material denoting use by glider species. Within NBRZ 'OC5' two post-clearing installed microbat boxes (type C2. or MB2.) were also recorded to contain drey material and one of these boxes (C2.6) was occupied by a family of at least three Sugar Gliders (as it was in winter 2016). The post-clearing installed microbat boxes are a slightly different design to the pre-clearing installed boxes, constructed with a larger entry hole than the pre-clearing boxes at the bottom of the box. This is where the gliders have gained entry to these microbat boxes.

No occupancy or evidence of use of boxes by microbats was recorded (as per the winter 2016 monitoring); two microbat boxes were being used by gliders in the zone at OC5.

Plate 1.1 Box SF1.10 (Zone New NBRZ) Abandoned European bee hive with drey material pulled in on top of honeycomb.

Plate 1.2 Box SG3.14 (Zone T) Active native stingless bee hive in a small glider box.

Plate 1.3 Box Po5.18 (Zone D) Owlet Night-jar occupying a possum box, face visible in entry hole.

Plate 1.4 Box C8.4 (Zone D) Bird excrement on old drey material.

Plate 1.5 Box Po5.17 (Zone S) Common Brushtail Possum.

Plate 1.6 Box P/L 8.9 (Zone B) introduced Black Rat in Parrot box in camphor laurel forest.

Plate 1.7 Box C3.9 (Zone S) Seven Sugar Gliders in drey in small glider box; the largest number of gliders in a box together.

Plate 1.8 Box C2.6 (Zone OC5) Sugar Gliders in opened bottom wedge shaped microbat box.

Plate 1.9 Box SF1.2 (Zone S) One Sugar Glider sitting on the skeleton of a dead glider. Note: spine and tail bones under glider.

Plate 1.10 Box LG4.5 (Zone U) Sugar Gliders in large glider box. Note: typical fresh leaf material indicative of glider dreys.

4.2 Annual Results Comparison (winter 2016 and summer 2017)

The results of the current assessment have been analysed with the previous (winter) results. **Table 1** summarises and compares the results of the two NB monitoring events carried out to date. **Table 2** lists all species observed occupying boxes for each monitoring period.

The results indicate that occupation rates of the nest boxes decreased slightly in the current (summer) monitoring event, however signs of use increased substantially (from 44% to 57%), an encouraging result. For both events, the Sugar Glider was the most commonly recorded species and no threatened species were recorded. While not shown in Table 1, it is also noted that the number of European bee hives recorded has increased, with two hives recorded for winter 2016 in comparison with 6 hives recorded for the current event.

Table 1: Comparison of NB results winter 2016 and summer 2017

Period	*NB checked*	*NB occupied*	*% occupied*	*NB with evidence of use*	*% with evidence of use*	*Species diversity recorded*	*Active European bee hives*
Winter 2016	135	27	20	59	44	7	2
Summer 2017	143	22	15	82	57	6	6

Table 2: Fauna Species Recorded Occupying Nest Boxes

Scientific name	*Common name*	*Winter 2016*	*Summer 2017*	*Native*	*Exotic*
Aegotheles cristatus	Owlet Night-jar	x	x	x	
Antechinus sp.	unidentified Antechinus	x		x	
Dendrelaphis punctulatus	Green Tree Snake	x		x	
Trichosurus vulpecula	Common Brushtail Possums	x	x	x	
Petaurus breviceps	Sugar Glider	x	x	x	
Pseudocheirus peregrinus	Ringtail Possum	x		x	
Rattus rattus	Black Rat		x		x
Tetragonula or Austroplebeia sp.	Native Stingless Bee	x	x	x	
Trichoglossus chlorolepidotus	Scaly-breasted Lorikeet		x	x	
Total number of species diversity		7	6		

4.3 Structural Integrity and Maintenance

Twenty-nine (29) of the boxes required some form of maintenance as follows:

- Seven boxes had springs added to their cables in accordance with the NBMP requirements.
- Five boxes were rehung due to the following:
  - Attachment wire wrapped around tree (Box C3.1);
  - Box P/L8.8 replaced by Box Po5.4 as damage to lid of original box from termites;
  - Box fallen from tree (Box LG4.12);
  - Supporting tree broken in storm so rehung in adjacent tree (Box C3.10);
  - Box moved to a southern aspect on same tree (Box C5.9).

- Four boxes either had new cattle ear tags (which contain a chemical that helps repel Buffalo Flies) placed near entrance holes or previously placed tags moved closer to holes in an attempt to cause active European bee hives to be abandoned. The attachment of cattle ear tags was recommended from consultation with Hollow Log Homes, a reputable Australian Nest Box manufacturer as suitable method to deter or to cause European bees to vacate a NB. This method is also a recommendation from the NBMP (Lewis, 2014).
- Eight boxes had old bee hive honeycomb and/or active ants nests removed.
- Two boxes had dead Sugar Glider carcasses removed (or partly removed).

Light chewing was evident on four boxes (SF1.2, C5.6, SG3.14, and P/L8.9) around the entry hole but had not caused significant damage to the boxes. Overall very few boxes required maintenance and given the relatively short time since installation, it was expected that minimal structural maintenance would be required.

4.4 Invertebrate Pests

A total of 29 boxes (20 per cent of total) recorded evidence of pest invertebrate species:

- Twelve boxes contained ant nests
- Two boxes contained mud wasp nests
- One box had its lid damaged by termites (and was replaced)
- Fourteen European bee hives (an increase from seven hives in winter 2016), six active and eight abandoned or with evidence of honeycomb.
- At least one box contained both an inactive European bee hive and an active ant nest.

Box P/L8.7 which contained Sugar Gliders during the winter 2016 inspection is now occupied by an active European bee hive.

The six active European bee hives were not disturbed during the monitoring event; however cattle ear tags which contain a chemical that helps repel Buffalo Flies have been hung near the entrance to each of these boxes with the expectation that the bees will abandon the hive. Two hives had ear tags installed during December but as yet this has not caused the hive to abandon the NB. Further investigation into an effective method of hive removal/ deterrent will be required.

Where boxes contained abandoned hives, large pieces of honeycomb were generally removed to open up the box again for use by native species (four NBs). Five NBs also included a drey or nesting material placed over the top of old honeycomb indicating some fauna use post hive abandonment (refer to **Plate 1.1**).

The option to insert insecticidal strips into the box may be explored, though ongoing monitoring will demonstrate whether the ear tags were effective in expelling the hive during the subject monitoring event and whether this method was adequate to deter the subject insect pests in the long-term.

4.5 Exotic Bird Colonisation

No exotic birds were directly detected at any of the NBs. Five NBs had evidence of use by birds by presence of feathers or excrement but it was not clear whether this was due to exotic rather than native species. Consequently no corresponding management objectives are recommended at this stage.

4.6 Nest Box Relocation

No boxes have been relocated since the winter 2016 monitoring report.

4.7 Value of Nest Boxes

The monitoring results indicate that the NBs are providing valuable habitat to local biodiversity (particularly the Sugar Gliders) in terms of providing nesting/ denning opportunities to help reduce the impacts of the habitat loss associated with the project.

A total of 82 NBs (57 per cent of 143) were recorded as having evidence of use by fauna with 22 NBs (15 per cent of 143) actually occupied by fauna at the time of monitoring. Evidence of fauna use of NBs installed in November (four NBs) and December (1 NB) is similar to the evidence of use and occupancy in recently installed boxes from the winter 2016 monitoring period (where 20 recently installed boxes showed evidence of use). This demonstrates at least some short-term value in installing boxes as compensatory habitat and installing boxes prior to clearing operations.

Four dead Sugar Gliders were observed in a total of four separate NBs, also a dead parrot, likely a Scaly-breasted Lorikeet (*Trichoglossus chlorolepidotus*) in another box. Possible reasons for the deaths could be attributed to higher than usual temperatures and/or more prolonged periods of hot weather, limited food resources/ flowering over the last few months due to dry conditions, disease, natural mortality or a combination of factors. As for the lorikeet death it may be possible that it was predated by a Sugar Glider as studies have recorded Sugar Gliders predating on the threatened Swift Parrot in Tasmania (Stojanovic *et al.* 2014).

The monitoring results to date indicate that the NBs are providing valuable compensatory habitat for some species and particularly the non-threatened Sugar Glider. However the failure to record other target species using NBs which were recorded during clearing inspections and/or at the environmental assessment stage of the project (e.g. microbats, tree skinks, geckos, and tree frogs and particularly the threatened Yellow-bellied Glider) indicates that the NBs are not compensating for the habitat losses for all species – at least in the short term.

The primary objective of the WC2U Nest Box Management Plan (Lewis, 2014) is to implement nest boxes as a compensatory mechanism for loss of den, roost and nest resources to meet the Minister Condition of Approval B6 which requires replacement hollows for displaced fauna.

The nest box program can therefore be said to be only partially meeting this objective in terms of providing compensatory nesting/ denning/ roosting resources to help reduce the impacts of the habitat loss associated with the project.

5. Recommendations

The next monitoring event is scheduled for winter 2017. The following recommendations are made to improve the value and longevity of the NBs for the WC2NH project:

- Maintenance will be on-going as required (including removal of European Bee Hives) and will be undertaken at the time of scheduled monitoring events, so as to maximise the number of boxes which are available for use by native fauna.

We trust this letter report satisfies the project requirements. If you have any questions please call me on phone 0407 756 033 or email joleary@geolink.net.au.

Yours sincerely
GeoLINK

Jessica O'Leary
Ecologist

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Issue Log

UPR	*Description*	*Date Issued*	*Issued By*
2378-1327	First issue	10/02/2017	JOL
2378-1346	Second Issue	06/032017	JOL

Attachment A WC2NH Nest Box Monitoring Results, summer 2017

Nest Box Replacement Zone	Box Code	Date of Install	Date of Inspection	Weather Conditions	Min Temp	Max Temp	Box Height (m)	Box Aspect	Tree Species	Tree Height (m)	Surrounding Vegetation Type	Box Occupied	Species Present	Evidence of use by Fauna	Type of use by Fauna	Evidence of Pest Species	Changes to Surrounding Landscape	Maintenance Required	Comments	Image No.	Easting	Northing
A	SF1.6	29/11/2014	23/01/2017	Sunny fine light breeze	16.4	29.5	5 - 8	South east	Tallowwood	15	Moist Open Forest - Flooded Gum	N	No	N	No	Inactive European Bee hive	No	Yes	Remove inactive bee hive comb only. Also black ants present.	0534 - 0538	489579	6594410
A	C4.6	9/07/2016	23/01/2017	Sunny fine light breeze	16.4	29.5	5 - 8	South east	Blue Gum	25	Moist Open Forest - Flooded Gum	N	No	Y	Drey	No	No	No	Dry drey leaves in the box.	0539 - 0540	489636	6594462
A	SF1.13	30/11/2014	23/01/2017	Sunny fine light breeze	16.4	29.5	5 - 8	South east	Casuarina	18	Moist Open Forest - Flooded Gum	N	No	N	No	Inactive European Bee hive	No	Yes	Remove inactive bee hive.	0542 - 0545	489675	6594535
A	C5.10	9/07/2016	23/01/2017	Sunny fine light breeze	16.4	29.5	5 - 8	East	Turpentine	20	Moist Open Forest - Flooded Gum	N	No	Y	Drey	No	No	No	Semi fresh drey.	0549	489707	6594598
A	LG4.11	30/11/2014	23/01/2017	Sunny fine light breeze	16.4	29.5	8 - 10	East	Tallowwood	25	Moist Open Forest - Flooded Gum	N	No	Y	Drey	Active European Bee hive	No	Yes	Active European bee hive installed cattle ear tags close to entry hole.	N/A		
A	C5.7	11/12/2016	23/01/2017	Sunny fine light breeze	16.4	29.5	5 - 8	East	See Comments	20	Moist Open Forest - Flooded Gum	N	No	N	No	No	No	No	Installed in December.	N/A		
B	Cockatoo 7.2	30/11/2014	23/01/2017	Sunny fine moderate breeze	16.4	29.5	10 - 12	North	Blue Gum	20	Camphor Laurel Forest	N	No	N	No	Spider web	No	No	N/A	0551	490772	6595939
B	Po5.6	30/11/2014	23/01/2017	Fine sunny moderate breeze	16.4	29.5	5 - 8	North east	Camphor Laurel	17	Camphor Laurel Forest	N	No	N	No	Active European Bee hive	No	Yes	Active European bee hive installed cattle ear tags close to entry hole.	N/A	490740	6595944
B	Mb2.9	30/11/2014	23/01/2017	Sunny fine moderate to strong wind.	16.4	29.5	5 - 8	East	Tallowwood	20	Camphor Laurel Forest	N	No	N	No	No	No	No	Empty. Bark at entry point now removed.	0553	490735	6595930
B	P/L8.6	30/11/2014	23/01/2017	Sunny fine moderate breeze	16.4	29.5	5 - 8	East	Camphor Laurel	18	Camphor Laurel Forest	N	No	N	No	Insects	No	Yes	Empty ants nest.	N/A	490745	6595983
B	SF1.3	30/11/2014	23/01/2017	Fine sunny moderate breeze	16.4	29.5	5 - 8	East	Camphor Laurel	18	Camphor Laurel Forest	N	No	N	No	Insects	No	Yes	Empty ants nest	N/A	490744	6595991
B	Po5.9	30/11/2014	23/01/2017	Sunny fine moderate breeze	16.4	29.5	5 - 8	South east	Camphor Laurel	20	Camphor Laurel Forest	N	No	N	No	Insects	Not since last inspection.	No	Some flying ants present removal not needed.	N/A	490728	6596059
B	Mb2.13	30/11/2014	23/01/2017	Sunny fine moderate breeze	16.4	29.5	5 - 8	North east	Camphor Laurel	18	Camphor Laurel Forest	N	No	N	No	No	Not since last inspection.	No	No evidence of any fauna or pests. No image	N/A	490734	6596070
B	P/L8.9	30/11/2014	23/01/2017	Fine sunny moderate breeze	16.4	29.5	5 - 8	South east	Camphor Laurel	18	Camphor Laurel Forest	Y	Black Rat	Y	Chewings	Black Rat	No	No	Chewings around the entry hole recorded at last monitoring event. Black Rat present in box no other nesting material present.	0568 - 0569.	490757	6596026
B	Po5.2	30/11/2014	23/01/2017	Sunny fine moderate wind	16.4	29.5	5 - 8	South east	Camphor Laurel	18	Camphor Laurel Forest	N	No	N	No	No	No	No	N/A empty	N/A	490759	6595990
C	C1.4	9/07/2016	23/01/2017	Sunny warm light breeze	16.4	29.5	5 - 8	South east	Melaleuca	20	Mixed Floodplain Forest EEC	N	No	N	No	No	No	No	Torn off melaleuca bark removed.	0571	492506	6599227
C	Po5.1	30/11/2014	23/01/2017	Sunny fine light breeze	16.4	29.5	5 - 8	North	Flooded Gum	30	Mixed Floodplain Forest EEC	N	No	N	No	Insects	No	No	Small black ants present. Not removed not many.	N/A	492458	6599169
C	SF1.11	30/11/2014	23/01/2017	Sunny warm light breeze	16.4	29.5	5 - 8	South east	Blueberry Ash	25	Mixed Floodplain Forest EEC	N	No	N	No	Insects	No	No	Removed dead Longicorn beetle from inside box.	iPhone image	492475	6599133
C	Mb2.2	30/11/2014	23/01/2017	Sunny fine light breeze	16.4	29.5	5 - 8	East	Melaleuca	20	Mixed Floodplain Forest EEC	N	No	N	No	See comment	No	No	N/A	N/A	492513	6599166
C	C5.4	17/07/2016	23/01/2017	Sunny fine light breeze	16.4	29.5	5 - 8	South	Melaleuca	18	Mixed Floodplain Forest EEC	N	No	N	No	No	No	No	N/A	0572	492544	6599220
New NBRZ	C5.5	9/06/2016	31/01/2017	Cloudy warm humid light breeze	20.3	30.8	5 - 8	South east	Tallowwood	18	Open Forest - Blackbutt	N	No	Y	Flattened material in box	No	No	Yes	Original material squashed down evidence of use. Spring attached to wire.		497486	6610313
New NBRZ	C4.7	9/06/2016	31/01/2017	Cloudy warm humid light breeze	20.3	30.8	5 - 8	South east	Tallowwood	18	Open Forest - Blackbutt	N	No	N	No	No	No	Yes	Added spring. Original material in box.	0055	497501	6610327
New NBRZ	P/L8.0	9/06/2016	31/01/2017	Cloudy warm humid light breeze	20.3	30.8	5 - 8	South	Tallowwood	18	Open Forest - Blackbutt	N	No	Y	Drey	Insects	No	Yes	Remove ants nest. Fit spring to wire. Dry drey leaves on top of sawdust.	N/A as box taken to ground to clean out ants	497511	6610340
New NBRZ	SF1.10	9/06/2016	31/01/2017	Cloud hot humid light breeze	20.3	30.8	5 - 8	South	Tallowwood	20	Open Forest - Blackbutt	N	No	Y	Drey	Inactive European Bee hive	No	Yes	Abandoned european bee hive. Removed larger pieces of old comb. Green tinged drey leaves brought in ontop of hive comb. Spring	0050-52	497515	6610408

Nest Box Replacement Zone	Box Code	Date of Install	Date of Inspection	Weather Conditions	Min Temp	Max Temp	Box Height (m)	Box Aspect	Tree Species	Tree Height (m)	Surrounding Vegetation Type	Box Occupied	Species Present	Evidence of use by Fauna	Type of use by Fauna	Evidence of Pest Species	Changes to Surrounding Landscape	Maintenance Required	Comments	Image No.	Easting	Northing
																			fitted to wire.			
New NBRZ	C5.12	9/06/2016	31/01/2017	Sunny hot humid light breeze	20.3	30.8	5 - 8	South	Tallowwood	22	Open Forest - Blackbutt	N	No	Y	Flattened material in box	No	No	No	Original material squashed down - possum?	0036-37	497338	6610385
New NBRZ	C4.2	9/06/2016	31/01/2017	Sunny humid hot light breeze	20.3	30.8	5 - 8	North	Tallowwood	17	Open Forest - Blackbutt	N	No	Y	Bird excrement and drey material.	No	OCR tie in earthworks	No	Bird excrement and drey present - in December unknown bird species was observed exiting box.	0034	497238	6610280
New NBRZ	C8.1	9/06/2016	31/01/2017	Sunny humid hot light breeze	20.3	30.8	5 - 8	South	Swamp Mahogany	17	Open Forest - Blackbutt	N	No	Y	Drey	No	Old coast rd tie in earthworks	No	Old drey material.	0032	497177	6610264
New NBRZ	C4.10	12/12/2016	31/01/2017	Sunny hot humid light breeze	20.3	30.8	8 - 10	East	Tallowwood	30	Open Forest - Blackbutt	N	No	N	No	No	No	Yes	Spring placed on wire	0041	497404	6610590
New NBRZ	C3.2	12/12/2016	31/01/2017	Sunny hot humid still	20.3	30.8	5 - 8	East	Tallowwood	25	Open Forest - Blackbutt	N	No	N	No	No	No	Yes	Spring placed on wire	0044	497399	6610581
New NBRZ	C3.13	12/12/2016	31/01/2017	Part cloud hot humid light breeze	20.3	30.8	5 - 8	North east	Blackbutt	25	Open Forest - Blackbutt	N	No	Y	Drey	No	No	Yes	New drey. Fresh green leaves. Spring placed on wire.	0046	497511	6610415
New NBRZ	C6.1	12/12/2016	31/01/2017	Sunny hot humid still	20.3	30.8	10 - 12	North east	Turpentine	25	Open Forest - Blackbutt	N	No	N	No	No	No	Yes	Jumping ant nest sw corner of tree. Moved cattle ear tags closer to entry hole to deter bees	0039	497371	6610443
G	C1.6	10/06/2016	31/01/2017	Cloudy warm humid light breeze	20.3	30.8	5 - 8	South east	Turpentine	18	Open Forest - Blackbutt	Y	Sugar Glider	Y	Drey	No	No	No	Minimum of 2 Sugar Gliders in box with drey. Very noisy location adjacent to OCR tie in and bridge construction.	0060	497427	6610227
G	LG4.10	29/11/2014	31/01/2017	Sunny humid hot light warm	20.3	30.8	8 - 10	South	Turpentine	30	Open Forest - Blackbutt	N	No	N	No	Active European Bee hive	No	No	Active European bee hive - need to rethink bee control ear tags not working	No	497371	6610146
G	C3.1	10/06/2016	31/01/2017	Sunny humid hot light breeze	20.3	30.8	5 - 8	South east	Tallowwood	20	Open Forest - Blackbutt	Y	Sugar Glider	Y	Drey	No	No	Yes	Min of 2 sugar gliders. Re-hung box due to attachment wire wrapped around tree.	0999	497304	6610070
G	SG3.17	30/11/2014	31/01/2017	Sunny humid hot light breeze	20.3	30.8	8 - 10	North east	White Mahogany	25	Open Forest - Blackbutt	N	No	Y	Drey	No	No	No	Smell and drey	0998	497272	6610048
G	Po5.12	10/06/2016	31/01/2017	Sunny humid hot light breeze	20.3	30.8	5 - 8	East	Tallowwood	25	Open Forest - Blackbutt	N	No	Y	Drey	No	No	No	Heavy use of trunk, disturbance of bark, up to box and relatively new leaves/ drey material brought into box. Distinct smell.	0995	497253	6610029
G	SF1.1		31/01/2017	Sunny humid hot still	20.3	30.8	5 - 8	South east	Tallowwood	20	Open Forest - Blackbutt	Y	Sugar Glider	Y	Drey	No	No	No	Minimum of 1 x Sugar Glider - huge tick in left ear. Jumping ant nest at base of tree, be careful!	0003-0004	497245	6610013
G	Po5.15	30/11/2014	31/01/2017	Sunny humid hot light breeze	20.3	30.8	5 - 8	North east	Tallowwood	20	Open Forest - Blackbutt	N	No	Y	Drey	No	No	No	Old dry deep drey	0992	497212	6609983
G	HMP	10/06/2016	31/01/2017	Sunny humid hot light breeze	20.3	30.8	5 - 8	North east	Turpentine	18	Open Forest - Blackbutt	N	No	N	No	No	No	No	Original material in box.	0989	497205	6609967
G	Po5.11	30/11/2016	31/01/2017	Sunny humid hot light breeze	20.3	30.8	5 - 8	North east	Tallowwood	25	Open Forest - Blackbutt	N	No	Y	Bird excrement and drey material.	No	No	No	Bird excrement and drey in box	0985-0986	497068	6609857
G	SF1.14	10/08/2016	31/01/2017	Sunny humid hot light breeze	20.3	30.8	5 - 8	East	Tallowwood	30	Open Forest - Blackbutt	N	No	N	No	No	No	No	Original material in box.	Tbc	497037	6609831
G	C4.8	10/06/2016	31/01/2017	Sunny humid hot still	20.3	30.8	5 - 8	East	Tallowwood	22	Open Forest - Blackbutt	N	No	Y	Scratching and fibrous bark drey in box.	No	No	No	Obvious activity on trunk up to box. Shredded bark pulled into box not typical leafy drey.	0980	497036	6609788
G	C4.3	10/06/2016	31/01/2017	Sunny hot humid light breeze	20.3	30.8	5 - 8	East	White Mahogany	17	Open Forest - Blackbutt	N	No	Y	Fibrous bark drey.	No	No	No	Obvious activity on trunk up to box. Shredded bark pulled into box not typical leafy drey.	0976-0977	496957	6609729
G	C3.6	10/06/2016	30/01/2017	Sunny humid hot light breeze	19.7	31.2	5 - 8	North east	Tallowwood	23	Open Forest - Blackbutt	N	No	N	No	No	No	No	Original material in box.	0971	496924	6609701
G	C8.7	10/06/2016	31/01/2017	Sunny humid hot still	20.3	30.8	5 - 8	North	Turpentine	18	Open Forest - Blackbutt	N	No	N	No	No	No	No	N/A	0973	496948	6609702
G	LG4.9	10/11/2016	30/01/2017	Sunny humid hot light breeze	19.7	31.2	8 - 10	North east	Tallowwood	30	Open Forest - Blackbutt	N	No	Y	Drey	Insects	No	Yes	Small ant nest mostly removed.	0968	496917	6609683
G	SG3.13	30/11/2016	30/01/2017	Sunny humid hot light breeze	19.7	31.2	5 - 8	North east	Blackbutt	20	Open Forest - Blackbutt	N	No	N	No	Insects	No	No	Small ant nest not removed.	0964	496853	6609671
G	C7.1	12/12/2016	30/01/2017	Sunny humid hot light breeze	19.7	31.2	10 - 12	South east	Tallowwood	25	Open Forest - Blackbutt	N	No		No	No	No	No	Newly installed in December	0966	496872	6609668
F	Po5.16	29/11/2014	31/01/2017	Sunny humid hot light breeze	20.3	30.8	5 - 8	South east	Turpentine	28	Open Forest - Blackbutt	N	No	N	No	No	No	No	Box empty nothing inside.	N/A	496488	6609157
F	SF1.9	29/11/2014	31/01/2017	Sunny humid hot light breeze	20.3	30.8	5 - 8	North east	Turpentine	15	Open Forest - Blackbutt	N	No	N	No	Insects	No	Yes	Ant nest removed. No drey present.	N/A	496508	6609236
F	P/L8.8	29/11/2014	31/01/2017	Sunny humid hot light breeze	20.3	30.8	5 - 8	East	Tallowwood	28	Open Forest - Blackbutt	N	No	N	No	Insects	No	Yes	This box has been replaced with box 5.4 due to termite damage to the lid. Re-hung in adjacent tree - Grey Gum.	iphone pic	496492	6609235

Nest Box Replacement Zone	Box Code	Date of Install	Date of Inspection	Weather Conditions	Min Temp	Max Temp	Box Height (m)	Box Aspect	Tree Species	Tree Height (m)	Surrounding Vegetation Type	Box Occupied	Species Present	Evidence of use by Fauna	Type of use by Fauna	Evidence of Pest Species	Changes to Surrounding Landscape	Maintenance Required	Comments	Image No.	Easting	Northing
F	Sg3.7	29/11/2014	31/01/2017	Sunny humid hot light breeze	20.3	30.8	8 - 10	North	Tallowwood	28	Open Forest - Blackbutt	N	No	N	No	Insects	No	Yes	Ants removed	N/A	496527	6609397
F	SF1.5	29/11/2014	31/01/2017	Sunny humid hot light breeze	20.3	30.8	5 - 8	North	Turpentine	20	Open Forest - Blackbutt	N	No	N	No	Inactive European Bee hive	No	Yes	Abandoned European bee hive and active ant nest, both removed.	0013	496585	6609519
F	LG4.12	29/11/2014	31/01/2017	Sunny hot humid light breeze	20.3	30.8	8 - 10	East	Blackbutt	35	Open Forest - Blackbutt	N	No	Y	Drey	No	No	Yes	Box re-hung and wire replaced as box fallen from tree. Deep drey inside.	0012-0015	496620	6609594
F	C5.3	10/07/2016	31/01/2017	Sunny humid hot light breeze	20.3	30.8	5 - 8	South	Tallowwood	28	Open Forest - Blackbutt	N	No	Y	Grass nest and bird excrement.	No	No	No	Grass nest material. Bird excrement inside.	0024	496640	6609618
F	SF3.6	29/11/2014	31/01/2017	Sunny humid hot light breeze	20.3	30.8	5 - 8	South east	Tallowwood	23	Open Forest - Blackbutt	Y	Sugar Glider	Y	Drey	No	no	No	Minimum of 1 x Sugar Glider	0029	496639	6609599
F	C1.2	11/06/2016	30/01/2017	Sunny humid hot still	19.7	31.2	5 - 8	South	Tallowwood	22	Open Forest - Blackbutt	N	No	N	No	No	No	No	Original material in box.	0959	496649	6609338
F	C4.1	11/06/2016	30/01/2017	Sunny humid hot still	19.7	31.2	8 - 10	South	Tallowwood	25	Open Forest - Blackbutt	N	No	N	No	No	No	No	Box empty nothing inside.		496663	6609320
E	SG3.18	30/11/2014	30/01/2017	Sunny humid still	19.7	31.2	5 - 8	North	Tallowwood	22	Open Forest - Blackbutt	N	No	N	No	Insects	No	No	Small number of ants did not remove.	0947	496479	6608614
E	Po5.8	30/11/2014	30/01/2017	Sunny humid hot	19.7	31.2	5 - 8	South	See Comments	20	Moist Open Forest Flooded Gum	N	No	Y	Scratching	No	No	No	No drey but lots of scratches on top of box.	0955-0956	496259	6608217
E	C8.6	11/12/2016	30/01/2017	Sunny humid hot	19.7	31.2	5 - 8	North east	White Mahogany	25	Moist Open Forest - Flooded Gum	N	No	N	No	No	No	No	Original leaf material in box.	0953	496268	6608279
E	C3.8	11/12/2016	30/01/2017	Sunny humid still	19.7	31.2	5 - 8	East	Casuarina	20	Open Forest - Blackbutt	N	No	N	No	No	No	No	Original leaf material in box	Tbc	496288	6608309
D	SF1.7	30/11/2014	30/01/2017	Sunny humid light breeze	19.7	31.2	5 - 8	East	Blackbutt	30	Open Forest - Blackbutt	N	No	N	No	Spider web	No	No	Huntsman spider inside.	N/A	495407	6607000
D	C8.5	11/07/2016	30/01/2017	Sunny humid light breeze	19.7	31.2	5 - 8	South	Blackbutt	30	Open Forest - Blackbutt	N	No	N	No	See comment	No	No	Mud wasp nest removed.	N/A	495369	6606961
D	MB2.4	11/07/2016	30/01/2017	Sunny humid light breeze	19.7	31.2	5 - 8	East	Bloodwood	18	Open Forest - Blackbutt	N	No	N	No	No	No	No	Moved to new tree nearby	N/A	495377	6606934
D	C3.10	11/07/2016	30/01/2017	Sunny humid light breeze	19.7	31.2	5 - 8	East	Casuarina	13	Open Forest - Blackbutt	N	No	N	No	No	No	Yes	Supporting tree broken in storm re-hung box in tree holding MB2.4 moved MB2.4 to new smaller tree adjacent.	iPhone photo	495377	6606930
D	C4.5	11/07/2016	30/01/2017	Sunny humid light breeze	19.7	31.2	5 - 8	South east	Tallowwood	30	Open Forest - Blackbutt	N	No	N	No	No	No	No	No empty	0920	495465	6607081
D	C2.7	11/07/2016	30/01/2017	Sunny humid light breeze	19.7	31.2	5 - 8	East	Tallowwood	25	Open Forest - Blackbutt	N	No	N	No	No	No	No	Earthworks at time of inspection.	N/A	495470	6607086
D	PO5.18	30/11/2014	30/01/2017	Sunny warm light breeze	19.7	31.2	5 - 8	East	Blackbutt	30	Open Forest - Blackbutt	Y	Owlet Nightjar	Y	Owlet Nightjar present	No	No	No	Owlet nightjar visible inside box entry hole from the ground. Did not inspect box.	0921	495470	6607148
D	C8.4	11/07/2016	30/01/2017	Sunny hot light breeze	19.7	31.2	5 - 8	South east	Turpentine	16	Open Forest - Blackbutt	N	No	Y	Bird excrement in box.	No	No	No	Bird excrement in the box.	0927-0928	495528	6607229
D	C1.9	11/07/2016	30/01/2017	Sunny humid light breeze	19.7	31.2	5 - 8	South east	Turpentine	16	Open Forest - Blackbutt	Y	Sugar Glider	Y	Drey	No	No	No	Minimum of 3 x Sugar Gliders.	0924-0925	495524	6607228
D	SG3.11	30/11/2014	30/01/2017	Sunny hot light breeze	19.7	31.2	5 - 8	South east	Blackbutt	35	Open Forest - Blackbutt	Y	Sugar Glider	Y	Drey	No	No	No	Minimum of 2 x Sugar Gliders	0930-0932 check this	495547	6607265
D	SO6.2	30/11/2014	30/01/2017	Sunny hot light breeze	19.7	31.2	10 - 12	South east	Bloodwood	30	Open Forest - Blackbutt	N	No	Y	Drey	No	No	No	Old dry drey inside	0934	495540	6607280
D	Po5.3	30/11/2014	30/01/2017	Sunny hot light breeze	19.7	31.2	5 - 8	South east	Bloodwood	25	Open Forest - Blackbutt	N	No	Y	Drey	No	No	No	Dry drey present.	0938	495604	6607333
D	LG4.3	29/11/2014	30/01/2017	Sunny hot light breeze	19.7	31.2	8 - 10	East	See Comments	28	Open Forest - Blackbutt	N	No	N	No	No	No	No	N/A	0941	495613	6607394
D	C5.8	29/11/2014	30/01/2017	Sunny hot light breeze	19.7	31.2	5 - 8	South east	Turpentine	23	Open Forest - Blackbutt	N	No	Y	Drey	No	No	No	Empty drey, scratching at entry hole.	0944	495634	6607441
U	C3.7	11/07/2016	29/01/2017	Sunny and calm	20.5	30.2	5 - 8	South east	Blackbutt	30	Open Forest - Blackbutt	Y	Sugar Glider	Y	Drey	No	No	No	Minimum of 3 x Sugar Gliders. 1 adult male, a female and 1 juvenile visible.	0903	494815	6605915
U	P/L8.3	11/11/2014	29/01/2017	Sunny and calm	20.5	30.2	5 - 8	East	Blackbutt	35	Open Forest - Blackbutt	N	No	Y	Drey	No	Yes	No	N/A	0901	494804	6605885
U	SG3.5	29/11/2014	29/01/2017	Sunny and calm	20.5	30.2	5 - 8	South west	Blackbutt	25	Open Forest - Blackbutt	N	No	Y	Drey	No	No	No	Old drey material.	Tbc	494785	6605876
U	C5.2	29/11/2014	29/01/2017	Sunny and calm	20.5	30.2	5 - 8	East	Turpentine	20	Open Forest - Blackbutt	N	No	N	No	No	No	No	Original material in box.	0898	494800	6605875
U	MB2.11	29/11/2014	29/01/2017	Sunny and moderate breeze	20.5	30.2	5 - 8	South east	Turpentine	18	Open Forest - Blackbutt	N	No	N	No	No	No	No	Empty Box.	N/A	494792	6605863
U	LG4.4	29/11/2014	29/01/2017	Sunny and calm	20.5	30.2	8 - 10	South east	Blackbutt	35	Open Forest - Blackbutt	Y	Native bee hive	Y	Active native bee hive	No	No	No	Native bee hive present no bees observed - early in the morning.	0893	494775	6605856
U	Cockatoo 7.1	30/11/2014	29/01/2017	Sunny and calm	20.5	30.2	10 - 12	South east	Blackbutt	35	Open Forest - Blackbutt	N	No	Y	Feathers	Spider web	No	No	Termites on trunk near lid. Dead parrot, feathers and wing shape preserved.	0890	494755	6605824

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U	3.15	30/11/2014	29/01/2017	Sunny and calm	20.5	30.2	5 - 8	North east	Tallowwood	30	Open Forest - Blackbutt	N	No	Y	Drey	Spider web	No	No	N/A	0887	494750	6605817
U	MB2.7	30/11/2014	29/01/2017	Sunny and calm	20.5	30.2	5 - 8	South east	Tallowwood	25	Open Forest - Blackbutt	N	No	N	No	No	No	No	No box empty.	N/A	494766	6605815
U	C1.1	30/11/2014	29/01/2017	Sunny and calm	20.5	30.2	5 - 8	South east	Tallowwood	25	Open Forest - Blackbutt	N	No	Y	Drey	No	No	No	N/A	0885	494766	6605817
U	L/G 4.5	30/11/2014	25/01/2017	Overcast humid light breeze	23.5	33.1	5 - 8	East	Blackbutt	30	Open Forest - Blackbutt	Y	Sugar Glider	Y	Drey	No	No	No	New record fresh drey material recently placed for the first time. 3 x Sugar Gliders.	0710-0713	494749	6605782
U	Po5.14	30/11/2014	25/01/2017	Overcast humid light breeze	23.5	33.1	5 - 8	North west	Blackbutt	35	Open Forest - Blackbutt	N	No	Y	Fur and scratching	No	No	No	Scratching on box also. Leaves inside not typical of drey material.	0715-0717	494743	6605760
U	P/L8.7	30/11/2014	25/01/2017	Overcast humid light breeze	23.5	33.1	5 - 8	East	Blackbutt	18	Open Forest - Blackbutt	N	No	Y	Drey	Active European Bee hive	No	Yes	Active European bee hive - Cattle ear tags attached to entry of box. Occupied by gliders during last monitoring.	N/A	494736	6605739
U	SF1.12	30/11/2014	25/01/2017	Overcast humid light breeze	23.5	33.1	5 - 8	East	Tallowwood	25	Open Forest - Blackbutt	N	No	Y	Drey	No	No	No	Dry drey inside	0719	494726	6605715
U	SG3.8	30/11/2014	25/01/2017	Overcast humid no breeze	23.5	33.1	5 - 8	East	Tallowwood	30	Open Forest - Blackbutt	Y	Sugar Glider	Y	Drey	No	No	No	1 dead juvenile small glider very dry carcass.	0685 - 0690	494740	6605718
U	LG4.7	30/11/2014	25/01/2017	Overcast humid no breeze	23.5	33.1	8 - 10	South east	Tallowwood	35	Open Forest - Blackbutt	N	No	Y	Drey	Inactive European Bee hive	No	No	Started by not continued European bee hive. Dry drey present.	0724 - 0727	494703	6605653
U	C8.2	30/11/2014	25/01/2017	Overcast humid no breeze	23.5	33.1	5 - 8	South east	Blackbutt	35	Open Forest - Blackbutt	N	No	N	No	No	No	No	Original material placed in the box only.	N/A	494705	6605641
U	C3.11	12/07/2016	25/01/2017	Overcast humid no breeze	23.5	33.1	5 - 8	North east	Turpentine	18	Open Forest - Blackbutt	Y	Sugar Glider	Y	Drey	No	No	No	Minimum of 3 Sugar Gliders.	0733-0734	494663	6605631
U	Po5.7	30/11/2014	25/01/2017	Overcast humid no breeze	23.5	33.1	5 - 8	East	Tallowwood	35	Open Forest - Blackbutt	N	No	Y	Drey	No	No	No	Fresh drey material brought into box	0731	494691	6605660
U	C5.1	30/11/2014	25/01/2017	Overcast humid no breeze	23.5	33.1	5 - 8	North east	Turpentine	22	Open Forest - Blackbutt	N	No	N	No	No	No	No	Original material in box	0737	494677	6605595
T	SG3.14	29/11/2014	24/01/2017	Sunny hot light breeze			5 - 8	West	Tallowwood	22	Open Forest - Blackbutt	Y	Native bee hive	Y	Active native bee hive	No	No	No	Still active native bee hive, first recorded in August 2016.	N/a	494744	6605507
T	P/L8.10	29/11/2014	24/01/2017	Sunny hot light breeze			5 - 8	South west	Turpentine	18	Open Forest - Blackbutt	N	No	Y	Drey	No	No	No	Drey present.	Tbc	494733	6605511
T	LG4.8	29/11/2014	24/01/2017	Sunny hot light breeze			8 - 10	South	Blackbutt	20	Open Forest - Blackbutt	N	No	Y	Drey	Inactive European Bee hive	No	No	Dry drey present.	101-0651	494730	6605488
T	2.1	15/06/2016	25/01/2017	Overcast humid light cool breeze	23.5	33.1	5 - 8	South	Bloodwood	16	Open Forest - Blackbutt	N	No	N	No	No	Construction works in progress at time of monitoring.	No	Empty	N/A	494672	6605442
T	C5.9	15/06/2016	25/01/2017	Overcast humid light cool breeze	23.5	33.1	5 - 8	West	Blackbutt	18	Open Forest - Blackbutt	N	No	Y	Drey	No	Use previous comments	Yes	Moved box to south facing aspect	0694	494664	6605431
T	C3.3	15/07/2016	25/01/2017	Overcast humid light cool breeze	23.5	33.1	5 - 8	East	Turpentine	18	Open Forest - Blackbutt	N	No	Y	Drey	No	Not since install	No	Reasonably fresh dry drey material	0695	494655	6605389
T	C4.9	15/07/2016	25/01/2017	Overcast humid light cool breeze	23.5	33.1	5 - 8	South	Turpentine	23	Open Forest - Blackbutt	N	No	Y	Drey	No	No	No	Dry leaf inside	0698	494634	6605322
T	P/L8.4	30/11/2014	25/01/2017	Overcast humid light cool breeze	23.5	33.1	5 - 8	South	Bloodwood	20	Open Forest - Blackbutt	N	No	Y	Drey	Inactive European Bee hive	No	No	Deep dry drey in box.	0700-0701	494615	6605318
T	Po5.5	30/11/2014	25/01/2017	Overcast humid light cool breeze	23.5	33.1	5 - 8	East	White Mahogany	22	Swamp Forest Swamp Mahogany/ Paperbark EEC	N	No	Y	Drey	No	No	No	Huntsman inside	0703	494600	6605317
T	C1.3	15/07/2016	25/01/2017	Overcast humid light cool breeze	23.5	33.1	5 - 8	South	Swamp Mahogany	18	Swamp Forest Swamp Mahogany/ Paperbark EEC	N	No	Y	Drey	No	No	No	Deep dry drey inside.	0705	494611	6605257
T	C3.4	15/07/2016	25/01/2017	Overcast humid light cool breeze	23.5	33.1	5 - 8	East	Blackbutt	20	Open Forest - Blackbutt	Y	Sugar Glider	Y	Drey	No	No	No	Minimum of 2 x Sugar Gliders	0707-0708	494619	6605294
T	SG3.2	30/11/2014	24/01/2017	Sunny hot light breeze	17.7	28.5	2	North	Tallowwood	20	Open Forest - Blackbutt	N	No	Y	Drey	No	No	No	This box is only 2 m off the ground as relocated to this tree during basin clearing.	0655	494755	6605557

Nest Box Replacement Zone	Box Code	Date of Install	Date of Inspection	Weather Conditions	Min Temp	Max Temp	Box Height (m)	Box Aspect	Tree Species	Tree Height (m)	Surrounding Vegetation Type	Box Occupied	Species Present	Evidence of use by Fauna	Type of use by Fauna	Evidence of Pest Species	Changes to Surrounding Landscape	Maintenance Required	Comments	Image No.	Easting	Northing
																			Last time inspected this box contained 4 Sugar Gliders 2 adults and 2 juveniles.			
OC5	C1.5	15/06/2016	24/01/2017	Sunny warm light breeze	17.7	28.5	5 - 8	North east	Casuarina	15	Open Forest - Blackbutt	N	No	Y	Drey	No	No	No	N/A	0630	494351	6605047
OC5	C2.6	15/06/2016	24/01/2017	Sunny hot light breeze	17.7	28.5	5 - 8	East	White Mahogany	18	Open Forest - Blackbutt	Y	Sugar Glider	Y	Drey	No	No	No	3 x Sugar Gliders very little drey material in box	0633-0635	494365	6605000
OC5	C2.1	15/06/2016	24/01/2017	Sunny hot light light breeze	17.7	28.5	5 - 8	East	Turpentine	18	Open Forest - Blackbutt	N	No	Y	Drey	No	No	No	Only 6-7 leaves inside	0637	494364	6604984
OC5	C2.3	15/06/2016	24/01/2017	Sunny hot light breeze	17.7	28.5	5 - 8	North	Turpentine	22	Open Forest - Blackbutt	N	No	N	No	No	No	No	Box completely empty	N/A	494367	6604964
OC5	C2.5	16/06/2016	24/01/2017	Sunny hot light breeze	17.7	28.5	5 - 8	North east	Bloodwood	15	Open Forest - Blackbutt	N	No	N	No	No	No	No	Box empty.	N/A	494361	6604949
OC5	C1.10	16/06/2016	24/01/2017	Sunny hot light breeze	17.7	28.5	5 - 8	North	Bloodwood	15	Open Forest - Blackbutt	Y	Sugar Glider	Y	Drey	No	No	No	Min 3 x Gliders (alive) likely Sugar. Could not see their heads. Appears to be 1 dry glider carcass in corner of box, not removed.	0639-0642	494366	6604916
OC5	C3.5	16/06/2016			17.7	28.5	5 - 8	North east	Turpentine	13	Open Forest - Blackbutt	N	No	Y	Drey	No	No	No	N/A	0643	494378	6604909
S	C8.3	15/07/2016	23/01/2017	Sunny fine light breeze	18.8	27.4	5 - 8	East	Blackbutt	25	Moist Open Forest - White Mahogany/ Grey Gum	Y	Sugar Glider	Y	Drey	Insects	No	Yes	Interesting mud wasp nest removed. Minimum of 5 x mature Sugar Gliders	0574-0576	494350	6604355
S	Sg3.12	29/11/2014	24/01/2017	Sunny warm light breeze	17.7	28.5	5 - 8	West	Blackbutt	20	Open Forest - Blackbutt	N	No	Y	Drey	No	No	No	N/A	0620	494331	6604346
S	LG4.1	29/11/2014	24/01/2017	Overcast humid light cool breeze	17.7	28.5	8 - 10	North east	Blackbutt	25	Moist Open Forest - White Mahogany/ Grey Gum	N	No	N	No	Spider web	No	No	Box empty no evidence of use. Small spider webs present.	N/A	494337	6604315
S	P/L8.1	29/11/2014	23/01/2017	Sunny warm light breeze	18.8	27.4	5 - 8	East	Tallowwood	28	Moist Open Forest - White Mahogany/ Grey Gum	Y	Sugar Glider	Y	Drey	No	No	No	1 x Sugar Glider in drey.	0582	494342	6604258
S	SG3.1	29/11/2014	24/01/2017	Overcast humid cool breeze	17.7	28.5	5 - 8	South	White Mahogany	30	Moist Open Forest - White Mahogany/ Grey Gum	N	No	Y	Drey	No	No	No	No	0657	494333	6604235
S	Po5.17	29/11/2014	24/01/2017	Overcast humid light cool breeze	17.7	28.5	5 - 8	North	White Mahogany	28	Moist Open Forest - White Mahogany/ Grey Gum	Y	Common Brushtail Possum	Y	Drey	No	Yes clearing for NFRs	No	Brushtail possum occupied this box during winter monitoring event also.	0658-0659	494343	6604199
S	SG3.10 relocated	29/11/2014	24/01/2017	Overcast humid light cool breeze	17.7	28.5	5 - 8	South	Tallowwood	30	Moist Open Forest - White Mahogany/ Grey Gum	Y	Sugar Glider	Y	Drey	No	Yes clearing for NFRs	No	Min of 4 x Sugar Gliders. During pre-dawns surveys for NFRs clearing. 2 x Sugar Gliders were observed entering this box in October Clearing limit within 5 m of this tree.	0661-0662	494338	6604180
S	SF1.4	29/11/2014	24/01/2017	Overcast humid light cool breeze	17.7	28.5	5 - 8	North	Tallowwood	25	Moist Open Forest - White Mahogany/ Grey Gum	Y	Native bee hive	Y	Active native bee hive	No	Yes relocated for NFRs.	No	Contains an active native bee hive south facing entry hole. Native bees on other side of road salvaged during NFRs clearing also persisting well.	0665-0669	494313	6603990
S	P/L8.11	29/11/2014	24/01/2017	Overcast humid light cool breeze	17.7	28.5	5 - 8	South east	White Mahogany	25	Moist Open Forest - White Mahogany/ Grey Gum	N	No	Y	Drey	No	No	No	Old drey present	0671	494316	6604003
S	Sg3.3	30/11/2014	24/01/2017	Overcast humid light cool breeze	17.7	28.5	5 - 8	East	White Mahogany	30	Moist Open Forest - White Mahogany/ Grey Gum	N	No	Y	Drey	No	No	No	No fauna present in drey	0672	494317	6604020
S	Sg3.4	16/11/2014	24/01/2017	Overcast humid light cool breeze	17.7	28.5	5 - 8	North	Tallowwood	25	Moist Open Forest - White Mahogany/ Grey Gum	N	No	Y	Scratching/ chewing and drey	Insects	No	Yes	Remove ants nest. Drey material and scratching on the box. Same as last monitoring. New drey material has been introduced since last monitoring. Also chewing around entry hole.	0674-0676	494321	6604041
S	MB2.8	16/11/2014	24/01/2017	Sunny warm light breeze	17.7	28.5	5 - 8	South west	Turpentine	15	Moist Open Forest - White Mahogany/ Grey Gum	N	No	N	No	No	No	No	No	N/A	494330	6604122
S	SF1.2	30/11/2014	24/01/2017	Overcast humid light cool breeze	17.7	28.5	8 - 10	South	White Mahogany	30	Moist Open Forest - White Mahogany/ Grey Gum	Y	Sugar Glider	Y	Chewings and drey	No	Yes clearing for NFRs	No	1 x Sugar Glider present in box sitting on top of 1 x dry skeleton of likely Sugar Glider. Fur, skull and shoulder section in corner of box, spine, pelvis and tail bones still in box. Fur and skull section removed from box.	0677-0690	494331	6604135
S	Mb2.5	16/11/2014	24/01/2017	Overcast humid light cool breeze	17.7	28.5	5 - 8	East	Tallowwood	25	Moist Open Forest - White Mahogany/ Grey Gum	N	No	N	No	Spider web	Nfrs over road	No	No	N/A	494328	6604164
S	C4.4	16/07/2016	24/01/2017	Overcast humid light cool breeze	17.7	28.5	5 - 8	South east	Tallowwood	25	Moist Open Forest - White Mahogany/ Grey Gum	N	No	N	See comments	No	Nfrs over road	No	Original material in box.	0691	494326	6604196
S	Po5.10	30/11/2014	23/01/2017	Sunny warm light breeze	18.8	27.4	5 - 8	North west	Blackbutt	25	Moist Open Forest - White Mahogany/	Y	Common Brushtail	Y	1 bird feather in box. No drey	No	No	No	Common brushtail possum present.	0577-0579	494363	6604313

Nest Box Replacement Zone	Box Code	Date of Install	Date of Inspection	Weather Conditions	Min Temp	Max Temp	Box Height (m)	Box Aspect	Tree Species	Tree Height (m)	Surrounding Vegetation Type	Box Occupied	Species Present	Evidence of use by Fauna	Type of use by Fauna	Evidence of Pest Species	Changes to Surrounding Landscape	Maintenance Required	Comments	Image No.	Easting	Northing
											Grey Gum		Possum		material.							
S	Mb2.10	16/11/2014	23/01/2017	Sunny warm light breeze	18.8	27.4	5 - 8	North	Tallowwood	25	Moist Open Forest - White Mahogany/ Grey Gum	N	No	N	No	No	No	No	No evidence of use.	0581	494354	6604286
S	C3.12	16/08/2016	24/01/2017	Sunny warm light breeze	17.7	28.5	5 - 8	South	Tallowwood	18	Moist Open Forest - White Mahogany/ Grey Gum	N	No	Y	Drey	No	No	No	N/A	0621	494316	6604201
S	So6.1	30/11/2014	24/01/2017	Sunny warm light breeze	17.7	28.5	10 - 12	North west	Tallowwood	30	Moist Open Forest - White Mahogany/ Grey Gum	N	No	N	No	Active European Bee hive	No	No	Active European bee hive still present. Cattle ear tags installed in December 2016 have not been effective.	N/A	494314	6604203
S	C5.6	16/07/2016	24/01/2017	Sunny warm light breeze	17.7	28.5	5 - 8	South east	Tallowwood	25	Moist Open Forest - White Mahogany/ Grey Gum	N	No	Y	Chewings around lid and Scat on lid.	No	No	No	Scat on lid and chewing around box opening. No drey inside.	0623-0626	494325	6604137
S	Mb2.12	16/11/2016	24/01/2017	Sunny warm light breeze	17.7	28.5	5 - 8	North west	Turpentine	18	Moist Open Forest - White Mahogany/ Grey Gum	N	No	N	No	No	Yes clearing for NFRs	No	N/A	N/A	494325	6604064
S	LG4.6	16/11/2016	23/01/2017	Sunny warm light breeze	18.8	27.4	8 - 10	South east	Tallowwood	35	Moist Open Forest - White Mahogany/ Grey Gum	N	No	Y	Drey	No	Yes clearing for NFRs	No	N/A	101-0584	494336	6604005
S	Mb2.3	16/11/2014	23/01/2017	Sunny fine light breeze	18.8	27.4	5 - 8	North east	Tallowwood	25	Moist Open Forest - White Mahogany/ Grey Gum	N	No	N	No	No	Yes clearing for NFRs	No	N/A	Yes tbc	494340	6603983
S	Sg3.9	30/11/2014	23/01/2017	Sunny warm light breeze	18.8	27.4	5 - 8	East	Tallowwood	25	Moist Open Forest - White Mahogany/ Grey Gum	Y	Sugar Glider	Y	Drey	No	Yes clearing for NFRs	Yes	1 x dead Sugar Glider very dry carcass. Removed carcass and drey material box now empty.	0591-0592	494325	6603917
S	Lg4.2	16/06/2016	23/01/2017	Sunny warm light breeze	18.8	27.4	8 - 10	West	Bloodwood	25	Moist Open Forest - White Mahogany/ Grey Gum	N	No	N	No	Active European Bee hive	Yes clearing for NFRs	Yes	Active European bee hive present. Ear tags installed.	N/A	494337	6603901
S	C3.9	16/07/2016	23/01/2017	Sunny warm light breeze	18.8	27.4	5 - 8	North	White Mahogany	20	Moist Open Forest - White Mahogany/ Grey Gum	Y	Sugar Glider	Y	Drey	No	Yes clearing for NFRs	No	Hollow also present in tree directly above nest box. Ringtail Possum observed exiting hollow at time of inspection. Minimum of 7 x Sugar Gliders in nest box.	0593-0603	494328	6603870
S	LG4.14	16/11/2016	23/01/2017	Sunny warm light breeze	18.8	27.4	5 - 8	North east	Grey Gum	35	Moist Open Forest - White Mahogany/ Grey Gum	N	No	Y	Drey	Inactive European Bee hive	Yes clearing for NFRs	No	Abandoned European bee hive. Hive not active. Older drey material present. No maintenance required.	0604-0606	494325	6603868
S	Po5.13	29/11/2014	23/01/2017	Sunny warm light breeze	18.8	27.4	5 - 8	East	Tallowwood	25	Moist Open Forest - White Mahogany/ Grey Gum	N	No	Y	Previous record of possum and drey.	No	Yes clearing for NFRs	No	Last monitoring had drey material and emptied box holding water. Possum recorded in this box before relocating for NFR clearing footprint.	0607	494318	6603797

Appendix E

Roadkill Monitoring Reports and Field Sheets

WC2NH Road Kill Monitoring – 1st March 2016 – 31st May 2016

Road kill monitoring has been undertaken daily throughout construction as per Appendix A of the Ecological Monitoring Program Procedure. This report captures from 1st March 2016 through to the 31st of May 2016. Field sheets from this period are attached in Appendix A.

Non-EPBC Species Road Kill

During monitoring, 1 road kill was identified. 1 Pretty-Faced Wallaby *(Macropus Parryi)* was identified on 3rd May 2016 along Old Coast Road at approximate chainage 60.900.

EPBC Species Road Kill

No EPBC species has been found during this monitoring period.

Road kill monitoring results to date are summarized in Figure 1 below.

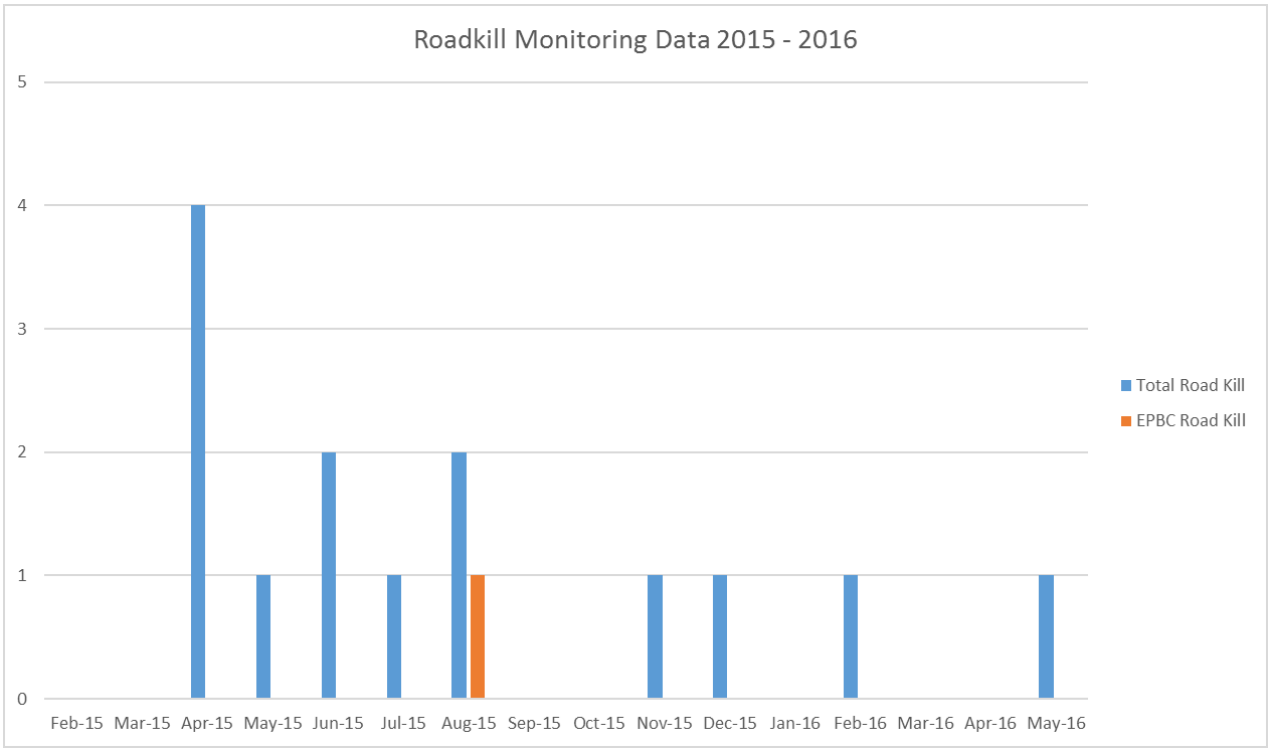


Figure 1 – WC2NH roadkill monitoring data to date including the last quarter 1st March - 31st May 2016

WC2NH Road Kill Monitoring Program
Data Recording Sheets

WC2NH Road Kill Monitoring Program

Data Recording Sheet

Observers: MAR + STEVE		
Date: 30/05/16 - 3/06/16		**Time:** 0700 - 1000
Location:	**Chainage:** See below	**GPS:**
Species:		
Photos (circle): *Yes / No*		**Photos sent to Ecologist** (circle): *Yes / No*
Ecologist Species Identification:		
Is it an EPBC Act Threatened Species (i.e. koala or s-t quoll)? (circle) *Yes / No*		
If the animal is an EPBC Act Thr. Sp., record the following information if possible:		
Temperature:	**Rainfall** (last 24hrs):	**Moon Phase:**
Sex (circle): *male / female*		**Age Class** (circle): *adult / juvenile*
Pouch Young/Back Young:		
Comments: PAC + ALBERT + ROSEWOOD + SCOTTS + B/HILL + GUMMA + CL + NURSERY MON 30 TUE 31 WED 1st THURS 2nd FRI 3rd NIL nil nil nil nil		

Observers:		
Date:		**Time:**
Location:	**Chainage:**	**GPS:**
Species:		
Photos (circle): *Yes / No*		**Photos sent to Ecologist** (circle): *Yes / No*
Ecologist Species Identification:		
Is it an EPBC Act Threatened Species (i.e. koala or s-t quoll)? (circle) *Yes / No*		
If the animal is an EPBC Act Thr. Sp., record the following information if possible:		
Temperature:	**Rainfall** (last 24hrs):	**Moon Phase:**
Sex (circle): *male / female*		**Age Class** (circle): *adult / juvenile*
Pouch Young/Back Young:		
Comments:		

WC2NH Road Kill Monitoring Program

Data Recording Sheet

Observers: MAL + STEVE + ANDREW		
Date: 23 – 27/05/16		**Time:** 0700 – 1000
Location:	**Chainage:** See below	**GPS:**
Species:		
Photos (circle): *Yes / No*		**Photos sent to Ecologist** (circle): *Yes / No*
Ecologist Species Identification:		
Is it an EPBC Act Threatened Species (i.e. koala or s-t quoll)? (circle) *Yes / No*		
If the animal is an EPBC Act Thr. Sp., record the following information if possible:		
Temperature:	**Rainfall** (last 24hrs):	**Moon Phase:**
Sex (circle): *male / female*		**Age Class** (circle): *adult / juvenile*
Pouch Young/Back Young:		
Comments: PAC + ALBERT + ROSEWOOD + SCOTTS + BILL + GUMMA + OC + NURSERY MON 23 TUE 24 WED 25 THUR 26 FRI 27 NIL NIL NIL NIL NIL		

Observers:		
Date:		**Time:**
Location:	**Chainage:**	**GPS:**
Species:		
Photos (circle): *Yes / No*		**Photos sent to Ecologist** (circle): *Yes / No*
Ecologist Species Identification:		
Is it an EPBC Act Threatened Species (i.e. koala or s-t quoll)? (circle) *Yes / No*		
If the animal is an EPBC Act Thr. Sp., record the following information if possible:		
Temperature:	**Rainfall** (last 24hrs):	**Moon Phase:**
Sex (circle): *male / female*		**Age Class** (circle): *adult / juvenile*
Pouch Young/Back Young:		
Comments:		

WC2NH Road Kill Monitoring Program

Data Recording Sheet

Observers: MAL + STEVE + ANDREW		
Date: 16 - 20/06/16		**Time:** 0700 - 1000
Location:	**Chainage:** See below.	**GPS:**
Species:		
Photos (circle): *Yes / No*		**Photos sent to Ecologist** (circle): *Yes / No*
Ecologist Species Identification:		
Is it an EPBC Act Threatened Species (i.e. koala or s-t quoll)? (circle) *Yes / No*		
If the animal is an EPBC Act Thr. Sp., record the following information if possible:		
Temperature:	**Rainfall** (last 24hrs):	**Moon Phase:**
Sex (circle): *male / female*		**Age Class** (circle): *adult / juvenile*
Pouch Young/Back Young:		
Comments: PAC + ALBERT + ROSEWOOD + SCOTTS + BLACK + GUMMA + OC + NURSEY MON 16 TUE 17 WED 18 THUR 19 FRI 20 NIL NIL NIL NIL NIL		

Observers:		
Date:		**Time:**
Location:	**Chainage:**	**GPS:**
Species:		
Photos (circle): *Yes / No*		**Photos sent to Ecologist** (circle): *Yes / No*
Ecologist Species Identification:		
Is it an EPBC Act Threatened Species (i.e. koala or s-t quoll)? (circle) *Yes / No*		
If the animal is an EPBC Act Thr. Sp., record the following information if possible:		
Temperature:	**Rainfall** (last 24hrs):	**Moon Phase:**
Sex (circle): *male / female*		**Age Class** (circle): *adult / juvenile*
Pouch Young/Back Young:		
Comments:		

WC2NH Road Kill Monitoring Program

Data Recording Sheet

Observers: Mal + Steve		
Date: 09-13/05/16		**Time:** 0700 - 1000 DAILY.
Location:	**Chainage:** See Below.	**GPS:**
Species:		
Photos (circle): *Yes / No*		**Photos sent to Ecologist** (circle): *Yes / No*
Ecologist Species Identification:		
Is it an EPBC Act Threatened Species (i.e. koala or s-t quoll)? (circle) *Yes / No*		
If the animal is an EPBC Act Thr. Sp., record the following information if possible:		
Temperature:	**Rainfall** (last 24hrs):	**Moon Phase:**
Sex (circle): *male / female*		**Age Class** (circle): *adult / juvenile*
Pouch Young/Back Young:		
Comments: Pac - Albert - Rosewood - Scotts - B/Hill - Gumma - OC - Nursery. MON 09 NIL; TUES 10 NIL; WED 11 NIL; THURS 12 NIL; FRI 13 NIL.		

Observers:		
Date:		**Time:**
Location:	**Chainage:**	**GPS:**
Species:		
Photos (circle): *Yes / No*		**Photos sent to Ecologist** (circle): *Yes / No*
Ecologist Species Identification:		
Is it an EPBC Act Threatened Species (i.e. koala or s-t quoll)? (circle) *Yes / No*		
If the animal is an EPBC Act Thr. Sp., record the following information if possible:		
Temperature:	**Rainfall** (last 24hrs):	**Moon Phase:**
Sex (circle): *male / female*		**Age Class** (circle): *adult / juvenile*
Pouch Young/Back Young:		
Comments:		

WC2NH Road Kill Monitoring Program

Data Recording Sheet

Observers: Mal + Steve			
Date: 25 - 29/04/16		Time: 0700 - 1000 Daily	
Location:	Chainage: See Below	GPS:	
Species:			
Photos (circle): *Yes / No*		Photos sent to Ecologist (circle): *Yes / No*	
Ecologist Species Identification:			
Is it an EPBC Act Threatened Species (i.e. koala or s-t quoll)? (circle) *Yes / No*			
If the animal is an EPBC Act Thr. Sp., record the following information if possible:			
Temperature:	Rainfall (last 24hrs):		Moon Phase:
Sex (circle): *male / female*		Age Class (circle): *adult / juvenile*	
Pouch Young/Back Young:			
Comments: PAC, Albert, Rosewood - Scotts - B/Hill - Gumma - OC - Nursery Mon 25 NIL; Tues 26 NIL; Wed 27 NIL; Thurs 28 NIL; Fri 29 NIL			

Observers: Mal + Steve			
Date: 02/05 - 06/05/16		Time: 0700 - 1000 Daily	
Location:	Chainage: See below	GPS:	
Species:			
Photos (circle): *Yes / No*		Photos sent to Ecologist (circle): *Yes / No*	
Ecologist Species Identification:			
Is it an EPBC Act Threatened Species (i.e. koala or s-t quoll)? (circle) *Yes / No*			
If the animal is an EPBC Act Thr. Sp., record the following information if possible:			
Temperature:	Rainfall (last 24hrs):		Moon Phase:
Sex (circle): *male / female*		Age Class (circle): *adult / juvenile*	
Pouch Young/Back Young:			
Comments: As Above Locations Mon 02/05 NIL; Tue 03 1x wallaby ~~NIL~~ OC Rd 0c 18; Wed 04 NIL; Thurs 05 NIL; Fri 06 NIL			

WC2NH Road Kill Monitoring Program

Data Recording Sheet

Observers: ANDREW & STEVE		
Date: 11/4/16 - 15/4/16		**Time:** 0700 - 1000
Location:	**Chainage:** see below	**GPS:**
Species:		
Photos (circle): *Yes / No*		**Photos sent to Ecologist** (circle): *Yes / No*
Ecologist Species Identification:		
Is it an EPBC Act Threatened Species (i.e. koala or s-t quoll)? (circle) *Yes / No*		
If the animal is an EPBC Act Thr. Sp., record the following information if possible:		
Temperature:	**Rainfall** (last 24hrs):	**Moon Phase:**
Sex (circle): *male / female*		**Age Class** (circle): *adult / juvenile*
Pouch Young/Back Young:		
Comments: Pac - Albert - Rosewood - Scotts - Bithill - Gumma - OC - Nursey MON 11 TUES 12 WED 13 THURS 14 FRI 15 NIL NIL NIL NIL NIL		

Observers: 18/04/16 - 22/04/16 Mal + Steve		
Date: ✓		**Time:** 0700 - 1000
Location:	**Chainage:** All Site	**GPS:**
Species:		
Photos (circle): *Yes / No*		**Photos sent to Ecologist** (circle): *Yes / No*
Ecologist Species Identification:		
Is it an EPBC Act Threatened Species (i.e. koala or s-t quoll)? (circle) *Yes / No*		
If the animal is an EPBC Act Thr. Sp., record the following information if possible:		
Temperature:	**Rainfall** (last 24hrs):	**Moon Phase:**
Sex (circle): *male / female*		**Age Class** (circle): *adult / juvenile*
Pouch Young/Back Young:		
Comments: As above locations. Mon 18 Tue 19 Wed 20 Thurs 21 Fri 22 NIL NIL NIL NIL NIL		

WC2NH Road Kill Monitoring Program

Data Recording Sheet

Observers: Andrew & STEVE		
Date: 04/04/16 - 08/04/16		**Time:** 0700 - 1000
Location:	**Chainage:** See below	**GPS:**
Species:		
Photos (circle): *Yes / No*		**Photos sent to Ecologist** (circle): *Yes / No*
Ecologist Species Identification:		
Is it an EPBC Act Threatened Species (i.e. koala or s-t quoll)? (circle) *Yes / No*		
If the animal is an EPBC Act Thr. Sp., record the following information if possible:		
Temperature:	**Rainfall** (last 24hrs):	**Moon Phase:**
Sex (circle): *male / female*		**Age Class** (circle): *adult / juvenile*
Pouch Young/Back Young:		
Comments: Pac - Albert - Rosewood - Scotts - B/Hill - Gunnm-OC - Nusey Mon 04 TUES 05 WED 06 THURS 07 FRI 08 NIL NIL. NIL NIL. NIL.		

Observers:		
Date:		**Time:**
Location:	**Chainage:**	**GPS:**
Species:		
Photos (circle): *Yes / No*		**Photos sent to Ecologist** (circle): *Yes / No*
Ecologist Species Identification:		
Is it an EPBC Act Threatened Species (i.e. koala or s-t quoll)? (circle) *Yes / No*		
If the animal is an EPBC Act Thr. Sp., record the following information if possible:		
Temperature:	**Rainfall** (last 24hrs):	**Moon Phase:**
Sex (circle): *male / female*		**Age Class** (circle): *adult / juvenile*
Pouch Young/Back Young:		
Comments:		

WC2NH Road Kill Monitoring Program

Data Recording Sheet

Observers: ANDREW + STEVE		
Date: 28/05/16 - 01/04/16		**Time:** 0700 - 1000 DAILY
Location:	**Chainage:** SEE BELOW	**GPS:**
Species:		
Photos (circle): *Yes / No*		**Photos sent to Ecologist** (circle): *Yes / No*
Ecologist Species Identification:		
Is it an EPBC Act Threatened Species (i.e. koala or s-t quoll)? (circle) *Yes / No*		
If the animal is an EPBC Act Thr. Sp., record the following information if possible:		
Temperature:	**Rainfall** (last 24hrs):	**Moon Phase:**
Sex (circle): *male / female*		**Age Class** (circle): *adult / juvenile*
Pouch Young/Back Young:		
Comments: Pac - Albert - Rosewood - Scotts - B/Hill - Gumming - Ocnl - Nursey Mon 28/3 tue Wed Thurs Fri 01/04 NIL NIL. NIL. NIL. NIL.		

Observers:		
Date:		**Time:**
Location:	**Chainage:**	**GPS:**
Species:		
Photos (circle): *Yes / No*		**Photos sent to Ecologist** (circle): *Yes / No*
Ecologist Species Identification:		
Is it an EPBC Act Threatened Species (i.e. koala or s-t quoll)? (circle) *Yes / No*		
If the animal is an EPBC Act Thr. Sp., record the following information if possible:		
Temperature:	**Rainfall** (last 24hrs):	**Moon Phase:**
Sex (circle): *male / female*		**Age Class** (circle): *adult / juvenile*
Pouch Young/Back Young:		
Comments:		

WC2NH Road Kill Monitoring Program

Data Recording Sheet

Observers: Mal + Steve		
Date: 21/03/16 – 25/03/16		**Time:** 0700 – 1000 DAILY
Location:	**Chainage:** See Below	**GPS:**
Species:		
Photos (circle): *Yes / No*		**Photos sent to Ecologist** (circle): *Yes / No*
Ecologist Species Identification:		
Is it an EPBC Act Threatened Species (i.e. koala or s-t quoll)? (circle) *Yes / No*		
If the animal is an EPBC Act Thr. Sp., record the following information if possible:		
Temperature:	**Rainfall** (last 24hrs):	**Moon Phase:**
Sex (circle): *male / female*		**Age Class** (circle): *adult / juvenile*
Pouch Young/Back Young:		
Comments: PAC – Albert – Rosewood – Scotts – B/Hill – Gumma – OCRd – Nursery Mon 21/03 Tue Wed Thur Fri 25/03/16 NIL NIL NIL NIL. —		

Observers:		
Date:		**Time:**
Location:	**Chainage:**	**GPS:**
Species:		
Photos (circle): *Yes / No*		**Photos sent to Ecologist** (circle): *Yes / No*
Ecologist Species Identification:		
Is it an EPBC Act Threatened Species (i.e. koala or s-t quoll)? (circle) *Yes / No*		
If the animal is an EPBC Act Thr. Sp., record the following information if possible:		
Temperature:	**Rainfall** (last 24hrs):	**Moon Phase:**
Sex (circle): *male / female*		**Age Class** (circle): *adult / juvenile*
Pouch Young/Back Young:		
Comments:		

WC2NH Road Kill Monitoring Program

Data Recording Sheet

Observers: Mal + Steve		
Date: 07/03/16 - 11/03/16		Time: 0700 - 1000 Daily
Location:	Chainage: See Below	GPS:
Species:		
Photos (circle): *Yes / No*		Photos sent to Ecologist (circle): *Yes / No*
Ecologist Species Identification:		
Is it an EPBC Act Threatened Species (i.e. koala or s-t quoll)? (circle) *Yes / No*		
If the animal is an EPBC Act Thr. Sp., record the following information if possible:		
Temperature:	Rainfall (last 24hrs):	Moon Phase:
Sex (circle): *male / female*		Age Class (circle): *adult / juvenile*
Pouch Young/Back Young:		
Comments: PAC - Albert - Rosewood - Scotts - B/W U - Gumma - Ocean Rd - Nursery Mon 07: Nil; Tue: Nil; Wed: Nil; Thurs: Nil; Fri 11/03/16: Nil		

Observers: Mal + Steve		
Date: 14/03/16 - 18/03/16		Time: 0700 - 1000 Daily
Location:	Chainage: See Below	GPS:
Species:		
Photos (circle): *Yes / No*		Photos sent to Ecologist (circle): *Yes / No*
Ecologist Species Identification:		
Is it an EPBC Act Threatened Species (i.e. koala or s-t quoll)? (circle) *Yes / No*		
If the animal is an EPBC Act Thr. Sp., record the following information if possible:		
Temperature:	Rainfall (last 24hrs):	Moon Phase:
Sex (circle): *male / female*		Age Class (circle): *adult / juvenile*
Pouch Young/Back Young:		
Comments: Mon 14/03: Nil; Tue: Nil; Wed: Nil; Thurs: Nil; Fri 18/03/16: Nil		

WC2NH Road Kill Monitoring Program

Data Recording Sheet

Observers: Mat + Steve		
Date: 22 - 26/02/16		**Time:** 0700 - 1000 DAILY.
Location:	**Chainage:** See Below.	**GPS:**
Species:		
Photos (circle): *Yes / No*		**Photos sent to Ecologist** (circle): *Yes / No*
Ecologist Species Identification:		
Is it an EPBC Act Threatened Species (i.e. koala or s-t quoll)? (circle) *Yes / No*		
If the animal is an EPBC Act Thr. Sp., record the following information if possible:		
Temperature:	**Rainfall** (last 24hrs):	**Moon Phase:**
Sex (circle): *male / female*		**Age Class** (circle): *adult / juvenile*
Pouch Young/Back Young:		
Comments: PAC-Albert-Rosewood-Scotts-B/Hill-Gumm-OCRd-Nursery.		

Mon 22	T23	W24	T25	F26
Nil	Nil	Nil	Nil	Nil

Observers: Mat + Steve		
Date: 29/02/16 - 04/03/16		**Time:** 0700 - 1000 DAILY.
Location:	**Chainage:** See Below	**GPS:**
Species:		
Photos (circle): *Yes / No*		**Photos sent to Ecologist** (circle): *Yes / No*
Ecologist Species Identification:		
Is it an EPBC Act Threatened Species (i.e. koala or s-t quoll)? (circle) *Yes / No*		
If the animal is an EPBC Act Thr. Sp., record the following information if possible:		
Temperature:	**Rainfall** (last 24hrs):	**Moon Phase:**
Sex (circle): *male / female*		**Age Class** (circle): *adult / juvenile*
Pouch Young/Back Young:		
Comments: PAC-Albert-Rosewood-Scotts-B/Hill-Gumm-OCRd-Nursery.		

Mon 29	T01/03	W02	T03	Fri 04
Nil	Nil	Nil	Nil	Nil

WC2NH Road Kill Monitoring – 1st June 2016 – 31st August 2016

Road kill monitoring has been undertaken daily, although only required weekly throughout construction as per Appendix A of the Ecological Monitoring Program Procedure. This report captures from 1st June 2016 through to the 31st of August 2016. Field sheets from this period are attached in Appendix A.

Non-EPBC Species Road Kill

During monitoring, 4 roadkill were identified. 1 Eastern Grey Kangaroo (*Macropus giganteus*) was identified on the 20th of July 2016 along the existing Pacific Highway at approximate chainage 49400. 1 Black Flying Fox was identified on the 26th of July 2016 along the existing Pacific Highway at approximate chainage 45000. 1 additional Eastern Grey Kangaroo was identified on the 15th of August 2016 along Old Coast Road, approximate chainage 54700. 1 European Hare (*Lepus europaeus*) was identified on the 15th August 2016 along Local Access Road E (Mattick Rd), at approximate chainage 54900.

EPBC Species Road Kill

No EPBC Species were identified during this monitoring period.

Road kill monitoring results to date are summarised in Figure 1.

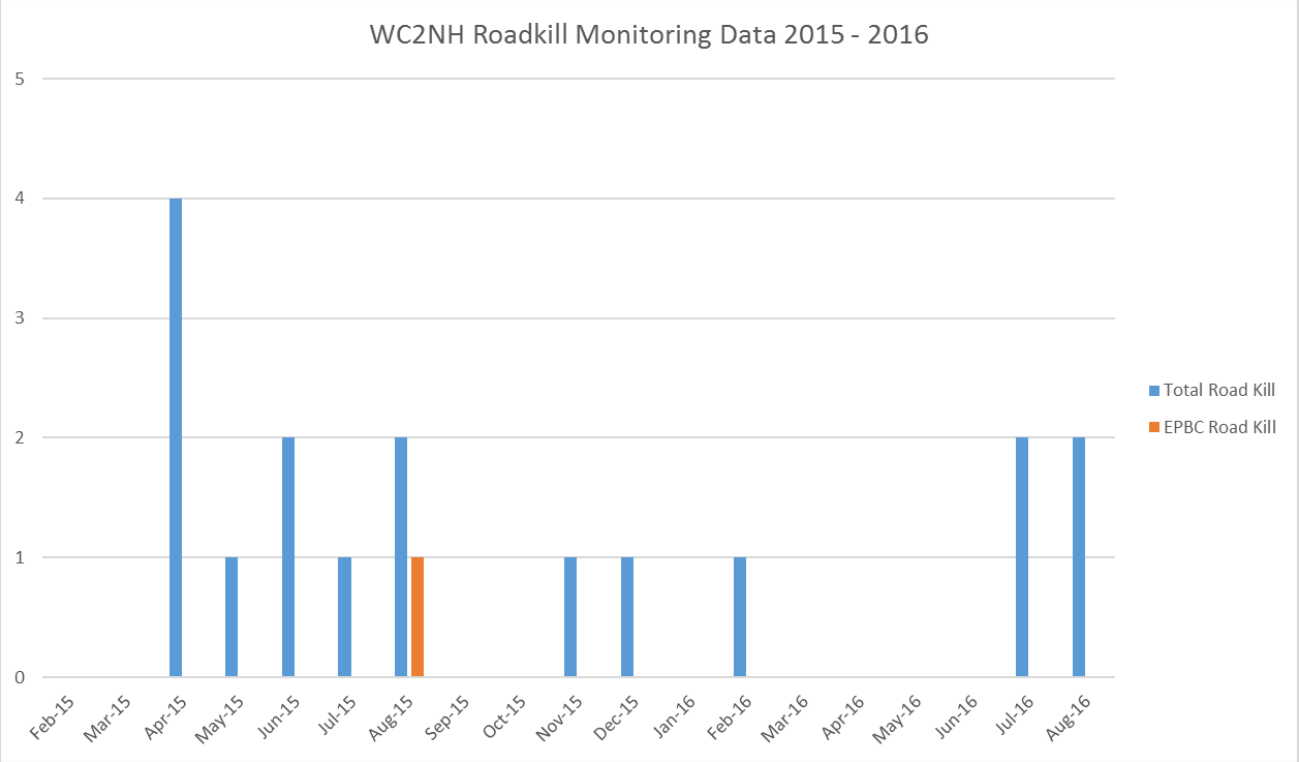


Figure 1 – WC2NH roadkill monitoring results for 2015-2016

Appendix A – Roadkill Monitoring Field Sheets June to August 2016

WC2NH Road Kill Monitoring Program

Data Recording Sheet

Observers: Mal & Steve		
Date: 29/08 - 02/09.		**Time:** 0700 - 1000
Location:	**Chainage:** See below.	**GPS:**
Species:		
Photos (circle): *Yes / No*		**Photos sent to Ecologist** (circle): *Yes / No*
Ecologist Species Identification:		
Is it an EPBC Act Threatened Species (i.e. koala or s-t quoll)? (circle) *Yes / No*		
If the animal is an EPBC Act Thr. Sp., record the following information if possible:		
Temperature:	**Rainfall** (last 24hrs):	**Moon Phase:**
Sex (circle): *male / female*		**Age Class** (circle): *adult / juvenile*
Pouch Young/Back Young:		
Comments: PAC + ALBERT + SCOTTS + B/HILL + GUMMA + OC +		

29/8 MON	TUE 30/8	WED 31/8	THURS 1/9	FRI 2/9.
nil.	nil	nil	nil	nil

Observers:		
Date:		**Time:**
Location:	**Chainage:**	**GPS:**
Species:		
Photos (circle): *Yes / No*		**Photos sent to Ecologist** (circle): *Yes / No*
Ecologist Species Identification:		
Is it an EPBC Act Threatened Species (i.e. koala or s-t quoll)? (circle) *Yes / No*		
If the animal is an EPBC Act Thr. Sp., record the following information if possible:		
Temperature:	**Rainfall** (last 24hrs):	**Moon Phase:**
Sex (circle): *male / female*		**Age Class** (circle): *adult / juvenile*
Pouch Young/Back Young:		
Comments:		

Observers: MAL & STEVE			
Date: 22 - 26/08		Time: 0700 - 1000	
Location:	Chainage: See Below.	GPS:	
Species:			
Photos (circle): *Yes / No*		Photos sent to Ecologist (circle): *Yes / No*	
Ecologist Species Identification:			
Is it an EPBC Act Threatened Species (i.e. koala or s-t quoll)? (circle) *Yes / No*			
If the animal is an EPBC Act Thr. Sp., record the following information if possible:			
Temperature:	Rainfall (last 24hrs):		Moon Phase:
Sex (circle): *male / female*		Age Class (circle): *adult / juvenile*	
Pouch Young/Back Young:			
Comments: PAC + ALBERT + SCOTTS + B/HILL + GUMMA + OC + NURSEY MON 22/08: 1x kangaroo sthbound edge @ pacific hwy browns. TUE 23/08: nil WED 24/08: nil THURS 25/08: nil FRI 26/08: nil.			

Observers:			
Date:		Time:	
Location:	Chainage:	GPS:	
Species:			
Photos (circle): *Yes / No*		Photos sent to Ecologist (circle): *Yes / No*	
Ecologist Species Identification:			
Is it an EPBC Act Threatened Species (i.e. koala or s-t quoll)? (circle) *Yes / No*			
If the animal is an EPBC Act Thr. Sp., record the following information if possible:			
Temperature:	Rainfall (last 24hrs):		Moon Phase:
Sex (circle): *male / female*		Age Class (circle): *adult / juvenile*	
Pouch Young/Back Young:			
Comments:			

WC2NH Road Kill Monitoring Program

Data Recording Sheet

Observers: Mal & Steve		
Date: 15-19/08		**Time:** 0700-1000
Location:	**Chainage:** See below	**GPS:**
Species:		
Photos (circle): *Yes / No*		**Photos sent to Ecologist** (circle): *Yes / No*
Ecologist Species Identification:		
Is it an EPBC Act Threatened Species (i.e. koala or s-t quoll)? (circle) *Yes / No*		
If the animal is an EPBC Act Thr. Sp., record the following information if possible:		
Temperature:	**Rainfall** (last 24hrs):	**Moon Phase:**
Sex (circle): *male / female*		**Age Class** (circle): *adult / juvenile*
Pouch Young/Back Young:		
Comments: PAC + ALBERT + SCOTTS + B/HILL + GUMMA + OC + NURSEY MON 15/08: 1x kangaroo + Have on old coastal and LRE TUE 16/08: nil WED 17/08: nil THUR 18/08: nil FRI 19/08: nil		

Observers:		
Date:		**Time:**
Location:	**Chainage:**	**GPS:**
Species:		
Photos (circle): *Yes / No*		**Photos sent to Ecologist** (circle): *Yes / No*
Ecologist Species Identification:		
Is it an EPBC Act Threatened Species (i.e. koala or s-t quoll)? (circle) *Yes / No*		
If the animal is an EPBC Act Thr. Sp., record the following information if possible:		
Temperature:	**Rainfall** (last 24hrs):	**Moon Phase:**
Sex (circle): *male / female*		**Age Class** (circle): *adult / juvenile*
Pouch Young/Back Young:		
Comments:		

WC2NH Road Kill Monitoring Program

Data Recording Sheet

Observers: Mal & Steve		
Date: 08-12/08		**Time:** 0700-1000
Location:	**Chainage:** See below	**GPS:**
Species:		
Photos (circle): *Yes / No*		**Photos sent to Ecologist** (circle): *Yes / No*
Ecologist Species Identification:		
Is it an EPBC Act Threatened Species (i.e. koala or s-t quoll)? (circle) *Yes / No*		
If the animal is an EPBC Act Thr. Sp., record the following information if possible:		
Temperature:	**Rainfall** (last 24hrs):	**Moon Phase:**
Sex (circle): *male / female*		**Age Class** (circle): *adult / juvenile*
Pouch Young/Back Young:		
Comments: Pact Albert + Scotts + B/Hill + Gumma + OC + Nursey Mon 08/08 nil; Tue 09/08 nil; Wed 10/08 nil; Thur 11/08 nil; Fri 12/08 nil		

Observers:		
Date:		**Time:**
Location:	**Chainage:**	**GPS:**
Species:		
Photos (circle): *Yes / No*		**Photos sent to Ecologist** (circle): *Yes / No*
Ecologist Species Identification:		
Is it an EPBC Act Threatened Species (i.e. koala or s-t quoll)? (circle) *Yes / No*		
If the animal is an EPBC Act Thr. Sp., record the following information if possible:		
Temperature:	**Rainfall** (last 24hrs):	**Moon Phase:**
Sex (circle): *male / female*		**Age Class** (circle): *adult / juvenile*
Pouch Young/Back Young:		
Comments:		

WC2NH Road Kill Monitoring Program

Data Recording Sheet

Observers: Mal & Steve		
Date: 01-05/08/16		**Time:** 0700 – 1000 daily
Location:	**Chainage:** See below.	**GPS:**
Species:		
Photos (circle): *Yes / No*		**Photos sent to Ecologist** (circle): *Yes / No*
Ecologist Species Identification:		
Is it an EPBC Act Threatened Species (i.e. koala or s-t quoll)? (circle) *Yes / No*		
If the animal is an EPBC Act Thr. Sp., record the following information if possible:		
Temperature:	**Rainfall** (last 24hrs):	**Moon Phase:**
Sex (circle): *male / female*		**Age Class** (circle): *adult / juvenile*
Pouch Young/Back Young:		
Comments: Pac + Albert + Scotts + B/Hill + Gumma + OC + Nursey Mon 01/08 nil; Tues 02/08 nil; Wed 03/08 nil.; Thurs 04/08 nil; Fri 05/08 nil		

Observers:		
Date:		**Time:**
Location:	**Chainage:**	**GPS:**
Species:		
Photos (circle): *Yes / No*		**Photos sent to Ecologist** (circle): *Yes / No*
Ecologist Species Identification:		
Is it an EPBC Act Threatened Species (i.e. koala or s-t quoll)? (circle) *Yes / No*		
If the animal is an EPBC Act Thr. Sp., record the following information if possible:		
Temperature:	**Rainfall** (last 24hrs):	**Moon Phase:**
Sex (circle): *male / female*		**Age Class** (circle): *adult / juvenile*
Pouch Young/Back Young:		
Comments:		

WC2NH Road Kill Monitoring Program

Data Recording Sheet

Observers: Mal & Steve.	
Date: 18-22/07/16	**Time:** 0700-1000 daily
Location: **Chainage:** see below	**GPS:**
Species:	
Photos (circle): *Yes / No*	**Photos sent to Ecologist** (circle): *Yes / No*
Ecologist Species Identification:	
Is it an EPBC Act Threatened Species (i.e. koala or s-t quoll)? (circle) *Yes / No*	
If the animal is an EPBC Act Thr. Sp., record the following information if possible:	
Temperature: **Rainfall** (last 24hrs):	**Moon Phase:**
Sex (circle): *male / female*	**Age Class** (circle): *adult / juvenile*
Pouch Young/Back Young:	

Comments: Pac + Albert + Rosewood + Scotts + B/Hill + Gumma + OC + Nursey

Mon 18th	Tue 19th	Wed 20th	Thur 21st	Fri 22nd
nil	nil	dead kangaroo pacific hwy / baldhill.	nil	nil

Observers: Mal & Steve	
Date: 25-~~28~~ 29/7/2016	**Time:** 0700-1000
Location: **Chainage:** See below	**GPS:**
Species: Tuesday 26th bat? found north of albert drive sth pacific hwy placed in box in given to enviro	
Photos (circle): *Yes / No*	**Photos sent to Ecologist** (circle): *Yes / No*
Ecologist Species Identification:	
Is it an EPBC Act Threatened Species (i.e. koala or s-t quoll)? (circle) *Yes / No*	
If the animal is an EPBC Act Thr. Sp., record the following information if possible:	
Temperature: **Rainfall** (last 24hrs):	**Moon Phase:**
Sex (circle): *male / female*	**Age Class** (circle): *adult / juvenile*
Pouch Young/Back Young:	

Comments: Pac + Albert + Rosewood + Scotts + B/Hill + Gumma + OC + Nursery

Mon 25th	Tue 26th	Wed 27th	Thur 28th	Fri 29th
nil.	bat on hwy passed onto enviro about 200m nth of albert drive sth.	nil	nil	nil

WC2NH Road Kill Monitoring Program

Data Recording Sheet

Observers: Mal & Steve.		
Date: 11-15/07/16		**Time:** 0700 - 1000 daily.
Location:	**Chainage:** See below	**GPS:**
Species:		
Photos (circle): *Yes / No*		**Photos sent to Ecologist** (circle): *Yes / No*
Ecologist Species Identification:		
Is it an EPBC Act Threatened Species (i.e. koala or s-t quoll)? (circle) *Yes / No*		
If the animal is an EPBC Act Thr. Sp., record the following information if possible:		
Temperature:	**Rainfall** (last 24hrs):	**Moon Phase:**
Sex (circle): *male / female*		**Age Class** (circle): *adult / juvenile*
Pouch Young/Back Young:		
Comments: PAC + ALBERT + ROSEWOOD + SCOTTS + B/HILL + GUMMA + OC + NURSEY MON 11 TUE 12 WED 13 THUR 14 FRI 15 Nil nil nil nil nil		

Observers:		
Date:		**Time:**
Location:	**Chainage:**	**GPS:**
Species:		
Photos (circle): *Yes / No*		**Photos sent to Ecologist** (circle): *Yes / No*
Ecologist Species Identification:		
Is it an EPBC Act Threatened Species (i.e. koala or s-t quoll)? (circle) *Yes / No*		
If the animal is an EPBC Act Thr. Sp., record the following information if possible:		
Temperature:	**Rainfall** (last 24hrs):	**Moon Phase:**
Sex (circle): *male / female*		**Age Class** (circle): *adult / juvenile*
Pouch Young/Back Young:		
Comments:		

WC2NH Road Kill Monitoring Program

Data Recording Sheet

Observers: Mal, Steve & Andrew.		
Date: 04 – 08/07/16		**Time:** 0700 – 1000
Location:	**Chainage:** See below	**GPS:**
Species:		
Photos (circle): *Yes / No*		**Photos sent to Ecologist** (circle): *Yes / No*
Ecologist Species Identification:		
Is it an EPBC Act Threatened Species (i.e. koala or s-t quoll)? (circle) *Yes / No*		
If the animal is an EPBC Act Thr. Sp., record the following information if possible:		
Temperature:	**Rainfall** (last 24hrs):	**Moon Phase:**
Sex (circle): *male / female*		**Age Class** (circle): *adult / juvenile*
Pouch Young/Back Young:		
Comments: PAC + BROWNS + SCOTTS + OC + NURSEY + BALD HILL + ALBERT DR + KOBENWOOD MON 04 TUE 05 WED 06 THURS 07 FRI 08. nil nil nil nil nil		

Observers:		
Date:		**Time:**
Location:	**Chainage:**	**GPS:**
Species:		
Photos (circle): *Yes / No*		**Photos sent to Ecologist** (circle): *Yes / No*
Ecologist Species Identification:		
Is it an EPBC Act Threatened Species (i.e. koala or s-t quoll)? (circle) *Yes / No*		
If the animal is an EPBC Act Thr. Sp., record the following information if possible:		
Temperature:	**Rainfall** (last 24hrs):	**Moon Phase:**
Sex (circle): *male / female*		**Age Class** (circle): *adult / juvenile*
Pouch Young/Back Young:		
Comments:		

WC2NH Road Kill Monitoring Program

Data Recording Sheet

Observers: Mal & Steve.		
Date: 27/6/16 - 1/7/16		**Time:** 0700 - 1000 Daily
Location:	**Chainage:** See below	**GPS:**
Species:		
Photos (circle): *Yes / No*		**Photos sent to Ecologist** (circle): *Yes / No*
Ecologist Species Identification:		
Is it an EPBC Act Threatened Species (i.e. koala or s-t quoll)? (circle) *Yes / No*		
If the animal is an EPBC Act Thr. Sp., record the following information if possible:		
Temperature:	**Rainfall** (last 24hrs):	**Moon Phase:**
Sex (circle): *male / female*		**Age Class** (circle): *adult / juvenile*
Pouch Young/Back Young:		
Comments: Pac + Albert + Rosewood + Scotts + B/Hill + Gumma + OC + Nursey Mon 27 Nil; Tues 28 Nil; Wed 29 NIL; Thurs 30 NIL; Fri 1st. NIL		

Observers:		
Date:		**Time:**
Location:	**Chainage:**	**GPS:**
Species:		
Photos (circle): *Yes / No*		**Photos sent to Ecologist** (circle): *Yes / No*
Ecologist Species Identification:		
Is it an EPBC Act Threatened Species (i.e. koala or s-t quoll)? (circle) *Yes / No*		
If the animal is an EPBC Act Thr. Sp., record the following information if possible:		
Temperature:	**Rainfall** (last 24hrs):	**Moon Phase:**
Sex (circle): *male / female*		**Age Class** (circle): *adult / juvenile*
Pouch Young/Back Young:		
Comments:		

WC2NH Road Kill Monitoring Program

Data Recording Sheet

Observers: Mal + Steve.		
Date: 20-24/6/16		**Time:** 0700-1000 Daily
Location:	**Chainage:** See below	**GPS:**
Species:		
Photos (circle): *Yes / No*		**Photos sent to Ecologist** (circle): *Yes / No*
Ecologist Species Identification:		
Is it an EPBC Act Threatened Species (i.e. koala or s-t quoll)? (circle) *Yes / No*		
If the animal is an EPBC Act Thr. Sp., record the following information if possible:		
Temperature:	**Rainfall** (last 24hrs):	**Moon Phase:**
Sex (circle): *male / female*		**Age Class** (circle): *adult / juvenile*
Pouch Young/Back Young:		
Comments: Pac + Albert + Rosewood + Scotts + B/Hill + Gumm - OC - Nursery MON 20 TUES 21 WED 22 THUR 23 FRI 24 Nil Nil Nil Nil NIL.		

Observers:		
Date:		**Time:**
Location:	**Chainage:**	**GPS:**
Species:		
Photos (circle): *Yes / No*		**Photos sent to Ecologist** (circle): *Yes / No*
Ecologist Species Identification:		
Is it an EPBC Act Threatened Species (i.e. koala or s-t quoll)? (circle) *Yes / No*		
If the animal is an EPBC Act Thr. Sp., record the following information if possible:		
Temperature:	**Rainfall** (last 24hrs):	**Moon Phase:**
Sex (circle): *male / female*		**Age Class** (circle): *adult / juvenile*
Pouch Young/Back Young:		
Comments:		

WC2NH Road Kill Monitoring Program

Data Recording Sheet

Observers: Mal + Steve		
Date: 13 - 17/6/16		**Time:** 0700 - 1000 Daily
Location:	**Chainage:** See below.	**GPS:**
Species:		
Photos (circle): *Yes / No*		**Photos sent to Ecologist** (circle): *Yes / No*
Ecologist Species Identification:		
Is it an EPBC Act Threatened Species (i.e. koala or s-t quoll)? (circle) *Yes / No*		
If the animal is an EPBC Act Thr. Sp., record the following information if possible:		
Temperature:	**Rainfall** (last 24hrs):	**Moon Phase:**
Sex (circle): *male / female*		**Age Class** (circle): *adult / juvenile*
Pouch Young/Back Young:		
Comments: Pac - Albert - Rosewood - Scotts - B/Hill - Gumma - OC - Nursey. Mon 13 Tues 14 Wed 15 Thurs 16 Fri 17. Nil Nil. Nil Nil. PTHOL		

Observers:		
Date:		**Time:**
Location:	**Chainage:**	**GPS:**
Species:		
Photos (circle): *Yes / No*		**Photos sent to Ecologist** (circle): *Yes / No*
Ecologist Species Identification:		
Is it an EPBC Act Threatened Species (i.e. koala or s-t quoll)? (circle) *Yes / No*		
If the animal is an EPBC Act Thr. Sp., record the following information if possible:		
Temperature:	**Rainfall** (last 24hrs):	**Moon Phase:**
Sex (circle): *male / female*		**Age Class** (circle): *adult / juvenile*
Pouch Young/Back Young:		
Comments:		

WC2NH Road Kill Monitoring Program

Data Recording Sheet

Observers: MVR + STEVE		
Date: 6/06/16 - 10/06/16		**Time:** 0700 - 1000
Location:	**Chainage:** See below.	**GPS:**
Species:		
Photos (circle): *Yes / No*		**Photos sent to Ecologist** (circle): *Yes / No*
Ecologist Species Identification:		
Is it an EPBC Act Threatened Species (i.e. koala or s-t quoll)? (circle) *Yes / No*		
If the animal is an EPBC Act Thr. Sp., record the following information if possible:		
Temperature:	**Rainfall** (last 24hrs):	**Moon Phase:**
Sex (circle): *male / female*		**Age Class** (circle): *adult / juvenile*
Pouch Young/Back Young:		
Comments: PAC - ALBERT - ROSEWOOD SCOTTS B/HILL GUMMA QC NURSERY MON 6TH nil; TUE 7TH nil; WED 8TH nil; THURS 9TH nil; FRI 10TH nil.		

Observers:		
Date:		**Time:**
Location:	**Chainage:**	**GPS:**
Species:		
Photos (circle): *Yes / No*		**Photos sent to Ecologist** (circle): *Yes / No*
Ecologist Species Identification:		
Is it an EPBC Act Threatened Species (i.e. koala or s-t quoll)? (circle) *Yes / No*		
If the animal is an EPBC Act Thr. Sp., record the following information if possible:		
Temperature:	**Rainfall** (last 24hrs):	**Moon Phase:**
Sex (circle): *male / female*		**Age Class** (circle): *adult / juvenile*
Pouch Young/Back Young:		
Comments:		

WC2NH Road Kill Monitoring Program

Data Recording Sheet

Observers: MAR + STEVE		
Date: 30/05/16 - 3/06/16		**Time:** 0700 - 1000
Location:	**Chainage:** See below	**GPS:**
Species:		
Photos (circle): *Yes / No*		**Photos sent to Ecologist** (circle): *Yes / No*
Ecologist Species Identification:		
Is it an EPBC Act Threatened Species (i.e. koala or s-t quoll)? (circle) *Yes / No*		
If the animal is an EPBC Act Thr. Sp., record the following information if possible:		
Temperature:	**Rainfall** (last 24hrs):	**Moon Phase:**
Sex (circle): *male / female*		**Age Class** (circle): *adult / juvenile*
Pouch Young/Back Young:		
Comments: PAC + ALBERT + ROSEWOOD + SCOTTS + B/HILL + Gumma + A + NURSERY MON 30 NIL · TUE 31 nil · WED 1st nil · THURS 2nd nil · FRI 3rd nil		

Observers:		
Date:		**Time:**
Location:	**Chainage:**	**GPS:**
Species:		
Photos (circle): *Yes / No*		**Photos sent to Ecologist** (circle): *Yes / No*
Ecologist Species Identification:		
Is it an EPBC Act Threatened Species (i.e. koala or s-t quoll)? (circle) *Yes / No*		
If the animal is an EPBC Act Thr. Sp., record the following information if possible:		
Temperature:	**Rainfall** (last 24hrs):	**Moon Phase:**
Sex (circle): *male / female*		**Age Class** (circle): *adult / juvenile*
Pouch Young/Back Young:		
Comments:		

WC2NH Road Kill Monitoring – 1st September 2016 – 30th November 2016

Road kill monitoring has been undertaken daily, although only required weekly throughout construction as per Appendix A of the Ecological Monitoring Program Procedure. This report captures from 1st September 2016 through to the 30th of November 2016. Field sheets from this period are attached in Appendix A.

Non-EPBC Species Road Kill

During monitoring, 11 roadkill were identified. 1 Brush-Tailed Possum (*Trichosurus vulpecula*) was identified on the 6th of September 2016 along the existing Pacific Highway at approximate chainage 45000. 1 Pretty-Faced Wallaby *(Macropus Parryi)* was identified on the 7th of September 2016 along the existing Pacific Highway at approximate chainage 41700. 1 additional Pretty-Faced Wallaby was identified on the 12th of September 2016 along the existing Pacific Highway, approximate chainage 49200. 1 Brush-Tailed Possum was identified on the 13th of October 2016 along the existing highway at approximate chainage 41800. 1 Eastern Grey Kangaroo *(Macropus giganteus)* was identified on the 24th of October 2016 along Old Coast Central, approximate chainage 55800. 1 Pretty Faced Wallaby and joey was identified on the 28th of October 2016 along Local Access Road E, approximate chainage 54800. 2 x Laughing Kookaburras *(Dacelo novaeguineae)* were identified on 17th November 2016 along the existing Pacific Highway, approximate chainage 45800 and 47000 respectively. 1 Pretty Faced Wallaby was identified on 21st of November 2016 along the existing highway, approximate chainage 41900. 1 Eastern Grey Kangaroo was identified on the 29th of November along the existing highway, approximate chainage 41500. 1 Purple Swamphen *(Porphyrio porphyrio)* was identified on the 30th November 2016 along the existing highway, approximate chainage 46300.

EPBC Species Road Kill

No EPBC Species were identified during this monitoring period.

Road kill monitoring results to date are summarised in Figure 1.

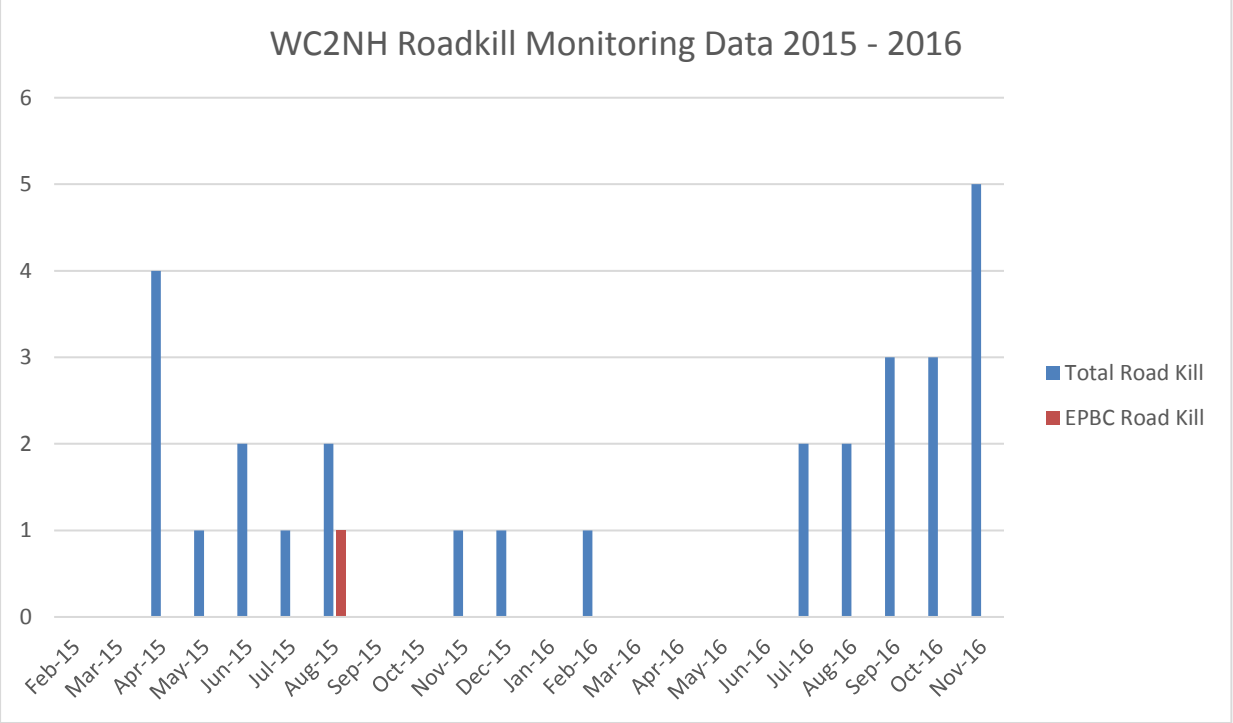


Figure 1 – WC2NH roadkill monitoring results for 2015-2016

Appendix A – Roadkill Monitoring Field Sheets June to August 2016

WC2NH Road Kill Monitoring Program

Data Recording Sheet

Observers: Mal & Steve		
Date: 29/08 - 02/09.		**Time:** 0700 - 1000
Location:	**Chainage:** See below.	**GPS:**
Species:		
Photos (circle): *Yes / No*		**Photos sent to Ecologist** (circle): *Yes / No*
Ecologist Species Identification:		
Is it an EPBC Act Threatened Species (i.e. koala or s-t quoll)? (circle) *Yes / No*		
If the animal is an EPBC Act Thr. Sp., record the following information if possible:		
Temperature:	**Rainfall** (last 24hrs):	**Moon Phase:**
Sex (circle): *male / female*		**Age Class** (circle): *adult / juvenile*
Pouch Young/Back Young:		
Comments: PAC + ALBERT + SCOTTS + B/HILL + GUMMA + OC + NURSEY 29/8 MON: nil. TUE 30/8: nil WED 31/8: nil THURS 1/9: nil FRI 2/9: nil		

Observers:		
Date:		**Time:**
Location:	**Chainage:**	**GPS:**
Species:		
Photos (circle): *Yes / No*		**Photos sent to Ecologist** (circle): *Yes / No*
Ecologist Species Identification:		
Is it an EPBC Act Threatened Species (i.e. koala or s-t quoll)? (circle) *Yes / No*		
If the animal is an EPBC Act Thr. Sp., record the following information if possible:		
Temperature:	**Rainfall** (last 24hrs):	**Moon Phase:**
Sex (circle): *male / female*		**Age Class** (circle): *adult / juvenile*
Pouch Young/Back Young:		
Comments:		

WC2NH Road Kill Monitoring Program

Data Recording Sheet

Observers: MAL & STEVE, ANDREW.		
Date: 05-09/09/16		**Time:** 0700 - 1000.
Location:	**Chainage:** See below.	**GPS:**
Species:		
Photos (circle): *Yes / No*		**Photos sent to Ecologist** (circle): *Yes / No*
Ecologist Species Identification:		
Is it an EPBC Act Threatened Species (i.e. koala or s-t quoll)? (circle) *Yes / No*		
If the animal is an EPBC Act Thr. Sp., record the following information if possible:		
Temperature:	**Rainfall** (last 24hrs):	**Moon Phase:**
Sex (circle): *male / female*		**Age Class** (circle): *adult / juvenile*
Pouch Young/Back Young:		
Comments: PAC + ALBERT + SCOTTS + B/HILL + GUMMA TOC + NURSEY.		

MON 05	TUE 06	WED 07	THUR 08	FRI 09
NIL	1x Possum PAC/ALBERT STH.	1x Wallaby upper wanell nth bound old fast lane	NIL	nil

Observers: ~~MAL & STEVE, ANDREW~~		
Date: ~~12-16/09/16~~		**Time:**
Location:	**Chainage:** ~~See below~~	**GPS:**
Species:		
Photos (circle): *Yes / No*		**Photos sent to Ecologist** (circle): *Yes / No*
Ecologist Species Identification:		
Is it an EPBC Act Threatened Species (i.e. koala or s-t quoll)? (circle) *Yes / No*		
If the animal is an EPBC Act Thr. Sp., record the following information if possible:		
Temperature:	**Rainfall** (last 24hrs):	**Moon Phase:**
Sex (circle): *male / female*		**Age Class** (circle): *adult / juvenile*
Pouch Young/Back Young:		
Comments:		

WC2NH Road Kill Monitoring Program

Data Recording Sheet

Observers: MAL, STEVE-, ANDREW		
Date: 12-16/09/16.		**Time:** 0700 - 1000
Location:	**Chainage** See below	**GPS:**
Species:		
Photos (circle): *Yes / No*		**Photos sent to Ecologist** (circle): *Yes / No*
Ecologist Species Identification:		
Is it an EPBC Act Threatened Species (i.e. koala or s-t quoll)? (circle) *Yes / No*		
If the animal is an EPBC Act Thr. Sp., record the following information if possible:		
Temperature:	**Rainfall** (last 24hrs):	**Moon Phase:**
Sex (circle): *male / female*		**Age Class** (circle): *adult / juvenile*
Pouch Young/Back Young:		
Comments: PAC + ALBERT + SCOTTS + BIHILL + GUMMA + OC + NURSEY MON 12: 1x Wallaby pac the hwy near bald hill TUE 13: NIL WED 14: NIL THURS 15: NIL FRI 16: NIL		

Observers:		
Date:		**Time:**
Location:	**Chainage:**	**GPS:**
Species:		
Photos (circle): *Yes / No*		**Photos sent to Ecologist** (circle): *Yes / No*
Ecologist Species Identification:		
Is it an EPBC Act Threatened Species (i.e. koala or s-t quoll)? (circle) *Yes / No*		
If the animal is an EPBC Act Thr. Sp., record the following information if possible:		
Temperature:	**Rainfall** (last 24hrs):	**Moon Phase:**
Sex (circle): *male / female*		**Age Class** (circle): *adult / juvenile*
Pouch Young/Back Young:		
Comments:		

WC2NH Road Kill Monitoring Program

Data Recording Sheet

Observers: MAC, STEVE-, ANDREW		
Date: 19-23/09/16		**Time:** 0700-1000
Location:	**Chainage** see below.	**GPS:**
Species:		
Photos (circle): *Yes / No*		**Photos sent to Ecologist** (circle): *Yes / No*
Ecologist Species Identification:		
Is it an EPBC Act Threatened Species (i.e. koala or s-t quoll)? (circle) *Yes / No*		
If the animal is an EPBC Act Thr. Sp., record the following information if possible:		
Temperature:	**Rainfall** (last 24hrs):	**Moon Phase:**
Sex (circle): *male / female*		**Age Class** (circle): *adult / juvenile*
Pouch Young/Back Young:		
Comments: PAC + ALBERT + SCOTTS + B/HILL + GUMMA + OC + NURSEY MON 19 TUE 20 WED 21 THURS 22 FRI 23 NIL. NIL NIL. NIL. NIL		

Observers:		
Date:		**Time:**
Location:	**Chainage:**	**GPS:**
Species:		
Photos (circle): *Yes / No*		**Photos sent to Ecologist** (circle): *Yes / No*
Ecologist Species Identification:		
Is it an EPBC Act Threatened Species (i.e. koala or s-t quoll)? (circle) *Yes / No*		
If the animal is an EPBC Act Thr. Sp., record the following information if possible:		
Temperature:	**Rainfall** (last 24hrs):	**Moon Phase:**
Sex (circle): *male / female*		**Age Class** (circle): *adult / juvenile*
Pouch Young/Back Young:		
Comments:		

WC2NH Road Kill Monitoring Program

Data Recording Sheet

Observers: MAL, STEVE-, ANDREW		
Date: 26-30/09/16		**Time:** 0700-1000
Location:	**Chainage** See below	**GPS:**
Species:		
Photos (circle): *Yes / No*		**Photos sent to Ecologist** (circle): *Yes / No*
Ecologist Species Identification:		
Is it an EPBC Act Threatened Species (i.e. koala or s-t quoll)? (circle) *Yes / No*		
If the animal is an EPBC Act Thr. Sp., record the following information if possible:		
Temperature:	**Rainfall** (last 24hrs):	**Moon Phase:**
Sex (circle): *male / female*		**Age Class** (circle): *adult / juvenile*
Pouch Young/Back Young:		
Comments: PAC + ALBERT + SCOTTS + B/HILL + GUMMA + OC + NURSEY MON 26 TUE 27 WED 28 THURS 29 FRI 30. nil nil. nil nil nil		

Observers:		
Date:		**Time:**
Location:	**Chainage:**	**GPS:**
Species:		
Photos (circle): *Yes / No*		**Photos sent to Ecologist** (circle): *Yes / No*
Ecologist Species Identification:		
Is it an EPBC Act Threatened Species (i.e. koala or s-t quoll)? (circle) *Yes / No*		
If the animal is an EPBC Act Thr. Sp., record the following information if possible:		
Temperature:	**Rainfall** (last 24hrs):	**Moon Phase:**
Sex (circle): *male / female*		**Age Class** (circle): *adult / juvenile*
Pouch Young/Back Young:		
Comments:		

WC2NH Road Kill Monitoring Program

Data Recording Sheet

Observers: MAL, STEVE, ANDREW.		
Date: 1.03-07/10/16		**Time:** 0700-1000.
Location:	**Chainage** see below.	**GPS:**
Species:		
Photos (circle): *Yes / No*		**Photos sent to Ecologist** (circle): *Yes / No*
Ecologist Species Identification:		
Is it an EPBC Act Threatened Species (i.e. koala or s-t quoll)? (circle) *Yes / No*		
If the animal is an EPBC Act Thr. Sp., record the following information if possible:		
Temperature:	**Rainfall** (last 24hrs):	**Moon Phase:**
Sex (circle): *male / female*		**Age Class** (circle): *adult / juvenile*
Pouch Young/Back Young:		
Comments: PAC + ALBERT + SCOTTS + B/HILL + GUMMA + OC + NURSEY MON 3rd TUE 4th WED 5th THUR 6th FRI 7th. NIL NIL NIL NIL NIL		

Observers:		
Date:		**Time:**
Location:	**Chainage:**	**GPS:**
Species:		
Photos (circle): *Yes / No*		**Photos sent to Ecologist** (circle): *Yes / No*
Ecologist Species Identification:		
Is it an EPBC Act Threatened Species (i.e. koala or s-t quoll)? (circle) *Yes / No*		
If the animal is an EPBC Act Thr. Sp., record the following information if possible:		
Temperature:	**Rainfall** (last 24hrs):	**Moon Phase:**
Sex (circle): *male / female*		**Age Class** (circle): *adult / juvenile*
Pouch Young/Back Young:		
Comments:		

WC2NH Road Kill Monitoring Program

Data Recording Sheet

Observers: MAL, STEVE, ANDREW		
Date: 10-14/10/16		**Time:** 0700-1000
Location:	**Chainage:** See below	**GPS:**
Species:		
Photos (circle): *Yes / No*		**Photos sent to Ecologist** (circle): *Yes / No*
Ecologist Species Identification:		
Is it an EPBC Act Threatened Species (i.e. koala or s-t quoll)? (circle) *Yes / No*		
If the animal is an EPBC Act Thr. Sp., record the following information if possible:		
Temperature:	**Rainfall** (last 24hrs):	**Moon Phase:**
Sex (circle): *male / female*		**Age Class** (circle): *adult / juvenile*
Pouch Young/Back Young:		
Comments: PAC + ALBERT + SCOTTS + B/HILL + GUMMA + OC + NURSEY MON 10 TUE 11 WED 12 THURS 13 FRI 14. NIL nil nil ~~WALLABY~~ PAC @ BROWNS Xing. Very Squashed Just blood + guts. nil.		

Observers:		
Date:		**Time:**
Location:	**Chainage:**	**GPS:**
Species:		
Photos (circle): *Yes / No*		**Photos sent to Ecologist** (circle): *Yes / No*
Ecologist Species Identification:		
Is it an EPBC Act Threatened Species (i.e. koala or s-t quoll)? (circle) *Yes / No*		
If the animal is an EPBC Act Thr. Sp., record the following information if possible:		
Temperature:	**Rainfall** (last 24hrs):	**Moon Phase:**
Sex (circle): *male / female*		**Age Class** (circle): *adult / juvenile*
Pouch Young/Back Young:		
Comments:		

WC2NH Road Kill Monitoring Program

Data Recording Sheet

Observers: MAL, STEVE & ANDREW		
Date: 17-21/10/16		**Time:** 0700 - 1000
Location:	**Chainage** See below	**GPS:**
Species:		
Photos (circle): *Yes / No*		**Photos sent to Ecologist** (circle): *Yes / No*
Ecologist Species Identification:		
Is it an EPBC Act Threatened Species (i.e. koala or s-t quoll)? (circle) *Yes / No*		
If the animal is an EPBC Act Thr. Sp., record the following information if possible:		
Temperature:	**Rainfall** (last 24hrs):	**Moon Phase:**
Sex (circle): *male / female*		**Age Class** (circle): *adult / juvenile*
Pouch Young/Back Young:		
Comments: PAC + ALBERT + SCOTTS + B/HILL + GUMMA + OC + NURSERY MON 17 TUE 18 WED 19 THURS 20 FRI 21 NIL. NIL. nil. nil. nil		

Observers:		
Date:		**Time:**
Location:	**Chainage:**	**GPS:**
Species:		
Photos (circle): *Yes / No*		**Photos sent to Ecologist** (circle): *Yes / No*
Ecologist Species Identification:		
Is it an EPBC Act Threatened Species (i.e. koala or s-t quoll)? (circle) *Yes / No*		
If the animal is an EPBC Act Thr. Sp., record the following information if possible:		
Temperature:	**Rainfall** (last 24hrs):	**Moon Phase:**
Sex (circle): *male / female*		**Age Class** (circle): *adult / juvenile*
Pouch Young/Back Young:		
Comments:		

WC2NH Road Kill Monitoring Program

Data Recording Sheet

Observers: MAL, STEVE, ANDREW		
Date: 24-28/10/16		**Time:** 0700 - 1000
Location:	**Chainage** See below	**GPS:**
Species:		
Photos (circle): *Yes / No*		**Photos sent to Ecologist** (circle): *Yes / No*
Ecologist Species Identification:		
Is it an EPBC Act Threatened Species (i.e. koala or s-t quoll)? (circle) *Yes / No*		
If the animal is an EPBC Act Thr. Sp., record the following information if possible:		
Temperature:	**Rainfall** (last 24hrs):	**Moon Phase:**
Sex (circle): *male / female*		**Age Class** (circle): *adult / juvenile*
Pouch Young/Back Young:		
Comments: PAC + ALBERT + SCOTTS + B/HILL + GUMMA + OC + NURSEY MON 24 — TUES 25 — WED 26 — THURS 27 — FRI 28 Small kangaroo Old Coast Central — nil — nil. — nil. — ~~nil~~. Local access road E small wallaby & joey		

Observers: Mal, Steve + Drew		
Date: ~~29/10/16~~ ~~03/11/16~~ 04/11/16		**Time:** 0700 - 1000
Location:	**Chainage:** All site See below	**GPS:**
Species:		
Photos (circle): *Yes / No*		**Photos sent to Ecologist** (circle): *Yes / No*
Ecologist Species Identification:		
Is it an EPBC Act Threatened Species (i.e. koala or s-t quoll)? (circle) *Yes / No*		
If the animal is an EPBC Act Thr. Sp., record the following information if possible:		
Temperature:	**Rainfall** (last 24hrs):	**Moon Phase:**
Sex (circle): *male / female*		**Age Class** (circle): *adult / juvenile*
Pouch Young/Back Young:		
Comments: Pac + Albert + Scotts + B/Hill + Gumma + OC + Nursey Mon 03/4 — Tue 04/4 — Wed 05/4 — Thu 06/4 — Fri 07/11 Nil — nil — Nil — Nil — Nil		

WC2NH Road Kill Monitoring Program

Data Recording Sheet

Observers: MAL, ANDREW	
Date: 31-10 – 4/11/16	**Time:** 0700 1000
Location: Chainage: See below	**GPS:**
Species:	
Photos (circle): *Yes / No*	**Photos sent to Ecologist** (circle): *Yes / No*
Ecologist Species Identification:	
Is it an EPBC Act Threatened Species (i.e. koala or s-t quoll)? (circle) *Yes / No*	
If the animal is an EPBC Act Thr. Sp., record the following information if possible:	
Temperature: **Rainfall** (last 24hrs):	**Moon Phase:**
Sex (circle): *male / female*	**Age Class** (circle): *adult / juvenile*
Pouch Young/Back Young:	

Comments: PAC + ALBERT + SCOTTS + B/HILL + GUMMA + OC + NURSRY

MON 31	TUE 1	WED 2	THURS 3	FRI 4
nil	nil	nil.	nil	nil

Observers: MAL, ANDREW & STEVE	
Date: 07-11/11/16	**Time:** 0700-1000
Location: **Chainage:** See below	**GPS:**
Species:	
Photos (circle): *Yes / No*	**Photos sent to Ecologist** (circle): *Yes / No*
Ecologist Species Identification:	
Is it an EPBC Act Threatened Species (i.e. koala or s-t quoll)? (circle) *Yes / No*	
If the animal is an EPBC Act Thr. Sp., record the following information if possible:	
Temperature: **Rainfall** (last 24hrs):	**Moon Phase:**
Sex (circle): *male / female*	**Age Class** (circle): *adult / juvenile*
Pouch Young/Back Young:	

Comments: PAC + ALBERT + SCOTTS + B/HILL + GUMMA + OC + NURSRY

MON 7	TUE 8	WED 9	THURS 10	FRI 11
NIL	NIL	nil.	nil	nil.

WC2NH Road Kill Monitoring Program

Data Recording Sheet

Observers: MAL STEVE. - ANDREW. W		
Date: 14-18/11/16		**Time:** 0700 1000
Location:	**Chainage** see below	**GPS:**
Species:		
Photos (circle): *Yes / No*		**Photos sent to Ecologist** (circle): *Yes / No*
Ecologist Species Identification:		
Is it an EPBC Act Threatened Species (i.e. koala or s-t quoll)? (circle) *Yes / No*		
If the animal is an EPBC Act Thr. Sp., record the following information if possible:		
Temperature:	**Rainfall** (last 24hrs):	**Moon Phase:**
Sex (circle): *male / female*		**Age Class** (circle): *adult / juvenile*
Pouch Young/Back Young:		
Comments: PAC + ALBERT + SCOTTS + B/HILL + GUMMA + OC + NURSEY MON 14: NIL. TUES 15: nil. WED 16: nil. THURS 17: 1× kookaburra 1@ albertdrive sth 1@ albert drive sth. FRI 18: nil.		

Observers: Mal Steve Andrew		
Date: 21-25/11/16		**Time:** 0700 - 1000
Location:	**Chainage:** See below	**GPS:**
Species:		
Photos (circle): *Yes / No*		**Photos sent to Ecologist** (circle): *Yes / No*
Ecologist Species Identification:		
Is it an EPBC Act Threatened Species (i.e. koala or s-t quoll)? (circle) *Yes / No*		
If the animal is an EPBC Act Thr. Sp., record the following information if possible:		
Temperature:	**Rainfall** (last 24hrs):	**Moon Phase:**
Sex (circle): *male / female*		**Age Class** (circle): *adult / juvenile*
Pouch Young/Back Young:		
Comments: PAC + ALBERT + SCOTTS + B/HILL + GUMMA + OC + NURSEY MON 21: NIL. TUES 22: 1× Wallaby pac/hwy brown for southern turn. WED 23: nil. THURS 24: nil FRI 25: nil.		

WC2NH Road Kill Monitoring Program

Data Recording Sheet

Observers: MAL, STEVE ANDREW		
Date: 1, 28/11/16/02/12/16.		**Time:** 0700 1000
Location:	**Chainage** See below	**GPS:**
Species:		
Photos (circle): *Yes / No*		**Photos sent to Ecologist** (circle): *Yes / No*
Ecologist Species Identification:		
Is it an EPBC Act Threatened Species (i.e. koala or s-t quoll)? (circle) *Yes / No*		
If the animal is an EPBC Act Thr. Sp., record the following information if possible:		
Temperature:	**Rainfall** (last 24hrs):	**Moon Phase:**
Sex (circle): *male / female*		**Age Class** (circle): *adult / juvenile*
Pouch Young/Back Young:		

Comments: PAC + ALBERT + SCOTTS + B/HILL + GUMMA + OC + NURSEY

MON 28TH: nil.. | TUE 29TH: 1x squashed kangaroo nthbound south of browns cross pathway. | WED 30TH: Water fowl sthbound pac hwy nth to albert. | THURS 1ST: nil | FRI 2ND: nil.

Observers: MAL, STEVE ANDREW		
Date: 05 - 09/12/16		**Time:** 0700 - 1000
Location:	**Chainage:** See below	**GPS:**
Species:		
Photos (circle): *Yes / No*		**Photos sent to Ecologist** (circle): *Yes / No*
Ecologist Species Identification:		
Is it an EPBC Act Threatened Species (i.e. koala or s-t quoll)? (circle) *Yes / No*		
If the animal is an EPBC Act Thr. Sp., record the following information if possible:		
Temperature:	**Rainfall** (last 24hrs):	**Moon Phase:**
Sex (circle): *male / female*		**Age Class** (circle): *adult / juvenile*
Pouch Young/Back Young:		

Comments: PAC + ALBERT + SCOTTS + B/HILL + GUMMA + OC + NURSEY

MON 5TH TUE 6TH WED 7TH THURS 8TH FRI 9TH

NIL.

WC2NH Road Kill Monitoring – 1st December 2016 – 28th February 2017

Road kill monitoring has been undertaken daily, although only required weekly throughout construction as per Appendix A of the Ecological Monitoring Program Procedure. This report captures from 1st December 2016 through to the 28th of February 2017. Field sheets from this period are attached in Appendix A.

Non-EPBC Species Road Kill

During monitoring, 5 roadkill were identified:

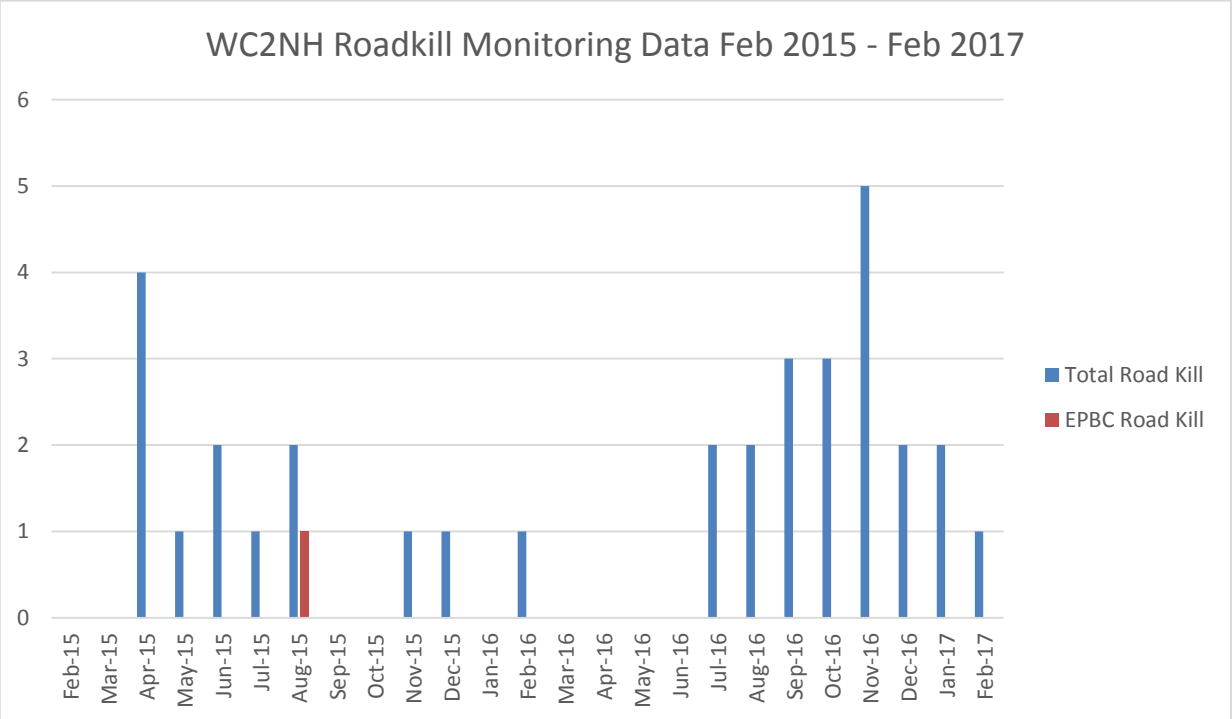
- 1 Eastern Grey Kangaroo *(Macropus giganteus)*, identified 12th December 2016, at existing highway approximate chainage 41,900
- 1 Eastern Grey Kangaroo *(Macropus giganteus)*, identified 14th December 2016, at existing Pacific Highway approximate chainage 41,600
- 1 Eastern Grey Kangaroo *(Macropus giganteus)*, identified 16th January 2017, at existing Pacific Highway approximate chainage 44,800
- 1 Australian Wood Duck (Chenonetta jubata), identified 23rd January 2017, at existing Pacific Highway approximate chainage 46,300
- 1 European Rabbit (*Oryctolagus cuniculus*), identified 20th February 2017, at existing Pacific Highway approximate chainage 42,000

EPBC Species Road Kill

No EPBC Species were identified during this monitoring period.

Road kill monitoring results to date are summarised in Figure 1.

Figure 1 – WC2NH roadkill monitoring results for 2015-2017



WC2NH Road Kill Monitoring Program

Data Recording Sheet

Observers: MAL, STEVE ANDREW		
Date: 28/11/16 - 02/12/16.		**Time:** 0700 1000
Location:	**Chainage:** See below	**GPS:**
Species:		
Photos (circle): *Yes / No*		**Photos sent to Ecologist** (circle): *Yes / No*
Ecologist Species Identification:		
Is it an EPBC Act Threatened Species (i.e. koala or s-t quoll)? (circle) *Yes / No*		
If the animal is an EPBC Act Thr. Sp., record the following information if possible:		
Temperature:	**Rainfall** (last 24hrs):	**Moon Phase:**
Sex (circle): *male / female*		**Age Class** (circle): *adult / juvenile*
Pouch Young/Back Young:		
Comments: PAC + ALBERT + SCOTTS + B/HILL + GUMMA + OC + NURSEY MON 28TH: nil. TUE 29TH: 1x squashed kangaroo nthbound south of browns cross pathway. WED 30TH: Water fowl stationed pac hwy nth bnd albert. THURS 1ST: nil FRI 2ND: nil.		

Observers: MAL, STEVE ANDREW		
Date: 05 - 09/12/16		**Time:** 0700 - 1000
Location:	**Chainage:** See below	**GPS:**
Species:		
Photos (circle): *Yes / No*		**Photos sent to Ecologist** (circle): *Yes / No*
Ecologist Species Identification:		
Is it an EPBC Act Threatened Species (i.e. koala or s-t quoll)? (circle) *Yes / No*		
If the animal is an EPBC Act Thr. Sp., record the following information if possible:		
Temperature:	**Rainfall** (last 24hrs):	**Moon Phase:**
Sex (circle): *male / female*		**Age Class** (circle): *adult / juvenile*
Pouch Young/Back Young:		
Comments: PAC + ALBERT + SCOTTS + B/HILL + GUMMA + OC + NURSEY MON 5TH: NIL. TUE 6TH: nil WED 7TH: nil. THURS 8TH: nil. FRI 9TH: nil		

WC2NH Road Kill Monitoring Program

Data Recording Sheet

Observers: MAL, STEVE - ANDREW		
Date: 12-16/12/2016		**Time:** 0700-1000
Location:	**Chainage** See below	**GPS:**
Species:		
Photos (circle): *Yes / No*		**Photos sent to Ecologist** (circle): *Yes / No*
Ecologist Species Identification:		
Is it an EPBC Act Threatened Species (i.e. koala or s-t quoll)? (circle) *Yes / No*		
If the animal is an EPBC Act Thr. Sp., record the following information if possible:		
Temperature:	**Rainfall** (last 24hrs):	**Moon Phase:**
Sex (circle): *male / female*		**Age Class** (circle): *adult / juvenile*
Pouch Young/Back Young:		

Comments: PAC + ALBERT + SCOTTS + B/HILL + GUMMA + OC + NURSEY

MON 12	TUE 13	WED 14	THURS 15	FRI 16
PAC HWY NORTHBOUND BEFORE BROWNS CROSSING 1 x SQUASHED KANGAROO.	nil.	PAC HWY NORTHBOUND BEFORE BROWNS CROSSING 1 x SQUASHED KANGAROO.	nil	nil

Observers:		
Date: 19-23/12/2016		**Time:** 0700-1000
Location:	**Chainage:** See below.	**GPS:**
Species:		
Photos (circle): *Yes / No*		**Photos sent to Ecologist** (circle): *Yes / No*
Ecologist Species Identification:		
Is it an EPBC Act Threatened Species (i.e. koala or s-t quoll)? (circle) *Yes / No*		
If the animal is an EPBC Act Thr. Sp., record the following information if possible:		
Temperature:	**Rainfall** (last 24hrs):	**Moon Phase:**
Sex (circle): *male / female*		**Age Class** (circle): *adult / juvenile*
Pouch Young/Back Young:		

Comments: ~~Pac~~ PAC + ALBERT + SCOTTS + B/HILL + GUMMA + OC + NURSEY.

MON 19	TUES 20	WED 21	THURS 22	FRI, 23
nil.	nil	nil.	nil.	

WC2NH Road Kill Monitoring Program

Data Recording Sheet

Observers: MAL, STEVE, ANDREW		
Date: 02-06/01/17		**Time:** 0700-1000
Location:	**Chainage:** See below	**GPS:**
Species:		
Photos (circle): *Yes / No*		**Photos sent to Ecologist** (circle): *Yes / No*
Ecologist Species Identification:		
Is it an EPBC Act Threatened Species (i.e. koala or s-t quoll)? (circle) *Yes / No*		
If the animal is an EPBC Act Thr. Sp., record the following information if possible:		
Temperature:	**Rainfall** (last 24hrs):	**Moon Phase:**
Sex (circle): *male / female*		**Age Class** (circle): *adult / juvenile*
Pouch Young/Back Young:		
Comments: PAC + ALBERT + SCOTTS + B/HILL + GUMMA + OC + NURSEY MON 02 TUE 03 WED 04 THURS 05 FRI 06. - NIL. NIL. nil nil.		

Observers: MAL, STEVE, ANDREW		
Date: 09-13/01/17		**Time:** 0700-1000
Location:	**Chainage:** See below	**GPS:**
Species:		
Photos (circle): *Yes / No*		**Photos sent to Ecologist** (circle): *Yes / No*
Ecologist Species Identification:		
Is it an EPBC Act Threatened Species (i.e. koala or s-t quoll)? (circle) *Yes / No*		
If the animal is an EPBC Act Thr. Sp., record the following information if possible:		
Temperature:	**Rainfall** (last 24hrs):	**Moon Phase:**
Sex (circle): *male / female*		**Age Class** (circle): *adult / juvenile*
Pouch Young/Back Young:		
Comments: PAC + ALBERT + SCOTTS + B/HILL + GUMMA + OC + NURSEY MON 09 TUES 10 WED 11 THURS 12 FRI 13 NIL. NIL NIL NIL NIL		

WC2NH Road Kill Monitoring Program

Data Recording Sheet

Observers: MAL, STEVE, ANDREW		
Date: 16-20/01/17		**Time:** 0700 - 1000 DAILY
Location:	**Chainage:** ~~SCOTTS~~ SEE BELOW	**GPS:**
Species:		
Photos (circle): *Yes / No*		**Photos sent to Ecologist** (circle): *Yes / No*
Ecologist Species Identification:		
Is it an EPBC Act Threatened Species (i.e. koala or s-t quoll)? (circle) *Yes / No*		
If the animal is an EPBC Act Thr. Sp., record the following information if possible:		
Temperature:	**Rainfall** (last 24hrs):	**Moon Phase:**
Sex (circle): *male / female*		**Age Class** (circle): *adult / juvenile*
Pouch Young/Back Young:		

Comments: PAC + ALBERT + SCOTTS + B/HILL + GUMMA + OC + NURSEY

MON 16th	TUES 17TH	WED 18TH	THURS 19TH	FRI 20TH.
1x kangaroo pacific hwy south of albert drive sth.	nil.	nil	nil	nil

Observers: MAL, STEVE ANDREW		
Date: 23-29/01/17		**Time:** 0700 - 1000 DAILY
Location:	**Chainage:** SEE BELOW	**GPS:**
Species:		
Photos (circle): *Yes / No*		**Photos sent to Ecologist** (circle): *Yes / No*
Ecologist Species Identification:		
Is it an EPBC Act Threatened Species (i.e. koala or s-t quoll)? (circle) *Yes / No*		
If the animal is an EPBC Act Thr. Sp., record the following information if possible:		
Temperature:	**Rainfall** (last 24hrs):	**Moon Phase:**
Sex (circle): *male / female*		**Age Class** (circle): *adult / juvenile*
Pouch Young/Back Young:		

Comments: PAC + ALBERT + SCOTTS + B/HILL + GUMMA + OC + NURSEY

MON	TUES	WED	THURS	FRI
1x DUCK PACIFIC HWY @ QUARRY.	nil.	NIL	—	NIL.

WC2NH Road Kill Monitoring Program

Data Recording Sheet

Observers: MAL, STEVE, ANDREW		
Date: 30/01 - 04/02/17		Time: 0700- 1000 DAILY
Location:	Chainage: SEE BELOW	GPS:
Species:		
Photos (circle): *Yes / No*		Photos sent to Ecologist (circle): *Yes / No*
Ecologist Species Identification:		
Is it an EPBC Act Threatened Species (i.e. koala or s-t quoll)? (circle) *Yes / No*		
If the animal is an EPBC Act Thr. Sp., record the following information if possible:		
Temperature:	Rainfall (last 24hrs):	Moon Phase:
Sex (circle): *male / female*		Age Class (circle): *adult / juvenile*
Pouch Young/Back Young:		

Comments: PAC + ALBERT + SCOTTS + B/HILL + GUMMA + OC + NURSEY.

MON 30th	TUES 31	WED 01	THURS 02	FRI. 03
NIL	NIL.	NIL	NIL.	NIL.

Observers: MAL, STEVE ANDREW		
Date: 06-11/02/17		Time: 0700- 1000 DAILY
Location:	Chainage: SEE BELOW	GPS:
Species:		
Photos (circle): *Yes / No*		Photos sent to Ecologist (circle): *Yes / No*
Ecologist Species Identification:		
Is it an EPBC Act Threatened Species (i.e. koala or s-t quoll)? (circle) *Yes / No*		
If the animal is an EPBC Act Thr. Sp., record the following information if possible:		
Temperature:	Rainfall (last 24hrs):	Moon Phase:
Sex (circle): *male / female*		Age Class (circle): *adult / juvenile*
Pouch Young/Back Young:		

Comments: PAC + ALBERT + SCOTTS + B/HILL + GUMMA + OC + NURSEY

MON 6	TUES 7	WED 8	THURS 9	FRI 10
NIL	NIL	NIL.	NIL.	NIL.

WC2NH Road Kill Monitoring Program

Data Recording Sheet

Observers: MAL, STEVE ANDREW		
Date: 13-17/02/17		Time: 0700-1000
Location:	Chainage: SEE BELOW	GPS:
Species:		
Photos (circle): *Yes / No*		Photos sent to Ecologist (circle): *Yes / No*
Ecologist Species Identification:		
Is it an EPBC Act Threatened Species (i.e. koala or s-t quoll)? (circle) *Yes / No*		
If the animal is an EPBC Act Thr. Sp., record the following information if possible:		
Temperature:	Rainfall (last 24hrs):	Moon Phase:
Sex (circle): *male / female*		Age Class (circle): *adult / juvenile*
Pouch Young/Back Young:		
Comments: PAC + ALBERT + SCOTTS + B/HILL + GUMMA + OC + NURSERY MON 13TH TUES 14TH WED 15TH THURS 16TH FRI 17TH NIL. NIL. NIL NIL NIL		

Observers: MAL - STEVE - MUZ		
Date: 20-2-17		Time: 07:00
Location:	Chainage: SEE BELOW	GPS:
Species: RABBIT		
Photos (circle): *Yes / (No)*		Photos sent to Ecologist (circle): *Yes / No*
Ecologist Species Identification:		
Is it an EPBC Act Threatened Species (i.e. koala or s-t quoll)? (circle) *Yes / (No)*		
If the animal is an EPBC Act Thr. Sp., record the following information if possible:		
Temperature:	Rainfall (last 24hrs):	Moon Phase:
Sex (circle): *male / female*		Age Class (circle): *adult / juvenile*
Pouch Young/Back Young:		
Comments: PAC + ALBERT + SCOTTS + B/HILL + GUNMA + OC + NURSERY MON 20TH TUE 21ST WED 22ND THURS 23RD FRID 24TH ~~NIL~~ ✓ NIL NIL NIL NIL -1		

WC2NH Road Kill Monitoring Program

Data Recording Sheet

Observers: MAL - STEVE - MUZ - TROY		
Date: 27-2-17 - 03-3-17		Time:
Location:	Chainage: SEE BELOW	GPS:
Species:		
Photos (circle): *Yes / No*		Photos sent to Ecologist (circle): *Yes / No*
Ecologist Species Identification:		
Is it an EPBC Act Threatened Species (i.e. koala or s-t quoll)? (circle) *Yes / No*		
If the animal is an EPBC Act Thr. Sp., record the following information if possible:		
Temperature:	Rainfall (last 24hrs):	Moon Phase:
Sex (circle): *male / female*		Age Class (circle): *adult / juvenile*
Pouch Young/Back Young:		
Comments: PAC + ALBERT + SCOTTS + B/HILL + GUMMA + NURSERY MON 27TH TUE 28TH WED 1ST THU 2ND FRI 3RD NIL ✓ NIL ✓ NIL NIL NIL.		

Observers: MAL - STEVE - ANDREW		
Date: 6-10/03/17		Time: 0700 - 1000
Location:	Chainage: SEE BELOW	GPS:
Species:		
Photos (circle): *Yes / No*		Photos sent to Ecologist (circle): *Yes / No*
Ecologist Species Identification:		
Is it an EPBC Act Threatened Species (i.e. koala or s-t quoll)? (circle) *Yes / No*		
If the animal is an EPBC Act Thr. Sp., record the following information if possible:		
Temperature:	Rainfall (last 24hrs):	Moon Phase:
Sex (circle): *male / female*		Age Class (circle): *adult / juvenile*
Pouch Young/Back Young:		
Comments: PAC + ALBERT + SCOTTS + B/HILL + GUMMA + NURSERY MON 6TH TUES 7TH WED 8TH THURS 9TH FRI 10TH NIL. NIL		

Appendix F

In-situ Threatened Flora Monitoring Report

Warrell Creek to Nambucca Heads

Monitoring of In-situ Threatened Flora (Annual Report 2016)

PO Box 119
Lennox Head NSW 2478
T 02 6687 7666

PO Box 1446
Coffs Harbour NSW 2450
T 02 6651 7666

PO Box 1267
Armidale NSW 2350
T 02 6772 0454

Unit 10 Warina Walk Arcade
156 Molesworth St
Lismore NSW 2480
T 02 6621 6677

info@geolink.net.au

Prepared for: Pacifico

UPR	*Description*	*Date Issued*	*Issued By*
2378-1307	First Issue	30/11/2016	JOL
2378-1313	Second Issue	7/12/2016	JOL
2378-1322	Third Issue	13/01/2017	JOL

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Illustrations

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Plates

1. Introduction

As part of the Warrell Creek to Nambucca Heads (WC2NH) Pacific Highway upgrade project, a Threatened Flora Management Plan (TFMP) has been prepared by Ecos Environmental Pty Ltd (2014) to prescribe measures to manage all threatened flora species occurring on the project. A number of threatened flora occur on the edge of the construction footprint which are to be protected during the construction and operation of the upgrade. Measures to be implemented to protect in-situ specimens are outlined in Section 5 of the TFMP.

The TFMP requires that monitoring of in-situ roadside specimens be undertaken. Monitoring is to be undertaken initially after installing protective barriers (prior to the start of clearing) at six monthly intervals for two years and once a year thereafter. An annual monitoring report is to be prepared at the end of each year describing the results of monitoring. This report represents the second annual monitoring report for the 2016 calendar year and second year of construction.

2. Methodology

All in-situ threatened flora were located and tagged prior to clearing activities commencing. Temporary fencing (orange bunting) and no-go signage was installed around all plants with ecologist supervision. The location of all threatened flora was shown on project sensitive area plans. Threatened flora which were within the project footprint were translocated prior to clearing commencing by Ecos Environmental Pty Ltd. A number of threatened plants are to be retained in-situ outside the project footprint. These plants are the subject of this monitoring report and are shown in **Illustration 2.1-2.5**. Monitoring of in-situ threatened flora was undertaken by GeoLINK ecologists, Jessica O'Leary, David Havilah and Frank Makin at the following times:

- Prior to clearing commencing – 5 - 9 January 2015
- 6 monthly interval (autumn) – 25 - 29 May 2015
- 12 monthly interval (spring)– 26 - 27 November 2015
- 18 monthly interval (autumn) – 23 - 27 May 2016
- 24 monthly interval (spring) – 21 - 23 November 2016.

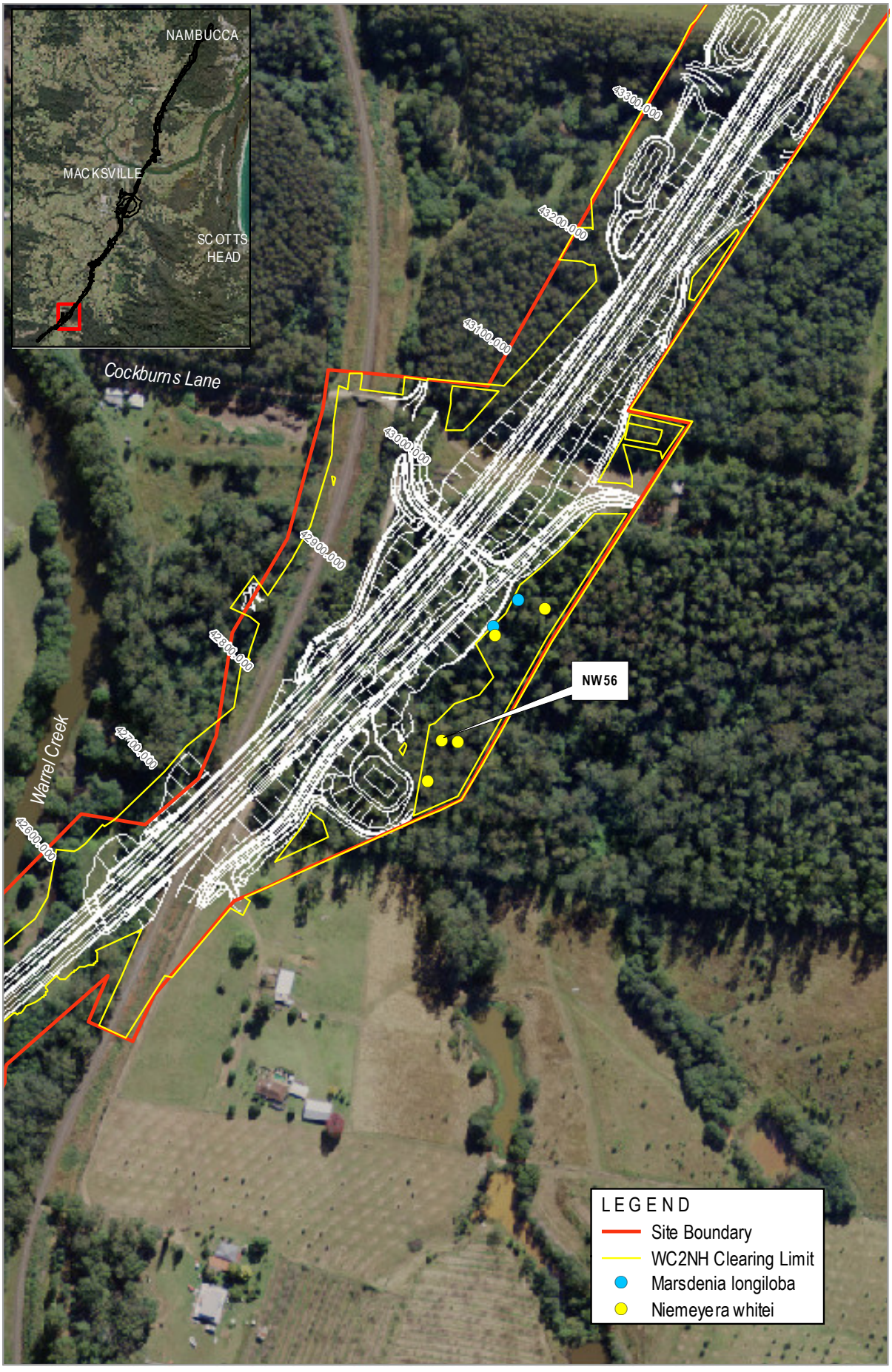
The following identification/ plant condition data was recorded for each in-situ specimen:

- genus/ species;
- plant identification number;
- leaf condition;
- flower/ fruit presence;
- new growth/ shoots;
- recruitment; and
- notes were also made on weed infestations and evidence of any other impacts.

Drawn by: AB Checked by: RE Reviewed by: DGH Date: 13/01/2017

Information shown is for illustrative purposes only

Source of base data: Roads and Maritime Services and Pacifico



0 80

North

In-situ Threatened Flora - Map 1 of 5

GeoLINK environmental management and design

Date: 28 November 2016 Revision: Rev1

2378-1301

Illustration 2.1

Drawn by: AB Checked by: RE Reviewed by: DGH Date: 13/01/2017

Information shown is for illustrative purposes only

Source of base data: Roads and Maritime Services and Pacifico

0 80

North

In-situ Threatened Flora - Map 2 of 5

GeoLINK environmental management and design

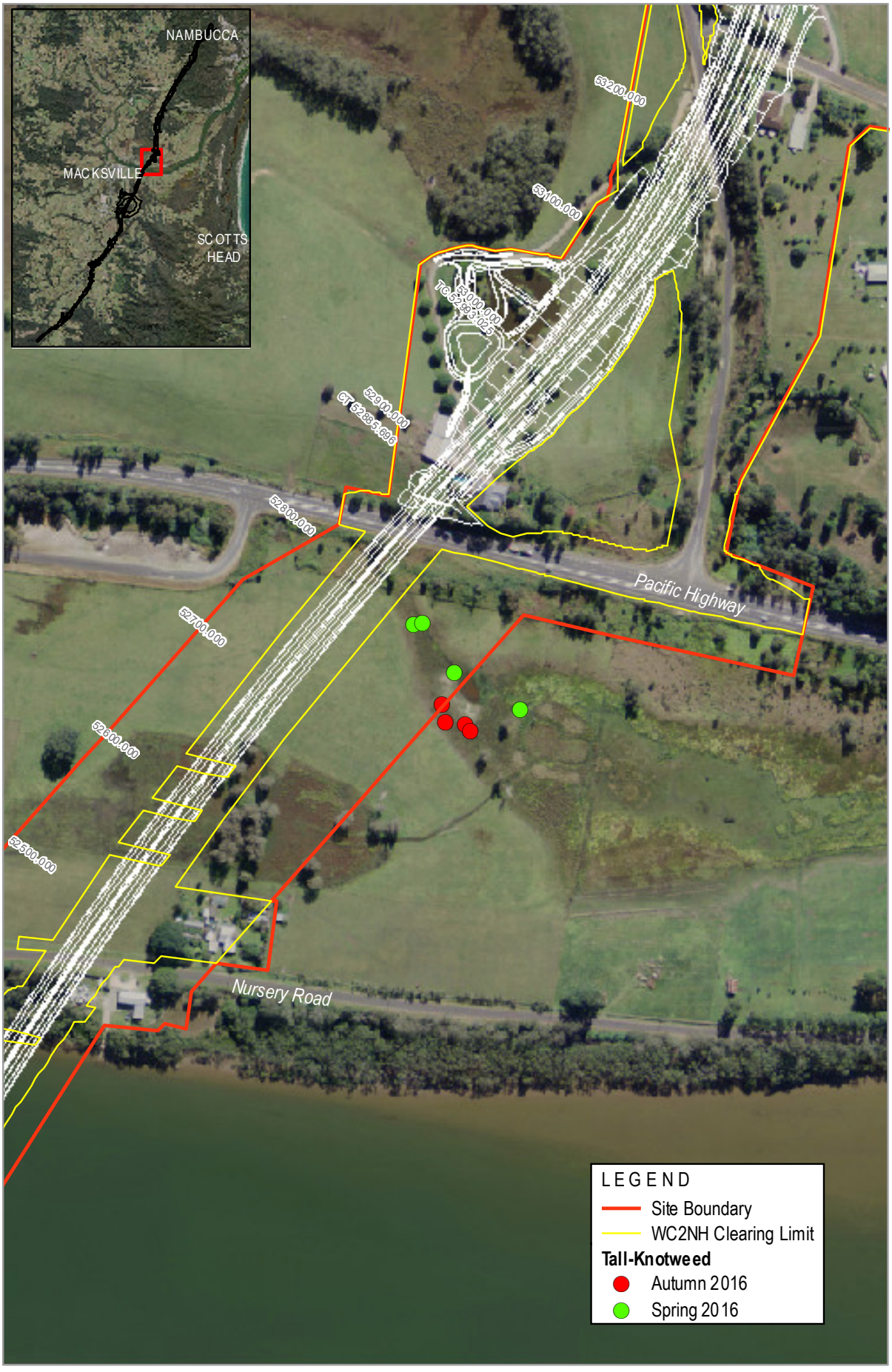
Date: 28 November 2016 Revision: Rev1

2378-1301

Illustration 2.2

Information shown is for illustrative purposes only

Drawn by: AB Checked by: RE Reviewed by: DGH Date: 13/01/2017
Source of base data: Roads and Maritime Services and Pacific



0 80

North

In-situ Threatened Flora - Map 3 of 5

GeoLINK environmental management and design

Date: 28 November 2016 Revision: Rev1

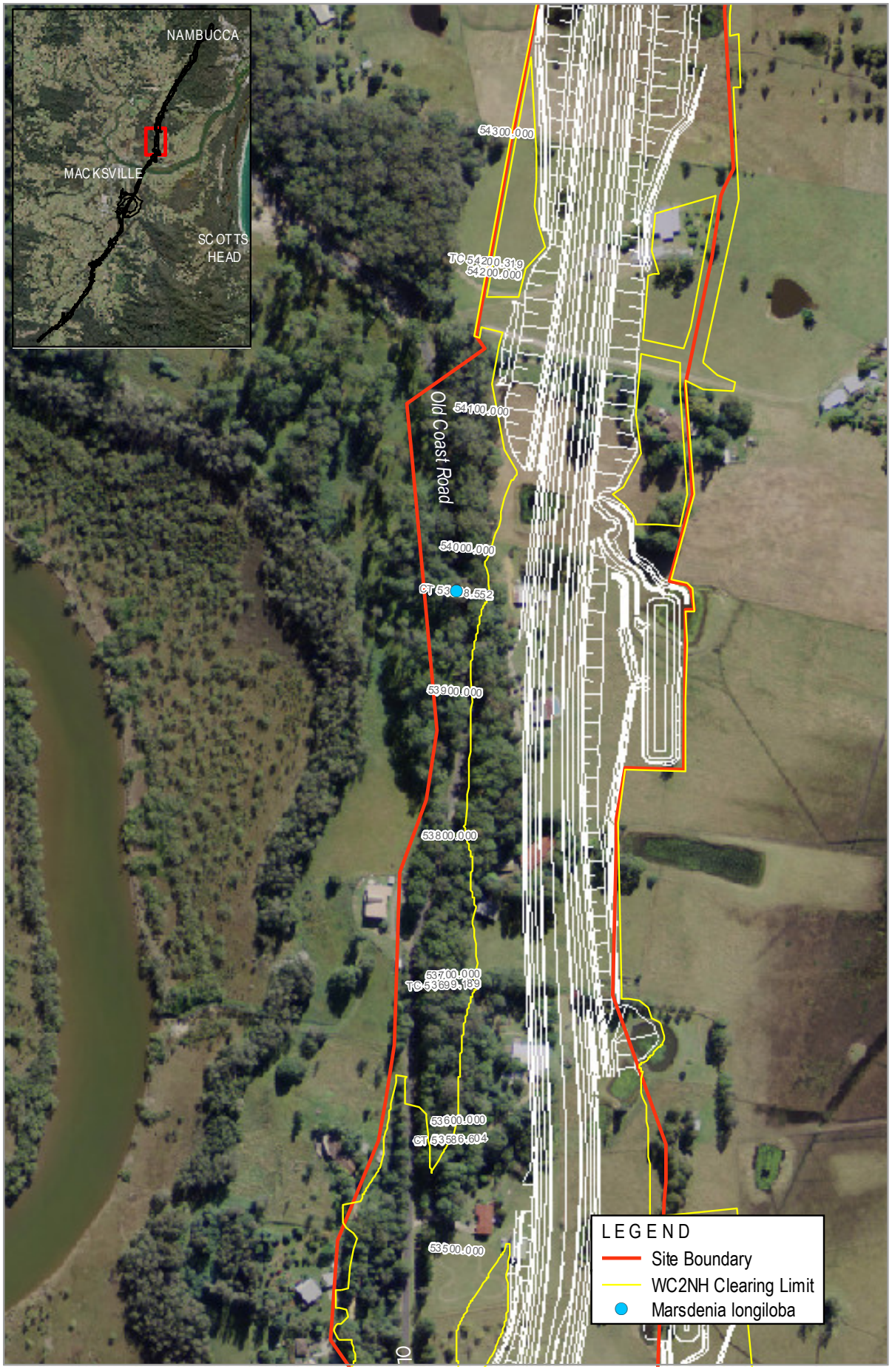
2378-1301

Illustration 2.3

Drawn by: AB Checked by: RE Reviewed by: DGH Date: 13/01/2017

Information shown is for illustrative purposes only

Source of base data: Roads and Maritime Services and Pacific



0 80

North

In-situ Threatened Flora - Map 4 of 5

GeoLINK environmental management and design

Date: 28 November 2016

2378-1301

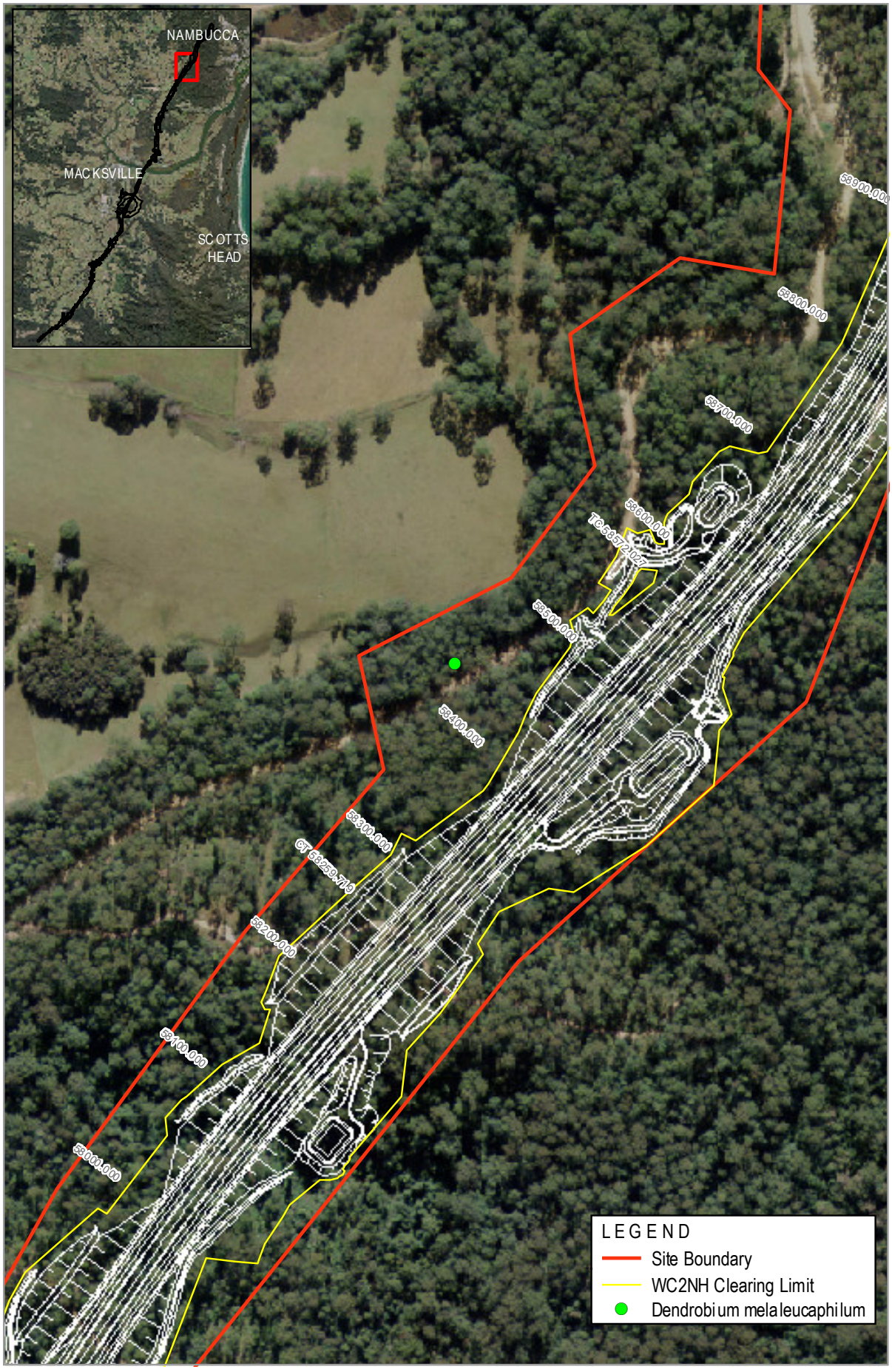
Revision: Rev1

Illustration 2.4

Drawn by: AB Checked by: RE Reviewed by: DGH Date: 13/01/2017

Information shown is for illustrative purposes only

Source of base data: Roads and Maritime Services and Pacifico



0 80

North

In-situ Threatened Flora - Map 5 of 5

GeoLINK environmental management and design

Date: 28 November 2016 Revision: Rev1

2378-1301

Illustration 2.5

3. Results

3.1 In-situ Threatened Flora

Monitoring results for in-situ threatened flora are included below in **Table 3.1**. Key points arising from the second year of monitoring are summarised as follows:

- All Tall Knotweed plants within the monitoring area died back prior to the Autumn 2015 monitoring surveys. A reference population of Tall Knotweed located in the Maclean locality (far north coast of NSW) was surveyed at the same time and was also found to have experienced complete die back during this period.
- New plants were identified within the monitoring area in Autumn 2016 and were again recorded during Spring 2016. This finding appears to be indicative of the natural life cycle of this species suggesting it may have an annual lifecycle. More detailed monthly monitoring of Tall Knotweed over differing seasonal conditions would be necessary to gain a further understanding of the lifecycle of this species. The subject population of this species is persisting in a healthy manner within the monitoring area.
- Favourable growing conditions for Maundia (indicated by generally high rainfall) were present prior to and during construction in 2015. During this period large areas of Maundia were recorded adjacent to the project footprint in the Nambucca floodplain area. This population has remained generally similar (as evidenced by health and abundance) throughout monitoring to date. Recent surveys detected a decrease in cover of Maundia within the Nambucca Floodplain area, most likely linked to drier conditions experienced in the lead up to these surveys. During this time decreased surface water was detected across areas of Maundia floodplain habitat. Similar reference populations in the Woodburn locality (far north coast of NSW) showed similar, apparent seasonal decreases in abundance.
- The population of Maundia within Crouches Creek was removed as part of the diversion of the creek in this location. Although translocation of this species was not prescribed as part of the WC2NH Threatened Flora Management Plan, salvage translocation was attempted within the new alignment of Crouches Creek. This translocation has been successful; the Maundia plants translocated to the creek bed have established and appear in good health.
- The in-situ Spider Orchid specimen remains in a healthy condition with recruitment of an additional individual occurring immediately below this plant on the same tree. The number of pseudobulbs (storage organs) on this plant has increased substantially during recent monitoring events.
- In-situ Rusty Plums in the Cockburns Lane locality remain generally healthy and in good condition, the one exception to this being NW56. This plant continues to show signs of discolouration which are likely due to edge effects associated with its now exposed location. Remediation measures to protect this plant from edge effects are recommended to prevent mortality of this plant. Appropriate mitigation measures will be discussed the WC2NH botanist, Dr Andrew Benwell and will be actioned as soon as possible.
- Slender Marsdenia plants at monitoring locations remain healthy with evidence of new growth. Evidence of regular die back of stems and plants has been a common observation with this species with the origin of stems being difficult due to sharing common rhizomes in some instances. This has made the tracking of individual plants over time problematic. Notwithstanding this, the monitoring to date has demonstrated the perseverance of Slender Marsdenia plants at monitoring locations. A number of additional plants have recently been translocated as part of the approved WC2NH North-facing Ramps project.

Plate 3.1 Recruitment of juvenile Spider Orchid

Plate 3.2 Flowering Maundia on the Nambucca Floodplain Site

Table 3.1 In-situ Threatened Flora Monitoring Results

Tall Knotweed (Persicaria elatior)																															
Plant ID #	***Height (cm)***					***Leaf Condition***					***Flower/ Fruit Present***					***New Growth***					***Recruitment***					***Damage/ Disturbance***					***Notes***
	PC	***Aut***	***Spr***	***Aut***	***Spr***	***PC***	***Aut***	***Spr***	***Aut***	***Spr***	***PC***	***Aut***	***Spr***	***Aut***	***Spr***	***PC***	***Aut***	***Spr***	***Aut***	***Spr***	***PC***	***Aut***	***Spr***	***Aut***	***Spr***	***PC***	***Aut***	***Spr***	***Aut***	***Spr***	
P1	42	-	-	-	-	5	0	0	0	0	Y	N	N	N	N	Y	N	N	N	N	Y	N	N	N	N	N	N	N	N	N	All plants were found to be dead as of Autumn 2015. Recruitment of new plants were recorded from Autumn 2016 as shown below.
P2	56	-	-	-	-	5	0	0	0	0	Y	N	N	N	N	Y	N	N	N	N	Y	N	N	N	N	N	N	N	N	N	
P3	30	-	-	-	-	5	0	0	0	0	Y	N	N	N	N	Y	N	N	N	N	Y	N	N	N	N	N	N	N	N	N	
P4	26	-	-	-	-	5	0	0	0	0	Y	N	N	N	N	Y	N	N	N	N	Y	N	N	N	N	N	N	N	N	N	
P5	35	-	-	-	-	5	0	0	0	0	Y	N	N	N	N	Y	N	N	N	N	Y	N	N	N	N	N	N	N	N	N	
P6	42	-	-	-	-	5	0	0	0	0	Y	N	N	N	N	Y	N	N	N	N	Y	N	N	N	N	N	N	N	N	N	
P7	25	-	-	-	-	5	0	0	0	0	Y	N	N	N	N	Y	N	N	N	N	Y	N	N	N	N	N	N	N	N	N	
P8	18	-	-	-	-	5	0	0	0	0	Y	N	N	N	N	Y	N	N	N	N	Y	N	N	N	N	N	N	N	N	N	
P9	35	-	-	-	-	5	0	0	0	0	Y	N	N	N	N	Y	N	N	N	N	Y	N	N	N	N	N	N	N	N	N	
P10	54	-	-	-	-	5	0	0	0	0	Y	N	N	N	N	Y	N	N	N	N	Y	N	N	N	N	N	N	N	N	N	
New Plants Recorded as of Autumn 2016 (previous plants had died back)																															
P11	-	-	-	50	100	-	-	-	1	5	-	-	-	Y	Y	-	-	-	Y	Y	-	-	-	N	Y	-	-	-	N	N	All plants with minor insect presence but otherwise healthy.
P12	-	-	-	65	40	-	-	-	1	2	-	-	-	Y	N	-	-	-	Y	Y	-	-	-	N	N	-	-	-	N	N	
P13	-	-	-	90	45	-	-	-	3	4	-	-	-	Y	N	-	-	-	Y	Y	-	-	-	N	N	-	-	-	N	N	
P14	-	-	-	90	60	-	-	-	3	4	-	-	-	Y	N	-	-	-	Y	Y	-	-	-	N	N	-	-	-	N	N	

Spider Orchid (Dendrobium melaleucaphilum)																															
Plant ID #	***Length of longest pseudobulb (cm)***					***Leaf Condition***					***Number of pseudobulbs with leaves***					***New Growth***					***Recruitment***					***Damage/ Disturbance***					***Notes***
	PC	***Aut***	***Spr***	***Aut***	***Spr***	***PC***	***Aut***	***Spr***	***Aut***	***Spr***	***PC***	***Aut***	***Spr***	***Aut***	***Spr***	***PC***	***Aut***	***Spr***	***Aut***	***Spr***	***PC***	***Aut***	***Spr***	***Aut***	***Spr***	***PC***	***Aut***	***Spr***	***Aut***	***Spr***	
DM3	30	35	35	35	35	2	2	2	2	3	6	6	7	25	25	Y	Y	Y	Y	Y	N	N	Y	N	N	N	N	N	N	N	Very healthy with signs of increased flowering activity.

Maundia (Maundia triglochinoides)																									
Population	Cover-Abundance					Flower/ Fruit Present					New Growth					Recruitment					Damage/ Disturbance				
	PC	Aut	Spr	Aut	Spr	PC	Aut	Spr	Aut	Spr	PC	Aut	Spr	Aut	Spr	PC	Aut	Spr	Aut	Spr	PC	Aut	Spr	Aut	Spr
*Crouches Creek	20-40%	30-60%	30-60%	-	10-20%	N	Y	N	-	-	N	Y	Y	-	Y	N	Y	Y	-	N	N	N	N	-	N
Nambucca Floodplain	10-20%	70-80%	70-80%	10-20%	20-40%	N	Y	N	N	Y	N	Y	Y	Y	Y	N	Y	Y	Y	Y	N	N	N	N	N

*Notes: * Maundia within Crouches Creek removed as part of creek realignment and temporarily stored during autumn. No requirements for translocation within TFMP however salvage translocation was successfully undertaken.*

Rusty Plum (Niemeyera whitei)																														Notes
Plant ID #	Height (cm)					Leaf Condition					Flower/ Fruit Present					New Growth					Recruitment					Damage/ Disturbance					
	PC	Aut	Spr	Aut	Spr	PC	Aut	Spr	Aut	Spr	PC	Aut	Spr	Aut	Spr	PC	Aut	Spr	Aut	Spr	PC	Aut	Spr	Aut	Spr	PC	Aut	Spr	Aut	Spr	
NW58	700	700	750	750	750	5	5	5	5	4	N	N	N	N	N	Y	Y	Y	Y	Y	N	N	N	N	N	N	N	N	N	N	
NW56	100	100	100	110	120	5	4	4	3	2	N	N	N	N	N	Y	N	N	Y	Y	N	N	N	N	N	N	N	N	N	N	Discolouration of leaves due to being exposed (edge effects).
NW73	600	600	600	600	600	5	5	5	5	4	N	N	N	N	N	Y	N	Y	Y	Y	N	N	N	N	N	N	N	N	N	N	
NW66	400	400	400	420	450	5	5	5	5	5	N	N	N	N	N	Y	Y	Y	Y	Y	N	N	N	N	N	N	N	N	N	N	
NW57	500	500	500	550	600	5	5	5	5	5	N	N	N	N	Y	Y	N	Y	Y	Y	N	N	N	N	N	N	N	N	N	N	

Slender Marsdenia (Marsdenia longloba)																															
Plant ID #	Height (cm)					Leaf Condition					Flower/ Fruit Present					New Growth					Recruitment					Damage/ Disturbance					Notes
	PC	Aut	Spr	Aut	Spr	PC	Aut	Spr	Aut	Spr	PC	Aut	Spr	Aut	Spr	PC	Aut	Spr	Aut	Spr	PC	Aut	Spr	Aut	Spr	PC	Aut	Spr	Aut	Spr	
ML93	5	5	5	12	20	3	3	3	3	3	N	N	N	N	N	N	N	Y	N	Y	N	N	N	Y	Y	N	N	N	N	N	15 plants now within 1 m of subject plant. All healthy.
ML92	5	8	10	8	-	2	2	2	2	-	N	N	N	N	-	Y	N	Y	N	-	N	N	Y	N	-	N	N	N	N	-	These plants were translocated as part of the approved north-facing ramps proposal.
ML140	15	15	20	25	-	2	2	3	2	-	N	N	N	N	-	N	N	Y	N	-	N	N	Y	N	-	N	N	N	N	-	
ML131	5	-	-	-	-	1	0	0	0	-	N	-	-	-	-	N	-	-	-	-	N	-	-	-	-	N	-	-	-	-	
ML132	40	40	50	52	30	3	3	3	2	3	N	N	N	N	N	Y	Y	Y	N	N	N	N	N	N	N	N	N	N	N	N	N	Partially natural die back occurring.
ML72	5	5	8	15	31	2	3	3	3	4	N	N	N	N	N	N	Y	Y	Y	Y	N	N	N	N	N	N	N	N	N	N	
MI138	5	5	5	10	40	2	0	0	2	3	N	N	N	N	N	N	N	N	N	Y	N	N	N	N	N	N	N	N	N	N	
ML63	10	10	10	11	13	2	0	0	2	3	N	N	N	N	N	N	N	N	N	Y	N	N	N	N	N	N	N	N	N	N	

3.2 Slender Marsdenia and Wools' Tylophora Habitat Condition Monitoring

As required within the WC2NH TFMP, monitoring of potential changes in the habitat of Slender Marsdenia and Wools' Tylophora is to be conducted within the indirect impact zone – i.e. within 10 m of the edge of clearing construction. Monitoring is to be conducted in areas of this habitat adjacent to the construction footprint and is to be plot based.

Permanent plots were established in the indirect impact zones at ten representative points in Slender Marsdenia and Wools' Tylophora habitat as mapped by Andrew Benwell in Spring 2010. The plots are 10 m wide and 20 m long, with the long axis parallel to the edge of clearing, as shown in **Illustration 3.1-3.3**. The corners of each plot were marked with pink flagging tape with the GPS co-ordinates of the corners of plots also recorded. Plots were established on 26 November 2015 which was around the time that clearing operations in the northern zone of the project were being completed. Data was collected at the plots again during Autumn (23 - 27 May 2016) and Spring (21 - 13 November 2016). The following parameters were measured at each plot (refer to TFMP **Section 5.4** for more information):

- Native vegetation structure;
- Level of weed incursion; and
- Microclimate class.

A summary of the results of this monitoring is provided in **Table 3.2**. The data to date shows only minor changes in the groundcover strata and to a lesser extent the mid-storey strata. The minor changes in vegetation strata to date have not affected any microclimate class scores for quadrats. To date there are no substantial changes in Wools' Tylophora and Slender Marsdenia habitat occurring adjacent to the clearing boundary as recorded from the monitoring plots. It is envisaged that any substantial changes to the condition/ composition of monitoring plots would be likely to be recorded over a longer time period from the initial disturbance associated with clearing for the project (i.e. in Year 3 or Year 4 of the monitoring program). Further analysis of data will be undertaken at this time if data indicates changes are occurring.

It should be noted that a review of Quadrat 9 (Q9) monitoring location was undertaken due to a recorded increase in the presence of Broad-leaf Paspalum between autumn and spring monitoring (5 - 20%). This species is the dominant groundcover within an area of previously cleared access track located within the northern end of Q9. Based on this review Q9 has been relocated 15 m further south to capture a more representative example of Slender Marsdenia and Wools' Tylophora habitat now excluding the area of previously cleared access track. This has reduced the weed level to <5% weed cover for spring monitoring in Q9.

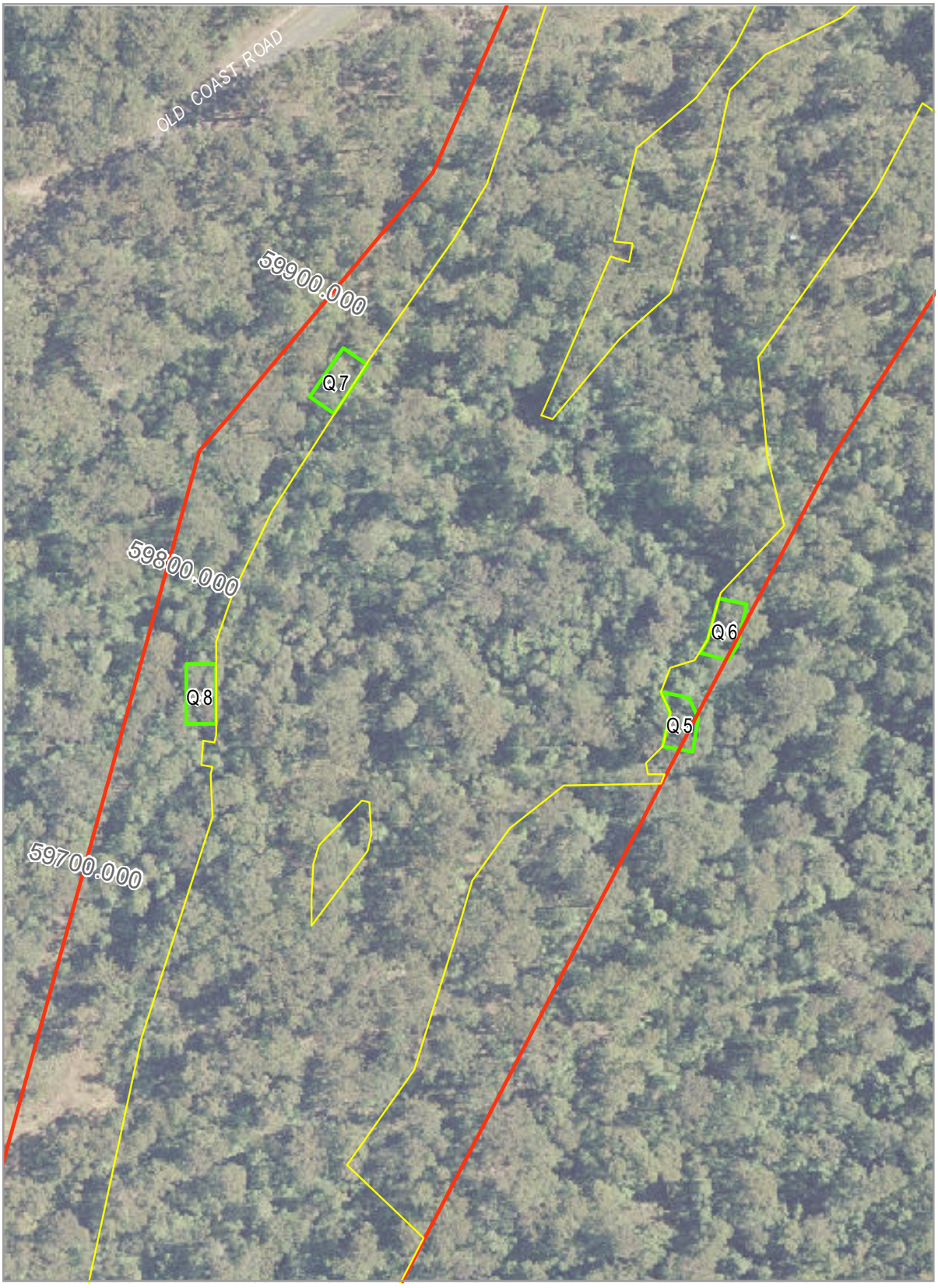
Plate 3.3 Example Habitat Condition Monitoring Plots

Plate 3.4 Example Habitat Condition Monitoring Plots

Drawn by: AB Checked by: RE Reviewed by: JOL Date: 7/12/2016

Information shown is for illustrative purposes only

Source of base data: AFJV



LEGEND

- Project boundary
- Clearing limit
- Quadrat

North

0 40

Slender Marsdenia and Wools Tylophora Habitat Monitoring Locations

GeoLINK environmental management and design

In-situ Threatened Flora Monitoring 2016

2378-1312

Illustration 3.1

Drawn by: AB Checked by: RE Reviewed by: JOL Date: 7/12/2016

Information shown is for illustrative purposes only

Source of base data: AFJV

LEGEND

- Project boundary
- Clearing limit
- Quadrat

North

0 40

Slender Marsdenia and Wools Tylophora Habitat Monitoring Locations

GeoLINK environmental management and design

In-situ Threatened Flora Monitoring 2016

2378-1312

Illustration 3.2

Drawn by: AB Checked by: RE Reviewed by: JOL Date: 7/12/2016

Information shown is for illustrative purposes only

Source of base data: AFJV

LEGEND

Project boundary

Clearing limit

Quadrat

0 40

North

Slender Marsdenia and Wools Tylophora Habitat Monitoring Locations

GeoLINK environmental management and design

In-situ Threatened Flora Monitoring 2016

2378-1312

Illustration 3.3

Table 3.2 Slender Marsdenia and Wools' Tylophora Habitat Condition Monitoring

Quadrat	*Vegetation Structure (dominant species, height, cover)*			*Weed Level*	*Microclimate Class*
	Canopy	*Midstorey*	*Ground cover*		
1	**Flooded Gum, Swamp Turpentine – 25m**	**Red Ash, Brush Box, Swamp Turpentine, Rosewood – 3-8m**	**Blechnum, Cissus, Lomandra, Native Jasmine – 0.5m**	**Lantana**	
Spring 15	5%	50%	40%	<5%	5
Autumn 16	5%	50%	40%	5%	5
Spring 16	5%	45%	45%	5%	5
2	**Swamp Turpentine, Forest Oak, Tallowwood – 20m**	**Callicoma, Red Ash, Brushbox, Rosewood – 3-6m**	**Blechnum, Cordyline, Lomandra, Native Jasmine – 0.5m**	**Lantana**	
Spring 15	15%	60%	10%	<5%	5
Autumn 16	15%	65%	15%	5%	5
Spring 16	15%	65%	15%	10%	5
3	**Swamp Turpentine, Flooded Gum, Iron Bark – 22m**	**Rosewood, Red Ash, Callicoma, Cabbage Palm – 2-10m**	**Blechnum, Lomandra, Native Jasmine – 0.5m**	**Lantana**	
Spring 15	5%	70%	10%	<5%	1
Autumn 16	5%	70%	10%	<5%	1
Spring 16	5%	70%	10%	<5%	1
4	**Flooded Gum, White Mahogany, Swamp Turpentine – 25m**	**Red Ash, Forest Oak, Cabbage Palm, Rosewood -3-8m**	**Cissus, Cordyline, Gahnia, Blechnum – 0.5m**	**No weeds**	
Spring 15	5%	10%	30%	-	2
Autumn 16	5%	10%	30%	-	2
Spring 16	5%	10%	35%	-	2
5	**Ironbark, Brushbox, White Mahogany, Swamp Turpentine – 28m (50%)**	**Forest Oak, Swamp Turpentine, Cabbage Palm, Cordyline – 3-8m (15%)**	**Lomandra, Blechnum, Cordyline – 0.5m (15%)**	**Lantana**	
Spring 15	50%	15%	15%	<5%	5
Autumn 16	50%	20%	15%	<5%	5
Spring 16	50%	20%	15%	<5%	5
6	**White Mahogany, Brush Box, Paperbark – 20m**	**Callicoma, Cabbage Palm, Cordyline, Geebung – 3-8m**	**Lomandra, Blechnum, Cordyline <1m**	**Lantana**	
Spring 15	50%	40%	30%	5%	4
Autumn 16	50%	40%	30%	5%	4
Spring 16	50%	40%	35%	5%	4
7	**White Mahogany – 20m**	**Red Ash, Rosewood, Acacia sp, Leptospermum sp – 2-8m**	**Blechnum, Bracken Fern, Lomandra – 0.5m**	**No weeds**	
Spring 15	10%	25%	50%	-	1
Autumn 16	10%	25%	50%	-	1
Spring 16	10%	25%	50%	-	1
8	**Paperbark, Brushbox, White Mahogany – 18m**	**Cheese Tree, Rosewood, Geebung, Syzygium sp – 2-8m**	**Blechnum, Lomandra, Bracken Fern, Cissus, Cordyline – 0.5m**	**Lantana**	**1**
Spring 15	40%	40%	25%	5%	1
Autumn 16	40%	40%	30%	5%	1

Quadrat	Vegetation Structure (dominant species, height, cover)			Weed Level	Microclimate Class
	Canopy	Midstorey	Ground cover		
Spring 16	40%	40%	30%	7%	1
9	**Tallowwood, Swamp Turpentine, Flooded Gum – 20m**	**Cordyline, Paperbark, Cabbage Palm, Acacia sp – 2-8m**	**Gahnia, Jasmine, Blechnum, Lomandra - <0.5m (25%)**	**Lantana, Broad-leaved Paspalum**	
Spring 15	40%	30%	25%	5%	1
Autumn 16	40%	30%	25%	5%	1
Spring 16*	40%	30%	30%	<5%	1
10	**Flooded Gum – 30m**	**Sandpaper Fig, Red Ash 6-8m**	**Jasmine, Bracken Fern – 0.5m (5%)**	**Lantana <5%**	
Spring 15	5%	30%	5%		4
Autumn 16	5%	30%	10%		4
Spring 16	5%	30%	20%		4

**Denotes change in Q9 location from autumn to spring monitoring as described in Slender Marsdenia and Wools' Tylophora habitat condition monitoring discussion above.*

Authorised by:

GeoLINK

David Havilah Ecologist/ Associate

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Appendix G

Threatened Flora Translocation Area Monitoring Report

Warrell Creek to Nambucca Heads Upgrade of the Pacific Highway

Threatened Flora Translocation Project

Annual Monitoring Report – Year 2

Prepared for:

Pacifico
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5/2/2017

CONTENTS

Cover Plate: Rusty Plum (*Niemeyera whitei*) transplant at Receival Site 1 showing vigorous new shoot growth after two years.

EXECUTIVE SUMMARY

This report describes the implementation and results of threatened flora translocations carried out for the Warrell Creek to Nambucca Heads (WC2NH) upgrade of the Pacific Highway over two years (Feb 2015 to January 2017). The translocation project was implemented by Ecos Environmental for Pacifico (Acciona - Ferrovial joint venture) based on the Warrell Creek to Urunga Threatened Flora Management Plan (ECOS Environmental Ver. 4 (24/12/2014) and Ver. 5 (1/7/2016)). Five threatened species were translocated from the highway corridor to adjoining bushland: *Marsdenia longiloba* (Slender Marsdenia), *Tylophora woollsii* (Woolls' Tylophora), *Dendrobium melaleucaphilum* (Spider Orchid), *Niemeyera whitei* (Rusty Plum) and Floyds Grass (*Alexfloydia repens*). One nationally rare species, *Artanema fimbriata* (Koala Bells) was also translocated.

The translocation project aimed to establish populations of the impacted species in habitat adjacent to the highway corridor. To achieve this aim, the translocation program had three components:

- salvage transplanting of impacted individuals from the construction footprint;
- population enhancement by introduction of additional plants propagated from locally collected seed, to promote population establishment and long-term viability; and
- restoration of good quality habitat to the receival sites.

Potential receival sites were assessed according to physical, biotic and logistical criteria set out in the management plan. Nine receival sites were selected spread out along the road corridor to provide habitat suited to each species and to minimise the distance plants were moved from the donor sites. Eight were in the road reserve and one on adjoining RMS property. Receival sites were selected with a buffer of forest ~20 metres wide within the Road Reserve and with State Forest on the other side, to provide microclimatic protection.

Salvage of impacted plants was carried out by direct transplanting. Two years after translocation, all species had a survival rate greater than 80% with the exception of Koala Bells (see Table 1 below). The overall survival rate of Slender Marsdenia, the main species requiring translocation was 82% (173 individuals translocated). This survival rate is higher than achieved for Slender Marsdenia after two years on NH2U project (71.2%). Plants were transplanted directly to the new sites, watered in and given follow-up watering. Fertilisers were not applied.

Spider Orchid flowered in spring in Year 1 and 2 but no seed pods formed. Koala Bells started to flower a month after transplanting and set seed, then declined in Year 2 apparently due to its short life cycle. A novel approach was used to prepare the receival site for Floyds Grass which was heavily infested with Broad-leaved Pasplaum and other weeds. Ground layer vegetation and the top 10cm of soil containing most of the soil seedbank were stripped off using an excavator, creating largely weed free soil conditions for Floyds Grass to establish in. Nearly all Floyds Grass clumps survived (95%+) and produced substantial growth in Year's 1 and 2.

Assessment of the translocation outcomes after two years according to the performance criteria in Appendix 11 of the WC2U Threatened Flora Management Plan (Ver. 4 24/12/2014) found that all performance criteria had been met.

Table 1: WC2NH threatened flora translocation results – number of plants of each species translocated and percent survival rate after 6 months, 1 year and 2 years to 17/1/2017 (see Excel spreadsheet for all results recorded at each monitoring event).

Species/Receival Site	**Number of plants**	**% survival**		
		Aug 2015 (~6 mths)	**Feb 2016 (~1 Year)**	**Jan 2017 (~2 Years)**
Slender Marsdenia (*Marsdenia longiloba*)				
Receival Site 1 - Cockburns Lane	27	93	93	75
Receival Site 2 (3) – Old Coast Rd	15*	100	91	93
Receival Site 3 (5a) – Old Coast Rd	22	81	81	91
Receival Site 4 (5b) – Old Coast Rd	16	100	94	81
Receival Site 5 (7a) – Old Coast Rd	57	90	90	72
Receival Site 6 (8a) – Old Coast Rd	8	88	75	75
Receival Site 8 (8c) – Old Coast Rd	28	93	100	86
Total	173		91	82
Rusty Plum (*Niemeyera whitei*)				
Receival Site 1 - Cockburns Lane	7	100	100	88
Wooll's Tylophora (*Tylophora woollsii* – unconfirmed)				
Receival Site 6 (8a) – Old Coast Rd	6	100	100	100
Spider Orchid (*Dendrobium melaleucaphilum*)				
Receival Site 5 (7a) – Old Coast Rd	2	100	100	100
Floyds Grass (*Alexfloydia repens*)				
Receival Site 9 – Warrell Creek	54 clumps	100	94	94
Receival Site 9a – Warrell Creek	61 clumps			98
Koala Bells (*Artanema fimbriatum*)				
Receival Site 7 (8b) – Old Coast Rd	16	75	63	25

* increase as additional plants translocated due to design modification

1 INTRODUCTION

1.1 Background

This report documents the implementation and results of threatened flora translocations conducted for the Warrell Creek to Nambucca Heads (WC2NH) project, a 23.6 km section of the Pacific Highway upgrade on the Mid North Coast. The translocations were carried out by Ecos Environmental for Pacifico (Acciona and Ferrovial joint venture), the principal contractor for the WC2NH project. Implementation of the translocations followed the Warrell Creek to Urunga Threatened Flora Management Plan (ECOS Environmental Ver. 4 (24/12/2014) and Ver. 5 (1/7/2016)), as required by condition B7 of the project approval in relation to flora listed in the NSW *Threatened Species Conservation Act* 1995. Referral and approval was also required in relation to threatened plant species listed under the Commonwealth *Environmental Planning and Biodiversity Conservation Act* 1999, as indicated below.

The WC2NH project is the southern half of the Warrell Creek to Urunga section of the Pacific Highway upgrade, the northern half being the Nambucca Heads to Urunga project. Both projects are covered by the Warrell Creek to Urunga Threatened Flora Management Plan (TFMP). The structure of the translocation section of the TFMP was based on the ANPC (2004) guidelines for planning threatened flora translocation in Australia. (The TFMP also deals with management of in situ threatened flora in close vicinity to the new highway.)

Five threatened and one nationally rare plant species were translocated: -

Threatened

- Slender Marsdenia (*Marsdenia longiloba*) (TSC Act, EPBC Act) (Plate 1)
- Woolls' Tylophora (*Tylophora woollsii*) (TSC Act, EPBC Act) (Plate 2)
- Rusty Plum (*Niemeyera whitei*) (TSC Act) (Plate 3)
- Spider Orchid (*Dendrobium melaleucaphilum*) (TSC Act) (Plate 4)
- Floyds Grass (*Alexfloydia repens*) (TSC Act) (Plate 5)

Nationally Rare

- Koala Bells (*Artanema fimbriatum*) (Plate 6)

An additional threatened species *Maundia triglochinoides* (TSC Act) was translocated on the initiative of the principal contractor although this was not required by the Threatened Flora Management Plan.

This is the second annual monitoring report and describes results and implementation of the WC2NH translocation project from February 2015 to January 2017.

1.2 Strategy and Objectives

The overall strategy of the translocation project was to salvage individuals of threatened and rare species from the highway footprint and use these individuals plus additional propagated plants to re-establish compensatory populations adjacent to the highway corridor. To achieve this aim the translocation program had three components:

- salvage transplanting of impacted individuals from the construction footprint into receival sites containing similar habitat to the impact/donor sites;
- population enhancement by introduction of additional plants propagated from locally collected seed, to promote population establishment and long-term viability; and

- restoration of good quality habitat to the receival sites.

The objectives of the translocation project set out in the Warrell Creek to Urunga Threatened Flora Management Plan are as follows:-

- To salvage and re-establish impacted individuals of threatened (TSC/EPBC Act) species.
- To re-establish species at a relocation site in close proximity to the original site with closely matching habitat and long-term security of tenure.
- To enhance the size and genetic diversity of the translocated population by propagation and introduction of individuals additional to those salvaged from the road footprint.
- To maintain good quality habitat to the relocation site(s).
- To preserve individuals of threatened species in situ wherever possible and limit transplanting to plants within the highway footprint and construction buffer.

1.3 Reporting Requirements

The reporting requirements for the annual translocation monitoring report are specified in Section 4.8.5 of the TFMP The table below indicates the sections where reporting requirements are addressed.

Reporting requirement	**Where addressed in the annual monitoring report?**
Background and description of the translocation project;	Section 1, 2 and 3
Implementation of the translocation project;	Section 3
A description of monitoring methods;	Section 3.8
An analysis of monitoring data on a species by species basis;	Section 4
An assessment of causes of plant mortality;	Section 4
A record of the plants transplanted and propagated;	Section 3 Excel spreadsheet appended to report
A description of the population enhancement program;	Section 3
An assessment of the success or failure of the translocation based on criteria set out in the WC2U TFMP Ver.5 (Appendix 11 and Section 4.8.6);	Section 5
An evaluation of the methods and cost-effectiveness of the translocation project; and	Section 5
Work plan for the next twelve months.	Section 5

Plate 1: Slender Marsdenia (*Marsdenia longiloba*) produces umbels of white flowers in the leaf axils. Leaves are similar to Woolls' Tylophora, both species have clear sap.

Plate 2: Woolls' Tylophora (*Tylophora woollsii*) has purplish flowers arranged in a short cymose panicle in the leaf axil.

Plate 3: Rusty Plum (*Niemeyeria whitei*) is a medium sized rainforest tree.

Plate 4: Spider Orchid (*Dendrobium melaleucaphilum*) produces large, vanilla scented flowers in August and September.

Plate 5: Floyds Grass (*Alexfloydia repens*) a rare mat-forming grass found along creeks between Coffs Harbour and Warrell Creek

Plate 5a: Koala Bells (*Artanema fimbriatum*). An annual or short-lived perennial herb found in grassy forest on coastal floodplains.

2 RECEIVAL SITES

2.1 Site Selection

As offset lands had not been designated by the start of construction and residual parcels of RMS land outside the project boundary were generally cleared, selection of translocation receival sites focused on forest habitat within the Road Reserve next to the new highway. The Road Reserve includes all land between the property boundaries of the road corridor, including any strips of forest or other vegetation either side of the road. Where the WC2NU corridor was cleared through Nambucca State Forest, a strip of uncleared forest from 20 to 40+ metres wide generally remained within the Road Reserve next to State Forest after clearing. Small sections of forested road reserve adjoining private property were also available south of Warrell Creek.

Potential translocation receival sites in the Road Reserve were identified by desktop review of aerial photography overlaid with the road design, topography and vegetation communities. Approximately 20 sites were inspected and assessed according to selection criteria in the TFMP (Section 4.3.3; Table 2 below). In terms of number of individuals, Slender Marsdenia was the main species requiring translocation. As this species was impacted at several locations scattered along the full length of highway corridor, several receival sites were selected to maintain a distribution similar to the original one. Nine receival sites were selected, seven in the road reserve where the highway corridor crosses Nambucca State Forest. The other two were in the road reserve at the southern end of the project and on RMS land adjacent to the new highway bridge at Warrell Creek outside the project boundary.

Table 1: Translocation Receival Sites.

Receival Site	Species
1	Slender Marsdenia, Rusty Plum
2	Slender Marsdenia
3	Slender Marsdenia
4	Slender Marsdenia
5	Slender Marsdenia
6	Slender Marsdenia, Woolls' Tylophora(?)
7	Koala Bells
8	Slender Marsdenia
9	Floyds Grass

Receival sites were selected that contained similar habitat to the donor sites. The sites generally contained mature regrowth forest selectively logged 30-50 years ago. Understorey species composition and soil type were similar to the donor sites. All receival sites for Slender Marsdenia and Woolls' Tylophora were selected in moist open forest on lower to mid hill slopes with an east to southeast aspect. Dominant/canopy species included Grey Gum (*E. propinqua*), Ironbark (*E. siderophloia*), Tallowwood (*E. microcorys*), White Mahogany (*E. acmenoides*), Pink Bloodwood (*Corymbia intermedia*), Blackbutt *(E. pilularis*) and Turpentine (*Syncarpia glomulifera*), proportions varying from site to site.

A receival site was selected for Floyds Grass on alluvial soil next to Warrell Creek in semi-intact riparian forest with a weedy understorey of Broad-leaved Paspalum (*Paspalum mandiocanum*) and Lantana. This was the only site available with the requisite soil type and topography typical of Floyds Grass habitat. A novel approach was trialled to remove the Broad-leaved Paspalum and restore native species to the

ground layer, as described belowl. A gully floor site with seasonally waterlogged soil was selected for Koala Bells.

Brief descriptions of the nine receival sites are provided below. Photos of the receival sites are included with the plates at the end of the report.

2.2 Receival Site 1

Receival Site 1 is located in the road reserve on the eastern side of the highway alignment adjacent to Cockburn's Lane at the southern end of the project. The road reserve is relatively narrow at this point and exposed to the west, although timbered on the eastern side, giving reasonable microclimatic protection. The soil type is a red loam formed on a black, glassy rock different to the metasediment geology along the rest of the alignment (Nambucca Beds). Slender Marsdenia and Rusty Plum impacted at Cockburns Lane were translocated to adjacent Receival Site 1 which has the same red loam soil type. A buffer of forest approximately 20m wide separates the receival site from the cleared road corridor.

2.3 Receival Site 2 (3)

(Note – the original numbering for the site selection process is shown in brackets).

Receival Site 2 is located north of the Nambucca River in a strip of forest between Old Coast Road and the highway alignment. The site faces east and is located on a mid slope. A buffer of forest approximately 30m wide separates the translocation area from the cleared road corridor.

2.4 Receival Site 3 (5a)

Receival Site 3 is located on the western side of the alignment in a narrow strip of forested road reserve. As the site adjoins Nambucca State Forest on the western side, which extends upslope for more than 100 metres, the site is relatively protected. The site aspect is east and the topographic position lower-slope. A buffer of forest approximately 15m wide separates the translocation area from the cleared road corridor.

2.5 Receival Site 4 (5b)

Receival Site 4 is located about 100 metres north of site 3 on the other side of a gully which intersects the alignment at right angles (site 3 being on the southern side of the gully). A buffer of forest approximately 30m wide separates the translocation area from the cleared road corridor.

2.6 Receival Site 5 (7a)

Receival Site 5 is located further north between Old Coast Road and the highway alignment, adjacent to the turn-off to the Council waste recycling depot. This site has similar aspect and topographic position to site 3 and is well protected on the western side by a wide strip of Nambucca State Forest between Old Coast Road and the new highway.

2.7 Receival Site 6 (8a)

Receival Site 6 is located a few hundred metres south of where the alignment crosses Old Coast Road just south of Nambucca Heads. The site is located in the road reserve in a narrow strip of forest next to an easement with a fiber-optic cable and water main, close to the road reserve boundary, again on the western side of the

highway. The site aspect is east and topographic position lower slope. There is a forested buffer approximately 20 metres wide between the site and the highway. The site is well protected on the western side by Nambucca State Forest.

2.8 Receival Site 7 (8b)

Receival Site 7 is located about 50 metres south of site 6 in a stand of Paperbark swamp forest on the flat gully floor. This was the only site found with swamp forest vegetation similar to the type of habitat preferred by Koala Bells. Being in a narrow section of the road reserve and close to a utilities easement the site was not ideal, but was the best that could be found within the road reserve. (Note – Koala Bells (*Artanema fimbriatum*) is not a listed threatened species, although regarded as rare and would probably qualify for listing as a threatened if nominated. Translocation of this species was not essential and undertaken more as a pre-cautionary measure. Koala Bells was translocated on other highway upgrade projects because of its rarity.)

2.9 Receival Site 8 (8c)

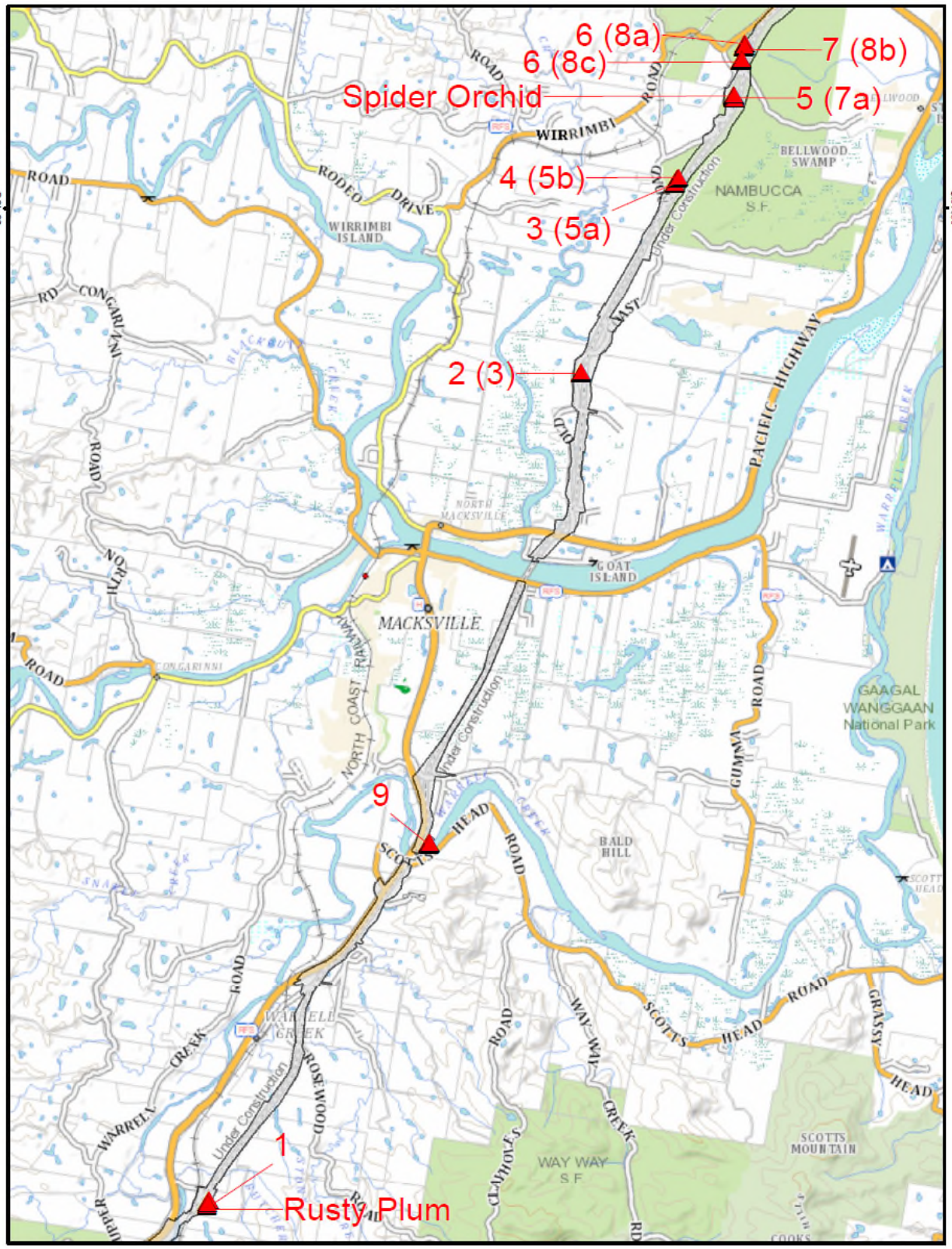
Receival Site 8 is located further south adjacent to the same utilities easement as sites 6 and 7. The site is well protected on the western side by Nambucca State Forest. The site aspect is east and topographic position lower slope. A buffer of forest approximately 30m wide separates the translocation area from the cleared road corridor.

2.10 Receival Site 9

Receival Site 9 selected for Floyds Grass is approximately 100 metres north of the donor site on the northern bank of Warrell Creek. Floyds Grass is usually found in open riparian forest within 30 metres of coastal waterways. Plant communities include swamp sclerophyll forest dominated by Swamp Sheoak (*Casuarina glauca*) and moist open forest dominated by Flooded Gum (*Eucalyptus grandis*), *Melaleuca* spp. and rainforest species, the latter type being found in Receival Site 9. Suitable habitat for Floyds Grass is fairly extensive on the northern side of Warrell Creek, but overrun with Broad-leaved Paspalum (*Paspalum mandiocanum*), which required fairly intensive weed removal and habitat restoration. Two areas were selected for planting at Receival Site 9, each covering approximately 30 m x 20 m. Receival Site 9 is located on RMS land outside the project boundary and has been identified for ecological restoration after the completion of road construction.

Table 2: Site attributes of the nine receival sites selected for translocation of threatened species on the WC2NH project

Receival Site/ Site Attributes	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Physical									
slope aspect (S-south,E-east)	S	E	E	E	E	E	E	E	flat
slope angle (m-low to mod.)	m	m	m	m	m	m	m	m	flat
topographic position	mid	mid	lower	lower	lower	lower	lower	lower	plain
landform	hills	hills	hills	hills	hills	hills	hills	hills	plain
geology (✓ matching donor site)	✓	✓	✓	✓	✓	✓	✓	✓	✓
soil (✓ matching donor site)	✓	✓	✓	✓	✓	✓	✓	✓	✓
proximity to donor site (✓ <1km)	✓	✓	✓	✓	✓	✓	✓	✓	✓
area of potential habitat available (✓ adequate)	✓	✓	✓	✓	✓	✓	✓	✓	✓
Vegetation									
plant community (✓ matching donor site)	✓	✓	✓	✓	✓	✓	✓	✓	✓
threatened species already present (p-possible)	p	p	p	p	p	p	p	p	n
invasive/difficult to control weeds present (y-yes; n-no)	n	n	n	n	n	n	n	n	y
Logistical									
accessibility (g-good; f-fair; p-poor)	g	f	f	f	f	g	g	g	g
available water source (y-yes; n-no; water cart)	n	n	n	n	n	n	n	n	n
distance to water source	kms	kms	kms	kms	kms	kms	kms	kms	kms
likelihood of disturbance during construction (u-unlikely; p-possible)	u	u	u	u	u	u	u	u	u
Tenure/conservation									
land ownership/ protection mechanism	RMS	RMS	RMS	RMS	RMS	RMS	RMS	RMS	RMS
potential disturbance by future road widening (p – possible)	p	p	p	p	p	p	p	p	p
other project conservation uses (y-yes, forest habitat)	y	y	y	y	y	y	y	y	y


6 (8a)
7 (8b)
6 (8c)
Spider Orchid
5 (7a)
4 (5b)
3 (5a)
2 (3)
9
1
Rusty Plum
WIRRIMBI ROAD
RODEO DRIVE
WIRRIMBI ISLAND
BELLWOOD SWAMP
NAMBUCCA S.F.
Under Construction
PACIFIC HIGHWAY
NORTH MACKSVILLE
GOAT ISLAND
MACKSVILLE
NORTH COAST RAILWAY
GUMMA ROAD
GAAGAL WANGGAAN National Park
BALD HILL
SCOTTS HEAD ROAD
WARRELL CREEK
ROSEWOOD
WAY WAY S.F.
SCOTTS MOUNTAIN
GRASSY HEAD
CLAYHOLES
CONGARINNI ROAD
ECOS ENVIRONMENTAL PTY LTD
Receival Sites
WC2NH road corridor
A4 Scale 1:60,000
Receival Sites for the WC2NH Threatened Flora Translocation Project

3 TRANSLOCATION METHODS

3.1 General

Salvage transplanting was carried out in February 2015 before the start of clearing with the exception of Floyds Grass translocated in July 2015. There was minimal risk of frost damage to Floyds Grass by transplanting in winter as the receival site was next to a large water body (Warrell Creek) and there was partial tree cover. All species were translocated by direct transplanting, a method for salvaging wild plants designed to be fast and cost-effective, whilst achieving good survival rates. Excavation, transport and replanting are carried out as quickly as possible. Pruning and thorough watering are essential for good rates of survival. This approach minimises risk of disease and pest transfer to the wild as a result of holding plants in a nursery or exposing transplants to extraneous materials (e.g. soil mixes etc).

Shaded positions were selected for planting, or shade screens were erected if transplants were exposed to full sun. Slender Marsdenia were set out in rows at roughly equal spacing to assist with relocating and monitoring. No fertilisers were applied with the exception of Floyds Grass which was given 'Seasol' twice. This treatment had been applied at Bonville with good results. As the soil surface at the Floyds Grass site was initially bare (see below), the site was lightly mulched with cane mulch to minimise erosion and raindrop compaction. Rusty Plum was mulched with cane mulch and leaf litter was spread over the soil for other species. Translocation methods applied to each species are described in more detail below.

Translocation methods applied to each species are described in more detail below with some general plates showing examples of translocated individuals in Appendix 1.

3.2 Slender Marsdenia

3.2.1 Salvage Transplanting

Transplanting of Slender Marsdenia was carried out by tracing stems to the ground and marking the base with pink tape, then digging out a section of the root system about 40cm wide to a depth of about 20cm with a spade. Usually each mapped point represented more than one stem, each stem being one individual and all were salvaged. The excavated plants and soil were kept wet, transported to the receival site and planted in approximate rows at points pre-marked with pink tape. As clearing had not started, the clearing limit and project boundary were pegged out beforehand by surveyors to ensure plants were not placed in the clearing zone or outside the project boundary.

A total of 169 Slender Marsdenia plants were salvaged and planted at seven of the nine receival sites in Table 1, in February 2015. A few additional plants were translocated in Year 2 due to a design modification for off-ramps adjacent to the southern end of Old Coast Road. Any additional plants found during translocation work not specified in the TFMP were also salvaged. This is no uncommon with Slender Marsdenia as plants are often missed during surveys due to the cryptic nature of the plant.

Water was applied straight after transplanting to saturate the soil then once every second day for a week and once a week for four weeks. Chicken wire cylinders were installed around each individual to prevent damage by animal digging and grazing, to act as a climbing frame and make small plants and fine stems easier to see during

monitoring. Flagging tape was attached to the base of each stem just above the ground to assist with finding an individual if it had died back. Flagging tape with the individual's monitoring number and source identification code as per the TFMP was attached to each wire cage. Multiple individuals from the same mapped flora point were indicated by an additional suffix on the source identification code – e.g. Ml46-7

3.2.2 No use of fertiliser

No fertiliser was applied to Slender Marsdenia transplants on the WC2NH project as previous translocations of this species for the Bonville and NH2U projects indicated that fertiliser (slow release pellets) has an adverse effect on growth and survival. Experimental comparisons of fertiliser and no fertiliser treatments on the NH2U project confirmed that even relatively light applications of slow release fertiliser resulted in depressed plant growth (Ecos Environmental 2016).

By contrast, translocation experience has shown that most other species respond positively to fertiliser application, particularly tree and shrub species, although there are exceptions here also.

3.2.3 Propagation of population enhancement plants

The strike rate of rhizome cuttings of Slender Marsdenia on the NH2U project was less than 10% and the propagated plants grew slowly and lacked vigour. Seed propagation was more successful, as approximately 100 seedlings were propagated from one Slender Marsdenia seed pod. The seedlings grew rapidly in the nursery and after planting-out (Ecos Environmental 2016). Seed propagation was therefore the preferred method of propagation for the WC2NH project, but finding seed pods of Slender Marsdenia has proven difficult. Genetic analysis showed that out-crossing in Slender Marsdenia must occur fairly often, which implies that seed production occurs quite frequently, or used to in the recent past (Shapcott et al. 2016). The apparent rarity of pods could be due to them forming on larger vines in the forest mid-stratum, where the vine plant and any flowers and pods are well camouflaged and hard to see.

On the NH2U and S2W projects, Slender Marsdenia were recorded flowering in November and ripe pods were collected in December (only one pod each project). It is not known if pods form quickly (i.e. one or two months after flowering) or take longer. Large plants of Slender Marsdenia along the Nambucca Heads to Urunga and Sapphire to Woolgoolga projects and in Nambucca State Forest were searched unsuccessfully for pods in December 2016.

Propagation of Slender Marsdenia from seed to seedlings about 30cm tall ready for planting-out takes about 8 months (Ecos Environmental 2016).

3.3 Woolls' Tylophora

3.3.1 Species Identification

Woolls' Tylophora has not been positively identified on the WC2NH project, although a few translocated plants were thought to be possibly this species based on slight hairiness and purplish tinges to the leaves. The leaves of Slender Marsdenia vary in shape and some have leaves similar to Woolls Tylophora, as in Plate 2, a specimen of Woolls' Tylophora photographed during the Bonville project with flowers and leaves. Typical Slender Marsdenia has a more elongated leaf, pinnate venation,

cordate leaf base, paler green colour and is glabrous (without hairs). Woolls' Tylophora has a broader leaf with purplish tinges, tending to 3-veined at base and is sparsely hairy. Woolls' Tylophora from the Bonville project flowered in late August, whereas Slender Marsdenia flowers mainly in November.

About 10 flowering vines were positively identified as Slender Marsdenia on the WC2NH corridor. No flowering plants of Woolls Tylophora have been found so far indicating the latter species if present is rarer than Slender Marsdenia. Woolls' Tylophora if present would have been translocated along with Slender Marsdenia as it was identified as the latter species.

3.3.2 Salvage Transplanting

Woolls' Tylophora(?) was transplanted using the same method applied to Slender Marsdenia as both species are vines with elongated tuberous roots.

Plants identified in the TFMP as possibly Woolls' Tylophora were translocated to Receival Site 8a, which also contains translocated Slender Marsdenia.

3.3.3 Propagation of population enhancement plants

A possible *Tylophora woollsii* plant with one pod was found in the Boambee State Forest in April 2015 during other survey work. This location is a possible source of seed for propagation.

3.4 Rusty Plum

3.4.1 Salvage Transplanting

Tree and sapling sized Rusty Plums were translocated by direct transplanting. The largest Rusty Plums (~10m high) were trenched around to form a soil-root ball about 1 metre wide and 0.7m deep. After undercutting the root ball, the tree was leaned to the side for pruning. The trunk-branch system was cut back at least 50% and all foliage removed. Depending on the size and intactness of the root ball, the trunk was reduced further. Previous transplanting had shown that a good survival rate was dependent on reducing the trunk length to bring the shoot system into balance with the relatively small root ball.

All Rusty Plums were translocated from the footprint at Cockburn's Lane at the southern end of the project. These were transplanted into Receival Site 1 in the Road Reserve. Several in-situ Rusty Plums also remained in the Road Reserve at this location. The transplants received additional watering for a month. Sugar cane mulch was spread around each plant and hessian barriers erected for additional shade as the site is exposed to the afternoon sun. No fertilisers were used.

3.4.2 Population Enhancement

Searches were conducted for seed of Rusty Plum in State Forest in November 2016 at locations where seed has been collected before but were unsuccessful. Rusty Plum produces a large black fruit containing a single seed about the size of a golf-ball, which ripens in November. A large tree in the Coffs Harbour Botanical Gardens that had fruited before was also checked. Lack of seed production in 2016 may be due to intermittent seed production determined by inherent factors, or it may be a response to below average rainfall between August and December 2016.

Approximately 30 Rusty Plums are required for introduction to the road reserve near Receival Site 1.

3.5 Spider Orchid

3.5.1 Salvage Transplanting

Two mature Spider Orchid plants were salvaged from the highway footprint from Prickly Paperbark (*Melaleuca stypheloides*) trees. The orchids were translocated by cutting out the host stem or branch section supporting the orchid. These were tied onto the trunk of rainforest trees in a gully at Receival Site 7a. Apart from watering during transport, no additional watering or other treatments were applied.

3.5.2 Population Enhancement

The TFMP aims to propagate additional Spider Orchid plants for population enhancement. As there are not be enough wild plants to use for vegetative division without depleting populations, it was proposed to propagate from seed. Both of the translocated plants flowered in September 2015 and 2016, but no seed pods were formed. On the NH2U project, one seed pod was formed in a translocated population of 55 Spider Orchids in spring 2016, but the pod opened in November between site visits before the seed could be collected. Further monitoring of flowering and seed production will be carried out in 2017.

3.6 Koala Bells

3.6.1 Salvage Transplanting

Transplanting of Koala Bells was carried out by digging out plants in a block of soil 30-40 cm square with a spade, pruning, and planting into a shaded site and watering. Receival Site 8b was the only site found in the road reserve with habitat similar to the Koala Bells donor sites. Follow-up watering was carried out. No fertilisers were applied.

3.6.2 Population Enhancement

Cuttings of Koala Bells were propagated in summer 2015/2016 at Ecos Environmental's nursery and grown-on in large pots during 2016, as a receival site for the population enhancements had not been finalised. The plants grew rapidly and flowered in summer-autumn 2016, died back over winter then reshot in spring/2016. The regrowth was less vigorous than the first year's growth and small adventitious shoots were also produced around the edge of the pots. Twenty of these plants were introduced to the Floyds Grass receival site (Area 2) at Warrell Creek in January 2017. This site is on alluvial soil and has open ground layer habitat with little competition other plants except Floyds Grass.

3.7 Floyds Grass

3.7.1 Site Preparation

The receival site for Floyds Grass at Warrell Creek was heavily infested with Broad-leaved Paspalum (BLP) and it was necessary to remove this exotic grass before translocating Floyds Grass to the site. Killing BLP with herbicide would still leave the

weed seedbank in the soil to contend with. Follow-up spraying of weed germination was impractical as it was impossible to spray small weeds without hitting Floyds Grass which sends out long runners.

To create conditions suitable for establishment of Floyds Grass, BLP and the uppermost topsoil seedbank was stripped off using an excavator bucket. As the site was on a floodplain with relatively deep topsoil, sufficient depth of topsoil remained for Floyds Grass to establish after carrying out the stripping operation. Preparation of the site was carried out as follows. Firstly, BLP was scrapped off with the excavator bucket. After exposing the soil surface, the top 10cm of soil was scrapped off and placed to the side of the site and flattened out. Topsoil beneath the uppermost 10cm was slightly more clayey in texture, but had reasonable soil texture and drainage. Sed fencing was installed around the site to prevent run-off of sediment to Warrell Creek.

3.7.2 Salvage Transplanting

Small clumps of Floyds Grass approximately 10cm square were dug up with a spade and planted at the receival site. The clumps were watered thoroughly and sugar cane mulch (weed free) spread lightly over the soil surface to prevent raindrop compaction. Follow-up watering was carried out as conditions were dry. 'Seasol' seaweed and fish emulsion fertiliser was applied two weeks after introduction to stimulate growth. As the site was exposed to the afternoon sun, shade-cloth fences approximately 1m high and running N-S were erected to provide additional shade (Plates 35-37).

3.7.3 Population Enhancement

To promote population establishment and long-term viability, approximately 100 additional Floyds Grass plants were propagated and planted out in a second area at Receival Site 9 in March 2016. The plants were propagated from small pieces of runner that broke off plants during transplanting. As Area 2 was more exposed than Area 1 and had little shade, the shade cloth fences erected to protect from the afternoon sun, also had a roof to protect from the overhead sun (Plates 37 & 40). Hand weeding to remove competing exotic and native species was carried out by Pacifico workers under the supervision of the plant ecologist, as in Area 1.

3.8 Monitoring and Data Processing

Each individual was identified by a source identification code as per the TFMP and a monitoring number. Different individuals from the same donor point site were indicated by an additional suffix on the source identification code – e.g. MI46-7

Monitoring of transplants was required every 3 months during the first year and six months in the second year. As the spring monitoring session was missed in year 1, an additional monitoring session was carried out in the second year.

Data were recorded as per Section 3.8 of the WC2U TFMP. The main data fields recorded were as follows:-

> <u>Slender Marsdenia and other species except Spider Orchid:</u> Monitoring Number, Date, Line, Source Label, Species (Translocation Plan Label), Species (Current ID), Condition, Height (cm), New Shoots (Y/N), Comment, sig. growth (+) or sig. dieback (-), Waypoint, Coordinates

Spider Orchid: Monitoring Number, Date, Source Label, Species, Number of pseudobulbs with leaves, Length of the longest pseudobulb, New growth, Condition, Waypoint, Coordinates

All field data can be found in the Excel file appended to this report. Note – the gps coordinates of each translocated individual are provided in the spreadsheets labelled Feb 2016.

The key attribute for evaluating species performance, health and survival is Condition, which was scored on a scale of 0 to 5. The scale is defined slightly differently for different species, as indicated in Tables 3-5 below.

Species Percent Survival is calculated as follows:
number of individuals in condition classes (2+3+4+5/total)*100.

Means species height was averaged over all plants present at the start of monitoring in June 2015. Calculation of mean height at subsequent dates included plants that had died back to ground level (i.e. height = 0; condition class 1).

Table 3: Condition scores applied to Slender Marsdenia and Woolls' Tylophora

Score	Condition
0 dead	dead, no sign of reshooting after 1 year
1 poor	stem died back to ground level, possibly dead; live stem stub may be present
2 fair	plant < 75 cm tall; with leaves or leafless, new shoots/ active growth present or absent
3 good	plant > 75 cm tall, stem with leaves, new shoots/active growth present or absent; if stem leafless or leaves discoloured score as 2
4 advanced	plant > 1.5m tall with > 15 leaves, plant nearing maturity
5 mature	mature; plant flowering or seeding

Table 4: Condition scores applied to Rusty Plum and Koala Bells

Score	Condition
0	dead
1	leafless and no sign of re-shooting
2	pruned foliage retained, or small amount of re-shooting after defoliating, or foliage sparse/discoloured (<40 cm tall Koala Bells)
3	vigorous re-shooting (>40 cm tall Koala Bells)
4	crown recovering, foliage healthy
5	growing actively, flowering or seeding recorded

Table 5: Condition scores applied to Spider Orchid

Score	Condition
0	dead
1	pseudobulbs discoloured/grazed/withering, no new growth
2	pseudobulbs healthy in colour, not withering, no new growth
3	plant small, not many healthy pseudobulbs, new growth occurring
4	several healthy pseudobulbs present, new growth occurring
5	several good sized, healthy pseudobulbs, flowering or seeding recorded

4 RESULTS

4.1 Summary

Two years after translocation, all species had a survival rate greater than 80% with the exception of Koala Bells (Table 6). Survival rates were similar to the NH2U project where all species were translocated except Floyd Grass. Growth and survival of the latter species was similar to the translocation for the Bonville project.

Table 6: WC2NH threatened flora translocation results – number of plants of each species translocated and percent survival rate after 6 months, 1 year and 2 years to 17/1/2017 (see Excel spreadsheet for all results recorded at each monitoring event).

Species/Receival Site	**Number of plants**	**% survival**		
		Aug 2015 (~6 mths)	**Feb 2016 (~1 Year)**	**Jan 2017 (~2 Years)**
Slender Marsdenia (*Marsdenia longiloba*)				
Receival Site 1 - Cockburns Lane	27	93	93	75
Receival Site 2 (3) – Old Coast Rd	15*	100	91	93
Receival Site 3 (5a) – Old Coast Rd	22	81	81	91
Receival Site 4 (5b) – Old Coast Rd	16	100	94	81
Receival Site 5 (7a) – Old Coast Rd	57	90	90	72
Receival Site 6 (8a) – Old Coast Rd	8	88	75	75
Receival Site 8 (8c) – Old Coast Rd	28	93	100	86
Total	173		91	82
Rusty Plum (*Niemeyera whitei*)				
Receival Site 1 - Cockburns Lane	7	100	100	88
Wooll's Tylophora (*Tylophora woollsii* – unconfirmed)				
Receival Site 6 (8a) – Old Coast Rd	6	100	100	100
Spider Orchid (*Dendrobium melaleucaphilum*)				
Receival Site 5 (7a) – Old Coast Rd	2	100	100	100
Floyds Grass (*Alexfloydia repens*)				
Receival Site 9 – Warrell Creek	54 clumps	100	94	94
Receival Site 9a – Warrell Creek	61 clumps			98
Koala Bells (*Artanema fimbriatum*)				
Receival Site 7 (8b) – Old Coast Rd	16	75	63	25

* increase as additional plants translocated due to design modification

4.2 Slender Marsdenia (*Marsdenia longiloba*)

Combining results for the seven Slender Marsdenia receival sites (173 individuals) the survival rate after 2 years was 82%. Survivorship per site varied from 72% to 93% (Table 6).

Data for mean height and frequency of active shoot growth indicate general growth and increase in plant size since the start of translocation in five out of seven sites. In the other two sites, mean height declined or increased slightly (Table 2 – sites 4 and 6). Survival decreased in sites 1, 4, 5 and 8 with loss of ~15-20% of plants since introduction to the receival sites 2 years ago.

Survival increased in sites 2 and 3 as some individuals that had died back to the ground at the end of Year 1 (condition class 1), reshot in Year 2. A small minority of apparently dead plants (condition class 1) reshot again. (Note - an individual was classed as dead (condition class 0) if it died back to the ground and did not reshot after one year.) The percentage of plants in condition class 3 or higher was 30% after 2 years.

There was very little insect grazing of leaves, no disease was recorded, leaf discolouration was occasional and generally preceded leaf fall, and no flowering or seed production were recorded.

Causes of mortality

Mortality since introduction was ~15-20% in four of the seven sites, over two years. In the other three sites, survival was roughly constant or even increased slightly as plants recorded in condition class 1 reshot during the next 6 month period. Mortality generally occurred in small plants in condition class 2, although occasionally taller plants in condition class 3 died back to ground level.

In the first annual monitoring report, possible reasons for mortality included failure to recover from root system damage during transplanting. Mortalities in Year-2, after plants had survived the initial transplanting, were more likely due to processes that are part of the species' natural population dynamics. These include interspecific competition, environmental stresses and inherent demographic processes. An influx of new individuals in natural situations to a population or habitat area will generally be followed by thinning down of the population due to factors that affect survival such as competition, water availability, sun exposure, insect grazing and so on.

Within an area of generally suitable habitat, a central factor determining whether a translocated individual survives or not is the microsite or point at which it happens to be planted. This is particularly the case for small plant species. Natural habitats generally have high microsite heterogeneity. Selection of planting points within a generally suitable area of habitat is a largely random process although ones in the shade, near rooting logs and away from tree trunks etc were preferred. Perhaps this was a mistake and points next to large trees and away from rotting logs would have been better. Regardless of slight biases in choice of site, microsite patterning will be heterogeneous, so a degree of thinning or population decrease over time is inevitable. Naturally occurring Slender Marsdenia populations are very sparse, suggesting that the specific type of microsite favoured by this species is also sparse. Without knowing what the specific indicators of a favourable microsite are, the selection of planting points is essentially a random procedure.

The demographic changes that occur in a cohort of plants over time are summarised as a transition matrix and exhibits as changes in population structure and percent survival over time. Species exhibit different transition matrices depending on life cycle and environmental factors. Environment factors including rainfall and temperature extremes, and the successional state of vegetation, whether open, occupied or closed and preventing colonisation and establishment, have significant effects on establishment. In the case of the Slender Marsdenia translocation, plants were introduced to mature, established forest (with a newly created forest edge nearby). This type of habitat was appropriate for Slender Marsdenia which is a relatively small vine that appears to occur only in the understorey of mature forest and not in disturbed or regenerating forest. By contrast, tree and many shrub species tend to produce a higher survival rate and faster growth if introduced to an open, disturbed site with low inter-specific competition.

Assigning a survival rate as a performance measure (see Table 8) needs to be realistic in terms of the rate of natural thinning or mortality observed in nature populations. Unfortunately, this information is not readily available and guesstimates of what seems reasonable given the species and the type of site must be used

Table 7: Mean height (cm) of Slender Marsdenia transplants 6, 12 and 24 months after translocation (± standard error) and the percentage change in height during this period.

Receival site	n	June 2015 (6 months)	Feb 2016 (12 months)	Jan 2017 (24 months)	% change in height 15/17
Receival Site 1	27	26.51±6.48	39.0±10.43	39.26±10.60	48.1%
Receival Site 2	11	25.64±10.09	60.82±15.50	67.27±13.57	162.4%
Receival Site 3	22	29.29±7.46	49.76±11.16	46.41±9.51	58.5%
Receival Site 4	16	38.69±11.44	47.00±14.84	29.44±9.45	-34.2%
Receival Site 5	57	29.54±3.72	51.74±6.78	47.74±7.62	61.6%
Receival Site 6	8	55.13±22.24	53.00±17.92	60.57±17.55	9.9%
Receival Site 8	28	43.68±6.39	69.57±9.16	50.82±5.29	16.4%
Total	169				

4.3 Rusty Plum (*Niemeyera whitei*)

Seven out of eight transplants survived after 2 years and there was a substantial amount of new shoot growth on larger individuals. Small plants showed some new shoot growth. Withholding mulch from one individual showed that mulching with sugar cane mulch stimulated reshooting and produced much healthier foliage compared with individuals that did not receive mulch. Shadecloth was installed as a result of previous monitoring actions, as recommended in the previous monitoring report.

Causes of mortality

The single mortality was due to Pacifico workers installing a shade cloth shelter and including a roof so the plant was completely enclosed. The shade cloth was dense and let in little light. This appeared to cause a fungal rot as the plant failed to reshoot after removal of the roof.

4.4 Wooll's Tylophora (*Tylophora woollsii* – unconfirmed)

Six possible Woolls' Tylophora in Receival Site 6 were all still alive after 2 years and are in reasonable condition.

Causes of mortality
See Slender Marsdenia above.

4.5 Spider Orchid (*Dendrobium melaleucaphilum*)

The two translocated Spider Orchid plants survived after two years and are in good condition, demonstrating the effectiveness of the minimal disturbance transplanting method used. Both flowered in spring 2015 and 2016, but no seed pods were formed. New pseudobulbs (stem units) have been produced since translocation.

Causes of mortality
No morality recorded.

4.6 Floyds Grass (*Alexfloydia repens*)

The survival rate of 54 clumps of Floyds Grass translocated to Area 1 in Receival Site 9 was the same as the first year annual monitoring (94%). The clumps sent out long runners in first 6-12 months and had coalesced to form a semi-continuous cover after two years in rows 1-3 closest to the creek. In rows 4-7, Floyds Grass was patchier and some section had been overrun by native Ottochloa grass at the 16/1/2017 monitoring. Pacifico is currently weeding out Ottochloa from these sections.

In Area 2 planted in March 2016 (~10 months ago), the clumps have established well with minimal mortality and are sending out runners (Plates 36 and 38).

The results showed that Floyds Grass can rapidly colonise bare soil stripped of other ground layer vegetation and with only a light litter layer. A similar response was recorded on the Bonville project where Floyds Grass was translocated to a site cleared of dense Lantana under Swamp Oak (*Casuarina glauca*) (Ecos Environmental 2013). The growth of Floyds Grass tends to be slowed dramatically when it encounters the native grass *Ottochloa gracillima*. Once Floyds Grass becomes well established as a thick mat it can resist this species. Weeding out competing species is important to get good establishment of Floyds Grass

Causes of mortality
The little mortality recorded were probably due to water and heat stress as the receival site is relatively exposed and there have been long periods of hot dry weather over the last two years.

4.7 Koala Bells (*Artanema fimbriatum*)

The survival rate of Koala Bells in Receival Site 7 was 76% after six months, 63% after one year and 25% after two years, although the later includes several individuals transplanted later by Pacifico to site 7. At least half the transplants flowered and produced seed in Year 1. A fairly rapid decline was recorded in Year 2 similar to the pattern of survival of this species on the NH2U translocation project.

Causes of mortality

Koala Bells generally flowers and sets seed in the first six months, after transplanting in spring or summer, then it gradually dies back in autumn and winter. The plant may die completely or reshoot the following spring. This appears to be the plant's natural life cycle rather than a factor related to translocation. Koala Bells can appear suddenly on disturbed sites such roadsides in State Forest and then disappear. Some populations have been observed persisting for more than one year, so longevity can apparently vary depending on site conditions, but overall Koala Bells is a relatively short-lived species. Observations on translocated plants indicate that plants that survive into the second year often grow from adventitious shoots produced from lateral roots.

Fertiliser addition during translocation appears to speed up the life cycle, causing plants to flower and seed prolifically then die out in the first year, leaving behind dormant seed in the soil. However, no fertilizer was added on the WC2NH project. Receival Site 7 for Koala Bells was not ideal habitat and a possible reason for some of the mortality recorded.

4.8 Maundia (*Maundia triglochinoides*)

Maundia a sedge-like plant found in freshwater swamps and streams is listed as Vulnerable under the TSC Act. This species was originally included in the WC2U TFMP but was taken out as it was not considered to warrant translocation on the Frederickton to Eungai (F2E) project. This was partly because large stands of Maundia were present both within and adjacent to the F2E project in 2012, although earlier targeted surveys conducted during the millennium drought (when the species was first recorded on F2E) found the species was very rare in the same area. Translocation on F2E did not seem to be warranted as the species had built up a large population which extended well beyond the F2E corridor, but also because a previous attempt to translocate Maudia by the Royal Botanic Gardens (Sydney) by propagation of seedlings and planting out had failed (Ecos Environmental 2012).

Smaller occurrences of Maundia were present within the WC2NH corridor and larger stands just outside the alignment. Pacifico undertook translocation of Maundia from the Williamson's Creek bridge site south of Warrell Creek following discussions with Ecos Environmental on the practicality of translocating this species. As Maundia grows from a network of rhizomes in the bottom mud, it was considered feasible to translocate this species by scooping up the plant with its rhizomes with an excavator bucket and depositing them in suitable wetland habitat. If the leaves were damaged the plant would most likey regrow from the rhizomes.

Pacifico initially translocated Maundia to a site downstream of the Williamson's Creek bridge site. The clumps survived and grew, but it became necessary to move them again. This time they were transplanted to a nearby sedimentation basin where the water level was managed to maintain a suitable depth for Maundia. The plants thrived while being held in the sedimentation basin and have since been planted back into Williamson's Creek. Five patches of Maundia have been established over a distance of approximately 30 metres along the creek and plants are growing well (Plate 6). The results show that Maundia can be translocated with a high success rate by direct transplanting of rhizome material and muddy substrate.

Plate 6: Clumps of Maundia (the sword-leaved aquatic plant) reinstated along Williamson's Creek two years after salvaging Maundia from the creek prior to construction of a new bridge and stabilisation of the creek banks.

4.9 Habitat Restoration

4.9.1 Site 9 - Floyds Grass

Habitat restoration was required mainly for the Floyds Grass site covered by dense Broad-leaved Paspalum (BLP). Although the topsoil seedbank was removed, some weed growth occurred from seed blown onto the site, carried on boots etc, or deeply buried seed (particularly *Phytolacca octandra* – Ink Weed). Both exotic and native species regenerating from seed tend to reduce the growth of Floyds Grass by competing for space, light and nutrients. Fortunately, the level of weed regeneration was low after removing ground layer vegetation and the top 10cm of soil, so that it was practical to weed out competing exotic and native species to maintain Floyds Grass expansion.

No maintenance was carried out in first six months after introduction (to February 2016). After six months the most abundant weeds in terms of crown cover were Ink Weed (*Phytolacca octandra*) and Tobacco Bush (*Solanum mauritanicum*). Ink Weed had grown 1-1.5 metres tall and covered most of the site, but caused little if any damage to Floyds Grass, which can grow in the shade or full sun. Other common species included the native grass *Ottochloa gracillima* and herb *Commelina cyanea*. These species germinated at low density but grew rapidly. Ottochloa is difficult to weed out as it produces runners that root at nodes and its leave look very similar to Floyds Grass. Red Ash (*Alphitonia excelsa*) and *Acacia floribunda* also germinated across the site at low density and were removed with other native species. Seedlings of the above species germinated from seed buried deeper than 10cm in soil, possibly by ants. Very little Broad-leaved Paspalum germinated indicating that nearly all of its seedbank had been removed..

Two days of hand weeding by two people were carried out in February 2016 to remove six months of weed and native species regeneration. Ink Weed and Tobacco Bush were removed in a couple of hours by hand pulling. Removal of the native grass Ottochloa and other native herbs took longer. These species would have been left if the aim was simply to regenerate native bush, but as Ottochloa competes strongly with Floyds Grass it is best to remove it.

Swamp Oak (*Casuarina glauca*) in six inch pots were planted over the site three months after introduction. These were heavily grazed by wallabies, killing most of them. The site has now been fenced with chicken wire and star pickets to keep wallabies out. Wallabies did not graze Floyds Grass.

Weeding of the Floyds Grass areas is currently being carried out once ever six months by a team of two people from Pacifico (trained by Ecos Environmental) over 2-3 days.

The pattern of native plant regeneration recorded after removal of BLP, other weeds and the topsoil seedbank to a depth of 10cm indicates how the same method could be used to rehabilitate native vegetation at this location, which has apparently been identified by RMS for ecological restoration after completion of construction.

4.9.2 Site 1 (Rusty Plum and Slender Marsdenia)

Receival Site 1 was moderately infested with Lantana. This has been removed by hand, requiring half a day by one person once a year. Some weed spraying of BLP near the transplanted Rusty Plums was also carried out.

5 ASSESSMENT

5.1 Introduction

This section assesses the outcomes of the WC2NH translocation project after two years according to performance criteria in Section 4.8.6 and Appendix 11 of the Warrell Creek to Urunga Threatened Flora Management Plan Ver. 5 (1/7//2016) (TFMP).

5.2 Performance Assessment

Table 8: Assessment of outcomes of the threatened flora translocation project after two years according to performance criteria in TFMP.

Project Phase	**Were Performance Criteria Met?**
Pre-construction phase (Appendix 11, Table 1)	
• Salvage translocation (transplanting) of all directly impacted threatened flora completed according to the TFMP, Sections 4.5, 4.6 & 4.7.	Yes - all directly impacted individuals were translocated, including all tagged individuals and additional individual found during pre-translocation surveys and while transplanting
• No loss or damage to threatened flora occurs prior to translocation being implemented.	Yes - no loss or damage prior to translocation
Construction phase (Appendix 11, Table 2)	
• All translocation actions required during the construction phase are implemented including monitoring and preparation of the annual monitoring report.	Yes – maintenance, monitoring and reporting implemented. The monitoring schedule was changed from four times in Year 1 and twice in Year 2 to three times in both years in Ver. 5 of the TFMP.
• Annual monitoring report provides full description of management plan implementation and results, as per the required contents in Section 4.8.5, and an evaluation of outcomes according to criteria listed in Section 4.8.6 of the TFMP.	Yes - annual reports including detailed descriptions of plan implementation, results and an evaluation of outcomes according to criteria in the TFMP were prepared.
Summary (Appendix 11, Table 4)	
1. All recorded directly impacted individuals are translocated.	Yes
2. At least 60% of transplant and enhancement individuals are surviving after the first year, 50% after five years and 40% after eight years.	Yes – survival rate greater than 60%
3. At the end of the monitoring program at least 50% of surviving individuals have a Condition Class of 3.	not applicable yet

5.3 Evaluation of Methods and Cost-effectiveness

The translocation methods applied for the WC2NH threatened flora translocation achieved relatively high survival rates for all species after two years (>80%) for all threatened species. The general approach to translocation was based on the ANPC guidelines for the translocation of threatened plants in Australia (ANPC 2004). Methods were developed for WC2NH taking into consideration the results of previous translocation projects involving the subject threatened species, including the NH2U, Bonville and S2W threatened flora translocation projects.

Methods were applied that aimed to achieve a satisfactory translocation outcome while keeping costs to a reasonable level. A full evaluation of the costs of the project would require an analysis of input to the threatened flora translocation project by ECOS Environmental, Geolink and Pacifico which is beyond the scope of this report.

5.4 Work Plan for Year 3 (February 2017 – February 2018)

Task	**Time**
Monitoring	
Monitoring (once a year)	November 2017 (to coincide with flowering of Slender Marsdenia and Rusty Plum)
Population enhancement	
Seed collection Rusty Plum	November 2017
Seed collection Slender Marsdenia and Woolls Tylophora – if possible	December 2017 possibly into 2018 if pods not ripe
Seed collection Spider Orchid – if possible	November - December 2017
Maintenance	
Weeding – Floyds Grass site	May 2017, November 2017
Reporting	
Supply monitoring summary	November 2017
Prepare Year-3 annual monitoring report	January 2018

6 REFERENCES

ANPC (2004). Guidelines for the Translocation of Threatened Plants in Australia. 2nd Edition. Australian Network for Plant Conservation.

ECOS Environmental (2013). Bonville Threatened Flora Translocation Project - Final Monitoring Report (No. 5). Report prepared for Lend Lease Infrastructure.

ECOS Environmental (2012 ver.5) Pacific Highway Upgrade Frederickton to Eungai *Maundia triglochinoides* Field Survey and Assessment. Report to Lewis Ecological Surveys.

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ECOS Environmental (2016). Nambucca Heads to Urunga Threatened Flora Translocation Project – Annual Monitoring Report Year-3. Report prepared for Lend Lease Infrastructure.

Shapcott, A, Lamont, R, O'Connor, K, James, H and Benwell, A. (2016). How is genetic variability in the endangered rainforest vine *Marsdenia longiloba* (Benth:Slender Marsdenia) distributed at different geographic scales? Botanical Journal of the Linnaen Society.

APPENDIX 1: Photographs (Plates 7-40) of the translocation receival sites and translocated individuals taken in January 2017 at the 2-Year monitoring visit.

Plate 7: Receival Site 1 in the Road Reserve at the southern end of the project. Moist open forest with a leaf litter and light fern dominated ground layer. 16/1/2017

Plate 8: Receival Site No. 1. Plant no. 14. A small shoot of Slender Marsdenia. 16/1/2017

Plate 9: Receival Site No. 1. Plant no. 15. Slender Marsdenia climbing wire cage. 16/1/2017

Plate 10: Receival Site No. 1. Plant no. 21. Small shoot of Slender Marsdenia. 16/1/2017

Plate 11::Receival site no. 1, Rusty Plum reshooting vigorously from trunk pruned down to 1.3 metres after the tree was excavated with little root ball. 16/1/2017

Plate 12 : Receival site no. 1, small Rusty Plum with new growth. 16/1/2017

Plate 13: Receival site no. 2 adjacent to Old Coast Rd, highway corridor in background. Wire cages contain transplanted Slender Marsdenia. 16/1/2017

Plate 14: Receival site no. 2, plant no. 2, Slender Marsdenia climbing out of wire cage. This site is relatively exposed to NE to SE winds due to the cleared road corridor, but there are no obvious adverse effects on Slender Marsdenia. 16/1/2017

Plate 15: Receival Site no. 3 habitat showing same type of open litter and fern covered ground layer in moist open forest favoured by Slender Marsdenia. 17/1/2017

Plate 16: Receival site no. 3, plant no. 13. Small shoot of Slender Marsdenia. 17/1/2017

Plate 17: Receival site no. 3, plant no. 18. Slender Marsdenia. 17/1/2017

Plate 18: Receival site no. 5 adjacent to Old Coast Rd. Habitat overview. 17/1/2017

Plate 19: Receival site no. 5, plant no. 4. Slender Marsdenia climbing out of cage. A long thin leader stem can be seen drooping down to the left. Leaders die back if they cant find something to grasp onto so they can climb higher. 17/1/2017

Plate 20: Receival site no. 5, plant no. 5. The other identifier is the source/donor site code. 17/1/2017

Plate 21: Receival site no. 5, plant no. 8. Another plant consisting of a small shoot, generally produced after a previous stem died back. 17/1/2017

Plate 22: Receival site no. 5, plant no. 23 consisting of two small shoots produced after a previous stem died back. 17/1/2017

Plate 23: Receival site no. 5, plant no. 40. A fine leader stem can be seen ascending into the vegetation above. 17/1/2017

Plate 24: Receival site no. 5. The larger of two Spider Orchid clumps translocated to site 5. The plant consists of numerous angled pseudobulbs produced on wiry stems, with a pair of leaves at the end. Flowers are produced from the apex between the leaves. The section of branch/stem of the host tree supporting the orchid plant and its roots that extend for some distance along the stem was tied onto the trunk of a rainforest mid-stratum tree in a shaded gully with nylon rope. 17/1/2017

Plate 25: Receival site no. 6 for Slender Marsdenia and Woolls Tylophora, habitat overview. 17/1/2017

Plate 26: Receival site no. 6, plant no. 4, possible Woolls Tylophora. 17/1/2017

Plate 27: Receival site no. 6, plant no. 6. 17/1/2017

Plate 28: Receival site no. 6, plant no. 7. 17/1/2017

Plate 29: Receival site no. 7, Koala Bells, habitat overview, translocated plants on left hand side. 17/1/2017

Plate 30: Receival site no. 7, Koala Bells with flower buds. 17/1/2017

Plate 31: Receival site no. 8, habitat overview. 17/1/2017

Plate 32: Receival site no. 8, plant no. 14. Slender Marsdenia with long leader arching down over top of cage which has stopped growing and died off (turned brown). 17/1/2017

Plate 33: Receival site no. 8, plant no. 20. Slender Marsdenia

Plate 34: Receival site no. 8, plant no. 21

Plate 35 :Receival site no. 9 for Floyds Grass, Area 1, habitat overview. 17/1/2017

Plate 36:Receival site no. 9 for Floyds Grass, Area 1. Rows 1-3 closest to the creek on the left hand side had a good cover of Floyds Grass after 1.5 years. 17/1/2017

Plate 37: Receival site no. 9 for Floyds Grass, Area 2, habitat overview. 17/1/2017

Plate 38 :Receival site no. 9 for Floyds Grass, Area 2. Floyds Grass runner extending from pink tag to under shade cloth to the right after 9 months. 17/1/2017

Plate 39: Receival site no. 9. One year old Koala Bells plant introduced to site 9 in January 2017.

Plate 40: Receival site no. 9, Area 2. Koala Bells planted in a row marked by bamboo stakes with Floyds Grass. 17/1/2017.

Appendix H

Landscape Rehabilitation Monitoring Report Summer 2017 (Spring 2016 and Summer 2017 Results Comparison)

Landscape Rehabilitation Monitoring Report – Summer 2017

WC2NH Pacific Highway Upgrade

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Prepared for: Pacifico

Certification

	Name	***Signature***	***Date***
Prepared by	Ian Colvin		27/02/2017
Reviewed by	Jessica O'Leary		28/02/2017

UPR	***Description***	***Date Issued***	***Issued By***
2378-1336	First issue	28/02/2017	JOL

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1. Introduction and Background

1.1 Introduction and Background

GeoLINK has prepared this *Landscape Monitoring Report* on behalf of Pacifico as part of the Warrell Creek to Nambucca Heads (WC2NH) Pacific Highway upgrade. This report is the second *Landscape Monitoring Report* completed to date, with a baseline *Landscape Monitoring Report* prepared December 2016 (GeoLINK ref. 2378-1308) for the spring monitoring period in 2016.

Landscape Monitoring Reports are required under the approved Ecological Monitoring Program (Benchmark Environmental Management 2014) for the WC2NH project, where Section 2.5 prescribes the following broad actions:

Landscape rehabilitation

Relevant EA and management plan mitigation measures include:

- *Chapter 10 Section 10.5.1.1 - Revegetation/rehabilitation of the site should be conducted progressively during the construction phase to ensure the use of collected topsoil and seed and to develop different successional stages of rehabilitation;*
- *Chapter 10 Section 10.5.1.1 - A weed management plan is to be prepared as part of the flora and fauna management sub plan, outlining weed management actions to be carried out during construction to prevent the spread of weeds and plant pathogens;*
- *Chapter 10 Section 10.5.2 - Native and locally indigenous plants will be used in the landscaping and disturbed areas will be progressively revegetated;*
- *Chapter 10 Section 10.5.2 - Weeds in areas disturbed by construction activities will be managed for a minimum of two years after construction completion;*
- *Chapter 10 Section 10.5.4 - Development of a rehabilitation and weed control strategy as part of the construction environmental management plan, with specific mitigation measures for control of the spread of weeds and habitat rehabilitation, particularly along roadside verges, adjacent to culvert entrances and bridge pylons;*
- *Chapter 10 Section 10.5.4 - A protocol be developed for weed infested areas to ensure that all potential weed propagules from soil and vegetative material are appropriately disposed of;*
- *Chapter 10 Section 10.5.5 - Roadside verges will be rehabilitated adjacent to culvert entrances and bridge pylons; and*
- *Koala Management Plan Section 6.3.2 - Habitat rehabilitation works will be conducted within areas identified for additional koala habitat/connectivity.*

In order to comply with MCoA B21(c) the contractor will prepare and implement an Urban Design and Landscape Plan (UDLP) for the project. The UDLP will include locations along the project corridor directly or indirectly impacted by the construction of the project (e.g. temporary ancillary facilities, access tracks, watercourse crossings, etc.) that are proposed to be actively rehabilitated, regenerated and/or revegetated to promote biodiversity outcomes and visual integration. The UDLP will provide details of species to be replanted, including their appropriateness to the area and considering existing vegetation and habitat for threatened species.

Review of Roads and Maritime Vegetation and Landscaping Schedules (R178 and R179 respectively) and the specifications in Section 5.7.2 of the adopted *Pacific Highway Upgrade Warrell Creek to Nambucca Heads Detail Design*[1] report (Spackman Mossop Michaels 2016) the following matters are required for Landscape Rehabilitation Monitoring as part of the Ecological Monitoring Program:

1. *A colour coded and annotated map detailing the treatments applied, including:*

    - *Treatment type and date of application/treatment for each lot/area*
    - *Noting where cover crop has been applied to each area*
    - *Seed or planting mix type (native) applied for each area*
    - *Topsoil media component mix % for each area (topsoil, integral shredded mulch, other ameliorants)*
    - *Fertilizer application rates and types for each area. Ensure application is not carried out in a manner that could contaminate drainage lines*
    - *Details of any herbicide application for each area in accordance with R178. Ensure application is not carried out in a manner that could contaminate drainage lines*
    - *Details of any weed removal (by hand) including location. To be plotted on a map.*

2. *Photo points – Ensure photos are taken monthly at the established monitoring locations (plotted on map with GPS coordinates and marked onsite with a colour coded stake). Data obtained is to be used to:*

    - *Monitor progress of rehabilitation works and record using photo points*
    - *Modify treatments and identify areas requiring further attention*
    - *Erect signage in accordance with R178 and R179*
    - *Details of any seed suppliers (name, address, etc.) used (native and cover crop) and*
    - *Details of seed certification or seed treatment by the supplier.*

To enable effective monitoring of the landscape sites, Pacifico have selected 12 monitoring locations as follows:

1. Seed Mix 1 (Fill or Cut Embankment) - South
2. Seed Mix 2 (Fill Embankment) - South
3. Seed Mix 3 (Cut Batter) - South
4. Seed Mix 4 - Fill 19 EAST Rehabilitated Stockpile
5. Seed Mix 5 (Vegetated Drainage Swale) - South
6. BRC - North CC05
7. BRC - North CC05
8. BRC - North CC04
9. BRC - North CC04
10. Williamson Creek - Landscape Planting
11. Stoney Creek - Landscape Planting
12. Butchers Creek - Landscape Planting.

[1] The *Urban Design and Landscape Plan (UDLP) referred to in Section 2.5 of the* Ecological Monitoring Program.

Descriptions of each of the three treatment methods are as below:

- Seed Mix: A range of seed mix treatments (via hydromulching) have been prescribed, including:
  - Seed Mix 1 - hydromulching
  - Seed Mix 2 - hydromulching
  - Seed Mix 4 – direct seeding
  - Seed Mix 3 - hydromulching
  - Seed Mix 5 - hydromulching.
- BRC (Bushland Reconstruction): Bushland reconstruction requires a mix of bushland topsoil media, integrated shredded mulch, seed and ameliorants; the ratio required for this mix requires a maximum of 40% shredded mulch. The species included in the BRC mix comprise:
  - *Acacia longifolia* @ 0.25 kg/ha
  - *Acacia floribunda* @ 0.25 kg/ha
  - *Acacia fimbriata* @ 0.25 kg/ha
  - *Cymbopogon refractus* @ 1 kg/ha
  - *Hardenbergia violacea* @ 1 kg/ha
  - *Themeda australis* @ 1 kg/ha.
- Landscape plantings: Indigenous species suited to the bioregion.

A summary of the monitoring sites is shown at **Table 1.1**. A summary of the details of the seed mixes and BRC requirements as per the adopted *Pacific Highway Upgrade Warrell Creek to Nambucca Heads Detail Design* report (Spackman Mossop Michaels 2016) is provided at **Appendix A**.

Table 1.1 Summary of Monitoring Sites and Treatments

Site	ID	Seed Mix	BRC	Landscape Planting
1	Seed Mix 1	✓		
2	Seed Mix 2	✓		
3	Seed Mix 3	✓		
4	Seed Mix 4	✓		
5	Seed Mix 5	✓		
6	BRC – North CC05		✓	
7	BRC – North CC05		✓	
8	BRC – North CC04		✓	
9	BRC – North CC04		✓	
10	Williamson Creek			✓
11	Stoney Creek			✓
12	Butchers Creek			✓

1.2 The Site

The site (i.e. WC2NH) comprises the approved Pacific Highway upgrade alignment between Warrell Creek and Nambucca Heads, which covers approximately 19 km between chainages 41600 and 61300. The landscaping works were initiated in April 2016.

The site is depicted at **Illustration 1.1**.

1.3 Monitoring Frequency

This report presents the second monitoring event of the landscape rehabilitation works and represents the summer period for year 2 of construction. Dates of monitoring completed to date are summarised as follows:

- Construction year 2: spring 2016 monitoring (monitored 22/11/2016; report reference 2378-1308)
- Construction year 2: summer 2016/17 monitoring (monitored 15/02/2017; report reference 2378-1336 **[this report]**)

Landscape monitoring frequencies during the construction phase of the WC2NH upgrade are summarised at **Table 1.2**.

Table 1.2 Summary of Monitoring Frequency (Construction Phase)

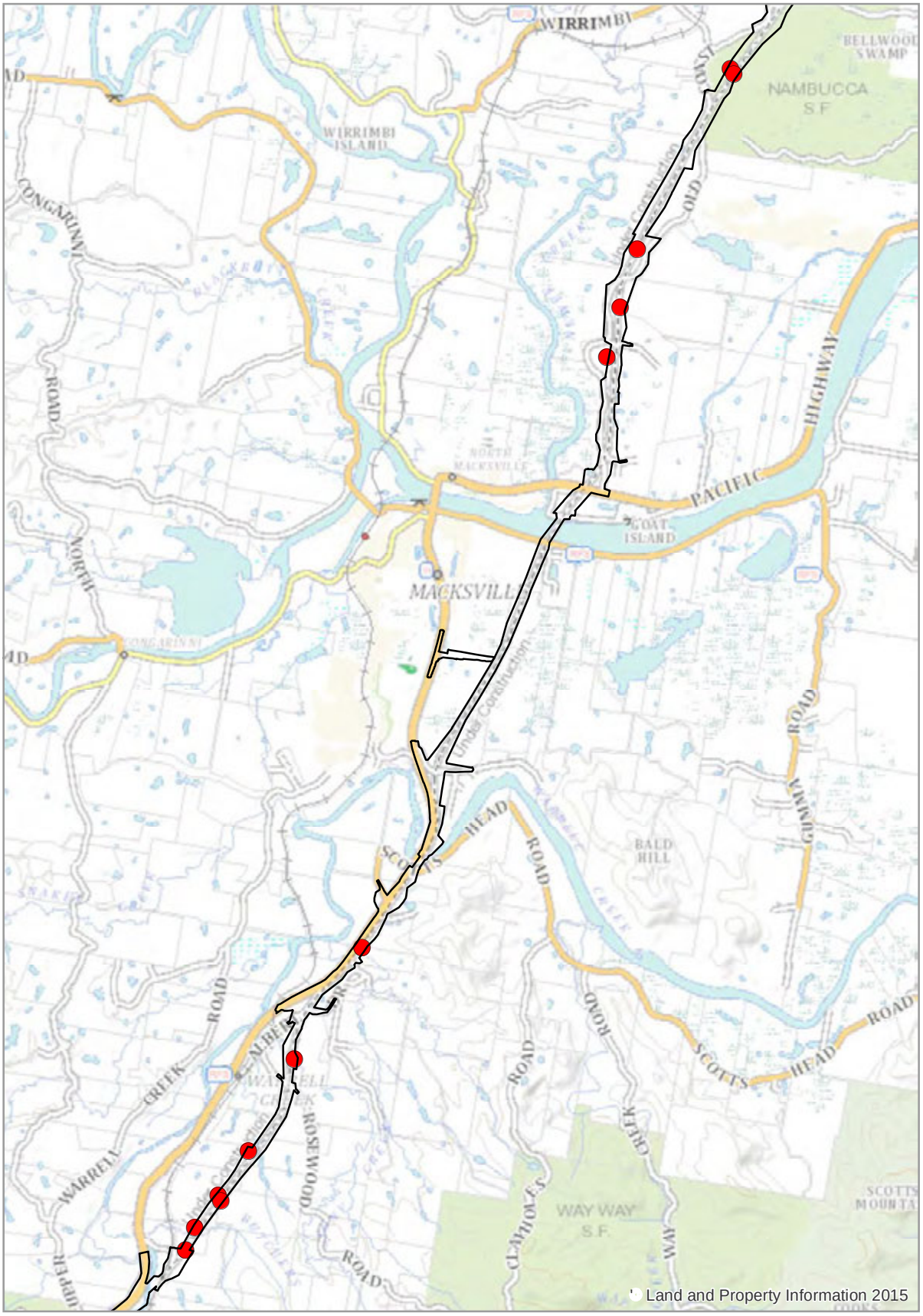
Construction Year	*Spring*	*Summer*	*Autumn*	*Winter*
2	✓ **(complete)**	✓ **(this report)**		
3	✓	✓	✓	✓
4			✓	✓

Future monitoring and reporting will occur for a further six events during the construction period with the next monitoring event due in autumn 2017 within the year 3 construction period.

In addition to the monitoring requirements, monthly photographic assessments of each monitoring site are also required, to be included within each seasonal report.

Information shown is for illustrative purposes only

Drawn by:AB Checked by: RE Reviewed by: ILC Date: 30/11/2016
Source of base data: Six Maps



LEGEND

Project boundary

Landscape monitoring site

0 1.5 Km

North

Site Locality

GeoLINK environmental management and design

Landscape Monitoring Report
2378-1305

Illustration 1.1

2. Methodology

A standardised monitoring methodology was utilised for this assessment and was the same as for the spring 2016 baseline assessment, as follows:

- Monitoring of permanent 50 m monitoring transects at each of the 12 monitoring sites using a 50 m tape measure and installation of a white wooden stake at each end of the transect. The transect locations are typically aligned along the face of each batter (usually in a north-south alignment). Monitoring site details are written on each stake at each location for easy identification and flagging tape tied to each post. Each marker post has been surveyed by GPS.
- A photograph was taken from one of the marker stakes along the transect. Photographs were taken looking to the north at monitoring sites located north of the Nambucca River and typically looking south at sites located to the south of the Nambucca River (refer to photograph descriptions at **Section 3.3**).
- Collection of data based on field proforma as follows:
  - Treatment percent cover.
  - Braun Blanquet cover class score (refer to **Table 2.1**).
  - Weed species present.
  - Details on plant species present (included in plant mix).
  - Details of plant species present (not included in plant mix).
  - Signs of stress, predation or disease.

Table 2.1 Braun Blanquet cover score classes

Score	*Cover Class*
1	<5 %
2	5-25 %
3	25-50 %
4	50-75 %
5	>75 %

Field assessment was completed by GeoLINK ecologists on 15/02/2017. At each monitoring site the transect was walked down one side and back the other with a width of two metres on each side assessed (total transect area of 200 m²) recording information as detailed above.

Following collection of field data and photographs, information was entered into a summary spreadsheet. Additional information relating to the landscaping application was also sought from Pacifico and included:

- Treatment type and application.
- Seed supplier details.
- Areas requiring further treatment.
- Date of application.
- Topsoil or media component mix %.
- Fertiliser application rates.
- Details of herbicide application (in accordance with R178).
- Details on any weed removal by hand.

The location of monitoring sites is shown at **Illustrations 2.1 - 2.7**. GPS co-ordinates for each of the stake locations are provided at **Table 2.2**.

Table 2.2 GPS Co-ordinates for each Monitoring Site*

Site	*ID*	*Stake 1 co-ordinates*	*Stake 2 co-ordinates*
1	Seed Mix 1	490057, 6595205	490079, 6595238
2	Seed Mix 2	490052, 6595299	490026, 6595259
3	Seed Mix 3	489722, 6594721	489686, 6594689
4	Seed Mix 4	494369, 6604590	494387, 6604626
5	Seed Mix 5	490383, 6595788	490359, 6595741
6	BRC – North CC05	495781, 6607729	495814, 6607767
7	BRC – North CC05	495744, 6607783	495782, 6607824
8	BRC – North CC04	494514, 6605138	494523, 6605177
9	BRC – North CC04	494703, 6605781	494721, 6605830
10	Williamson Creek	491650, 6598045	491599, 6598037
11	Stoney Creek	490895, 6596807	490897, 6596754
12	Butchers Creek	489789, 6594939	489789, 6594909

**Projection: GDA94*

The detailed landscape plans for each of the sites as per original approved documentation are provided at **Appendix B**. Refer to original documentation for further details:

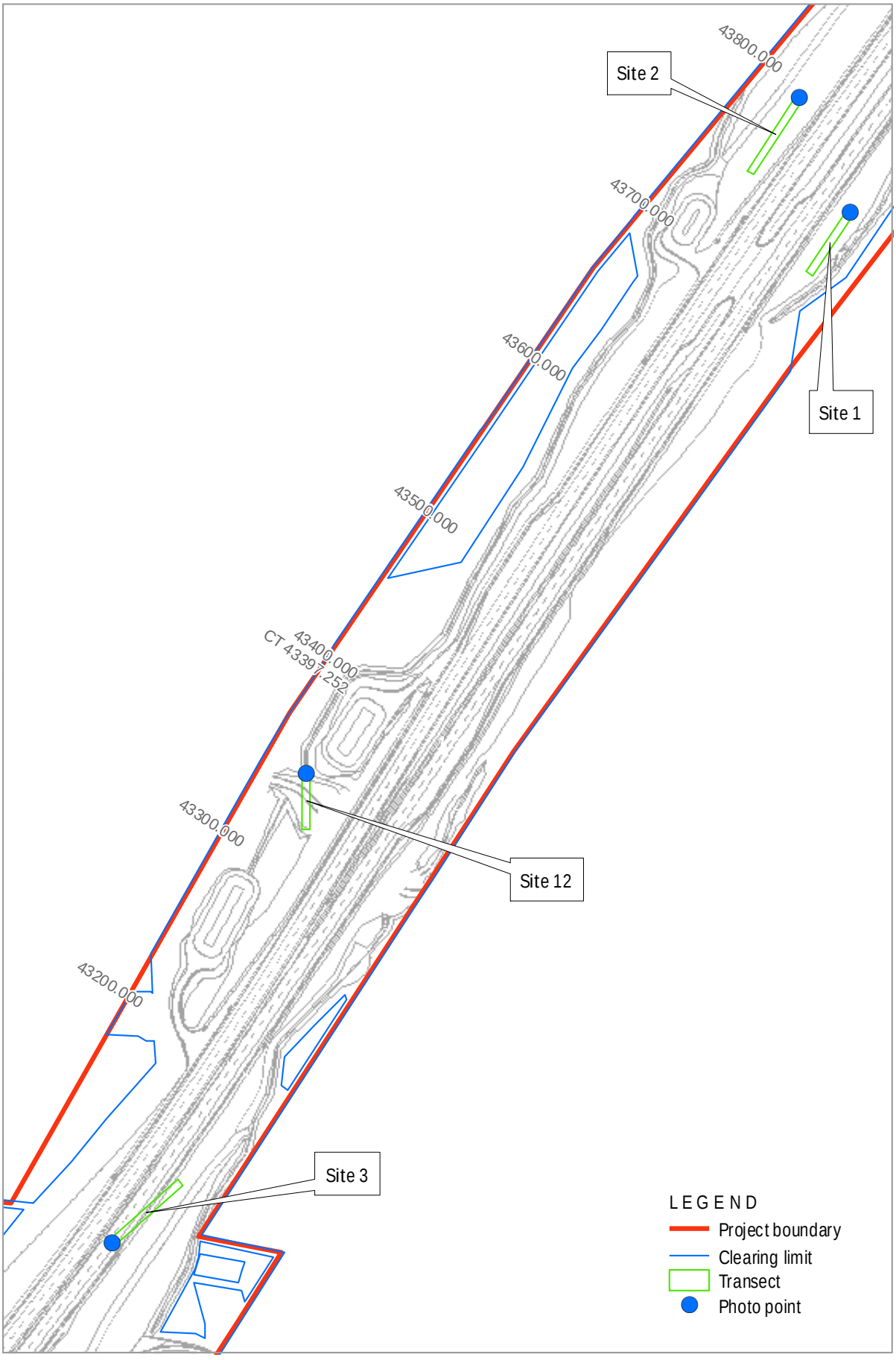
- WC2NH-DD02-UD02-DRG-0001 Area CC02.
- WC2NH-DD02-UD02-DRG-0001 Area CC03.
- WC2NH-DD02-UD02-DRG-0001 Area CC04.
- WC2NH-DD02-UD02-DRG-0001 Area CC05.

Note: While not completed as part of the monitoring assessment, monthly photographic assessments of each monitoring site were also completed by Pacifico (December 2016, January 2017) as required (refer to **Section 1.3**).

Drawn by: AB Checked by: RE Reviewed by: JOL Date: 30/11/2016

Information shown is for illustrative purposes only

Source of base data: AFJV



0 60

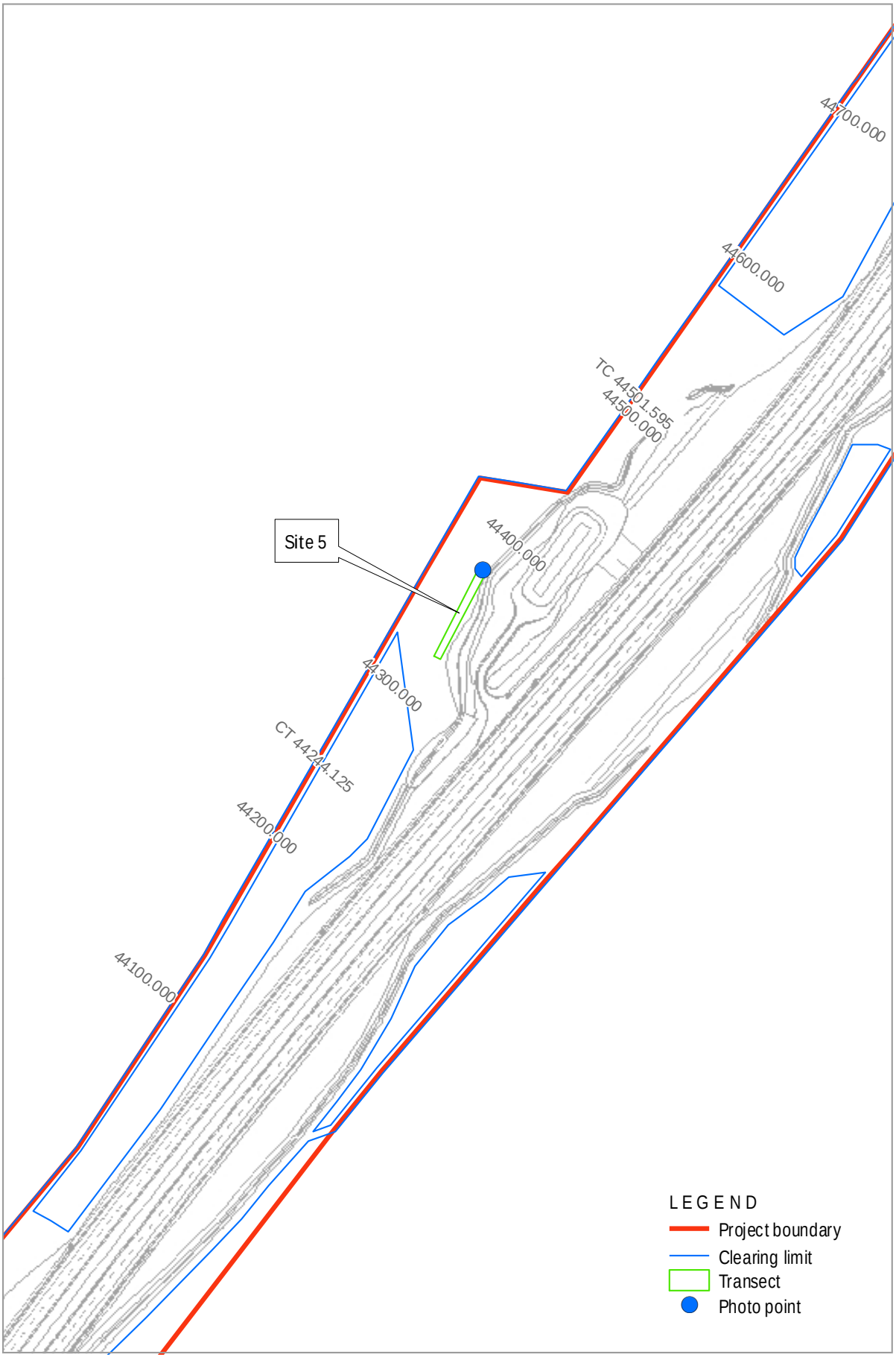
North

Monitoring Location

Drawn by: AB Checked by: RE Reviewed by: JOL Date: 30/11/2016

Information shown is for illustrative purposes only

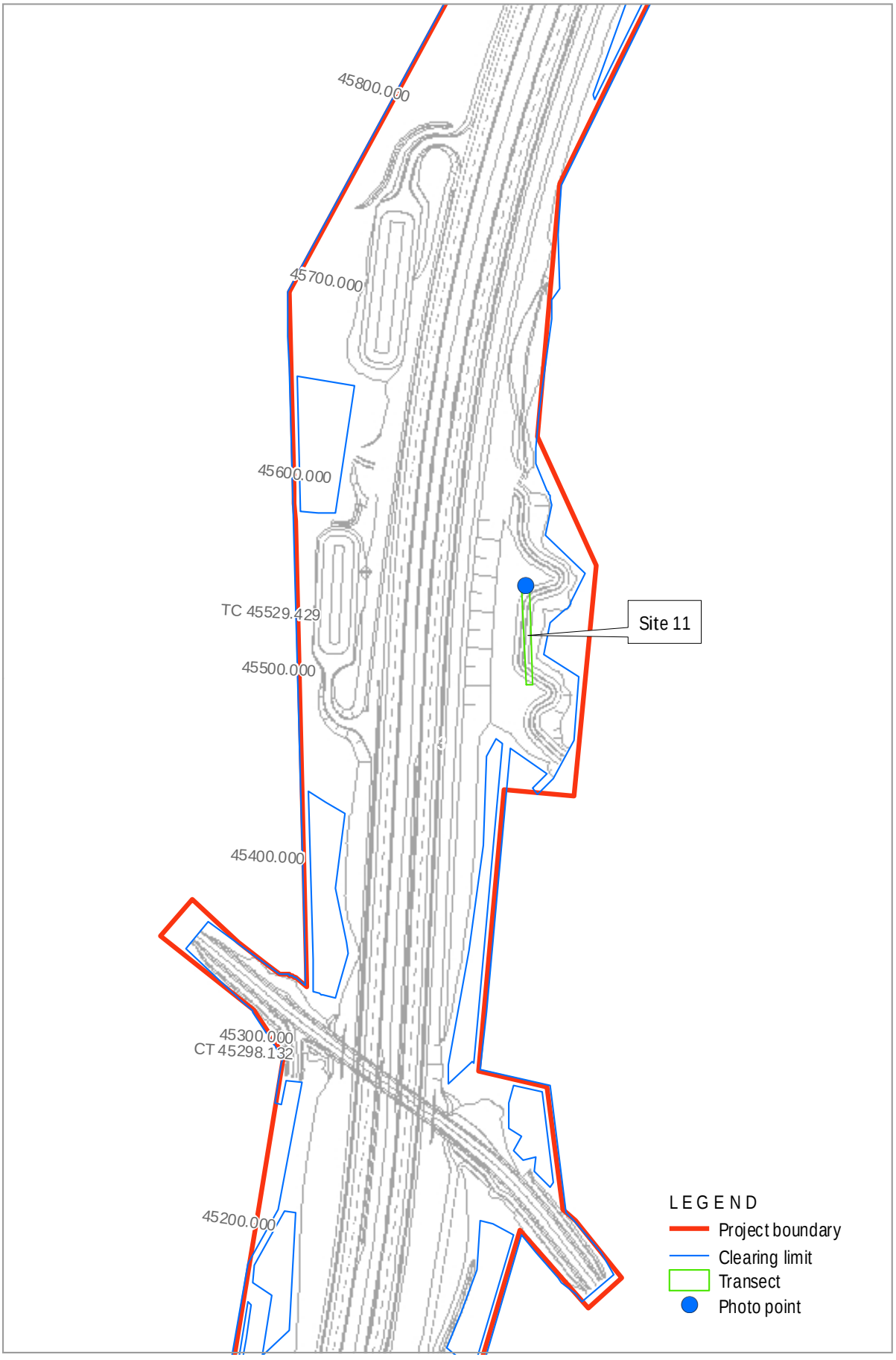
Source of base data: AFJV



North

0 60

Monitoring Location



0 60

North

Monitoring Location

Drawn by: AB Checked by: RE Reviewed by: JOL Date: 30/11/2016

Information shown is for illustrative purposes only

Source of base data: AFJV

North

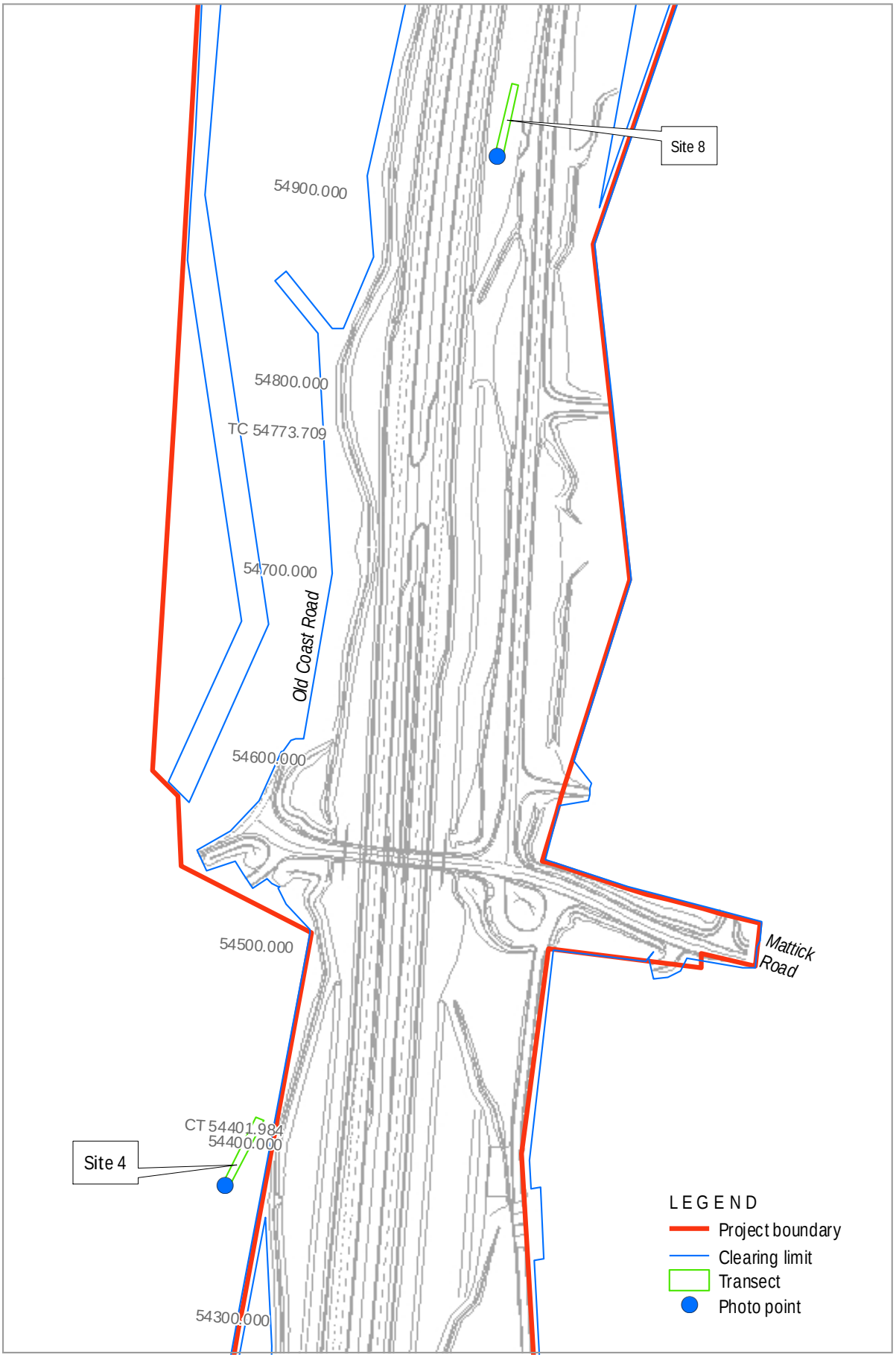
0 60

Monitoring Location

Drawn by: AB Checked by: RE Reviewed by: JOL Date: 30/11/2016

Information shown is for illustrative purposes only

Source of base data: AFJV



North

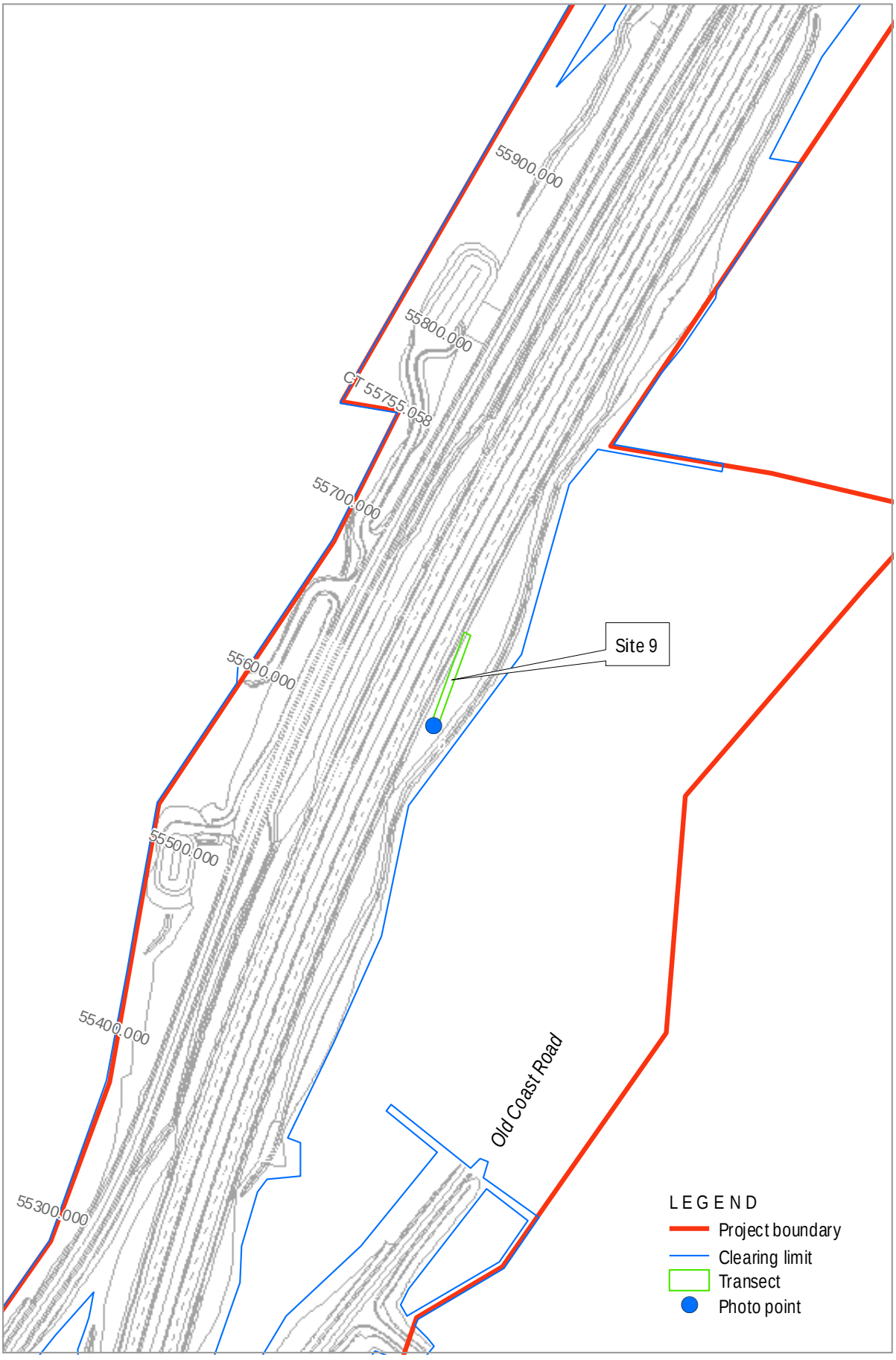
0 60

Monitoring Location

Drawn by: AB Checked by: RE Reviewed by: JOL Date: 30/11/2016

Information shown is for illustrative purposes only

Source of base data: AFJV



North

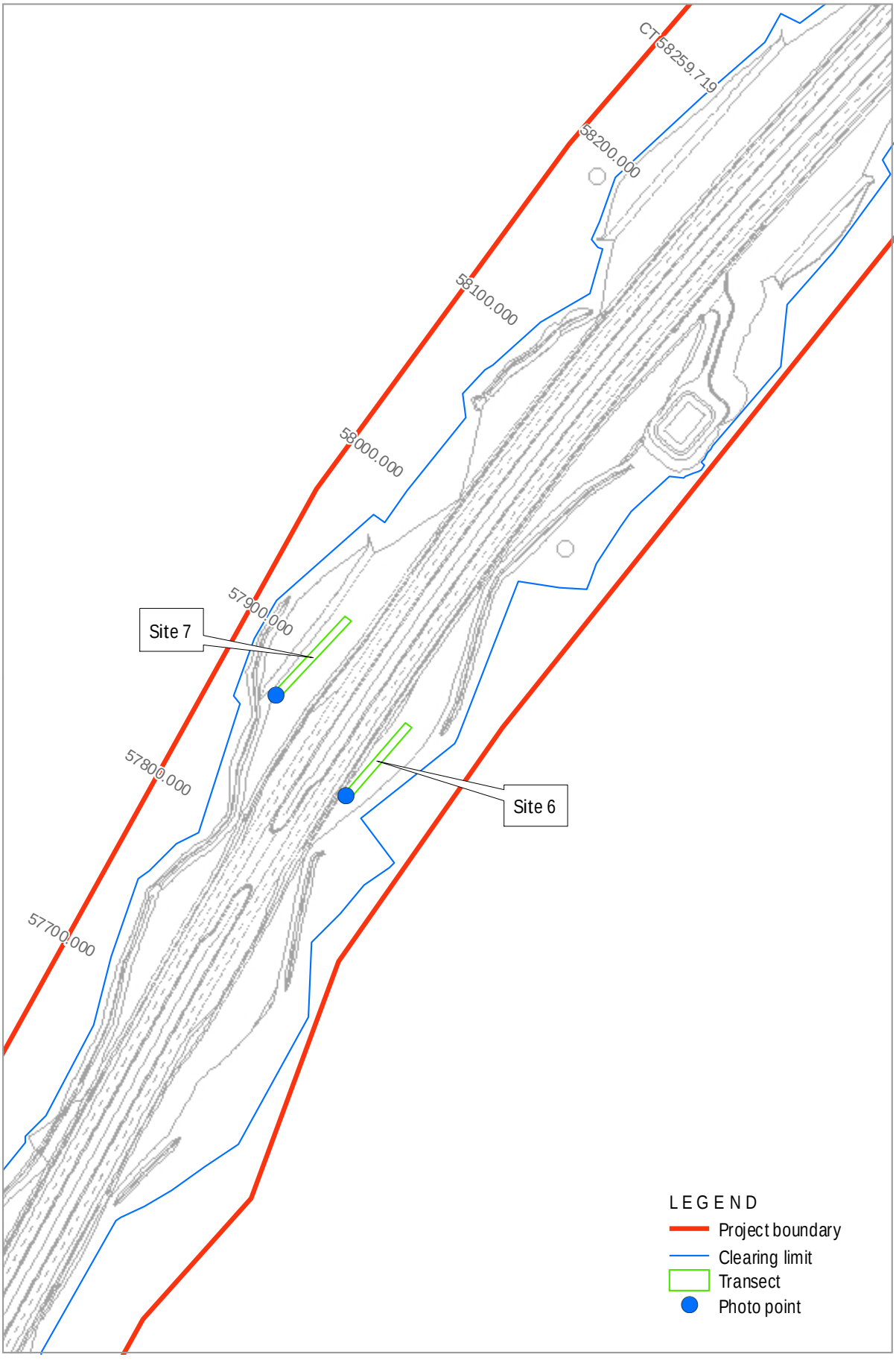
0 60

Monitoring Location

Drawn by: AB Checked by: RE Reviewed by: JOL Date: 30/11/2016

Information shown is for illustrative purposes only

Source of base data: AFJV



North

0 60

Monitoring Location

3. Results

3.1 Landscape Treatments

A summary of each of the landscape treatments at each site is provided at **Appendix C**. This information forms the background to each of the landscaping sites and is useful for tracking the future progress of the landscaping over time to identify any failings or inconsistencies.

3.2 Monitoring Results

A summary of the landscape monitoring results at each site is shown at **Table 3.1***. The results of the monitoring indicate sites 1 - 9 are establishing well, although some sites have weeds present, notably Pigeon Grass (*Setaria sphacelata*) (e.g. sites 1, 2 and 3). Weed control in accordance with the Weed and Pathogen Management Plan will be a priority for the future management of all sites to prevent suppression of native species. Although Pigeon Grass is not a listed noxious weed under the *Noxious Weeds Act 1993* it is a locally prevalent pastoral species which has the potential to outcompete native species.

Two of the three riparian sites (sites 10 & 12) indicate poor performance with regard to plant health and vigour. Site 10 has had the beams placed on the bridge since last monitoring event which may affect light levels at this site over time. Site 12 particularly is in poor condition with an estimated 50% of plants having died since baseline monitoring in November 2016; the dead plants will require replacement. Due to a low incidence of weeds at these sites, poor performance may be related to the current dry conditions and minimal rainfall in recent weeks. A range of native species was recorded at all sites, indicating successful germination from treatments in addition to native regeneration.

Variation in the monitoring results from the baseline results (November 2016) indicate some minor variations in regeneration and mulch cover (refer to **Table 3.2**); native species diversity substantially increased at sites 6 and 9. Further monitoring will determine any longer term trends as monitoring continues. A variety of weed specie continues to occur at the monitoring sites (not depicted in the table), as expected in disturbed and dynamic landscapes.

* The columns in **Table 3.1** relating to species in mix treatments as per the baseline report (December 2016) have been removed for future reporting, as they add little information of any value.

3.3 Photographs

Photographs of each monitoring site are compared with the previous monitoring event (November 2016) and are shown in the following Sections (refer to **Plates 3.1 – 3.24**). Future monitoring will continue the photo-recording process to enable comparisons over time, which will be documented in future landscape monitoring reports (refer to **Section 5**).

Monthly monitoring photographs by Pacifico (refer to **Section 1.3**) are provided at **Appendix D**. These photographs capture the transition and growth stages between the current monitoring event and the previous baseline monitoring event and are provided for comparison only. No analysis or floristics interpretation has been completed for these photographs.

Table 3.1 Summary of Monitoring Results

Site	% Cover	Cover Class	Native Regen. Cover (%)	Native Regen. Cond.	Native Species Regeneration	Mulch Cover %	Weeds	Stress, Predation, Disease
1	90	5	<5	Very good	*Acacia* sp. *Kennedia rubicunda* *Schenkia australis* *Glycine clandestina*	15	*Setaria sphacelata (80%), Verbena bonariensis, Senecio madagascariensis, Cinnamomum camphora, Cirsium vulgare, Sida rhombifolia, Passiflora subpeltata, Gomphocarpus physocarpus, Conyza bonariensis*	Native regen component is healthy but very low percentage of cover.
2	85	5	<4	Very good	*Acacia* sp. *Kennedia rubicunda* *Hardenbergia violacea* *Glycine clandestine* *Centella asiatica*	20	*Setaria sphacelata (80%), Sida rhombifolia, Solanum nigrum*	Native regen component is healthy but very low percentage of cover.
3	90	5	<5	Very good	*Acacia* sp. *Kennedia rubicunda* *Indigofera australis* *Dichondra repens* *Acacia floribunda* *Acacia longifolia* *Acacia irrorata*	20	*Setaria sphacelata (85%), Verbena bonariensis, Sida rhombifolia*	Native regen component is healthy but very low percentage of cover.
4	40	3	nil	Very good	nil	15	nil	Good health, no signs of stress/predation/disease.
5	70	4	<2	Very good	*Acacia irrorata* *Kennedia rubicunda* *Hardenbergia violacea* *Centella asiatica* *Cynodon dactylon*	<10	*Setaria sphacelata (50%), Verbena bonariensis, Pennisteum clandestinum, Sida rhombifolia*	Native regen component is healthy but very low percentage of cover.
6	15	2	10	Very good - at least 13 different native species recorded	*Acacia* sp. (several) *Kennedia rubicunda* *Hardenbergia violacea* *Callistemon* sp. Unknown legume *Indigofera australis* *Goodenia heterophylla* *Acacia myrtifolia* *Acacia longifolia* *Dodonaea triquetra* *Kunzea capitata*	30-35% only; 15% where scour repair has occurred	*Lolium perenne (<5%),* no other weeds observed	Good health, no signs of stress/predation/disease.

Site	% Cover	Cover Class	Native Regen. Cover (%)	Native Regen. Cond.	Native Species Regeneration	Mulch Cover %	Weeds	Stress, Predation, Disease
					Persoonia virgata *Gonocarpus teucrioides*			
7	40	3	<5	Very good	*Acacia* sp. *Kennedia rubicunda* *Hardenbergia violacea* *Goodenia* sp. *Acacia falcata* *Acacia myrtifolia* *Cantella asiatica* *Hakea sericea*	25	*Lolium perenne (30%)*	Native regen component is healthy but very low percentage of cover.
8	60	4	<10	Very good	*Acacia* sp. *Kennedia rubicunda* *Hardenbergia violacea* *Centella asiatica* *Solanum lacianatum*	20% from hydromulch	*Ambrosia artemisiifolia, Bidens pilosa, Sida rhombifolia, Lolium perenne, Avena* sp., *Panicum* sp., *Setaria sphacelata (50%), Ageratum houstonianum, Echinochloa sp.*	Good health, no signs of stress/predation/disease.
9	40	3	35	Very good - at least 15 different native species recorded	*Acacia* sp. (several) *Kennedia rubicunda* *Hardenbergia violacea* *Callistemon* sp. *Eucalyptus* sp. *(seedlings)* *Acacia longifolia* *Commersonia* sp. *Solanum prinophyllum* *Cymbopogon refractus* *Dodonaea triquetra* *Kunzea capitata* *Gonocarpus teucrioides* *Acacia fimbriata* *Centella asiatica*	15	*Plantago lanceolata, Lolium perenne, Lantana camara, Paspalum mandiocanum*	Good health, no signs of stress/predation/disease.
10	<1	1	<1	Poor or dead	*Baumea articulata* *Eleocharis acuta* *Schoenoplectiella mucronata* *Eleocharis sphacelata* *Centella asiatica*	Jute mesh	*Setaria sphacelata, Paspalum mandiocanum*	Discolouration of leaves and dead leaf ends due to dry or poor soil conditions.
11	65	3	25	Very good with recent	*Juncus usitatus* *Lomandra longifolia*	Jute mesh	*Ageratum houstonianum, Verbena bonariensis, Paspalum mandiocanum,*	Discolouration of leaves and dead leaf ends due

Site	% Cover	Cover Class	Native Regen. Cover (%)	Native Regen. Cond.	Native Species Regeneration	Mulch Cover %	Weeds	Stress, Predation, Disease
				rainfall and growing conditions	*Carex appressa* *Lomandra hystrix* *Indigofera australis* *Baumea articulata* *Eleocharis acuta* *Schoenoplectiella mucronata* *Cyperus polystachyos.* *Persicaria strigosa* *Persicaria decipiens* *Centella asiatica* *Juncus planifolius* *Ludwigia peploides* Unknown legume		*Andropogon virginicus, Setaria sphacelata, Senecio madagascariensis, Ambrosia artemisiifolia, Aster subulatus, Cyperus eragrostis, Crotalaria lanceolata*	to dry or poor soil conditions.
12	<1	1	<1	>50% of plants have died. Surviving plants in good health.	*Lomandra hystrix* *Dianella* sp.	No mulch, as located in culvert outlet (98%) scour rock.	No weeds observed.	Discolouration of leaves and dead leaf ends due to dry or poor soil conditions.

Table 3.2 Comparison of Monitoring Results to Date

B = Baseline results (refer GeoLINK 2378-1038)

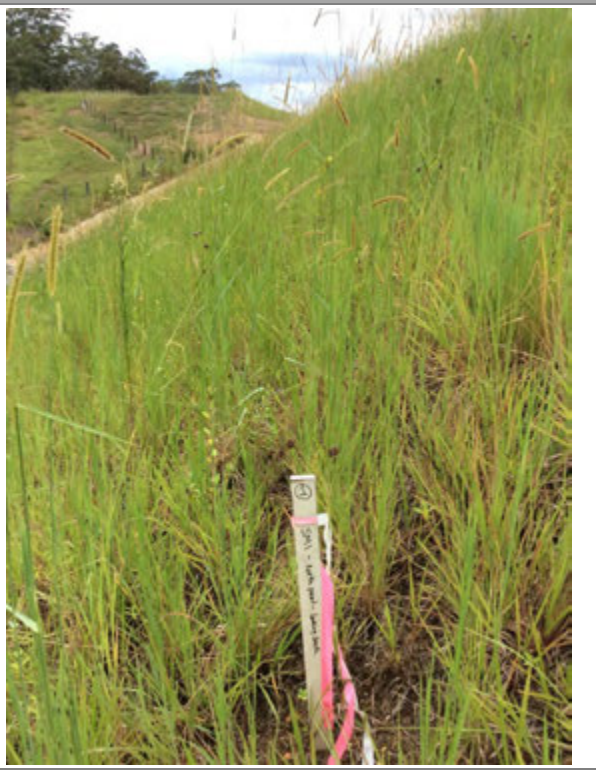
C = Current results (Feb 2017)

Site	*% Cover*		*Cover Class*		*Native Regen. Cover (%)*		*Native Species Regeneration*		*Mulch Cover %*	
	B	**C**	**B**	**C**	**B**	**C**	**B**	**C**	**B**	**C**
1	90	90	5	5	<5	<5	*Acacia* sp. *Kennedia rubicunda* *Schenkia australis*	*Acacia sp.* *Kennedia rubicunda* *Schenkia australis* *Glycine clandestina*	20	15
2	85	85	5	5	<2	<4	*Acacia* sp. *Kennedia rubicunda* *Hardenbergia violacea*	*Acacia* sp. *Kennedia rubicunda* *Hardenbergia violacea* *Glycine clandestine* *Centella asiatica*	30	20
3	90	90	5	5	<1	<5	*Acacia* sp. *Kennedia rubicunda* *Indigofera australis*	*Acacia* sp. *Kennedia rubicunda* *Indigofera australis* *Dichondra repens* *Acacia floribunda* *Acacia longifolia* *Acacia irrorata*	20	20
4	10	40	2	3	N/A	N/A	nil	nil	20	15
5	70	70	4	4	<1	<2	*Acacia irrorata* *Kennedia rubicunda* *Hardenbergia violacea* *Centella asiatica*	*Acacia irrorata* *Kennedia rubicunda* *Hardenbergia violacea* *Centella asiatica* *Cynodon dactylon*	<10	<10
6	10	15	2	2	6	10	*Acacia* sp. (several) *Kennedia rubicunda* *Hardenbergia violacea* *Callistemon* sp. Unknown legume	*Acacia* sp. (several) *Kennedia rubicunda* *Hardenbergia violacea* *Callistemon* sp. Unknown legume *Indigofera australis* *Goodenia heterophylla* *Acacia myrtifolia* *Acacia longifolia* *Dodonaea triquetra*	35-40%; only 20% where scour repair has occurred	30-35%; only 15% where scour repair has occurred

Site	% Cover		Cover Class		Native Regen. Cover (%)		Native Species Regeneration		Mulch Cover %	
	B	C	B	C	B	C	B	C	B	C
								Kunzea capitata *Persoonia virgata* *Gonocarpus teucrioides*		
7	40	40	3	3	<1	<5	*Acacia* sp. *Kennedia rubicunda* *Hardenbergia violacea* *Goodenia* sp.	*Acacia* sp. *Kennedia rubicunda* *Hardenbergia violacea* *Goodenia* sp. *Acacia falcata* *Acacia myrtifolia* *Cantella asiatica* *Hakea sericea*	35	25
8	10	60	2	4	<5	<10	*Acacia* sp. *Kennedia rubicunda* *Hardenbergia violacea* *Centella asiatica*	*Acacia* sp. *Kennedia rubicunda* *Hardenbergia violacea* *Centella asiatica* *Solanum lacianatum*	30% from hydromulch	20% from hydromulch
9	35	40	3	3	30	35	*Acacia* sp. (several) *Kennedia rubicunda* *Hardenbergia violacea* *Callistemon* sp. *Eucalyptus* sp. *(seedlings)* Unknown legume	*Acacia* sp. (several) *Kennedia rubicunda* *Hardenbergia violacea* *Callistemon* sp. *Eucalyptus* sp. *(seedlings)* *Acacia longifolia* *Commersonia* sp. *Solanum prinophyllum* *Cymbopogon refractus* *Dodonaea triquetra* *Kunzea capitata* *Gonocarpus teucrioides* *Acacia fimbriata* *Centella asiatica*	25	15
10	<1	<1	1	1	<1	<1	*Baumea articulata* *Eleocharis acuta* *Schoenoplectiella mucronata*	*Baumea articulata* *Eleocharis acuta* *Schoenoplectiella mucronata* *Eleocharis sphacelata* *Centella asiatica*	Jute mesh	Jute mesh
11	30	65	3	3	20	25	*Juncus usitatus* *Lomandra longifolia* *Carex appressa*	*Juncus usitatus* *Lomandra longifolia* *Carex appressa*	Jute mesh	Jute mesh

Site	% Cover		Cover Class		Native Regen. Cover (%)		Native Species Regeneration		Mulch Cover %	
	B	C	B	C	B	C	B	C	B	C
							Lomandra hystrix *Indigofera australis* *Baumea articulata* *Eleocharis acuta* *Schoenoplectiella mucronata* *Persicaria strigosa* *Persicaria dicipiens* *Centella asiatica*	*Lomandra hystrix* *Indigofera australis* *Baumea articulata* *Eleocharis acuta* *Schoenoplectiella mucronata* *Cyperus polystachyos.* *Persicaria strigosa* *Persicaria decipiens* *Centella asiatica* *Juncus planifolius* *Ludwigia peploides* Unknown legume		
12	<1	<1	1	1	<1	<1	*Lomandra hystrix* *Dianella sp.*	*Lomandra hystrix* *Dianella* sp.	No mulch as located in culvert outlet (98%) scour rock	No mulch as located in culvert outlet (98%) scour rock

3.3.1 Monitoring Site 1

November 2016	*February 2017*
	
Plate 3.1 Site 1 view to south (Nov 2016)	**Plate 3.2 Site 1 view to south (Feb 2017)**

3.3.2 Monitoring Site 2

November 2016	*February 2017*
	
Plate 3.3 Site 2 view to south (Nov 2016)	**Plate 3.4 Site 2 view to south (Feb 2017)**

3.3.3 Monitoring Site 3

November 2016	*February 2017*
	
Plate 3.5 Site 3 view to north (Nov 2016)	**Plate 3.6 Site 3 view to north (Feb 2017)**

3.3.4 Monitoring Site 4

November 2016	*February 2017*
	
Plate 3.7 Site 4 view to north (Nov 2016)	**Plate 3.8 Site 4 view to north (Feb 2017)**

3.3.5 Monitoring Site 5

November 2016	*February 2017*
	
Plate 3.9 Site 5 view to south (Nov 2016)	**Plate 3.10 Site 5 view to south (Feb 2017)**

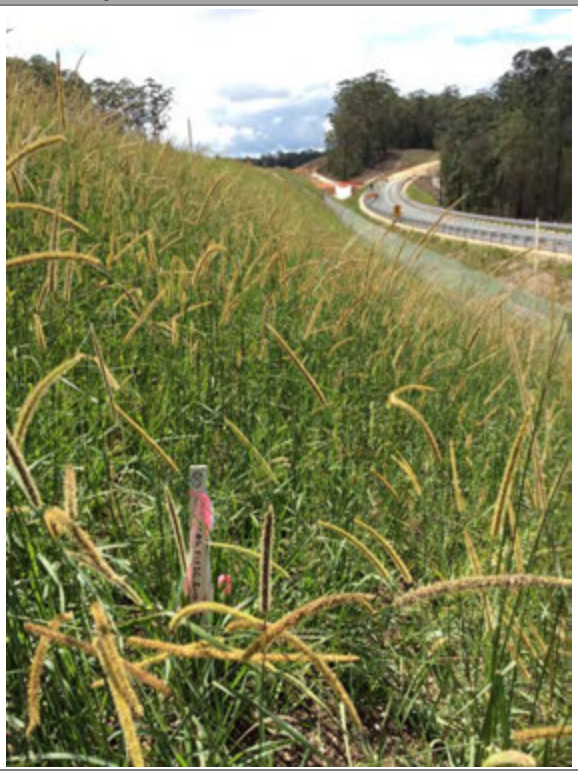
3.3.6 Monitoring Site 6

November 2016	*February 2017*
	
Plate 3.11 Site 6 view to north (Nov 2016)	**Plate 3.12 Site 6 view to north (Feb 2017)**

3.3.7 Monitoring Site 7

November 2016	*February 2017*
	
Plate 3.13 Site 7 view to north (Nov 2016)	**Plate 3.14 Site 7 view to north (Feb 2017)**

3.3.8 Monitoring Site 8

November 2016	*February 2017*
	
Plate 3.15 Site 8 view to north (Nov 2016)	**Plate 3.16 Site 8 view to north (Feb 2017)**

3.3.9 Monitoring Site 9

November 2016	*February 2017*
	
Plate 3.17 Site 9 view to north (Nov 2016)	**Plate 3.18 Site 9 view to north (Feb 2017)**

3.3.10 Monitoring Site 10 (Photo point peg needs to be replaced at this site)

November 2016	*February 2017*
	
Plate 3.19 Site 10 view to west (Nov 2016)	**Plate 3.20 Site 10 view to west (Feb 2017)**

3.3.11 Monitoring Site 11

November 2016	*February 2017*
	
Plate 3.21 Site 11 view to south (Nov 2016)	**Plate 3.22 Site 11 view to south (Feb 2017)**

3.3.12 Monitoring Site 12

November 2016	*February 2017*
	
Plate 3.23 Site 12 view to south (Nov 2016)	**Plate 3.24 Site 12 view to south (Feb 2017)**

4. Discussion and Recommendations

4.1 Discussion

Based on the monitoring results, most sites appear to be establishing well and indicate a high degree of native establishment and persistence, although dominance by Pigeon Grass appears to be a problem at some sites (e.g. sites 1, 2 and 3). Riparian sites were in a lower condition and will require attention to ensure plants survive and persist, with site 12 requiring significant replacement of dead plants. Aftercare of all landscaped sites should continue as per requirements, with weed control a priority at affected sites. Pigeon Grass is a locally prevalent pastoral grass within the southern zone, which can establish prolifically and has potential to outcompete native species. Control of this species maybe required if results overtime indicate reduced success of native species regeneration, in comparison with landscape treatment areas not supporting high percentages of Pigeon Grass.

4.2 Recommendations

Based on the monitoring results, the following recommendations apply:

- Aftercare of plants at all sites must continue as per the maintenance regime and in accordance with specifications in R178 and R179.
- Weed control should be undertaken in accordance with the WC2NH Weed and Pathogen Management Plan (GeoLINK, 2014) where listed noxious weeds are known to occur.
- In the event that plants at riparian sites (sites 10 & 12) continue to show poor signs of health, additional watering may be required.
- Site contractors continue to provide all details of landscape maintenance to Pacifico for inclusion in future monitoring reports.
- All dead plants at site 12 should be replaced to meet the planting requirements of the UDLP.

Recommendations for future monitoring and reporting are provided at **Section 5**.

5. Future Monitoring and Reporting

5.1 Monitoring Requirements

As noted, monthly photographs of all sites are required throughout the monitoring period, in addition to monthly monitoring where field data is collected. A summary of monitoring requirements is provided at **Table 5.1**.

Table 5.1 Summary of Monitoring Requirements (all sites)

Year	*Spring*			*Summer*			*Autumn*			*Winter*		
	Sept	**Oct**	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**
2	-	-	P&M	P	P	P&M						
3	P	P	P&M	P	P	P&M	P	P	P&M	P	P	P&M
4							P	P	P&M	P	P	P&M

P = Photographs only; P&M = Photographs & Monitoring
Red highlight indicates completion of task

5.2 Reporting Requirements

This report forms the landscape monitoring report for the summer period within year 2 of the construction period. Following each future seasonal monitoring event, an updated progress report will be prepared and results compared with the baseline assessment.

The next landscape monitoring report will be for the autumn period within construction year 3 and will be provided May 2017, based on:

- Two photograph (only) events (March, April) – to be completed by Pacifico.
- One photograph and monitoring (data collection) event – to be completed by GeoLINK.

References

Benchmark Environmental Management (2014). *Warrell Creek to Urunga Pacific Highway Upgrade Ecological Monitoring Program Stage 2: Warrell Creek to Nambucca Heads.* Report prepared for NSW Roads and Maritime Services.

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Spackman Mossop Michaels (2016) *Pacific Highway Upgrade - Warrell Creek to Nambucca Heads Detail Design. Project Wide - Urban Design and Landscape – Design Report*. Report prepared on behalf of Acciona Ferrovial Joint Venture (AFJV).

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Appendix A

Landscape Implementation Summary

Table A1. Landscape Implementation Techniques (seed mix and BRC)

Mix Type	*Description*	*Details*	*Rationale*
Seed Mix 1 - hydromulching and direct seeding	Indigenous grasses suited to bioregion	- Hydromulching with wood fibre mulch or sugarcane mulch. - Tractor drawn (direct) seeding.	Batters and embankments.
Seed Mix 2 - hydromulching	Indigenous and exotic pasture grass species	Hydromulching with wood fibre mulch or sugarcane mulch.	Mixture of native and exotic pasture grasses
Seed Mix 3 - direct seeding	Indigenous shrubs and grasses	Tractor drawn (direct) seeding.	Native grasses in medians, verges and 10H:1V slopes
Seed Mix 4 - hydromulching	Indigenous and exotic pasture grass species	Hydromulching	Ancillary site rehabilitation
Seed Mix 5 - hydroseeding	Indigenous grasses and sedges	Hydroseeding	Vegetated open drains
Bushland Reconstruction	Endemic seed material contained in local topsoil and shredded mulch	Refer bushland reconstruction process	Used in areas of existing forest

Source: Spackman Mossop Michaels (2016)

Appendix B

Final Landscape Plans

Legend

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Site

- Site boundary
- Clearing boundary (as provided on 14/5/15. Approval pending subject to consistency review)
- Cadastral boundary
- New gate
- New fence (refer to furniture package DD00-RF01 for fence types)
- Existing building retained (approximate location only)
- Existing building removed (approximate location only)

Road Design

- New Barrier (refer to furniture package for barrier types)
- Noise wall
- Retaining wall
- Road pavement
- Sealed verge
- Turfed Verge

Drainage design

- Drainage culvert
- D1> Vegetated drainage channel type D1
- BD1 Bench drain type BD1
- TD1 Table drain type TD1
- D1> Rock pitched D1 channel
- D1> Shotcrete D1 channel
- Rip rap protection
- Rock scour protection
- Exposed insitu rock

Lighting

- New light pole (refer to lighting drawings DDXX-EL02)

Revegetation mixes

- **SM1A** - Cut batter indigenous grasses
- **SM1B** - Fill embankment indigenous grasses
- **SM1C** - Verge indigenous grasses
- **SM1D** - Median indigenous grasses
- **SM1E** - Batter to boundary area indigenous grasses
- **SM1F** - Side road verges, cut batters and embankments indigenous grasses
- **SM2A** - Fill embankment pasture grasses
- **SM2B** - Batter to boundary area pasture grasses
- **SM3** - Cut batter indigenous shrubs and grasses
- **SM4** - Ancillary site pasture grasses
- **SM5** - Vegetated drainage swale indigenous grasses and sedges
- **BRC** - Bushland reconstruction

Note:
1. Refer to drawing DD02-UD02-0054 for seed application types

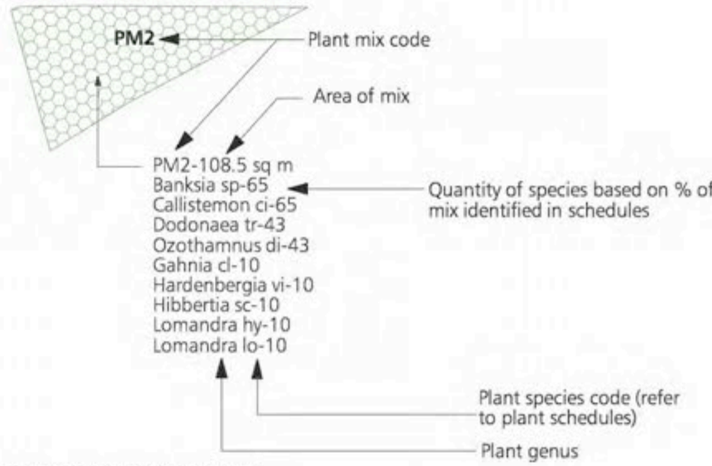
Ancillary design

Potential location for spoil mounds to be integrated with earthworks design during construction stage if required

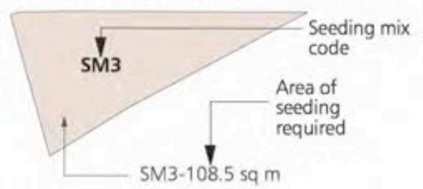
Planting mixes

- **PM1A** - Embankment Indigenous Screening Shrubs and Groundcovers
- **PM1B** - Embankment Indigenous Shrubs and Groundcovers
- **PM2** - Interchange indigenous feature shrubs
- **PM3** - Indigenous Frangible Shrub Mix in medians
- **PM4A** - River and creek banks, indigenous riparian species
- **PM4B** - Culverts and basins, Indigenous Grasses and Sedges
- **PM4C** - Low flow channels, indigenous riparian species
- **PM5** - Roundabouts, Indigenous Shrubs and Groundcovers
- **PM6** - Fauna culverts and passages, indigenous habitat species
- **PM7** - Drainage mounds
  Refer to detail DD00-UD02-0207 and drainage package for locations of mounds where not shown on landscape drawings

Example planting area



Example revegetation area



Tree mixes

- TM1 Blackbutt Open Forest
- TM2 Mixed Floodplain Forest
- TM3 Flooded Gum Forest
- TM4 Swamp Forest
- TM5 Swamp Oak Forest
- TM6 Lowland Rainforest
- TM7 - Interchanges and side roads

Existing Vegetation Communties

- Flooded Gum Forest
- Blackbutt Open Forest
- Moist Open Gum Forest
- Coastal Saltmarsh (EEC)
- Freshwater Wetlands (EEC)
- Swamp Oak Forest (EEC)
- Mixed Floodplain Forest (EEC)
- Swamp Forest (EEC)
- Lowland Rainforest (EEC)

Existing Flora species (surveryed)

- Ar *Alexfloydia repens* *
- Af *Artanema fimbriatum*
- Gf *Goodenia fordiana* *
- H *Hollow Bearing Tree* *
- Ml *Marsdenia longiloba* *
- Mt *Maundia triglochinoid* *
- Nw *Niemeyera whitei* *
- Pe *Persicaria elatior* *
- Tw *Tylophora woollsii* *
- Existing tree

Notes:
1. EEC = Endangered Ecological Community
2. Refer to Flora and Fauna Management Plan for 'To Be Removed' status and species to be translocated
3. * indicates endangered species. Refer to Sensitive Area Plans
4. Where *Niemeyera whitei* located within clearing boundary species to be translocatedin accordance with the Flora and Fauna Management Plan.

Fauna connectivity and habitat

- Fauna connectivity planting zone
- Green Thighed Frog habitat zone
- Giant Barred Frog habitat zone
- Flying-fox habitat zone
- Squirrel Glider habitat zone

Note: Extent of planting within habitat and Fauna connectivity planting zones defined by extent of planting mix

Fauna Furniture

- Fauna drop structure
- Coarse woody debris
- Fauna glider pole
- Fauna rope bridge crossing
- Green-Thighed frog pond to be installed in accordance with Green-Thighed frog management plan

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REVIEWED M. WRIGHT

ROADS AND MARITIME SERVICES

NAMBUCCA SHIRE COUNCIL
HW10 PACIFIC HIGHWAY UPGRADE
WARRELL CREEK TO NAMBUCCA HEADS
DD02 - LANDSCAPE AND PLANTING
GENERAL LEGEND

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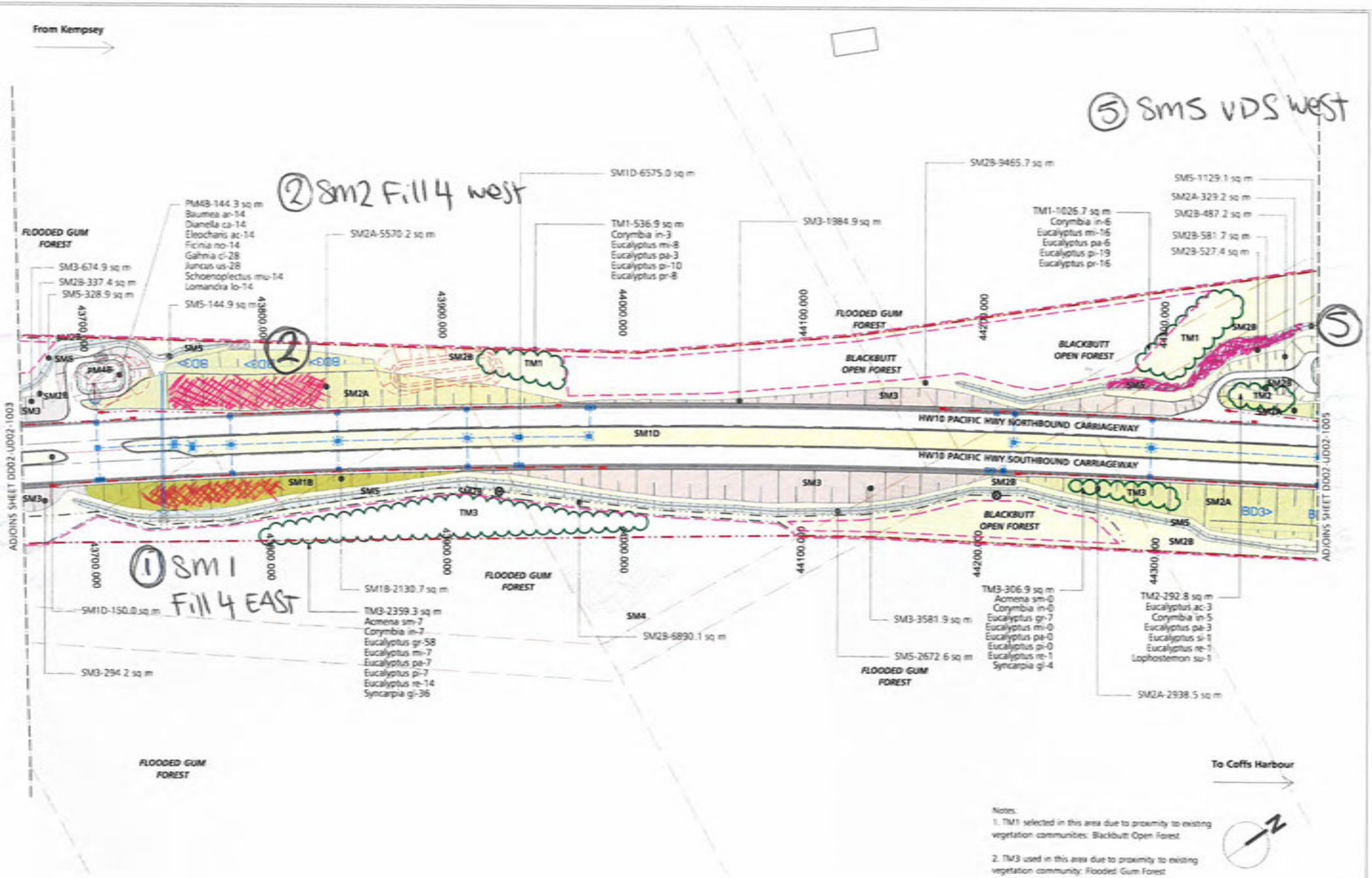

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HW10 PACIFIC HIGHWAY UPGRADE
WARRELL CREEK TO NAMBUCCA HEADS
DD02 - LANDSCAPE AND PLANTING
LANDSCAPE PLAN 4 OF 9

DRAWING	STAGE	PART	ISSUE
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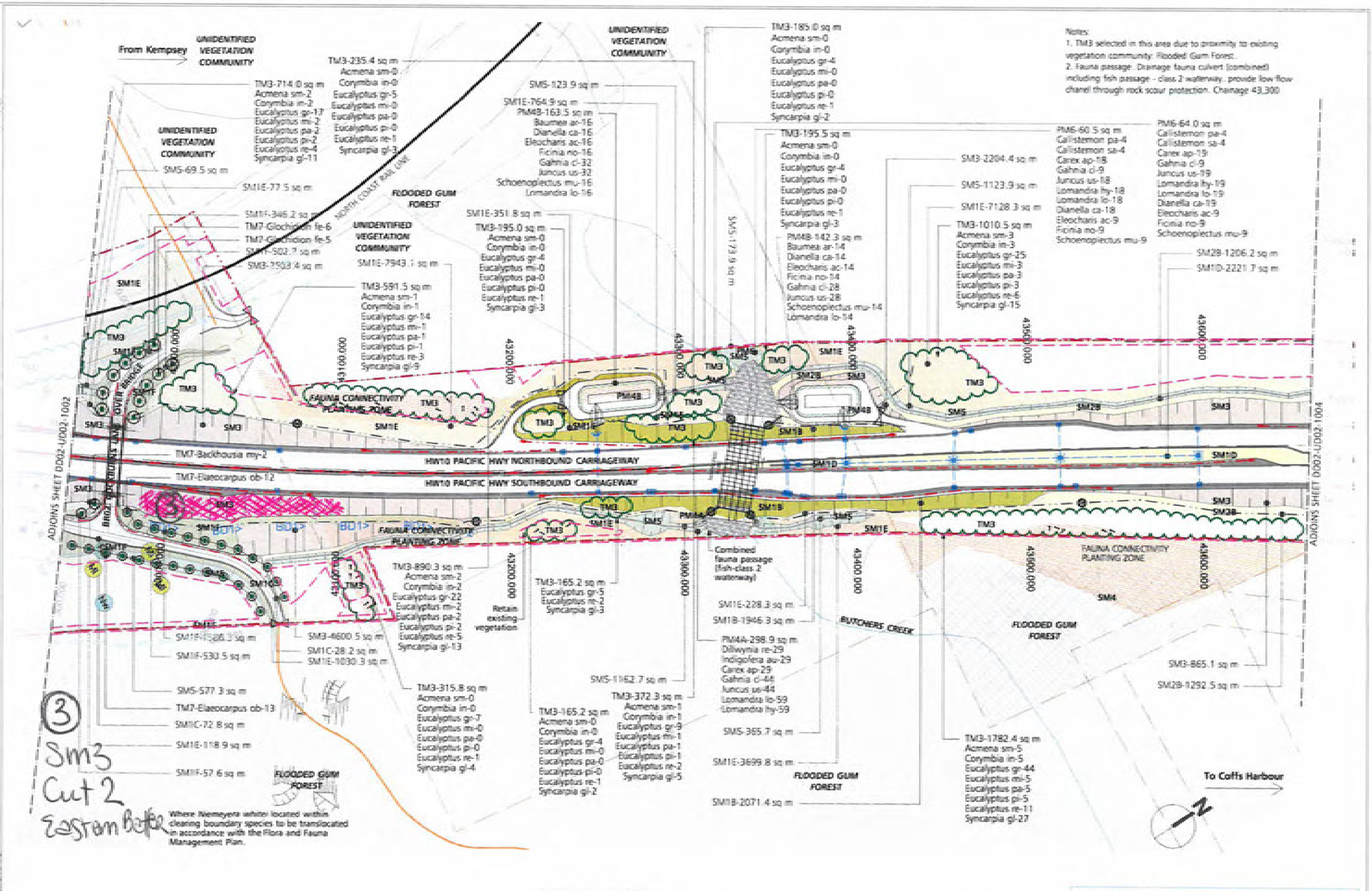

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NAMBUCCA SHIRE COUNCIL
HW10 PACIFIC HIGHWAY UPGRADE
WARRELL CREEK TO NAMBUCCA HEADS
DD02 - LANDSCAPE AND PLANTING
LANDSCAPE PLAN 3 OF 9

DRAWING	STAGE	PART	ISSUE
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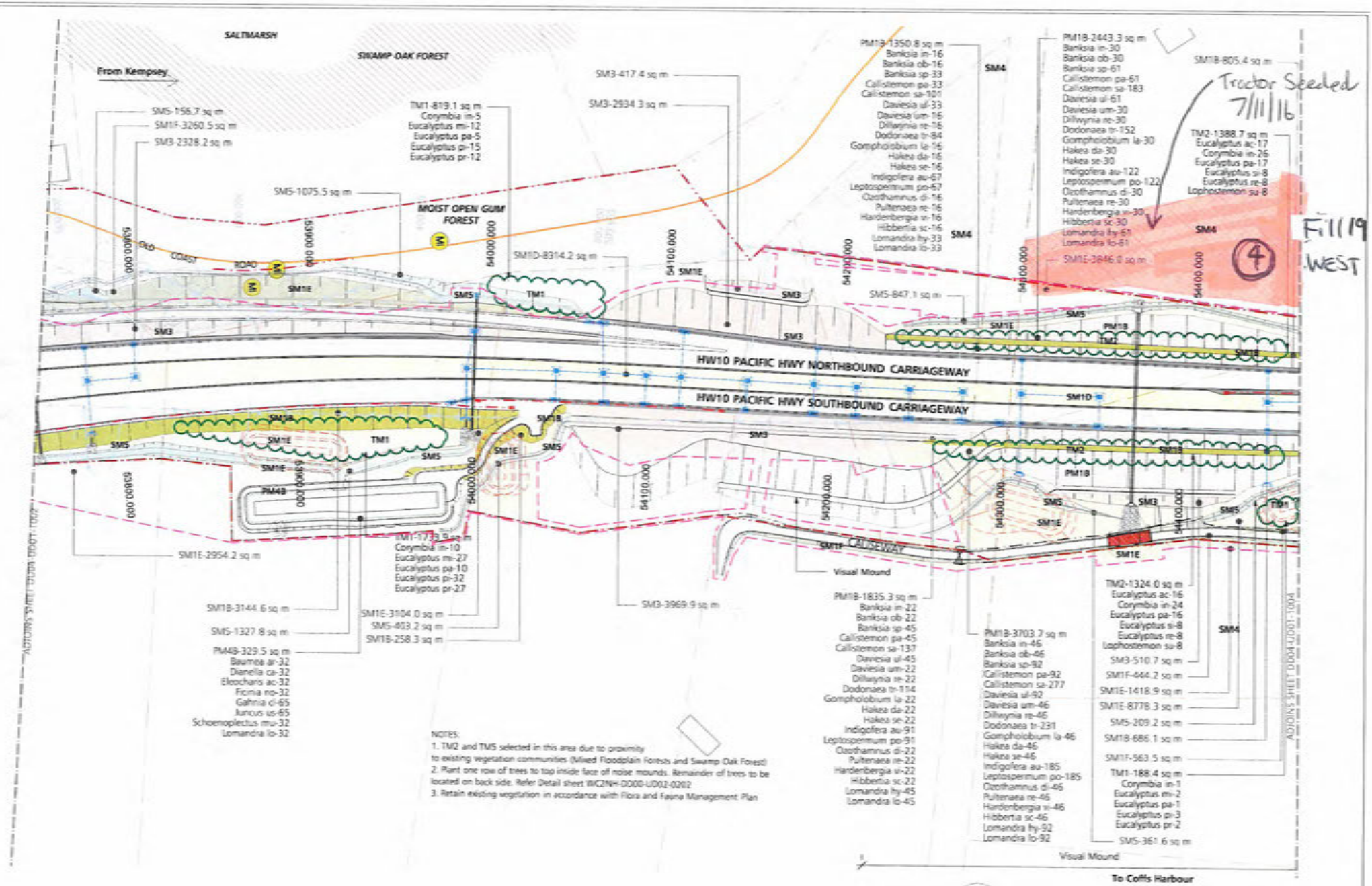

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HW10 PACIFIC HIGHWAY UPGRADE
WARRELL CREEK TO NAMBUCCA HEADS
DD04 - LANDSCAPE AND PLANTING
LANDSCAPE PLAN 3 OF 7

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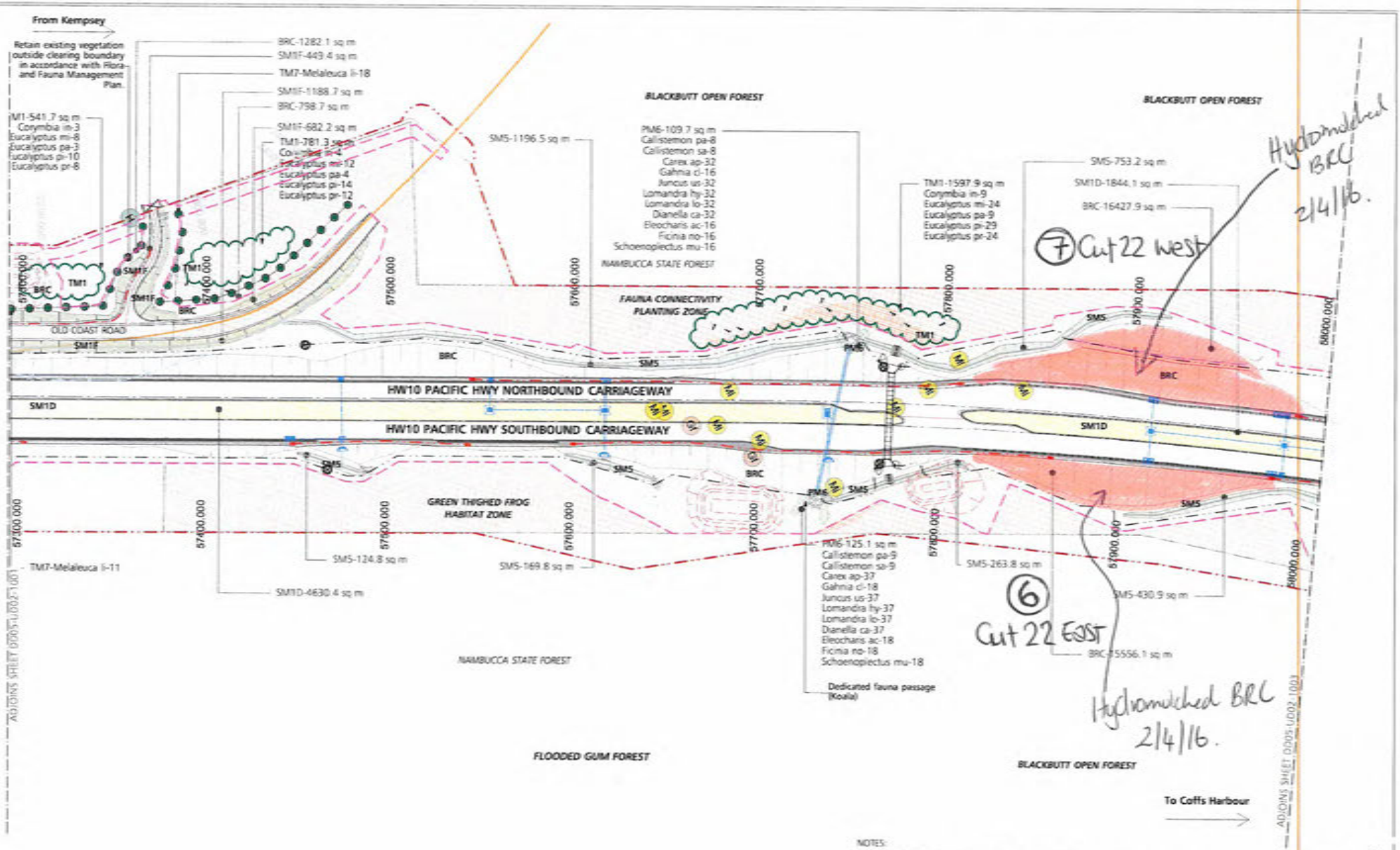

NOTES:
1. TM1 and TM3 selected in this area due to proximity to existing vegetation communities (Blackbutt Open Forest and Flooded Gum Forest)
2. Retain existing vegetation in accordance with Flora and Flora Management Plan.
3. Fauna culvert (dedicated- koala) at chainage 57,750

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WARRELL CREEK TO NAMBUCCA HEADS
DD05 - LANDSCAPE AND PLANTING
LANDSCAPE PLAN 2 OF 7

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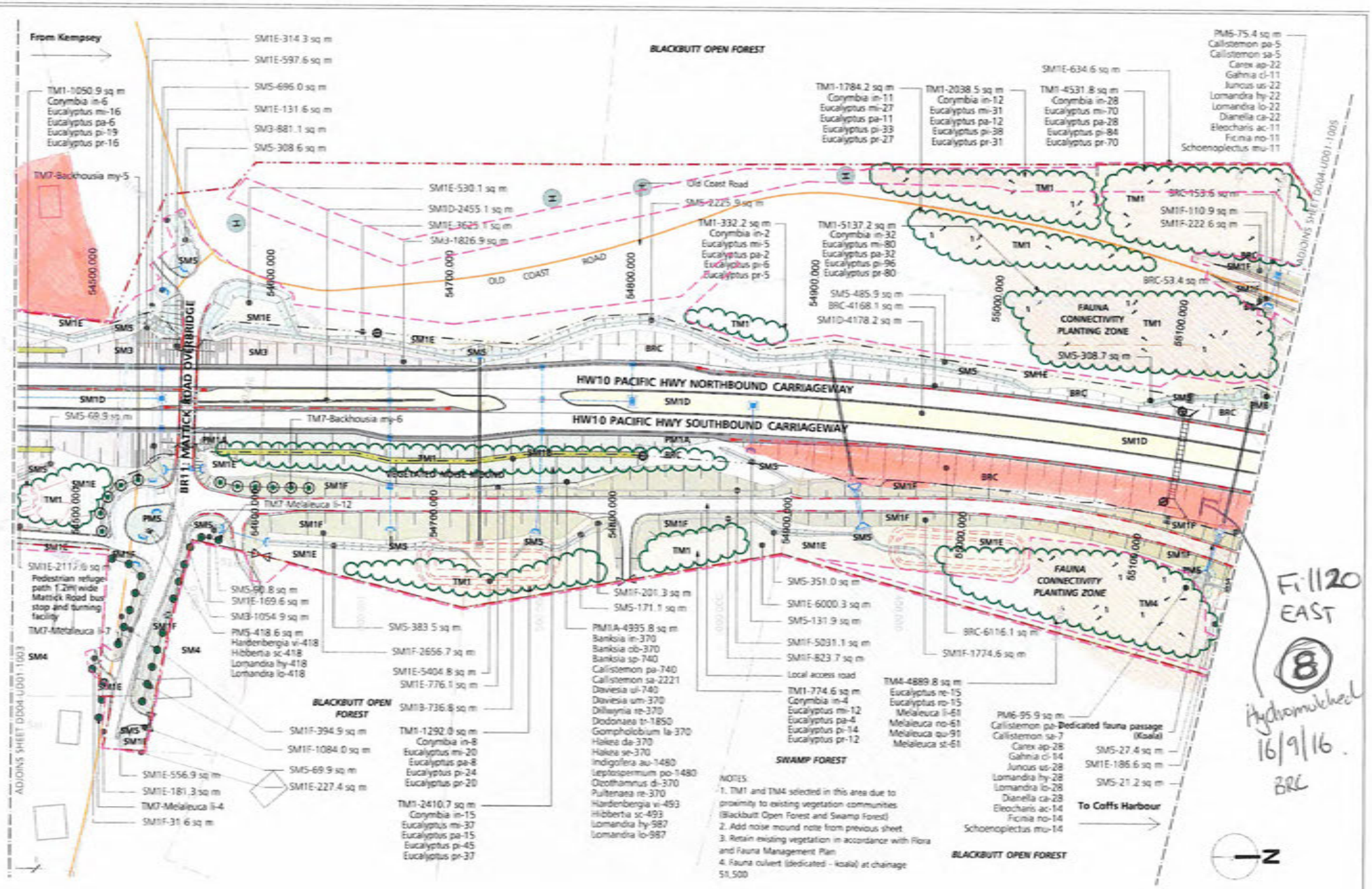

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HW10 PACIFIC HIGHWAY UPGRADE
WARRELL CREEK TO NAMBUCCA HEADS
DD04 - LANDSCAPE AND PLANTING
LANDSCAPE PLAN 4 OF 7

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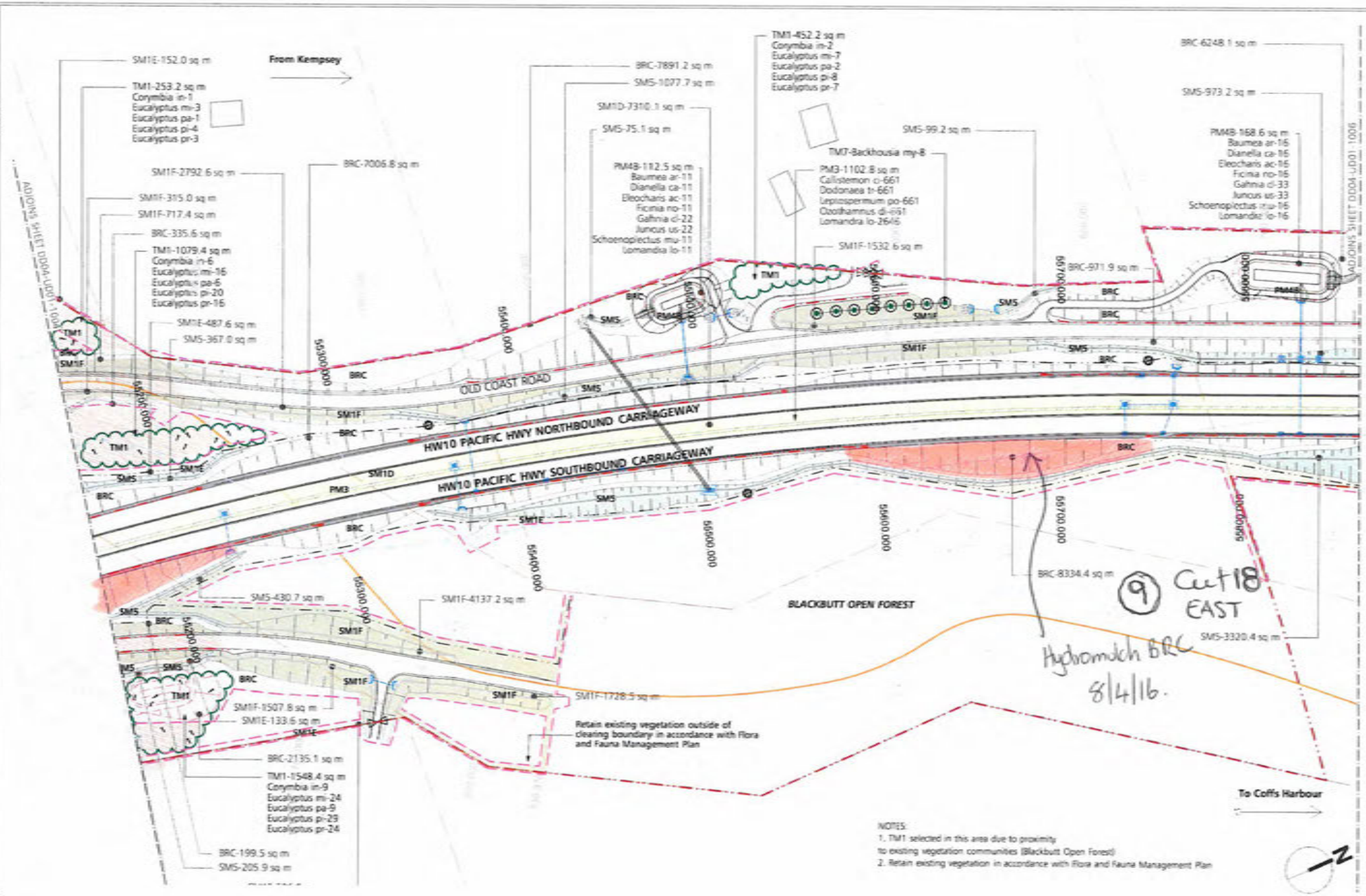

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HW10 PACIFIC HIGHWAY UPGRADE
WARRELL CREEK TO NAMBUCCA HEADS
DD04 - LANDSCAPE AND PLANTING
LANDSCAPE PLAN 5 OF 7

DRAWING	STAGE	PART	ISSUE
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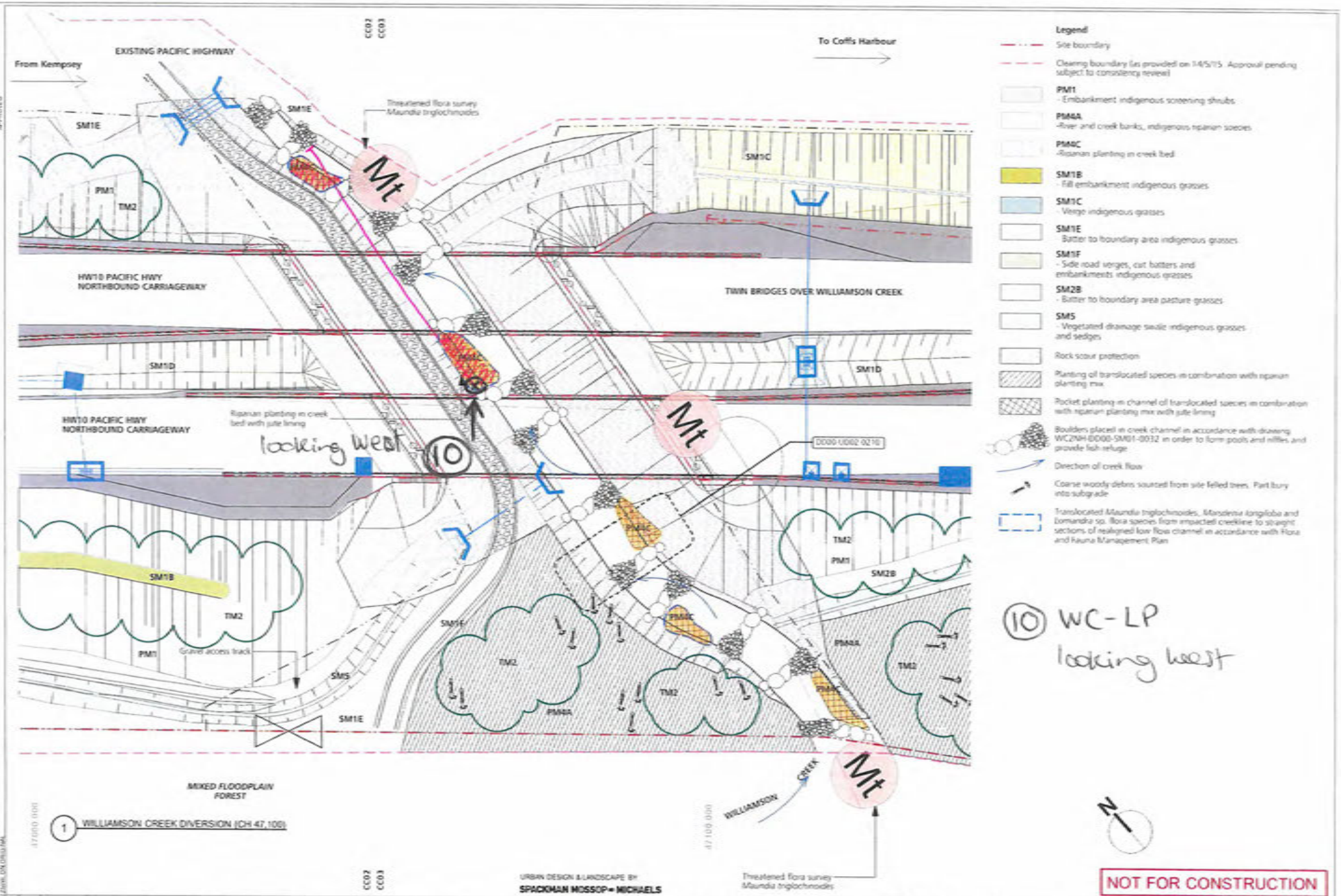

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C00	22-01-2016	Detailed Design Issued for 100% RMS Review
CE0	14-12-2015	Detailed Design Issued for 100%

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NAMBUCCA SHIRE COUNCIL
HW10 PACIFIC HIGHWAY UPGRADE
WARRELL CREEK TO NAMBUCCA HEADS
DD03 - LANDSCAPE AND PLANTING
LANDSCAPE DETAIL PLAN 1

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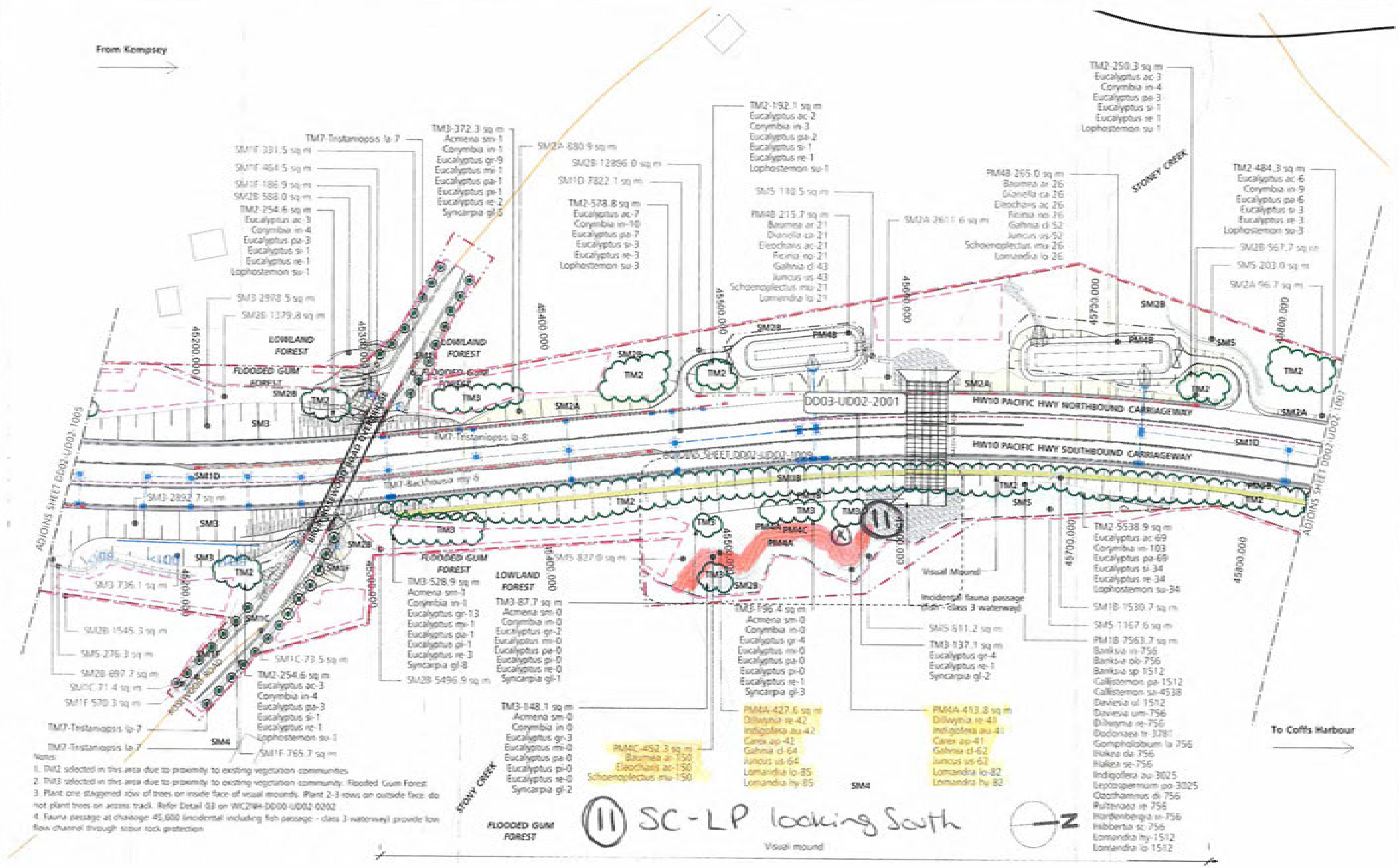

Notes:

1. TM2 selected in this area due to proximity to existing vegetation communities.
2. TM3 selected in this area due to proximity to existing vegetation community: Flooded Gum Forest.
3. Plant one staggered row of trees on inside face of visual mounds. Plant 2-3 rows on outside face; do not plant trees on access track. Refer Detail 03 on WC2NH-DD00-UD02-0202.
4. Fauna passage at chainage 45,600 (incidental including fish passage - class 3 waterway) provide low flow channel through scour rock protection.

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ROADS AND MARITIME SERVICES

NAMBUCCA SHIRE COUNCIL
HW10 PACIFIC HIGHWAY UPGRADE
WARRELL CREEK TO NAMBUCCA HEADS
DD02 - LANDSCAPE AND PLANTING
LANDSCAPE PLAN 6 OF 9

DRAWING	STAGE	PART	ISSUE
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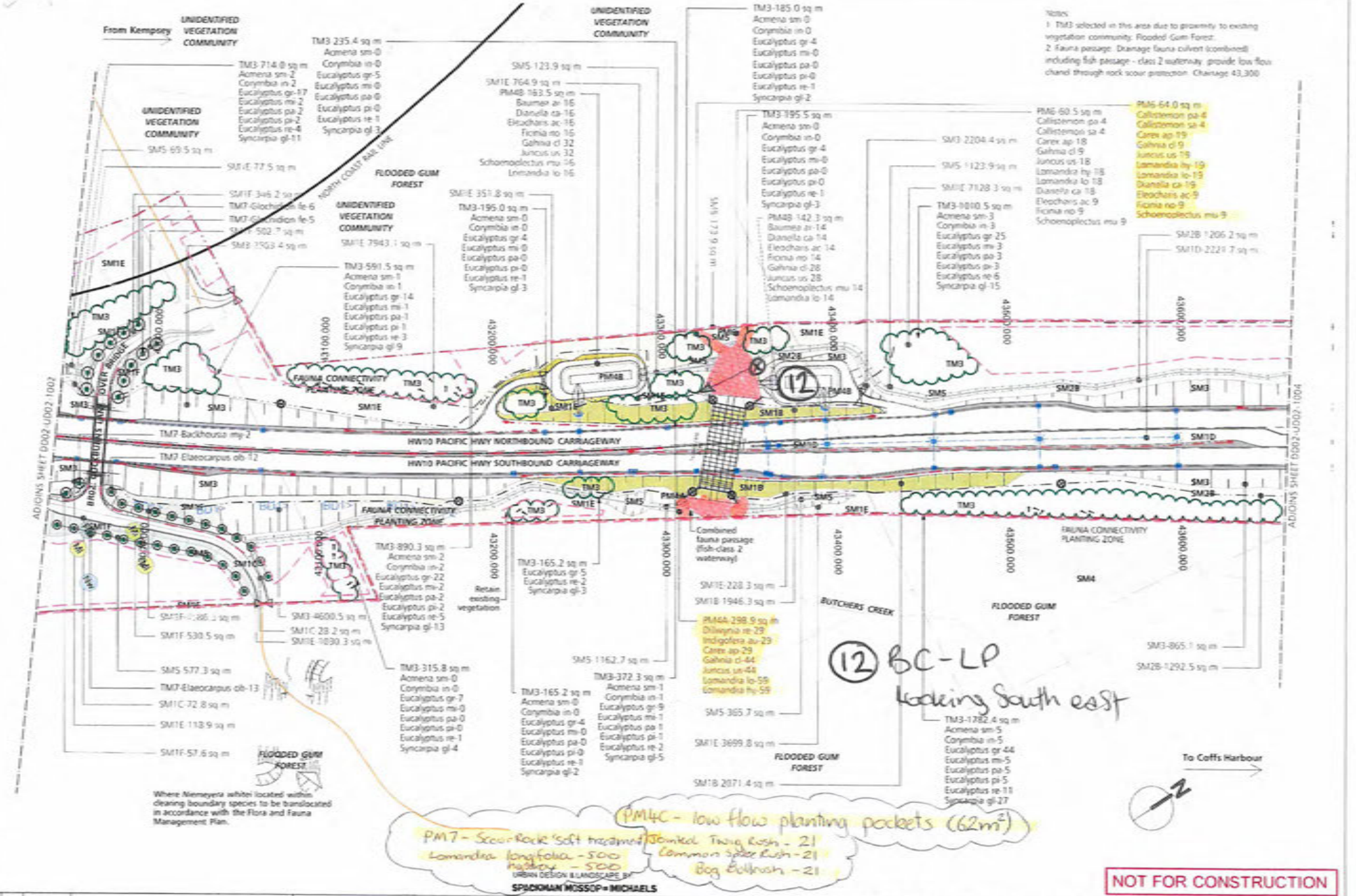

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ROADS AND MARITIME SERVICES

NAMBUCCA SHIRE COUNCIL
HW10 PACIFIC HIGHWAY UPGRADE
WARRELL CREEK TO NAMBUCCA HEADS
DD02 - LANDSCAPE AND PLANTING
LANDSCAPE PLAN 3 OF 9

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Appendix C

Summary of Landscape Treatments

Table C1. Summary of Landscape Treatments at each Monitoring Site

Site	*Seed Supplier*	*Areas Requiring Further Treatment*	*Treatment Type and Application*	*Date of Application*	*Topsoil or Media Component Mix %*	*Fertiliser Application Rates*	*Herbicide Application*	*Hand Weeding*
1	Seed World Australia (SWA)	Not Required	Seed Mix 1 Hydromulching	20/01/2016	Topsoil 100%	Organic Fertiliser (Dyno Fert) @ 250 kg/ha & Native Plant Food @ 200 kg/ha	Not Required	Not Required
2	SWA	Not Required	Seed Mix 2 Hydromulching	7/04/2016	Topsoil 100%	Organic Fertiliser (Dyno Fert) @ 250 kg/ha & Native Plant Food @ 200 kg/ha	Not Required	Not Required
3	SWA	Not Required	Seed Mix 3 Hydromulching	20/01/2016	Topsoil 100%	Organic Fertiliser (Dyno Fert) @ 250 kg/ha & Native Plant Food @ 200 kg/ha	Not Required	Not Required
4	SWA	Not Required	Seed Mix 4 Tractor Seeding	7/11/2016	60% Topsoil 40% Mulch Blend	Organic Fertiliser (Dyno Fert) @ 250kg/ha & Native Plant Food @ 200 kg/ha	Not Required	Not Required
5	SWA	Not Required	Seed Mix 5 Hydromulching	19/09/2016	Topsoil 100%	Organic Fertiliser (Dyno Fert) @ 250kg/ha & Native Plant Food @ 200 kg/ha	Not Required	Not Required
6	SWA	Not Required	BRC Hydromulching	2/04/2016	60% Topsoil 40% Mulch Blend	Organic Fertiliser (Dyno Fert) @ 250 kg/ha & Native Plant Food @ 200 kg/ha & Urea @ 400 kg/ha	Not Required	Not Required
7	SWA	Not Required	BRC Hydromulching	2/04/2016	60% Topsoil 40% Mulch Blend	Organic Fertiliser (Dyno Fert) @ 250 kg/ha & Native Plant Food @ 200 kg/ha & Urea @ 400 kg/ha	Not Required	Not Required
8	SWA	Not Required	BRC Hydromulching	16/09/2016	60% Topsoil 40% Mulch Blend	Organic Fertiliser (Dyno Fert) @ 250 kg/ha & Native Plant Food @ 200 kg/ha & Urea @ 400 kg/ha	Not Required	Not Required
9	SWA	Not Required	BRC Hydromulching	8/04/2016	60% Topsoil 40% Mulch Blend	Organic Fertiliser (Dyno Fert) @ 250 kg/ha & Native Plant Food @ 200 kg/ha &	Not Required	Not Required

Site	Seed Supplier	Areas Requiring Further Treatment	Treatment Type and Application	Date of Application	Topsoil or Media Component Mix %	Fertiliser Application Rates	Herbicide Application	Hand Weeding
						Urea @ 400 kg/ha		
10	Bluedale Wholesale Nursery (BWN)	Not Required	Landscape Planting (UD02) including PM4C	14/11/2016	100% Topsoil (conditioned with dolomite and lime as per SESL recommendations)	None applied as per specifications in R179 for wetland plantings	Undertaken as required prior to topsoil stockpiling	Not Required
11	BWN	Not Required	Landscape Planting (UD02) including PM4A & PM4C	12/09/2016	100% Topsoil (conditioned with dolomite and lime as per SESL recommendations)	None applied as per specifications in R179 for wetland plantings	Undertaken as required prior to topsoil stockpiling	Completed
12	BWN	Not Required	Landscape Planting (UD02) including PM4A, PM4C, PM6 & PM7	14/11/2016	100% Topsoil (conditioned with dolomite and lime as per SESL recommendations)	None applied as per specifications in R179 for wetland plantings	Undertaken as required prior to topsoil stockpiling	Completed

Appendix D

Monthly Photographic Records (Dec 2016, Jan 2017)

Monitoring Site 1

December 2016	*January 2017*
	
Site 1 view to south (Dec 2016)	**Site 1 view to south (Jan 2017)**

Monitoring Site 2

December 2016	*January 2017*
	
Site 2 view to south (Dec 2016)	**Site 2 view to south (Jan 2017)**

Monitoring Site 3

December 2016	*January 2017*
	
Site 3 view to north (Dec 2016)	**Site 3 view to north (Jan 2017)**

Monitoring Site 4

December 2016	*January 2017*
	
Site 4 view to north (Dec 2016)	**Site 4 view to north (Jan 2017)**

Monitoring Site 5

December 2016	*January 2017*
	
Site 5 view to south (Dec 2016)	**Site 5 view to south (Jan 2017)**

Monitoring Site 6

December 2016	*January 2017*
	
Site 6 view to north (Dec 2016)	**Site 6 view to north (Jan 2017)**

Monitoring Site 7

December 2016	*January 2017*
	
Site 7 view to north (Dec 2016)	**Site 7 view to north (Jan 2017)**

Monitoring Site 8

December 2016	*January 2017*
	
Site 8 view to north (Dec 2016)	**Site 8 view to north (Jan 2017)**

Monitoring Site 9

December 2016	*January 2017*
	
Site 9 view to north (Dec 2016)	**Site 9 view to north (Jan 2017)**

Monitoring Site 10 (Photo point peg needs to be replaced at this site)

December 2016	*January 2017*
	
Site 10 view to west (Dec 2016)	**Site 10 view to west (Jan 2017)**

Monitoring Site 11

December 2016	*January 2017*
	
Site 11 view to south (Dec 2016)	**Site 11 view to south (Jan 2017)**

Monitoring Site 12

December 2016	*February 2017*
	
Site 12 view to south (Dec 2016)	**Site 12 view to south (Jan 2017)**