Woolgoolga to Ballina Pacific Highway upgrade

Construction and Operational Monitoring of In-situ Threatened Flora Species (non-rainforest)

Annual Report 2018

NSW GOVERNMENT

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Woolgoolga to Ballina Pacific Highway Upgrade

Project No:	IA136900
Document Title:	In-situ Threatened Flora (non-rainforest flora) Annual Monitoring Report 2018
Document No.:	Final
Revision:	v.2
Date:	15 November 2019
Client Name:	Roads and Maritime Services
Client No:	IA136900
Project Manager:	Chris Thomson
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File Name:	J:\IE\Projects\04_Eastern\IA136900\21 Deliverables\02 Plants_in-situ\2018\IA136900_W2B_flora_annual_report _2018_Draft_04 09 2019.docx

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Document history and status

Revision	Date	Description	By	Review	Approved
Draft rev.1	04/09/2019	Draft rev.1	J. Carr	C. Thomson	C. Thomson
Final v.1	24/09/2019	Final v.1	J.Carr	C.Thomson	C.Thomson
Final v.2	15/11/2019	Final v.2	J.Carr	RMS	C.Thomson

Contents

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The sole purpose of this report and the associated services performed by Jacobs is to provide the results of flora monitoring for Roads and Maritime in accordance with the scope of services set out in the contract between Jacobs and Roads and Maritime. That scope of services, as described in this report, was developed with Roads and Maritime and Pacific Complete.

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1. Introduction

1.1 Background and objectives

As part of the Woolgoolga to Ballina (W2B) Pacific Highway upgrade project, a Threatened Flora Management Plan (TFMP) was developed to meet approval of the NSW condition requirements of MCoA D8 and the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) Condition of Approval (CoA) 12. The TFMP identified potential impacts to threatened flora species listed under the EPBC Act and formerly under the *Threatened Species Conservation Act 1995*, now the *Biodiversity Conservation Act 2016* (BC Act). Threatened plant species are being managed in two ways, 1) by the protection, monitoring and management of plants that remain in-situ adjacent to the W2B upgrade, and 2) by the translocation, monitoring and management of plants that are located within the road construction footprint. This report addresses the monitoring requirements for in-situ plant species.

The in-situ plant monitoring program documented in the TFMP outlines the methods and timing for targeted surveys of threatened plant species that are located in proximity to the project. The program aims to identify potential direct and indirect impacts during construction and the early stages of operation of the project by monitoring the performance of mitigation measures against management goals and implementing required corrective actions for adaptive management of the program.

The program commenced during the pre-construction phase in which (baseline) data was collected for a series of impact and control plots for each threatened species. Impact and control plots were monitored in the first year of construction in 2017 from two monitoring events for section 1 to 2 and four quarterly monitoring events for sections 3 to 10 of the W2B upgrade (Jacobs 2018). This report outlines the methods, results and assessment of performance measures for the second year of construction in 2018. The report provides discussion on avoiding and minimising impacts to threatened plant species with reference to the goals in the TFMP. Suggestions for adaptive management and corrective actions is also provided where deemed to be required.

The in-situ flora monitoring program is specific to 20 threatened flora species, these are listed in Table 1.1.

Table 1.1 Threatened flora species targeted in the construction monitoring

Species	Common Name	Status		Project section for monitoring
		EPBC Act	BC Act	
Angophora robur	Sandstone Rough Barked Apple	V	V	3
Arthraxon hispidus	Hairy Joint Grass	V	V	8, 9, 10
Cyperus aquatilis	Water Nutgrass	-	E	1, 2, 3, 6, 7
Eleocharis tetraquetra	Square-stemmed Spike-rush	-	E	1, 2, 3
Endiandra muelleri subsp. *bracteata*	Green-leaved Rose Walnut	-	E	4
Eucalyptus tetrapleura	Square-fruited Ironbark	V	V	2
Grevillea quadricauda	Four-tailed Grevillea	V	V	3
Lindernia alsinoides	-	-	E	1, 2, 3
Lindsaea incisa	Slender Screw Fern	-	E	1, 2, 3, 6
Macadamia tetraphylla	Rough-shelled Bush Nut	V	V	7, 8
Maundia triglochinoides	-	-	V	1, 2, 3, 6, 7
Melaleuca irbyana	Weeping Paperbark	-	E	7

Species	Common Name	Status		Project section for monitoring
		EPBC Act	BC Act	
Oberonia complanata	-	-	E	8
Oberonia titania	-	-	V	10
Persicaria elatior	Tall Knotweed	V	V	4, 5
Prostanthera cineolifera	Singleton Mint Bush	V	V	6
Quassia sp. Moonee Creek	Moonee Quassia	E	E	1, 3
Rotala tripartita	-	-	E	6
V=vulnerable, E=endangered				

1.2 Detailed design outcomes

A small number of the in-situ sites established during the pre-construction phase of the project, were inadvertently placed in areas that were subject to approved clearing associated from the detailed design. These sites which were removed during Year 1 construction activities were documented in the 2017 annual report (Jacobs 2018) and will be excluded from future annual reports. Details are provided in Appendix B. Following review of the detailed design and comparison with concept design the total number of remaining in-situ populations being monitored were reset across the whole project. Monitoring plots partially impacted in 2017 were continually monitored to examine any change post impact or from future direct or indirect impacts. Where possible, additional plots were established to monitor remaining populations adjacent to pre-existing impacted sites.

2. Methods

2.1 Timing and conditions

2.1.1 Survey timing

The timing of surveys followed in accordance with the monitoring program in the TFMP which prescribes that monitoring events be undertaken twice a year for the second year of construction and one annual monitoring event for the operational phase (relevant to sections 1-2).

As different sections of the W2B upgrade are being constructed independently, the timing of monitoring events occurred at different phases for 2018. For example, this report documents monitoring data at Year 2 construction and Year 1 operation as follows:

- Section 1-2 – Year 1 operation (2018). Surveys were completed in spring.
- Section 3-11 – Year 2 construction (2018). Biannual surveys completed in autumn and spring.

This information is summarised in Table 2.1. Although construction for sections 10-11 was delayed by approximately 12 months, the monitoring program has maintained the same classification as sections 3-9 for the purposes of survey timing and reporting results.

Table 2.1 Timing of data collection during different project phases for all sections/portions in 2018

Project sections	Timing of data collection for each project phase*	
	Autumn 2019	Spring 2019
Section 1	-	O1
Section 2	-	O1
Sections 3-4	C2	C2
Sections 5	C2	C2
Section 6	C2	C2
Sections 7,8,9	C2	C2
Sections 10-11	C2	C2
C2 = Construction Year 2, O1 = Operation Year 1		

2.1.2 Climatic conditions

Given the length of the project study area spanning over 160 km, localised climatic conditions and rainfall vary across this extent and is important to identify these conditions in interpreting the data and trends in natural variation of plants and also changes in their health, abundance and occurrence. This is particularly important for threatened flora that grow in wetland and riparian habitats and depend on rainfall.

Total annual rainfall for 2018 ranged from a high of 1461 mm at Lower Bucca (Sections 1 and 2), to 845 mm at Grafton Research Station (Sections 3-5), and a mid-range of 1042 mm at Woodburn (Sections 6-10).

All sites received below average annual rainfall (2-24%), with the greatest decrease at Woodburn which was also substantially less than 2017 annual rainfall of 2455 mm. Monthly rainfall trends were variable across the whole region (Refer to

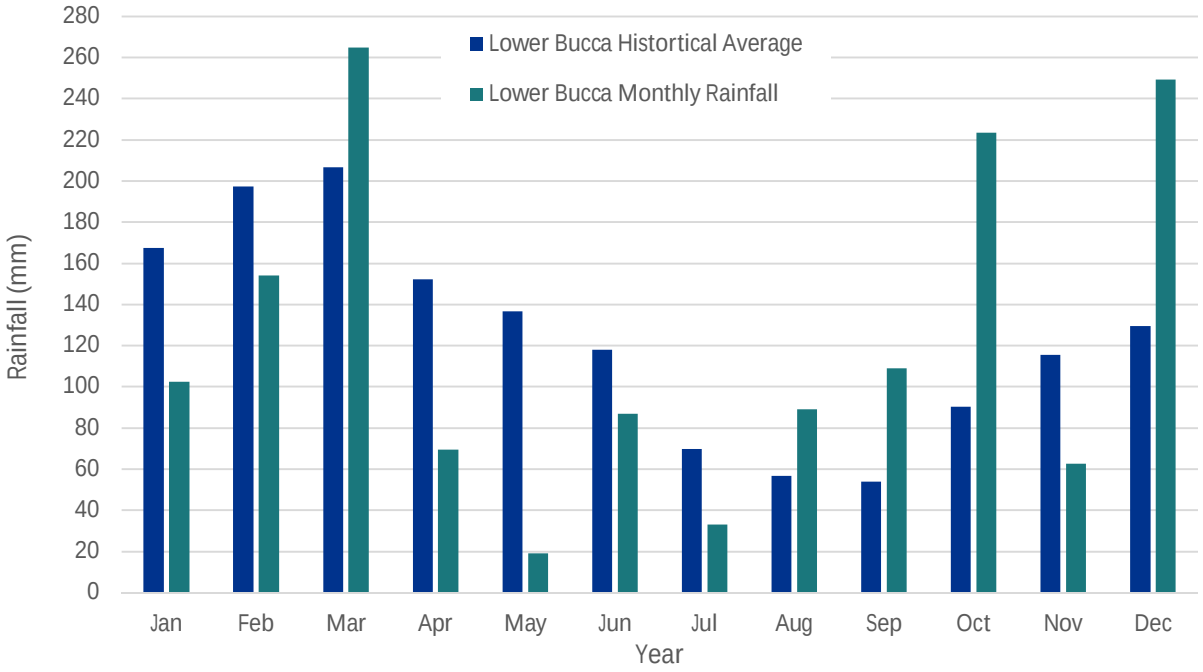


Figure 2.1 Monthly rainfall data and monthly historical average from Lower Bucca (0592006) for 2018

, Figure 2.2 and Figure 2.3). Autumn rainfall was mostly below average at all sites and spring was variable with high rainfall (above average) in October at all sites. Overall mean maximum and minimum temperatures were average for majority of months in 2018.

A summary of all monitoring events, survey timing and local weather conditions is presented in Tale 2-2 and monthly rainfall data against historical averages is illustrated on Figure 2-1-2-3.

Table 2.2 Survey timing and weather conditions experienced for each monitoring event in 2018

	Monitoring period 2018			Total mean rainfall three months preceding survey (mm)*			Mean minimum temp. (°C)	Mean maximum temp. (°C)
	Section 1-2	Section 3-5	Section 6-10	Lower Bucca	Grafton	Woodburn		
Autumn	-	16-21 Apr	16-20 Apr	521	271	426	15.6 (s3-5) 17.6 (s6-10)	27.1 (s3-5) 25.9 (s6-10)
Spring	22-23 Nov	19-21 Nov	7-11 Oct	421	223	157	16.5 (s1-2) 16.5 (s3-5) 15.8 (s6-10)	26.9 (s1-2) 30.1 (s3-5) 24.4 (s6-10)

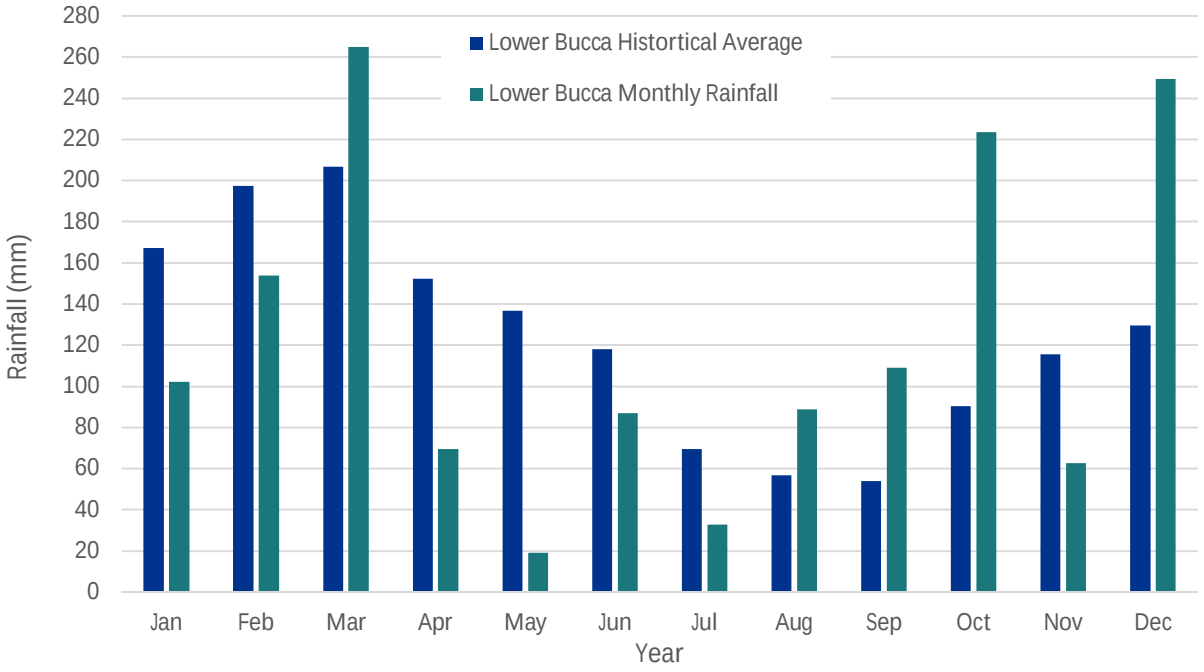


Figure 2.1 Monthly rainfall data and monthly historical average from Lower Bucca (0592006) for 2018

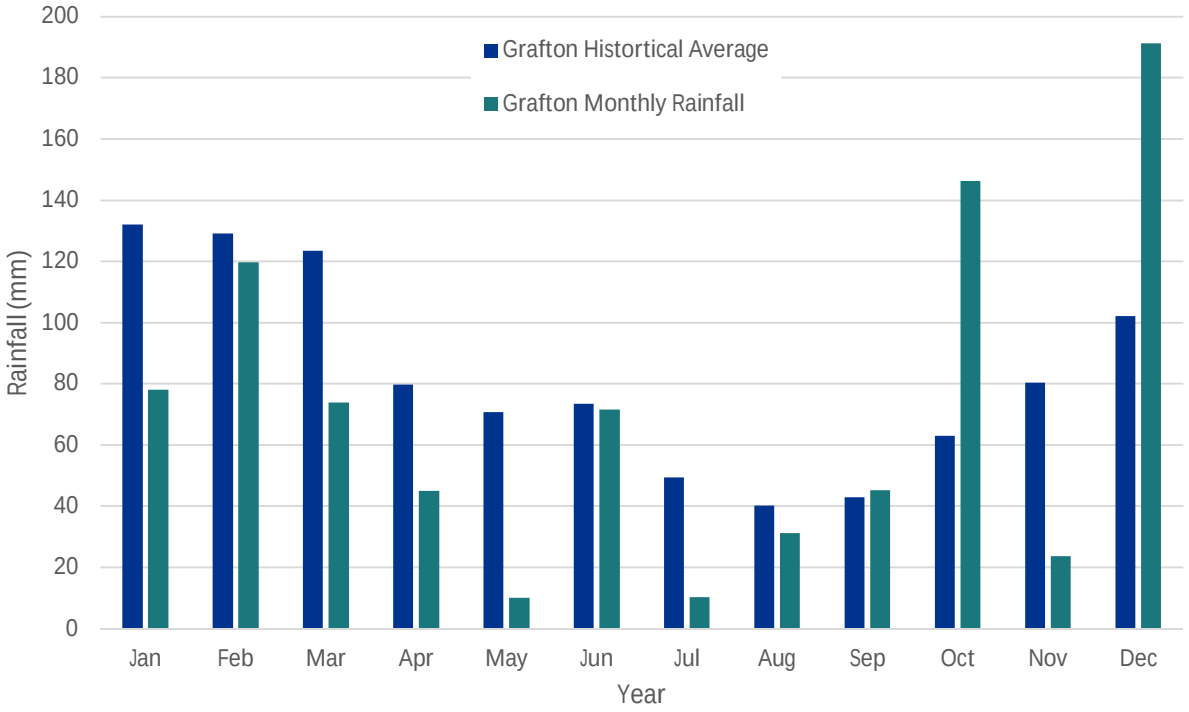


Figure 2.2 Monthly rainfall data and monthly historical average from Grafton Research Station (058077) for 2018

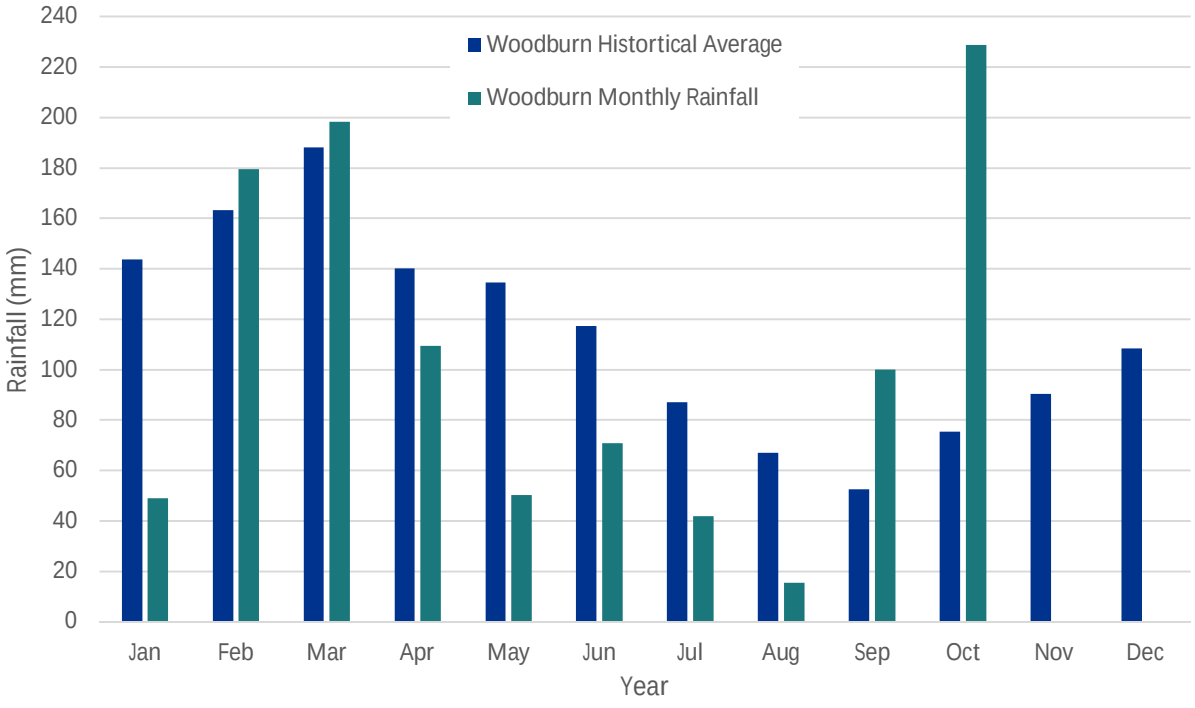


Figure 2.3 Monthly rainfall data and monthly historical average from Woodburn (058061) for 2018

2.2 Monitoring sites

The pre-construction baseline surveys undertaken by Jacobs (2014) identified 93 threatened flora species occurrences (sites) as the basis of the in-situ monitoring program. This comprised 69 impact monitoring sites and 24 control sites (outside of the impact area). Two or three threatened flora species sites may occur in the same plot location. All sites monitored for the pre-construction were established during the concept design.

All current site locations are displayed in Appendix A.

During the 2018 construction/operation monitoring period some of the same sites could not be accessed from the first year monitoring period due to continued landowner restrictions. The new control and impacts sites (added/replaced) established in 2017 were able to be accessed in 2018. This allowed for threatened species monitoring to be continued. An additional site La-1.3a was established in 2018 to replace La-1.3 which hasn't been accessed since pre-construction. This was a result of new *Lindernia alsinoides* plants observed growing along the road verge adjacent to La-1.3. New *L. alsinoides* plants were also found in Elt-2.1, and a second site La-2.2 was established to monitor these plants adjacent to the constructed highway.

A total of 81 sites are now monitored in the program comprising 62 impact and 19 control sites. Site locations are illustrated in Appendix A. Refer to the Construction Monitoring of In-situ Threatened Flora (non-rainforest flora) Annual Report 2017 for a description of replaced, removed or added sites from 2017.

2.2.1 Decommissioned monitoring sites

A total of 25 sites have been removed from the monitoring program due to continued access restrictions at 10 sites, loss of 10 sites impacted within the detailed design construction footprint and other reasons for five other sites. Some sites have been replaced or duplicated where possible and are referenced in the annual report 2017 (Jacobs). The list of sites removed is shown in Table 2.3.

Table 2.3 Sites removed from monitoring program

Site	Chainage	Reason/status	Site	Chainage	Reason/status
Elt-1.1	5700	Impact	Mt-3.3	64300	No access
Elt-1.2	6200	Impact	Ar-3.10	66500	Impact
Elt-C1.1	6400	No access	Ar-3.11	67700	Impact
Elt-C1.2	6400	No access	Pe-4.2	80600	Impact
Elt-1.4	6700	No access	Pe-5.1	83400	Impact
La-1.1	6200	Impact	Sp-4.1	80700	Not listed as threatened
La-C1.1	6400	No access	Sp-8.1	134900	Not listed as threatened
La-C1.2	6400	No access	Pc-6.2	101700	Impact
La-1.3	6700	No access	Pc-6.2a	101700	Monitored in translocation program
La-C1.3	6400	No access	Pc-C6.1	101700	Replaced with in-situ site
Mt-C1.1	4900	No access	Oc-8.1	132200	Impact
Mt-1.2	5700	Impact	Pa-9.1	144400	*Calanthe triplicata* - not listed as threatened
Mt-C1.2	5700	No access			

2.3 Sampling methods

2.3.1 Targeted surveys and species detection

The sampling approach ensured that different plant life stages were targeted over two monitoring events. The surveys focused on monitoring the health and condition of known individuals as well as investigating plant recruitment. Detection of cryptic threatened flora was reliant on suitable climatic and seasonal conditions, particularly for *Cyperus aquatilis* and *Rotala tripartita*. Climate variability also has an effect on *Lindernia alsinoides, Lindsaea incisa* and *Maundia triglochinoides,* however these species were generally detected throughout the monitoring period under suitable conditions. *Persicaria elatior* and *Arthraxon hispidus* have an annual life cycle and were only detectable at certain times of the year. *P. elatior* would generally show signs of natural dieback in late autumn with few plants remaining in winter and seedlings would appear in late spring. *A. hispidus* would dieback in winter and seedlings would appear in spring and begin to set seed in late autumn. *C. aquatilis* and *R. tripartita* are also short-lived annuals and rely on wet summer periods. All other subject species were detectable in all seasons throughout 2018.

2.3.2 Sampling technique

A 20 x 20 metre plot with a central 20 metre transect was used at each site following the same techniques carried out in 2017 and in line with the TFMP. Where possible, transects were aligned from north to south. At each monitoring event a photograph was taken at the northern end of the transect looking along the transect. Additional photographs were taken of the general habitat condition, individual plants and/or clusters of plants, and where insect attack and plant dieback was noted.

A tape measure was laid along the plot midline to record habitat condition (vegetation cover and structure) and used as a reference for plant locations. Vegetation condition was recorded along the transect with the canopy and midstorey (greater than one-metre high) cover recorded as percentage foliage cover every five metres (four points) along the transect and groundcover attributes were recorded at every metre (20 points) as either forb, grass, shrub (less than one-metre high), bare/water, litter or exotic. The central transect was also used to describe the distribution of threatened flora within the plot. Weed species and their cover abundance was recorded within the whole plot.

Habitat condition parameters and plant health indicators were recorded within the plot and the transect and associated with individuals in relation to threatened plants. This included but was not limited to:

- Genus, species and subspecies.
- Identifier – unique plant number.
- Location – location; easting, northing & description.
- General condition – score on a scale of 0 to 5, where 0 is dead and 5 is excellent.
- Leaf condition – healthy/unhealthy, colour, vigour.
- Flower/fruit – flower/fruit presence.
- Length of new shoots – average length of new shoots (estimate) and abundance of new shoots (counts or basic scale).
- Disease symptoms – evidence of disease (including presence / absence of Myrtle Rust, Cinnamon Fungus).
- Recruitment.
- Evidence of any other damage or disturbance.
- Plant community type.
- Canopy cover.
- Mid-storey cover.
- Ground-layer cover and composition.
- Weed cover of abundance and weed ground cover percentage.
- Recruitment of canopy and mid-storey species.
- Climatic events (e.g. drought, flood, unusually cold winter temperatures etc.).

- Maintenance carried out – when and what kind of maintenance carried out at the site since the last monitoring.
- Any other ecological impacts.

A quantitative measure of a subject plant's abundance and distribution within a plot was used for groundcover plants (and annuals) that are difficult to count and/or grow in large clusters. This included *C. aquatilis* and *R. tripartita*. *L. alsinoides, L. incisa* and *M. triglochinoides*

The technique involved the measurement of an area of occupancy (AoO) of subject plant's distribution within the plot and a series of 1x1 metre quadrats randomly placed within the AoO to estimate percentage ground cover and determine average cover. Any plots with continual low abundances of individuals were directly counted. Average cover was not used for *A. hispidus* to keep data consistent with previous baseline monitoring. Instead grass stems were directly counted within specified patches or mean number of stems determined in 1 x 1m quadrats for larger populations.

To measure consistent change (increase/decline) of in-situ plants, the mean percentage ground cover (or mean number of stems) was multiplied by the division of the AoO over the plot size (AoO / 400m^2 x mean cover). Densities were analysed as an index of abundance measured at plant cover or stems per metre squared.

The remaining shrubs, trees and orchids were directly counted as per the TFMP. A summary of plant health and habitat condition factors was recorded based on observing leaf condition, any notable dieback or insect attack, plant height, width, diameter at breast height (DBH) for tree species, number of trunks and habitat conditions.

Weed cover was measured using a modified Braun-Blanquet cover abundance score (Braun Blanquet, 1928; Poore 1955), refer Table 2.4.

Table 2.4 Cover abundance score used for measuring weeds

Score	Cover of abundance
1	Rare, few individuals present (three or less) and Cover <5%;
2	Common and cover <5%;
3	Very Abundant and Cover nearing 5% OR Cover from 5% to <25%;
4	Cover from 25% to less than 50%;
5	Cover from 50% to less than 75%;
6	Cover 75% or more

Other general information recorded at each plot included observations of the dominant flora species in each structural layer, prevailing site conditions (i.e. soil moisture, surface water levels and observed flow velocity for macrophyte species) and landscape parameters (i.e. landform, drainage, slope and aspect).

2.4 Performance thresholds and corrective actions

The TFMP details an adaptive management approach to achieve management goals and mitigate impacts in-situ threatened flora. The data from the construction phase of the project has been analysed and interpreted to evaluate any impacts and the effectiveness of any management measures used. This is assessed in the context of the performance measures identified in the plan.

Specific goals for mitigating impacts using performance thresholds and corrections actions during construction management (relevant to Sections 3-10) for in-situ threatened plants are outlined in Table 2.5 summarised from the TFMP.

The operational environmental planning measures for threatened flora species and corrective actions if the measure deviates from the performance criteria are outlined in Table 2.5.

Table 2.5 Mitigation measures and corrective actions for threatened flora during construction (relevant to Sections 3-11)

Performance goals	Proposed mitigation measure	Monitoring/timing frequency	Trigger for corrective actions	Corrective actions
Zero mortality of threatened plants from in situ populations (from physical damage during construction) and no loss of threatened plants directly adjacent to the project.	Implementation of the Roads and Maritime clearing protocol. Clearing areas identified and approved as required under the clearing protocol.	Clearing areas identified and approved prior to clearing activities being undertaken.	Clearing areas have not been marked out and approved prior to construction.	Delay construction until clearing areas have been marked out.
	Exclusion zones fenced off to protect in situ threatened plants. Induct all construction staff at the commencement of construction works. Induct new staff as appropriate	Exclusion zone fencing monitored at least weekly during construction. Faults rectified as soon as noticed.	Exclusion zone fencing is damaged or ineffective.	Stop construction in the area of the fencing breach until exclusion fencing has been repaired. Investigate why breach in fencing occurred and implement corrective actions as required to prevent reoccurrence.
	Monitor in-situ plants at established monitoring sites during construction.	Every three months during the first year of construction. Every six months during the second year of construction.	Any loss of retained in situ threatened plants.	Commence assessment of potential reasons for mortality, including seasonal fluctuations, natural events such as drought and fire within one month of trigger being identified. Compare with paired control site. Identify potential threats, implement corrective actions and modify monitoring as necessary.
No notable increase in the abundance of weeds within threatened plant habitat during monitoring of in situ populations.	Implementation of weed management as described in the CEMP and FFMP. Up to date Sensitive Area Plans.	Every three months during the first year of construction. Every six months during the second year of construction.	Noxious and environmental weeds reported in areas adjacent to threatened plants. Spread of noxious and environmental weeds into properties adjoining the	Review the weed management maintenance schedule and update as required. Implement appropriate weed measures as required within one month of the trigger for corrective action.

Performance goals	Proposed mitigation measure	Monitoring/timing frequency	Trigger for corrective actions	Corrective actions
			project noted in monitoring activities.	
Adequately planned translocation carried out such to maximise the chance of survival of the translocated plants.	Salvage and planting of identified plants for translocation undertaken prior to clearing, into suitable habitat, and using appropriate methods that maximise the chance of plant survival.	At the optimal time of year for species prior to clearing works commencing. Once salvaged, plants would need to be monitored throughout the construction phase at least three times a year (summer, autumn, spring).	All plants identified for translocation have not been translocated prior to commencement of construction.	Stop construction in vicinity of threatened plants. Investigate appropriate translocation activities. If translocation cannot be undertaken use reserves of species tube stock or seed to supplement and enhance populations.
The landscaping design includes details on revegetation requirements for areas adjacent to threatened plants and translocation/offset areas.	Revegetation and habitat management requirements included in the landscape design for areas adjacent to threatened plants. Specifically includes revegetation maintenance planned in consultation and implemented by experienced bush regenerators for areas adjacent to in situ populations.	Appropriate measures incorporated into the Urban Design and Landscape Plan.	Landscape design has not included specific revegetation requirements for areas adjacent to threatened plants and translocation/offset areas	Plan to be updated to include specific requirements prior to commencement of implementation of plan.
Dust managed in accordance with the CEMP.	Dust impacts would be managed in accordance with the CEMP including dust suppression measures.	Dust suppression would be implemented in accordance with the CEMP. Monitoring of dust on plants considered as part of plant health monitoring. Dust deposition is to be monitored monthly.	Dust exceedances recorded from dust monitoring within sections containing threatened plants.	Review dust suppression procedures to ensure adequate dust management. Where appropriate, shade cloth screening installed on edge of construction footprint to protect low growing threatened flora.

Performance goals	Proposed mitigation measure	Monitoring/timing frequency	Trigger for corrective actions	Corrective actions
Water and soil quality managed in accordance with the CEMP.	Adequate soil and water quality controls installed surrounding retained threatened plants. Procedures for maintenance and monitoring of erosion and sediment controls included in the CEMP.	Erosion, sediment and water quality controls would be monitored weekly throughout the construction period and as soon as practical after storm events.	Breaches of erosion, sediment and water quality controls recorded. Loss of ecological condition recorded from plant health monitoring particularly from altered water quality.	Review adequacy of the erosion, sediment and water quality controls and implement appropriate corrective actions. Commence review of monitoring procedures for controls and implement appropriate corrective actions.
Reduce impacts to threatened orchid species through illegal collection.	Restrict the availability of information identifying where orchids occur within the project area, and in close proximity to the project area. Limit site access to areas where orchids naturally occur and may be being managed in situ.	Threatened orchid populations will be regularly monitored during construction and post construction as part of the overall monitoring program.	There is evidence of public access to the orchid areas and/or evidence of illegal collection.	Discuss potential corrective measures with the regulatory authorities.

Table 2.6 Mitigation measures and corrective actions for threatened flora during operation (Sections 1-2)

Performance goals	Proposed mitigation measure	Monitoring/timing frequency	Trigger for corrective actions	Corrective actions
Zero mortality of retained in situ threatened plant populations during construction and for three consecutive monitoring periods post-construction. Post the above period 80 per cent survival of tree, shrub and herbaceous perennials after three years.	Clearly identify in situ populations and exclusion zones. Implementation of weed management measures throughout operational period.	Threatened plant health monitoring and weed monitoring to occur as per Sections 8. Monitoring to occur annually of in-situ monitoring sites and control sites. Monitoring will occur for a minimum of three years post-construction (subject to achieving three consecutive monitoring periods as per MCoA D8 (k)).	Any mortality of in situ threatened plants for the first three consecutive monitoring periods post construction. Post the above timeframe more than a 20 per cent decline for an in situ threatened plant population over one monitoring event from the baseline (depending on species specific seasonal fluctuations).	Commence assessment of potential reasons for mortality, including natural events such as drought and fire within one month of trigger being identified. Review weed maintenance schedule within one month of trigger being identified. Identify potential threats, implement corrective actions and modify monitoring as necessary. Offset any additional threatened plant impacts that have occurred as a result of the Project.
At least 90 per cent of the plants planted as part of the revegetated areas have survived after the first year and 80 per cent after three consecutive monitoring events.	Regular maintenance activities such as watering, mulching, weed control and supplementary plantings as required as per the landscape design.	For the first twelve months monitoring will be monthly. It will then go to every 6 months for two years. Monitoring will occur in Spring/Summer to evaluate the success of revegetation against performance objectives.	Monitoring and maintenance activities not being undertaken. More than 10 per cent of plants have died after year one, and more than 20% have died after three consecutive monitoring events.	Within one month of the trigger review and update maintenance methods as required. Identify any other potential threats and implement corrective actions as required. Any failed areas to be reseeded within 6 weeks of trigger. Ongoing monitoring and maintenance undertaken until plant health and/or ecological condition of habitat has been maintained at 80% survival after three consecutive monitoring events.

Performance goals	Proposed mitigation measure	Monitoring/timing frequency	Trigger for corrective actions	Corrective actions
Less than five per cent weed cover at retained in situ threatened flora sites (end of monitoring program).	Implementation of weed management measures throughout operational period.	Threatened plant health monitoring and weed monitoring to occur as per Sections 8. Weeds will be monitored in proximity to in situ flora populations annually. Monitoring will occur for a minimum of three years post-construction (subject to achieving three consecutive monitoring periods as per MCoA D8 (k)).	Weed cover increases by 10% from the baseline cover in areas surrounding in situ populations.* More than 30% weed coverage in revegetation areas.	Review weed maintenance program within one month of trigger being identified and update as required.

3. Results and Discussion

3.1 Operational Year 1 monitoring (Section 1 and 2)

3.1.1 Square-stemmed Spike-rush (*Eleocharis tetraquetra*)

Searches for *E. tetraquetra* at sites Elt-1.1a (chainage:5700), Elt-1.3 (chainage: 6600) and Elt-2.1 (chainage:14700) were undertaken on 22 and 23 November 2018. Individuals or clumps were detected at sites Elt-1.3 and Elt-2.1 (aka Elt-1.5) and appeared to be in good health at heights between 30-100 centimetres with fresh fruiting bodies. Fifteen clumps were counted at site Elt-1.3 (an increase in eleven clumps since March 2017) and two clumps at site Elt-2.1 (a decrease of six clumps since March 2017). No individuals were observed at site Elt-1.1a. Refer to Figure 3.1.

Sediment transport through adjacent culvert has ceased considerably at site Elt-2.1 and numerous native shrubs have established. The mean mid-storey cover has increased of 40% since last year and a reduction in weed cover abundance was observed.

The basin within site Elt-1.3 continues to hold sediment run-off from exposed soils, however the flow of sediment did not appear to be transported into habitat for threatened plants. Native macrophyte vegetation has re-established at the site and is capable of filtering sediment deposition. Weed cover abundance continues to remain low.

An increase in grass cover (40%) and decrease in reed cover (30%) was observed at site Elt-1.1a, possibly due to lower water levels. Sitting water was a grey colour, possibly leached from introduced rock situated around adjacent basin.

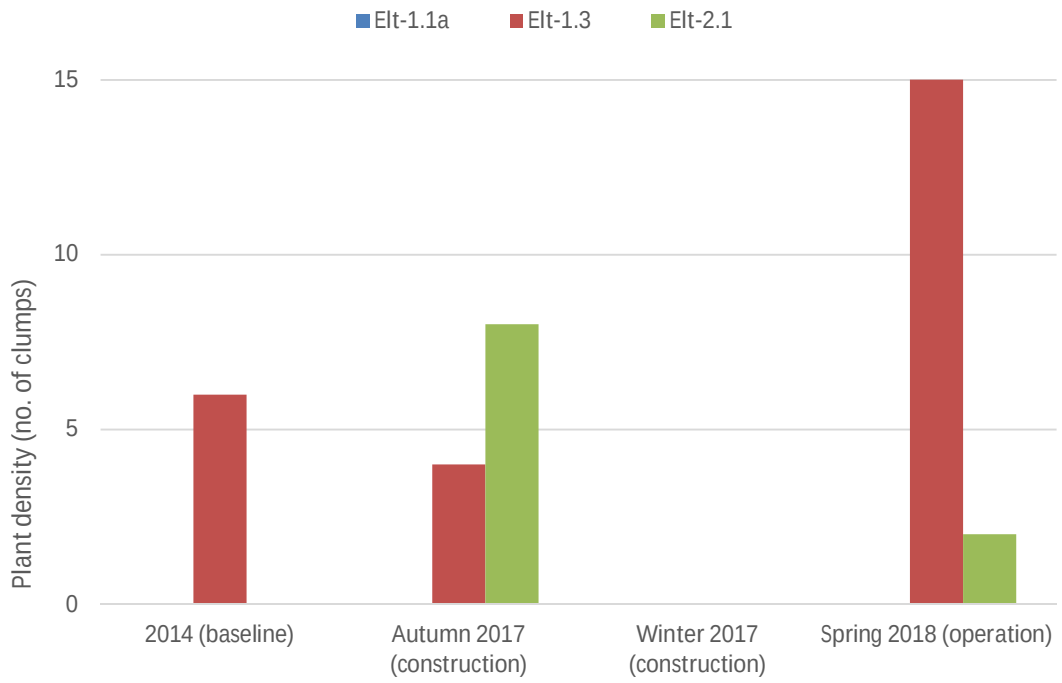


Figure 3.1 Number of clumps Eleocharis tetraquetra observed over four survey periods at three active in-situ monitoring sites (Elt-1.1a, Elt-1.3 and Elt-2.1)

3.1.3 Square fruited Ironbark (*Eucalyptus tetrapleura*)

All sites were searched on 21, 22 and 23 November 2018. All sites (chainage:9200-28400), except Et-1.1 and Et-C2.1 had slight declines in the number of trees. Sites Et-2.1 and Et-2.3 each had a single dead tree observed. Reasons for mortality are unknown and unlikely related to the project, however dieback of both small and large branches, and one trunk was detected in winter 2016 monitoring period as well as small branch dieback at site Et-2.1 in the baseline monitoring event. Site Et-2.2 had a single dead sapling observed, which previously had new shoots coppicing from fire in early 2017. *E. tetrapleura* recruitment was evident at control site Et-C2.1, with a single seedling found. Refer to Figure 3-2 for changes in tree abundance over six monitoring events.

Run-off is affecting site Et-2.3 (also observed during construction phase) and continues to wash away top soil within the plot. The drainage pipe initially diverting water to site during construction has been removed, however flow of water from the constructed embankment adjacent to the site is evident during high rainfall. The loss of top soil may impact on the success of seedlings to establish.

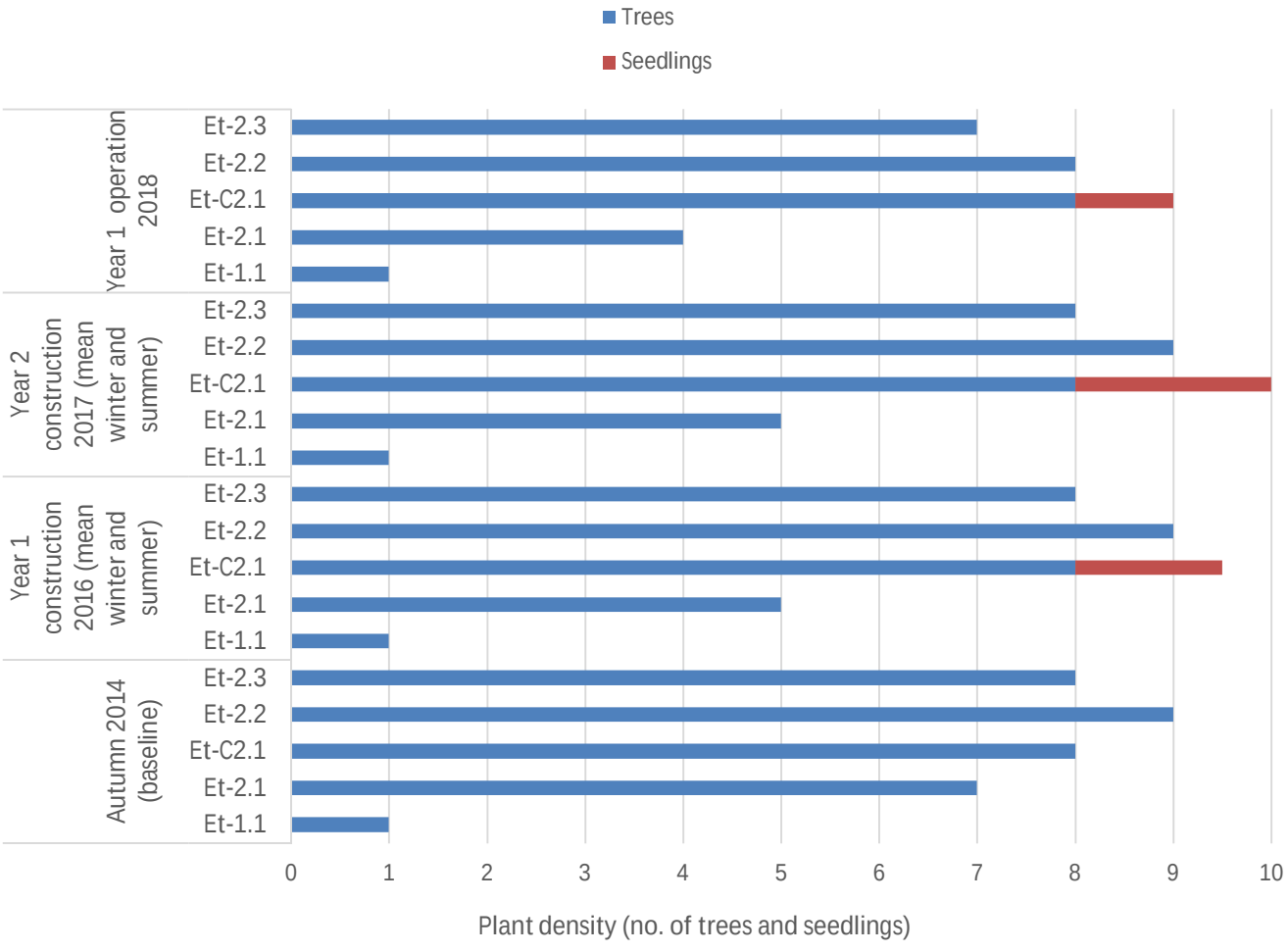


Figure 3.2 Number of Eucalyptus tetrapleura trees and seedlings observed over six monitoring events (mean results for 2016 (n=2) and 2017(n=2)) at four in-situ sites and one control site

3.1.4 Noah's False Chickweed (*Lindernia alsinoides*)

All accessible sites La-1.2 (chainage:6600), La-2.1 (chainage:22400), La-C1.3a were searched on 22 and 23 November 2018. All three sites had plants growing with flowers, fresh shoots and were in excellent health. Other sites had little to no change, but no reduction in plant cover from previous years.

An additional two sites were established for new populations appearing within or nearby existing sites. Numerous plants were observed (>50 individuals) at new in-situ site La-1.3a (chainage:6700) along a roadside drainage at Simmons Flat Road (refer to Photograph 1). Three plants were observed within Elt-2.1 at new in-situ site La-2.2 (chainage:14700).

New individuals were also observed along completed potions of section 1 (Corindi Beach) on seepage zones and on edge of constructed sedimentation basin near site La-1.2.

Refer to Figure 3.3 for changes in plant density over four monitoring events.

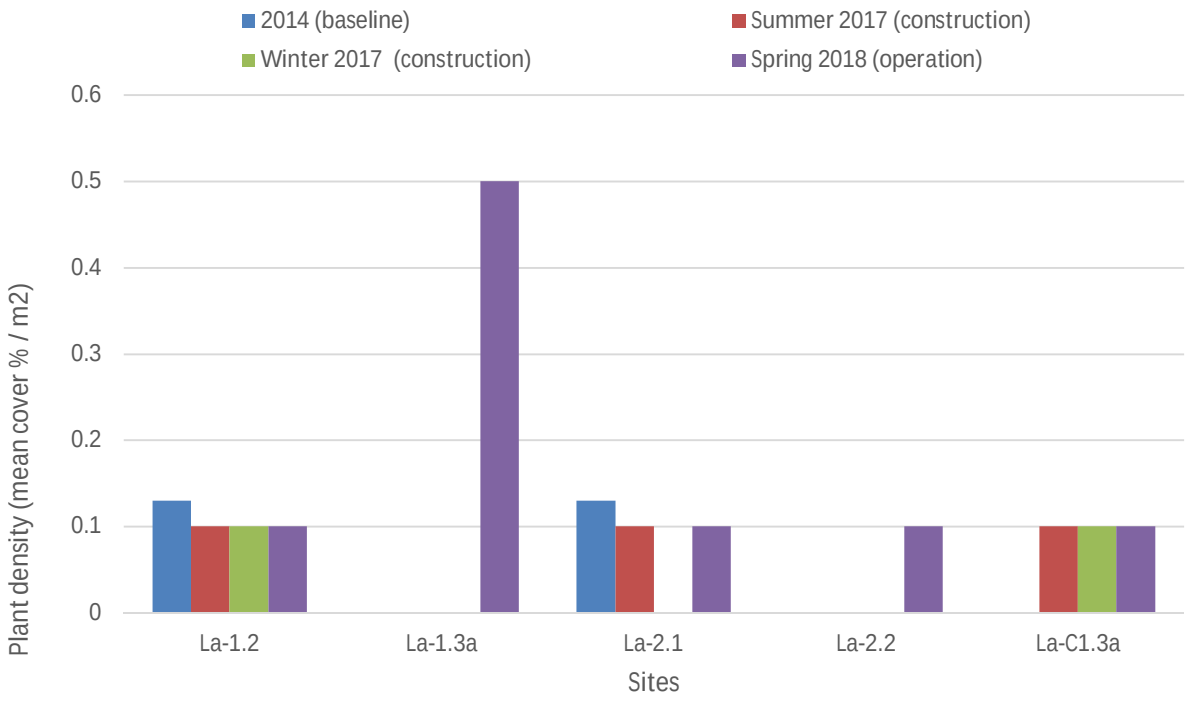


Figure 3.3 Density (mean cover % / m2) of Lindernia alsinoides observed over four monitoring events at four in-situ sites and one control site

Photograph 1: New Lindernia alsinoides sub-population at new site La-1.3a along roadside drainage (Simmons Flat Road) adjacent to old Site La-1.3.

Photograph 2: New Lindernia alsinoides observed on edge of constructed sedimentation pond on rocky substrate near site La-1.2

3.1.5 Slender Screw fern (*Lindsaea incisa*)

All active sites (chainage:5000-17500) were surveyed during the operational phase on 22 and 23 November 2018. There was no notable change in *L. incisa* mean cover at all sites. All fern fronds were in excellent health showing new growth, particularly at site Li-2.2 where ferns dominated the groundcover in a 50 m2 area of occupancy (refer to Photograph 3). Minor dieback (yellowing of fronds) of some *L. incisa* was observed at site Li-1.1. This site and the adjacent Paperbark Swamp Forest appeared to have low soil moisture than previous years which may have attributed to early frond dieback. Figure 3.4 shows changes in plant density (mean percent cover) over four monitoring events.

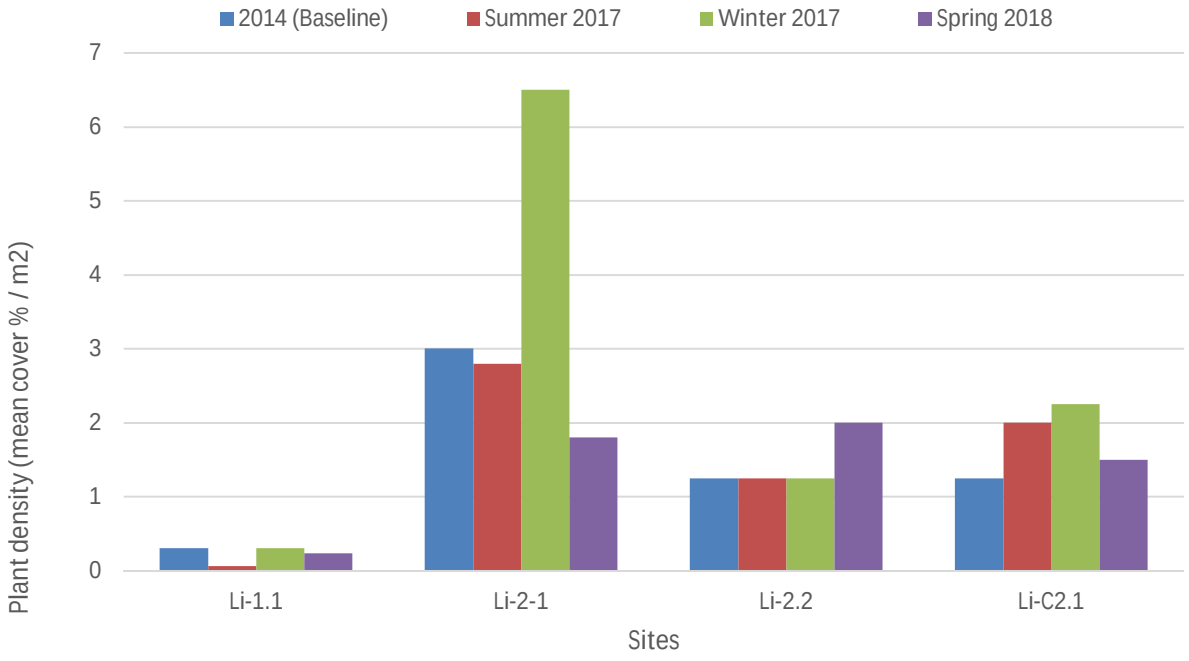


Figure 3.4 Density (mean cover % / m2) of Lindsaea incisa observed over four monitoring events at three in-situ sites and one control site

Photograph 3: Lindsaea incisa dominating groundcover with area of occupancy (50 m2) in site Li-2.2

Photograph 4: Minor dieback of Lindsaea incisa observed in site Li-1.1

3.1.6 Maundia triglochinoides

All active sites (chainage:4900-22400) during the operational phase were surveyed on 22 and 23 November 2018. Rainfall was above average three months preceding survey, and all site comprised moderate to high water levels, except Mt-1.1 (chainage:4900).

Minor insect attack and yellowing/browning of leaves was observed at sites all sites except Mt-2.3 (chainage:22400), but plant health was generally very good. Site Mt-1.1 continues to have no evidence of *M. triglochinoides*, even with broader searches beyond plot site. Evidence of *M. triglochinoides* plants were found at site Mt-1.2a (chainage:5700) after being absent in Winter 2017 during construction. Grey sediment-laden water (possibly leached from introduced rock) observed in waterway during construction phase is still present during project operation at site Mt-1.2a, but doesn't appear to be affecting *M. triglochinoides* plants.

M. triglochinoides plants at site Mt-2.1 originally observed growing under Geotextile fabric have died, however the mean cover of the species remains unchanged with healthy plants observed nearby in plot.

Control sites Mt-C1.2a (chainage:20500) and Mt-C2.2 (chainage:22400) had declines in *M. triglochinoides* cover, particularly at site Mt-C2.2 where higher cover (95%) of *Eleocharis sphacelata* was recorded, including in deeper pools once dominated by *M. triglochinoides*.

Other sites generally remained unchanged. The only major increase of *M. triglochinoides* cover was observed at site Mt-2.4 (chainage:22400) which also showed increased health and cover of other threatened plants *L. incisa* and *L. alsinoides* (Li-2.2 and La-2.1).

Summary of mean cover percentage of *M. triglochinoides* populations is shown in Figure 3.5.

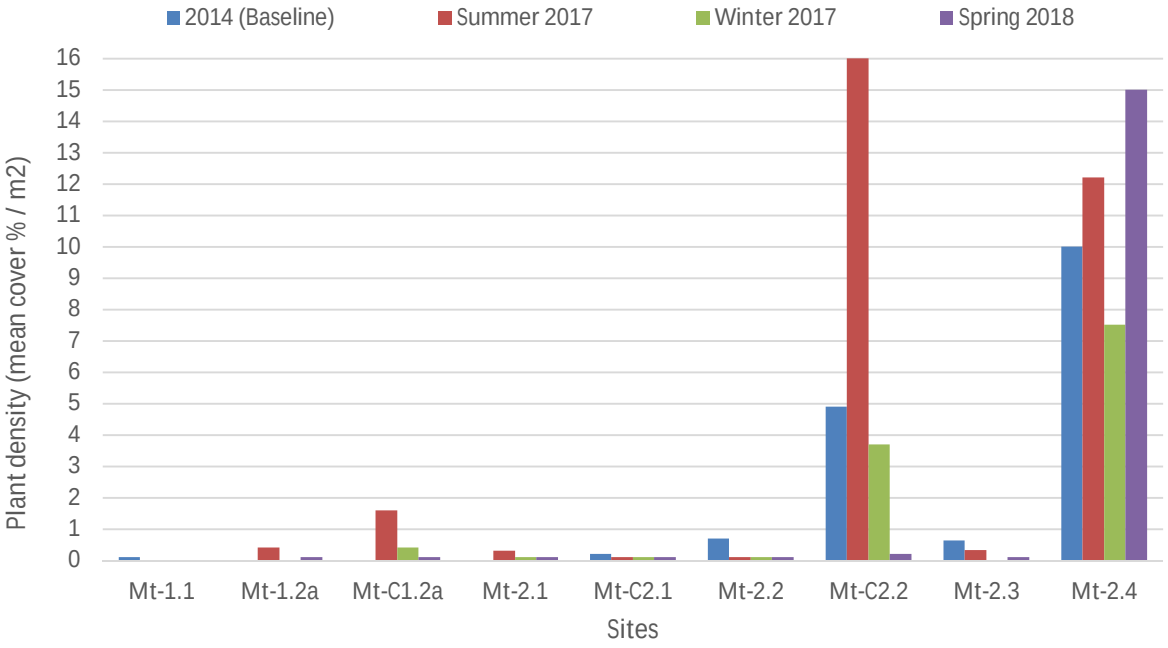


Figure 3.5 Density (mean cover % / m^2) of Maundia triglochinoides observed over four monitoring events at three in-situ sites and one control site

3.1.7 Moonee Quassia (*Quassia* sp. Moonee Creek)

The two in-situ sites (Qm-2.1-Qm-2.2) and two control sites (Qm-C2.1-Qm-C2.2) (chainage:8000-8300) were surveyed on 23 November 2018.

The abundance of *Quassia* sp. Moonee Creek clumps has remained unchanged and the number of stems has reduced in both in-situ and control sites. All plants remain in very good health. Plants were observed in flower with some fruiting buds and fresh shoots. Approximately five *Quassia* sp. seedlings were observed growing in mulch on the cleared edge up hill and adjacent to in-situ site Qm-2.2 (refer to Photographs 5 and 6). The location of seedlings is possibly due to seed dispersal by ants (myrmecochory). Refer to Figure 3.6.for changes in tree abundance over six monitoring events.

No weeds were observed at *Quassia* sp. sites. Dirty water was observed in drainage line within site Qm-2.2, downstream of project boundary.

Photograph 5: Quassia sp. Moonee Creek seedlings growing in mulch adjacent to Qm-2.2

Photograph 6: Cleared verge with Quassia sp. Moonee seedlings adjacent to highway fence and Qm-2.2.

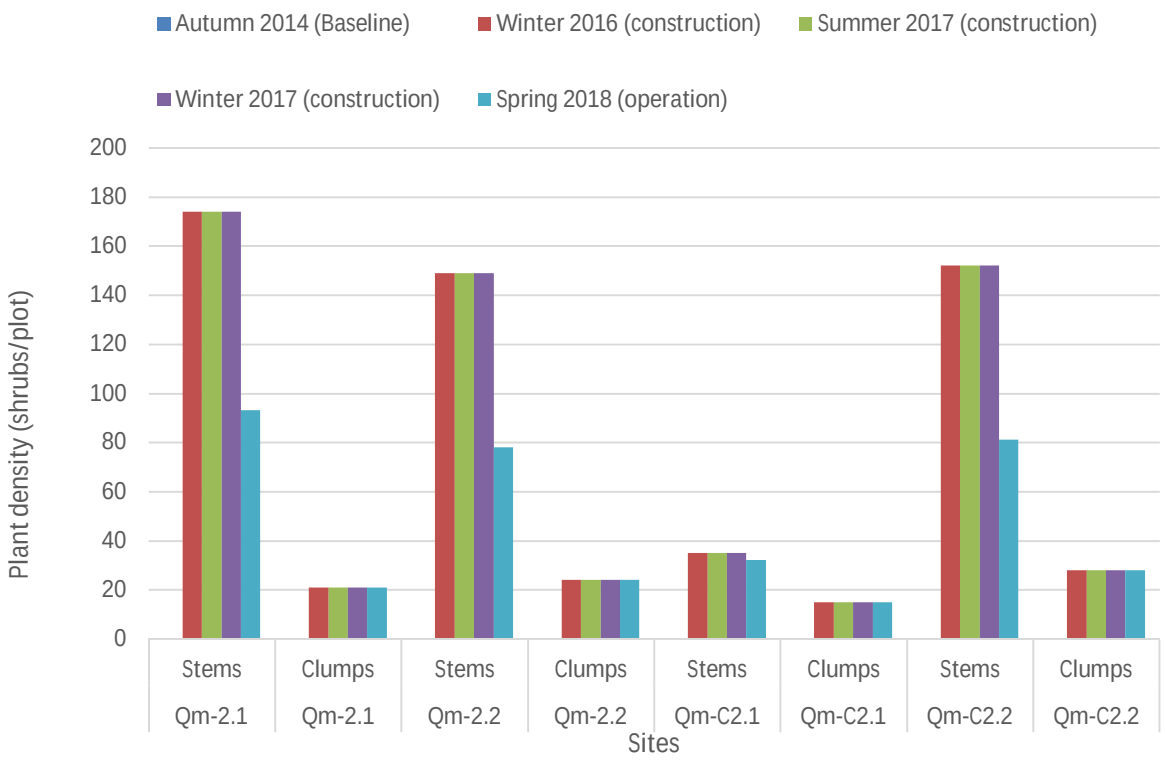


Figure 3.6 Clumps and stems counts of Quassia sp. Moonee Creek over five monitoring events (baseline, construction and operation) at two in-situ sites and two control sites

3.2 Construction Year 2 monitoring (Section 3-10)

3.2.1 Sandstone Rough-barked Apple (*Angophora robur*)

All thirteen sites (in-situ and control) (chainage:44600-67700) were surveyed over two monitoring events 18-19 April 2018 and 20-21 November 2018.

Year 2 construction monitoring of *A. robur* found no change in the abundance of mature trees at both in-situ and control sites, except for in-situ site Ar-3.5 where one tree was found dead. A decline in the number of seedlings since Year 1 construction was found at in-situ sites Ar-3.1, Ar-3.4 and Ar-3.5, as well as a large mortality of seedlings at control site Ar-C3.1 and is likely attributed to drought conditions (below average rainfall) experienced from January-August 2018. Recruitment on clearing edge adjacent to site Ar-3.10a also showed additional morality of seedlings. Two in-situ sites (Ar-3.2 and Ar-3.3) also showed a minor increase in recruitment since Year 1, likely stimulated by past bushfire at Ar-3.3.

Heat related plant stress and/or plant dieback continues to be evident (since Year 1 construction monitoring) at sites Ar-3.4 and Ar-3.7. Plant species affected include *A. robur* seedlings, *Xanthorrhoea* sp., *Duboisia myoporoides*, *Banksia oblongifolia*, *Pteridium esculentum* and *Alphitonia excelsa*. Dieback of *Xanthorrhoea* sp. and *B. oblongifolia* at Ar-3.7 is suspected to be caused by the epidemic infection of the root-rot fungus Cinnamon Fungus (*Phytophthora cinnamomic*), but this would need to be confirmed (refer to Photograph 7). Most sites with mature *A. robur* trees generally show some level of dieback in branches, and it is unknown whether minor tree dieback and seedling mortality at site Ar-3.7 is associated with the potential pathogen.

A summary of all in-situ and control *A. robur* sites is presented in Figure 3.7.

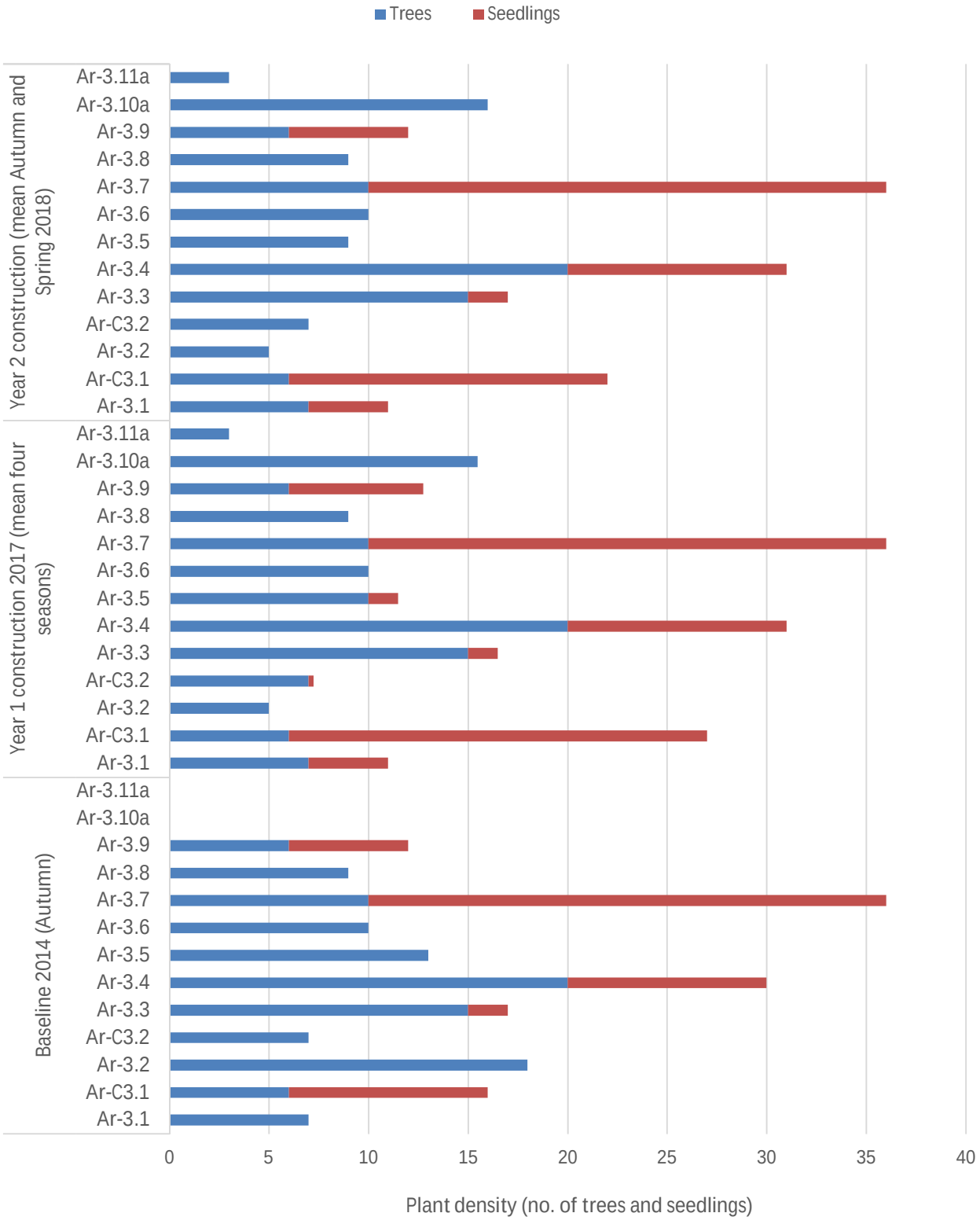


Figure 3.7 Number of A. robur trees and seedlings observed over seven monitoring events (mean results for 2017 (n=4) and 2018 (n=2) at eleven in-situ sites and two control sites

Photograph 7: Xanthorrhoea sp. dieback at in-situ site Ar-3.7 in November 2018.

3.2.2 Hairy-joint Grass (*Arthraxon hispidus*)

All seven in-situ sites (chainage:129300-157900) and two control sites (chainage:157200-157500) were surveyed on19 April 2018 and 9-10 October 2018, Ah-10.5 was not visited during October as it was completely cleared prior to April 2018 as part of detailed design impact. *Arthraxon hispidus* was able to be detected in both autumn and spring.

A. hispidus grass was absent at Ah-10.4 and Ah-10.5 after construction activities. Site Ah-10.5 has been removed from the monitoring program which was located within the detailed design boundary. Six *A. hispidus* individuals were detected during Year 1 construction monitoring prior to construction activities. Since Year 2 construction activities, both April and October surveys observed the site Ah-10.4 with higher water levels which has formed standing water dominated by *Persicaria* spp. Flooded wetland were also observed near other sites. These observations are likely attributed to higher than average rainfall was recorded in March and October 2018 and are not expected to be related to the project (refer Figure 2-3).

Livestock grazing has been removed from all in-situ sites with the commencement of construction activities, this has increased the abundance of weed species with many observations showing high competition with *A. hispidus* and often smothering grasses. Table 3.1 shows the change in weed cover and number of weed species for all sites over all monitoring periods. This impact is not project related.

The average number of *A. hispidus* stems per metre square in each plot for Year 2 construction remained similar or higher to the baseline and Year 1 construction results for in-situ sites Ah- 8.1, Ah-10.1, Ah-10.3. This was also evident for both control sites (Ah-C10.1 and Ah-C10.2). Other in-situ sites Ah-10.2 and Ah-10.6 had a lower average number of *A. hispidus* stems per metre square in each plot compared to previous years, perhaps as a result of increased weed cover abundance.

Table 3.1 Comparison of pre-construction and construction (mean Year 1 and Year 2) weed abundance (ground cover and richness) in Arthraxon hispidus habitat at in-situ and control sites

Site	Mean weed ground cover (%) / weed richness (spp.)			Change (%) in mean weed ground cover (baseline vs construction) (+/-)	Difference in number of weed species (+/-)	Detailed design impact
	Pre-construction	Construction Year 1	Construction Year 2			
Ah-8.1	100/8	67.5/8	82.5/8	-27.5	0	No
Ah-10.1	100/6	99/10	100/10	0	**+4 spp.**	**No**
Ah-C10.1	20/4	31.5/4	15/4	**+26.5**	0	No
Ah-10.2	85/3	75/3	57.5/10	-19	**+7 spp.**	**No**
Ah-C10.2	72.5/9	35/9	40/9	-35	0	No
Ah-10.3	65/3	82.5/11	77.5/11	**+15**	**+8 spp.**	**No**
Ah-10.4	75/5	64/9	65/5	-10.5	-4 spp.	**No**
Ah-10.5	60/3	100/6	**-**	**+40**	**+3 spp.**	**Yes**
Ah-10.6	65/2	96/9	**100**	**+33**	**+7 spp.**	**No**

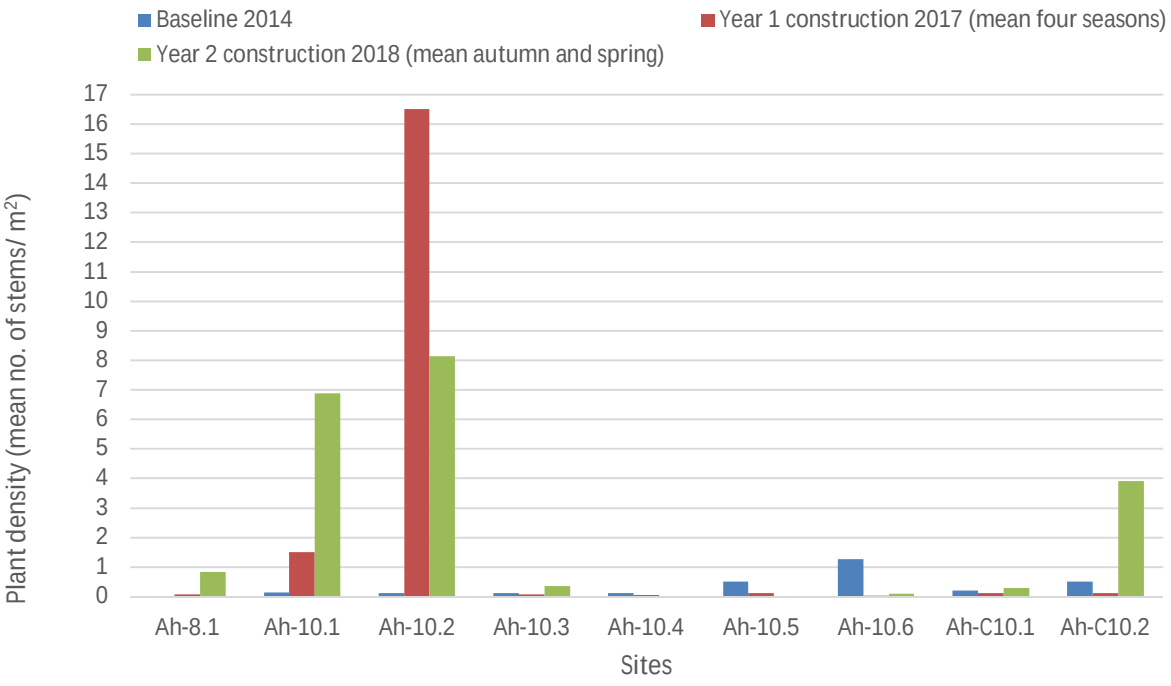


Figure 3.8 Mean number of stems/m^2 in each plot over seven monitoring events for seven in-situ sites and two control sites

3.2.3 Water Nutgrass (*Cyperus aquatilis*)

No *C. aquatilis* individuals were recorded during both visits to site Ca-6.1 (chainage: 102900), on 18 April 2018 and 9 October 2018 for Year 2 construction monitoring. This species is best detected during summer and autumn where climatic conditions are most suitable. Rainfall was generally below average preceding both autumn and spring surveys, and likely to be the cause of *C. aquatilis* absence rather than project construction. A mean weed groundcover of 30% was observed during 2018 which has increased to 60% cover since Year 1 construction. Greater cover of bare ground and litter was also observed likely due to prevalent dry weather conditions and dieback of other plants.

3.2.4 Green-leaved Rose Walnut (*Endiandra muelleri* subsp. *bracteata*)

Both Emb-4.1 (chainage: 81700) and Emb-4.2 (chainage: 80700) were surveyed on 19 November 2018

The single individual *E. muelleri* subsp. *bracteata* at site Emb-4.1 is in good health with new shoots and has maintained a height of 1.6 metres since Year 1 construction. Insect activity on shrub continues to be observed including caterpillar, moth, ant and aphids. Leaf insect damage has been noted but hasn't caused detrimental harm to plant. The *E. muelleri* shrub is currently being smothered by Dutchmen's Pipe (*Aristolochia elegans*) climber weed (refer to Photograph 8) Weed ground cover continues to increase at the site, particularly by Dutchmen's Pipe and *Lantana camara* was newly observed in November 2018 survey. The amount of sunlight entering this site has increased from vegetation clearing during construction to the south (inside the project boundary) and dieback of Flooded Gum (*Eucalyptus grandis*) tree canopy, suspected to be caused by irregular roosting of Flying Foxes. The increased sunlight to the groundcover has potentially caused increases in weed cover.

The small *E. muelleri* subsp. *bracteata* tree at site Emb-4.2 had new shoot growth on lower and upper branches. There continues to be dieback of crown and upper branches observed in both autumn and spring 2018. Weed cover has generally remained the same at site Emb-4.2, however the number of weed species has increased inside the plot from 10 to 19, particularly at the eastern end of plot where new substrate was deposited for embankment which may have introduced new weed species (refer to Photograph 9). No recruitment of *E. muelleri* subsp. *bracteata* was observed.

Photograph 8: E. muelleri subsp. bracteata at in-situ site Emb-4.1 showing Aristolochia elegans weed climber smothering shrub in November 2018.

Photograph 9: E. muelleri subsp. bracteata at in-situ site Emb-4.2 adjacent to new embankment.

3.2.5 Four-tailed Grevillea (*Grevillea quadricauda*)

Both in-situ site Gq-3.1 (chainage:59300) and control site Gq-C3.1 (chainage:59500) were surveyed on 19 April 2018 and 20 November 2018.

In-situ site Gq-3.1 showed no decline in adult *G. quadricauda* plants. Observations of plant recruitment, seed dispersal and seedling morality varied over autumn and spring surveys. There were 24 seedlings counted in autumn 2018, however in November 2018 only 21 seedlings were present with some in different locations. Interestingly, some seedlings had established over 20 metres from parent plants in disturbed areas with weeds close to the edge of the project. Seeds may have been dispersed via ant (or other animal), and *Grevillea* spp. Are known to colonise on disturbed soil surfaces where there is little competition. Some seedlings showed dieback in leaves, perhaps because of dry conditions. The old track is becoming overgrown with Broad-leaved Paspalum (*Paspalum mandiocanum*) and native shrubs and Monterey Pine (*Pinus radiata*) have increased mid-storey and canopy cover on site.

The number of adult plants and seedlings at control site Gq-C3.1 has remained unchanged since November 2017 and all plants are in good health with typical dieback on some branches of adult plants.

A summary of *G. quadricauda* plant numbers at monitoring sites is presented in Figure 3.9.

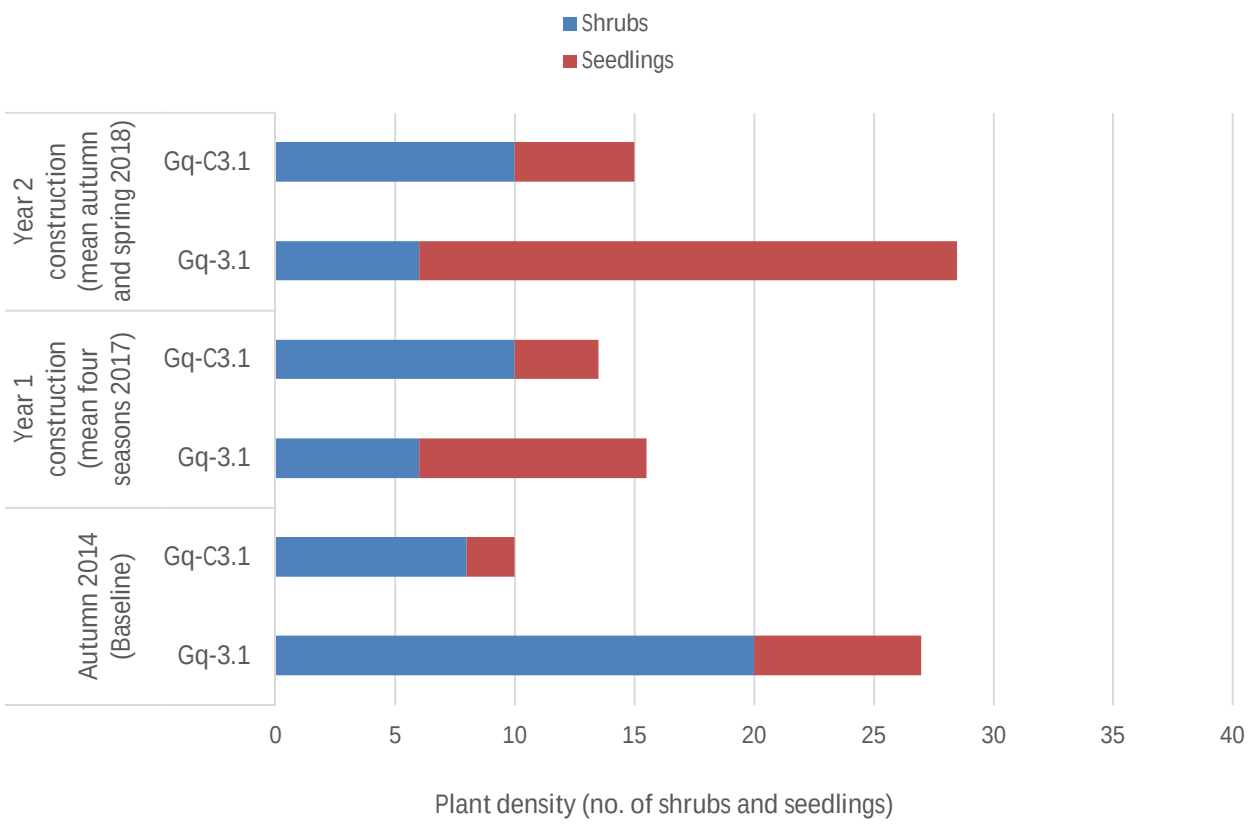


Figure 3.9 Number of G. quadricauda shrubs and seedlings observed over seven monitoring events (mean results for 2017 (n=4) and 2018 (n=2) at in-situ and control site

3.2.6 Slender Screw Fern (*Lindsaea incisa*)

Year 2 construction monitoring was undertaken on 17 April 2018 and 20 November 2018 for in-situ sites li-3.1 and Li-3.2 (chainage:55800-60200) and, 17 April 2018 and 8 October 2018 for in-situ sites Li-6.1, Li-6.2 and control site Li-C6.1 (chainage:98600-99300).

In-situ site Li-3.1 was directly impacted by detailed design work prior to autumn 2018 survey with the construction of a man-made drainage line in middle of site. This resulted in some loss of ferns, however many were observed in good health growing on edge of cleared space. Native flora are recovering with dense regrowth in previously cleared areas of site (refer to Photograph 10).

In-situ site Li-3.2 has remained unaffected by project. Native understorey vegetation has mostly regrown since burning of site in spring 2017. *L. incisa* ferns were in excellent health during Year 2 construction and had the highest recorded mean percent cover in April 2018 of 7.2%/m^2.

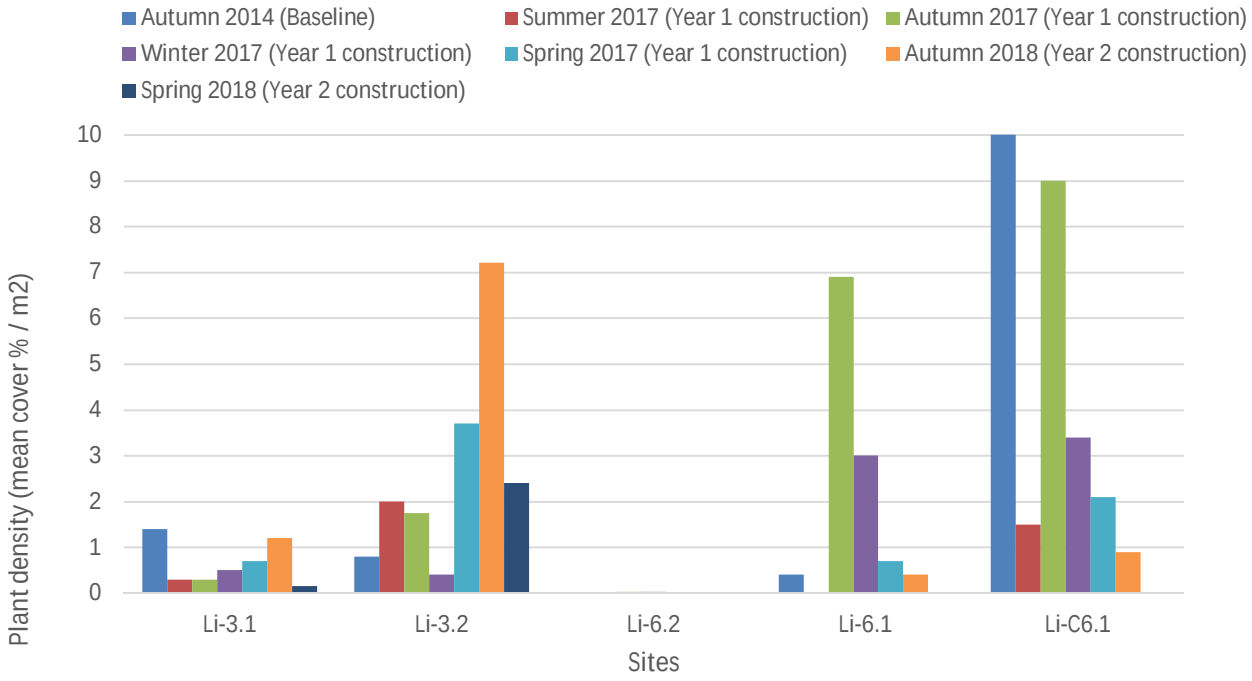
Mean percent cover of in-situ *L. incisa* populations in Section 6 generally remained unchanged in April 2018 surveys, however October 2018 surveys recorded a major decrease in fern cover at all sites. Ferns were absent at in-situ site Li-6.2 and control site Li-C6.1, and were scarce and in bad health at in-situ site Li-6.1. These observations are expected to be a result of reduced rainfall preceding early October 2018 surveys prior to heavy downpours experienced in mid-October. Healthy *L. incisa* ferns were observed along edge of track adjacent to in-situ sites Li-6.1 and Li-6.2 where ferns are exposed to track runoff (refer to Photograph 11).

A new *L. incisa* population has found outside the project boundary adjacent to control site Mt-C3.1 (chainage:61900), this population will be monitored as a control site in future to compare any changes to in-situ populations in Section 3.

Summary of mean percent cover for all *L. incisa* sites is presented in

Photograph 10: Year 2 construction in-situ Site Li-3.1 showing cleared habitat and geofabirc for drainage line and natural vegetation regeneration on edges (November 2018)

Photograph 11: Year 2 construction near-situ Site Li-6.1 showing healthy L. incisa ferns on edge of track (October 2018)



Density (mean cover % / m²) of Lindsaea incisa observed over seven monitoring events at four in-situ sites and one control site

3.2.7 Rough-shelled Bust Nut (*Macadamia tetraphylla*)

There was no notable change in tree health of *M. tetraphylla* or change in weed abundance and cover over the second year construction phase at Site Mac-8.1 (chainage: 134700). Weed cover remains high with 70% mean cover in the plot of which an additional two weed species observed making a total of 13 weed species. Four weeds species have a high cover of abundance including *Senecio madagascariensis*, *Cenchrus clandestinus*, *Bromus catharticus*, *Cirsium vulgare* and *Bidens pilosa*.

3.2.8 Maundia triglochinoides

Year 2 construction monitoring was undertaken on 17-18 April and 20-21 November 2018 for in-situ sites Mt-3.1, Mt-3.2 and control site Mt-C3.1, and on 8 April and 9 October 2018 for in-situ sites Mt-7.1, Mt-7.2 and Mt-7.3.

Notable changes in mean cover and area of occupancy of *M. triglochinoides* occurred during the Year 2 construction phase at some sites, mostly related to climatic conditions.

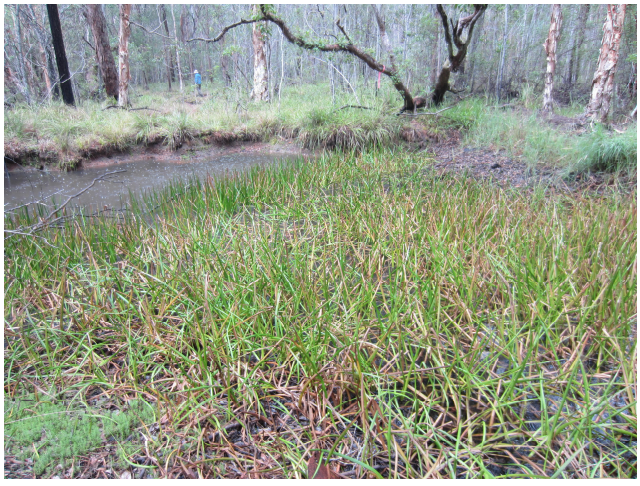
In-situ site Mt-3.1 and control site Mt-C3.1 showed an increase in mean percent cover of *M. triglochinoides* where ponds/streams had moderate water levels and remained quite stable, even with below average rainfall. In-situ site Mt-3.2 showed a slight decrease in mean percent cover which is likely due to drying of low-lying depressions and competition with other groundcover plants such as grass cover (increased by 40%).

In-situ site Mt-7.1 generally had no notable changes, but pig damage on edge of pond habitat was observed.

There was a large increase in mean percent cover of *M. triglochinoides* at in-situ site Mt-7.3 during Year construction over the same area of occupancy (100 m^2) observed during Year 1 construction. In this time, a bridge with ballast was constructed over the population, and management measures were implemented to reduce impacts to the population such as sediment-fence/curtain. At this stage these measures have been successful at protecting the population from construction impacts, and although there has been dieback and some plants smothered by sediment fence, the overall population is healthy and visual water quality retained.

Slow recovery of the *M. triglochinoides* population at in-situ site Mt-7.2 from inadvertent indirect impacts during Year 1 construction in 2017 was evident along the edges of the pond in both autumn and spring 2018 surveys. However, the core of the population has not recovered, refer to Photographs 12-15.

Summary of mean percent cover for all *M. triglochinoides* sites is presented in



Photograph 12: Pre-construction phase at in-situ site Mt-7.2 showing healthy population of M. triglochinoides (May 2014)

Photograph 13: Year 1 construction phase at in-situ site Mt-7.2 showing major decline of M. triglochinoides population (November 2017)

Photograph 14: Year 2 construction phase at in-situ site Mt-7.2 showing no recovery of M. triglochinoides core population (October 2018)

Photograph 15: Year 2 construction phase at in-situ site Mt-7.2 showing recovery of M. triglochinoides on edge of pond (October 2018)

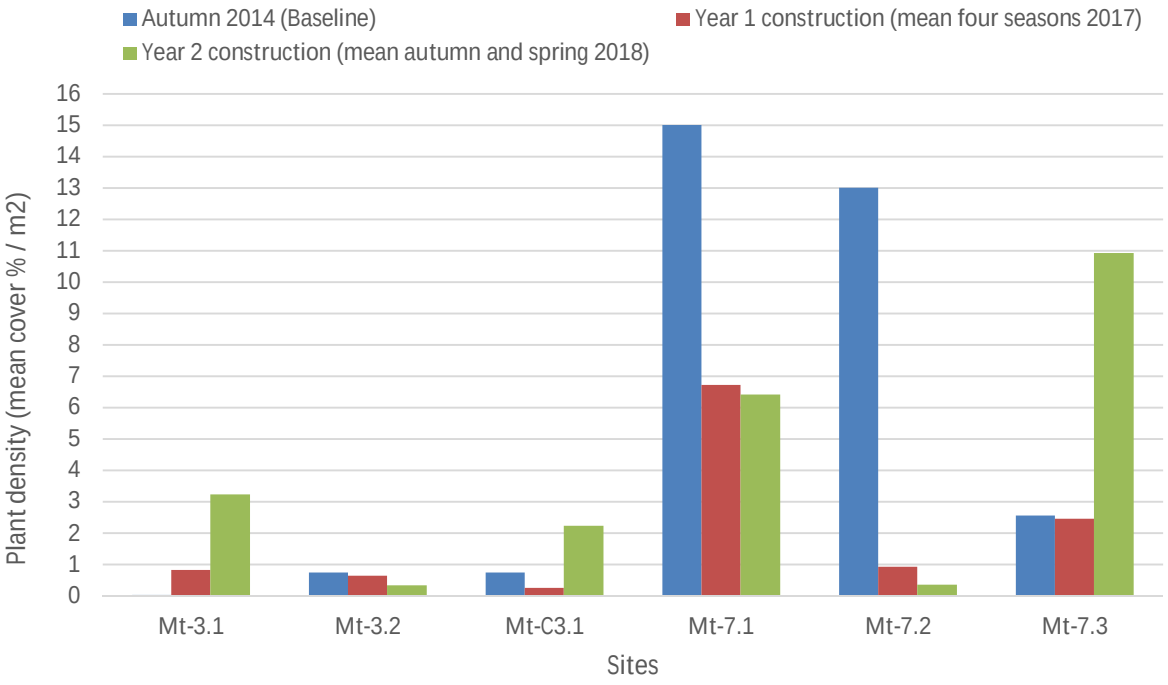


Figure 3.10 Density (mean cover % / m2) of Maundia triglochinoides observed over seven monitoring events at five in-situ sites and one control site

3.2.9 Swamp Tea-tree (*Melaleuca irbyana*)

All active sites for *Melaleuca irbyana* were surveyed on 18 April and 9 October 2018. The abundance of *M. irbyana* at in-situ sites (Mi-7.1 and Mi-7.2, chainage:120800-120900) has remained unchanged. However, in April 2018, two shrubs within in-situ site Mi-7.1 (Photograph 16-17). and two shrubs in site Mi-7.2 (Photograph 18-19) were damaged by fallen trees and branches during construction activities. Shrubs damaged in site Mi-7.1 occur within the project boundary, however shrubs in site Mi-7.2 occur outside the project boundary. These shrubs have regrowth from the base with new shoots observed in April and October 2018 and are expected to recover. In addition to *Lantana camara* weeds present in site Mi-7.2, Carpet grass (*Axonopus* spp.) has also been observed since construction.

The control site Mi-C7.1 (chainage: 120800) generally remains unchanged.

Photograph 16: In-situ site Mi-7.1 showing fallen tree trunk with damaged Melaleuca irbyana shrubs underneath within project boundary (April 2018)

Photograph 17: In-situ site Mi-7.1 showing remains of broken tree within project boundary (April 2018)

Photograph 18: Year 2 construction phase at in-situ site Mi-7.2 showing flagged and damaged Melaleuca irbyana shrubs outside the project boundary (April 2018)

Photograph 19: Damaged Melaleuca irbyana shrub with broken stem at in-situ site Mi-7.2 outside the project boundary (April 2018)

3.2.10 King of Fairies (*Oberonia titania*)

Data was collected for *Oberonia titania* on two occasions in autumn (19 April) and spring (10 October) 2018 for both sites (Ot-10.1 and Ot-C10.1) (chainage:152300). Conditions were very dry in wet forest habitat for *O. titania*.

There have been slight increases in *O. titania* in both sites. In-situ site Ot-10.1 had an additional seven plants observed high in canopy on leaning Brush Kurrajong (*Commersonia fraseri*). Although, control site Ot-C10.1 had an increase of two plants, two other dying plants were observed, possibly caused by below average rainfall in the 3 months preceding survey the October 2018 survey.

3.2.11 Tall Knotweed (*Persicaria elatior*)

Data was collected for *Persicaria elatior* on two occasions in autumn (17 April) and spring (19 November) 2018 for in-situ sites Pe-4.1, Pe-4.2a and Pe-5.1, and control site Pe-C4.1. Site Pe-4.2a was only observed from a distance during spring as there was construction activities nearby that inhibited full access.

There was notable change in the average abundance of *P. elatior* for Year 2 construction monitoring, particularly during spring surveys where individuals were only observed at site Pe-5.1. Individuals at site Pe-4.2a were assumed to be absent during spring surveys. Given that control site Pe-C4.1 exhibited no individuals during spring surveys and lack of construction impacts at sites, the low average abundance of plants at in-situ sites is considered to be caused by seasonal fluctuation. Weed abundance remained at the same or similar levels to the previous monitoring year. Autumn observations of site Pe4.2a showed continuing weed problems with 80% cover in weeds competing with *P. elatior* plants.

These declines are not project related. Refer to Figure 3.11 for a summary of results.

Figure 3.11 Mean number of Persicaria elatior plants over seven monitoring events (baseline and construction) at three in-situ sites and one control site

3.2.12 Singleton Mintbush (*Prostanthera cineolifera*)

Both the in-situ (Pc-6.1) and control (Pc-C6.1a) (chainage: 101700) were surveyed on 18 April 2018 and 9 October 2018. Plant abundance at Site Pc-6.1 has remained stable since winter 2017. Since Year 1 construction, there has been some minor natural plant mortalities but also seedling recruitment from mature plants. In October 2018, there were 67 plants recorded and plants remain in good health with new shoots and little dieback.

There were similar trends at control site Pc-C6.1a with minor fluctuations in plant abundance. In October 2018, there were 91 plants recorded in good health, with minor damages from fallen tree, herbivory and insect attack. Since winter 2017, there has been a loss of 17 plants and little recruitment.

Lantana camara cover and abundance remains low at both sites. Camphor laurel (*Cinnamomum camphora*) was recorded at site Pc-6.1 in low abundance.

No inadvertent construction impacts had occurred affecting *P. cineolifera*.

3.2.13 Rotala tripartita

Both the in-situ sites Rt-6.1 and Rt-6.2 were surveyed on 18 April 2018 and 9 October 2018. No plants were recorded at all sites, except Rt-6.2. Eight healthy plants were recorded at Rt-6.2 in April 2018. The site also had high soil moisture following above average rainfall. Plants disappeared in October during dry conditions, prior to heavy rainfall recorded 2 days later in October. Weed groundcover remained high (70%75%) at sites over both survey periods. The *R. tripartita* population is likely to fluctuate in response to future rainfall patterns and there has been no evidence of inadvertent construction impacts.

4. Evaluation of performance criteria, mitigation measures and impact thresholds

4.1 Amendments to the program and assessing impacts

As outlined in section 4.1 of the TFMP further pre-clearing flora surveys were undertaken by suitably qualified ecologists to reconfirm the distribution and abundance of threatened flora populations in proximity to the project prior to clearing for construction. Where additional populations of threatened flora were identified these were quantified and could be managed and translocated prior clearing. This has resulted in a revised baseline threatened flora layer and shown in the Appendix B as "*Additional finds & GIS consolidation".*

Through the detailed design process, the project construction footprint was reduced. This resulted in a significant reduction to the overall impacts to threatened flora in situ compared to quantities reported in the approved EIS/SPIR. Where there was an increase this was contained within the project approval boundary and where feasible additional translocation efforts were undertaken.

The minor changes to the construction footprint affected the previous placement of some impact monitoring plots established in the early pre-construction phase. Replacement sites were established where there was opportunity to do this and this allowed for threatened species adjacent to the project boundary to be continually monitored and addressed the refinements of detailed design. Additionally, it was agreed with Roads and Maritime to establish new control sites to allow for additional data to be collected where sites were on private land with access restriction.

The updated clearing boundary as a result of the Detailed Design has changed the total number of threatened flora expected to be impacted during construction and has reset the total remaining in-situ populations for the next monitoring years going forward.

Appendix B presents the updated threatened flora impact table for Year 2 construction 2018 for Sections 3-10, outlining the following:

1. *EIS/SPIR boundary/impact* – Expected impact on threatened flora based off the concept design boundary/EIS and outlined in the Threatened Flora Management Plan.

2. *EIS/SPIR boundary/impact + Additional finds and GIS consolidation* - Expected impact on threatened flora based off the Concept Design/EIS boundary using the revised threatened flora layer.

3. *Current boundary/impact + Additional finds and GIS consolidation* - Expected impact on threatened flora based off the current Detailed Design boundary using the revised threatened flora layer.

4. *Net change* – Comparison between the Concept Design EIS/SPIR boundary and the Detailed Design Clearing boundary using the revised threatened flora layer.

The updated clearing boundary has changed total number of threatened flora expected to be impacted during construction and has reset the total remaining in-situ populations for the next monitoring years going forward. The total differences for each threatened species directly and indirectly impacted is presented in Table B-1 of Appendix B.

As noted in Section 2.3.2, the baseline methods for determining the abundance of threatened groundcover species was coarse and a percentage of mean cover over an area of occupancy for each relevant species was introduced into the method during the construction monitoring surveys to improve the detection of change. This allowed for an effective measure of change to be monitored over each season and identified typical trends in plant dieback in response to rainfall and other climatic factors. A percentage mean cover for relevant species from baseline data was estimated to provide indicative comparisons for measuring performance criteria. Therefore, this information has been viewed with consideration of other site observations and evidence when scrutinising data after each sampling event prior to making and assessment of impact.

4.2 Discussion of observed impacts and threats to threatened flora

A total of 81 sites were monitored in the revised 2018 program comprising 62 impact and 19 control sites. All 37 threatened flora species sites for Section 1 and 2 were surveyed in spring 2018 for the Year 1 operational monitoring. The remaining 44 sites in Sections 3-10 were surveyed twice in autumn and spring 2018 for the Year 2 construction monitoring.

No major changes or impacts were observed during operational monitoring in Section 1 and 2 and most sites remained unchanged or improved in both plant health and habitat condition. For example, new populations or major recruitment events of threatened flora were observed at some sites, including *L. alsinoides* and *Quassia* sp. Moonee Creek. New individuals of *L. alsinoides* were observed along roadside near site La-1.3a, three plants were observed within Elt-2.1, and a new site established in-situ site La-2.2 (chainage:14700).

After revision of the 2018 results, there are now currently 80 sites comprising 61 in-situ and 19 control sites active for the ongoing future program. Site Ah-10.5 was recently removed from program following clearing within the current project boundary.

A small number of the in-situ sites monitored in Sections 3-10 were observed to have direct and/or indirect impacts in Sections 3-10 either associated with the project or non-project related activities. Observed impacts include:

1. Dieback of *Xanthorrhoea* sp. and *B. oblongifolia* at Ar-3.7 (outside the project boundary) is potentially caused by root-rot fungus Cinnamon Fungus but would need to be confirmed.

2. Two shrubs in site Mi-7.1 (within project boundary) and two shrubs in site Mi-7.2 (outside project boundary) were temporarily damaged by fallen trees and branches observed in April 2018.

3. Clearing and loss of site Ah-10.5 (within project boundary)

4. Changed hydrology and weed abundance at site Ah-10.4 likely caused by natural flood water following heavy rainfall event and cattle grazing removal both of which are not project related.

5. Increased weed cover and number of weed plant species at in-situ sites Emb-4.1 and Emb-4.2, potentially caused by the project given the immediate proximity to the project. Major threats include increased exposure to sunlight due to major natural dieback of Flooded Gum trees and vegetation clearing to the south of site Emb-4.1 and introduced soil material deposited near site Emb-4.2.

4.3 Measuring performance criteria

The TFMP provides indicative thresholds for measuring the performance of mitigation measures of project construction and operation. It is noted that some of the performance goals do not relate to this monitoring program such as plant translocation and dust monitoring. The relevant construction performance criteria and thresholds (refer to Section 2.4) that trigger corrective actions is presented in Table 4 1 and only relate to those sites situated outside of the updated clearing boundary.

Goals supporting the management of dust, translocation and habitat revegetation is not covered in the construction monitoring program. No dust was observed affecting in-situ sites.

The relevant goals for mitigating impacts from Year 2 construction (relevant to Sections 3-10) are addressed by the monitoring program as outlined in section 2.4, include:

- Zero mortality of threatened plants from in situ populations (from physical damage during construction) and no loss of threatened plants directly adjacent to the project

- No notable increase in the abundance of weeds within threatened plant habitat during monitoring of in situ populations

- Water and soil quality managed in accordance with the CEMP
- Reduce impacts to threatened orchid species through illegal collection.

This chapter focuses on addressing these goals relevant to the monitoring program and are summarised below.

Goals for mitigating impacts from Year 1 operation (relevant to Section 1 and 2) are addressed by the monitoring program as outlined in section 2.4, include:

- Zero mortality of retained in situ threatened plant populations during construction and for three consecutive monitoring periods post-construction.
- Post the above period 80 per cent survival of tree, shrub and herbaceous perennials after three years
- Less than five per cent weed cover at retained in situ threatened flora sites (end of monitoring program).

4.4 Effectiveness of mitigation measures implemented for in-situ sites

4.4.1 Method of mitigation and discussion of impacts

Where mitigation measures have been applied during construction and operation, the effectiveness of these were assessed in relation to impacts on in-situ threatened plants at the monitoring sites. The mitigation measures applied to protect threatened plants include:

- Identification of exclusion zones and clearing limits prior to clearing.
- Identification of exclusion zones informed by targeted surveys.
- Exclusion zones fenced off to protect in situ threatened plants.
- Monitor in-situ plants at established monitoring sites during construction.
- Salvage and planting of identified plants for translocation undertaken prior to clearing, into suitable habitat, and using appropriate methods that maximise the chance of plant survival.
- Adequate soil and water quality controls installed surrounding retained threatened plants.
- Procedures for maintenance and monitoring of erosion and sediment controls included in the CEMP.
- Restrict the availability of information identifying where orchids occur within the project area, and in close proximity to the project area.
- Limit site access to areas where orchids naturally occur and may be being managed in situ.

Examples of impacts observed during the second year of construction within and outside the project boundary are described below, with reference to whether these are project-related and therefore an assessment of the effectiveness of the mitigation applied.

- Major increases in the abundance and number of weed species was noted at sites with *Arthraxon hispidus* (Ah-10.1, Ah-10.3, Ah-10.4, Ah-10.5, Ah-10.6) and *Endiandra muelleri* subsp. *bracteata* (Emb-4.1 and Emb-4.2). Changes at *Arthraxon hispidus* sites are not project related, but reflective of the existing condition of sites prior to construction and non-project related land-use change (e.g. reduced cattle grazing).
- Major increases in the abundance and number of weed species was noted at sites *Endiandra muelleri* subsp. *bracteata* (Emb-4.1 and Emb-4.2). occurring within the project boundary. Although sites had existing weeds, long-term monitoring results and site observation of construction works indicate notable weed problems exacerbated by the project. At the time weed management controls had not taken place. At the time of writing this report weed control works were taking place and will be discussed in the next annual report.

- Damage to *Melaleuca irbyana* shrubs at sites Mi-7.1 and Mi-7.2 occurred during vegetation clearing. Measures to avoid plants was evidence by established flagging to identify clearing boundary and each individual plant was flagged as shown in (Photographs 16-19). However, damage to stems and dieback had occurred. It seems warranted that plants were damaged during tree felling where removed tree trunks and branches fell outside flagged exclusion areas. New shoots were evident in November 2018, indicating no mortality of plants and that these individuals are recovering. Plants damaged in site Mi-7.2 occurred outside the project boundary and continued monitoring will measure the recovery of these plants.

- Semi-permanent flooding of site Ah-10.4 following heavy rainfall. Changed hydrology is unlikely related to the project. Adequate soil and water quality controls were in place.

- Suspected root-rot fungus at site Ar-3.7, killing and causing dieback of native plants *Xanthorrhoea* sp. and *B. oblongifolia*. Pacific Complete engaged a consultant to undertake sampling for *Phytophthora cinnamomi* along the entire project alignment. Given the distribution of positive results in a relatively even distribution considered that (i) these results indicate that the entire site appears to have been historically affected by *Phytophthora cinnamomi*, and (ii) break up of the site into clean and contaminated zones is both not warranted and also impractical for bulk earthworks haulage operations. Management specification has included requirements for construction equipment wash downs before entering the project area.

- Population of *Maundia triglochinides* monitored at three in-situ sites (Mt-1.1, Mt-7.2 and Mt-7.3) was inadvertently impacted by the sediment run-off from the March 2017 storm event. Continued monitoring in 2018 has showed that the population is slowly recovering from this flood event. Site Mt-1.1 still has no evidence of re-appearing plants.

- No further breaches with ineffective exclusion fencing at *A. robur* sites has occurred. Permanent boundary fencing is now complete at most sites.

4.5 Thresholds triggering corrective actions

As discussed above, in-situ sites Mi-7.1 and Mi-7-2 were potentially inadvertently impacted outside the project boundary, but it is unknown whether impacts were caused by project construction activities or other contractors. Annual monitoring has shown no loss of threatened plants at sites Mi-7.1 and Mi-7-2 and damaged plants are recovering with healthy regrowth. Further action is required to investigate impacts to these sites. All sites will continue to be monitored for the remaining of the program.

The TFMP identifies the parameters for monitoring performance of in-situ populations during construction and operation. These are described as performance measures and set a threshold whereby if impacts occur and exceed this threshold, specific corrective actions are required. The set of threshold triggers and corresponding corrective actions from the TFMP are outlined in Table 4.1.

Table 4-1 Corrective actions relating to triggered performance thresholds

Threshold triggers	Corrective actions
Any loss of retained in situ threatened plants.	Commence assessment of potential reasons for mortality, including seasonal fluctuations, natural events such as drought and fire within one month of trigger being identified. Compare with paired control site. Identify potential threats, implement corrective actions and modify monitoring as necessary.
Breaches of erosion, sediment and water quality controls recorded.	Review adequacy of the erosion, sediment and water quality controls and implement appropriate corrective actions. Commence review of monitoring procedures for controls and implement appropriate corrective actions.

Threshold triggers	Corrective actions
Loss of ecological condition recorded from plant health monitoring particularly from altered water quality.	
Exclusion zone fencing is damaged or ineffective.	Stop construction in the area of the fencing breach until exclusion fencing has been repaired. Investigate why breach in fencing occurred and implement corrective actions as required to prevent reoccurrence.

Table 4.2 summarises the assessment of these species at in-situ sites that have been impacted within and outside the project boundary and triggered corrective actions. There was no evidence to suggest a breach of the performance goal 'reduce impacts to threatened orchid species through illegal collection' relevant to *O. titania*. Monitoring and location data is kept secure and only reported to Roads and Maritime.

Table 4.2 Assessment of thresholds triggering corrective actions for threatened flora during construction (relevant to Sections 3-10)

Species	Thresholds (triggers for corrective actions)				Impacts within approved project boundary.	Requires corrective actions (inadvertent construction impact
	Any loss of retained in situ threatened plants.	Noxious and environmental weeds reported in areas adjacent to threatened plants Spread of noxious and environmental weeds into properties adjoining the project noted in monitoring activities	Breaches of erosion, sediment and water quality controls recorded. Loss of ecological condition recorded from plant health monitoring particularly from altered water quality.	Exclusion zone fencing is damaged or found to be ineffective.		
Year 2 construction (Section 3-10)						
Angophora robur	Yes – 1 dead tree at Ar-3.5 but not project related	Possible – root rot fungus at Ar-3.7. No mortality noted for A. robur sites	No	No	No	No, past sampling of Cinnamon Fungus has indicated positive detection across entire site, with no know source. Appropriate mitigation measures were undertaken to reduce risk such as construction equipment wash downs before entering the project area.
Arthraxon hispidus	Yes – Loss of all plants in Ah-10.5	Yes – Ah-10.1, Ah-10.2, Ah-10.3, Ah-10.4, Ah-10.5 Ah-10.6, Ah-10.4 but not project related	No	No	Yes	No. because these individuals were found to be within the approved clearing limits of the detailed design and the impact was not construction related.
Cyperus aquatilis	N/A – no individuals identified	No	No	No	N/A	No
Endiandra muelleri subsp. *bracteata*	No	Yes – Emb-4.1, Emb-4.2	No	No	Yes	**Yes**, not consistent with goal 'No notable increase in the abundance of weeds within threatened plant habitat during monitoring of in situ populations'

Species	Thresholds (triggers for corrective actions)				Impacts within approved project boundary.	Requires corrective actions (inadvertent construction impact
	Any loss of retained in situ threatened plants.	Noxious and environmental weeds reported in areas adjacent to threatened plants Spread of noxious and environmental weeds into properties adjoining the project noted in monitoring activities	Breaches of erosion, sediment and water quality controls recorded. Loss of ecological condition recorded from plant health monitoring particularly from altered water quality.	Exclusion zone fencing is damaged or found to be ineffective.		
Grevillea quadricauda	No	No	No	No	No	No
Lindsaea incisa	Yes – Li-3.1	No	No	No	Yes	No, site is within approved project boundary
Macadamia tetraphylla	No	No	No	No	N/A	No
Maundia triglochinoides	No	No	No	No	No	No
Melaleuca irbyana	No – four shrubs damaged at Mi-7.1 (within project boundary) and Mi-7.2 (outside project boundary)	No	No	No	No	No. Although plants at site Mi-7.2 were damaged outside the project boundary, no loss of plants had occurred, and damaged plants are recovering with healthy regrowth. Continued monitoring will measure the recovery of these plants going forward.
Oberonia titania	No	No	No	No	No	No
Persicaria elatior	No	No	No	No	No	No
Prostanthera cineolifera	No	No	No	No	No	No
Rotala tripartita	No	No	No	No	No	No

Table 4.3 Assessment of thresholds triggering corrective actions for threatened flora during operation (relevant to Sections 1-2)

Species	Thresholds (triggers for corrective actions)		Impacts within approved project boundary.	Requires corrective actions (inadvertent construction impact
	Any loss of retained in situ threatened plant populations for three consecutive monitoring periods post-construction.	Less than five per cent weed cover at retained in situ threatened flora sites (end of monitoring program).		
Year 1 operation (Section 1 and 2)				
Eleocharis tetraquetra	No	No	No	No
Eucalyptus tetrapleura	Yes – loss of 1 tree at one site Et-2.1 and Et-2.3 but not project related	No	No	No
Lindernia alsinoides	No	No	No	No
Lindsaea incisa	No	No	No	No
Maundia triglochinoides	No	No	No	No
Quassia sp. Moonee Creek	No	No	No	No

5. Correction actions and recommendations

5.1 Adaptive management

The TFMP outlines an adaptive and responsive management approach, whereby the results of the monitoring program provide input into the design and refinement of mitigation measures and ongoing monitoring.

Where monitoring results have indicated a substantial decline in the health and number of threatened plants at in-situ sites, adaptive management measures can be implemented. Additional recommendations outlined below may be used to update the TFMP.

5.2 Recommendations

Construction activities exceeding the performance thresholds were noted at some locations that are inconsistent with the goals of the TFMP and therefore have triggered the need for corrective actions. The current TFMP sets out prescribed corrective actions for all threatened flora species that have in part been addressed in this report by the assessment of site observations and reasons for impact. Some corrective actions are time bound and require immediate implementation that are not achievable prior to reporting and permanent loss of threatened flora may result. Part of the monitoring program has been already slightly modified to improve the measure of change at threatened flora sites, as well as increasing and replacing the number of plot locations as required.

Operational corrective actions follow the same actions if thresholds are triggered for any loss of plants or increases in weeds. No notable impacts to threatened flora and/or sites observed in Section 1 and 2, therefore no corrective actions are required for sites in the Year 1 operation monitoring period.

Table B-1 in Appendix B provides a detailed overview of all net changes following detailed design which shows an overall reduction in direct impacts to threatened flora populations. Any impact increases have been contained within the approved project boundary as well as mitigation measures to translocate individuals where feasible. Investigation and future monitoring into impacted flora populations outside the approved project boundary is continuing of which none are project-related.

To supplement the prescribed corrective actions, in line with TFMP, the results of this report have identified (at a worst case) reasons for the loss of threatened flora and existing threats. It is recommended that in-situ sites with triggered corrective actions be investigated on the ground by the contractor, particularly sites with ongoing impacts such as any breaches in erosion or sediment control. A site-specific corrective action would be appropriate to improve the effectiveness of mitigation measures on a case by case basis. Based on the 2017/2018 monitoring findings, the following recommendations and Roads and Maritime responses are presented in Table 5-1.

Table 5-1 Recommendations following the 2018 of non-rainforest threatened flora monitoring and Roads and Maritime responses

Recommendation No.	Recommendation	Roads and Maritime response	Status
1	Perform weed control management actions to manage weeds at sites Emb-4.1 and Emb-4.2 (particularly Dutchmen's Pipe at Emb-4.1. Continue to review and monitor health of threatened flora and abundance and number of weed species.	Adopted	Current

6. References

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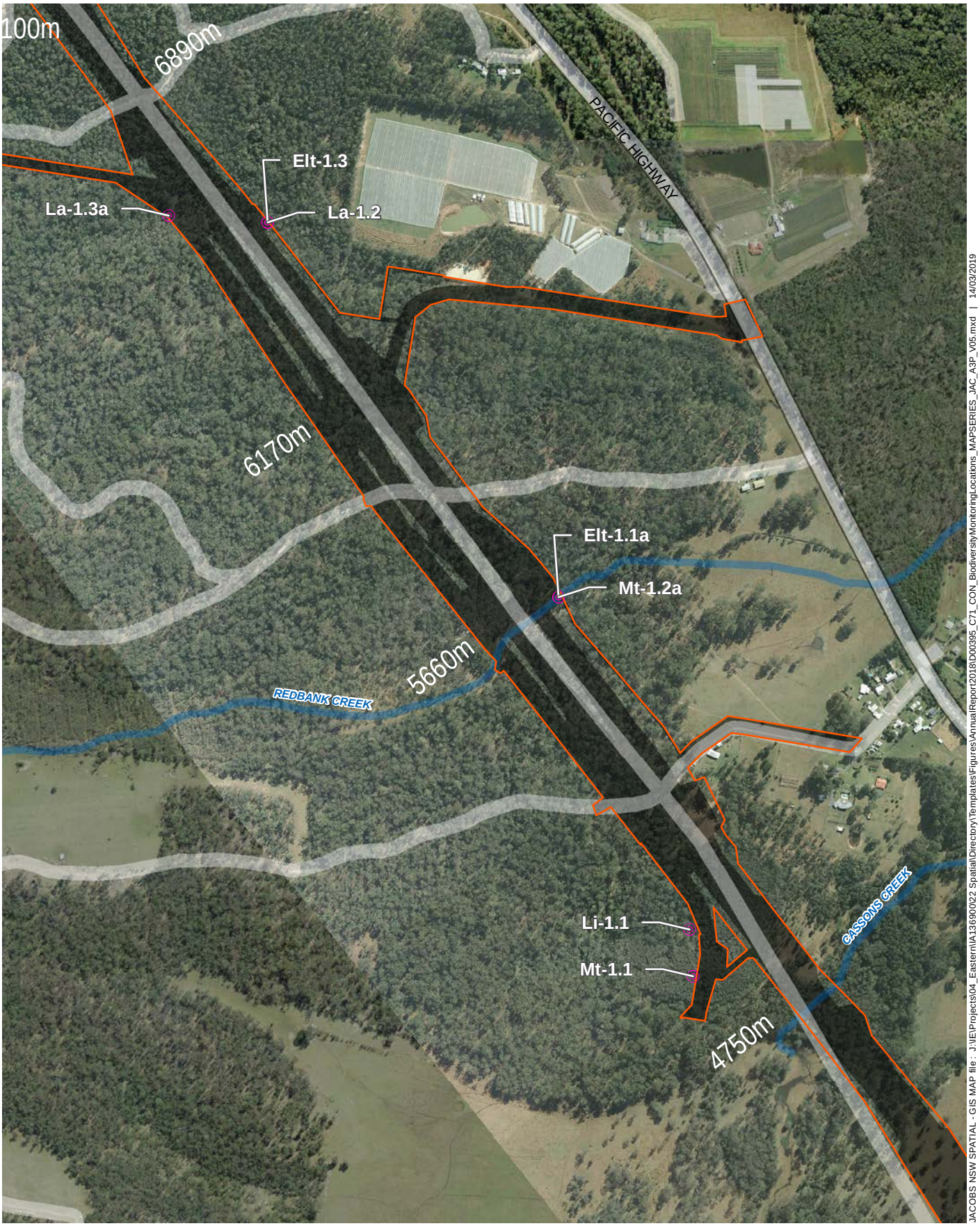
Appendix A. Threatened Flora Monitoring Sites (Figures)



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Legend

- Monitoring location - Impact (Jacobs 2018)
- Waterway (DFSI Mar 2018)
- Draft project boundary (v12A, PC Dec 2017)
- Clearing boundary (PC 2018)

Imagery Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community, Pacific Complete 2011, Nov 2017

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Figure A-1 | Threatened flora monitoring locations

JACOBS NSW SPATIAL - GIS MAP file : J:\E\Projects\04_Eastern\A136900\22 Spatial\Directory\Templates\Figures\AnnualReport2018\D00395_C71_CON_BiodiversityMonitoringLocations_MAPSERIES_JAC_A3P_V05.mxd | 14/03/2019

Legend

- Monitoring location - Control (Jacobs 2018)
- Monitoring location - Impact (Jacobs 2018)
- Draft project boundary (v12A, PC Dec 2017)
- Clearing boundary (PC 2018)
- Waterway (DFSI Mar 2018)
- State Forest (DFSI Mar 2018)

Imagery Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community, Pacific Complete 2011, Nov 2017

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Figure A-2 | Threatened flora monitoring locations

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Legend

- Monitoring location - Control (Jacobs 2018)
- State Forest (DFSI Mar 2018)
- National Park (DFSI Oct 2018)

Imagery Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community, Pacific Complete 2011, Nov 2017

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Figure A-3 | Threatened flora monitoring locations

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Legend

- Monitoring location - Impact (Jacobs 2018)
- Draft project boundary (v12A, PC Dec 2017)
- Clearing boundary (PC 2018)
- Waterway (DFSI Mar 2018)
- State Forest (DFSI Mar 2018)

Imagery Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community, Pacific Complete 2011, Nov 2017

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Figure A-4 | Threatened flora monitoring locations

JACOBS NSW SPATIAL - GIS MAP file : J:\E\Projects\04_Eastern\A136900\22 Spatial\Directory\Templates\Figures\AnnualReport2018\D00395_C71_CON_BiodiversityMonitoringLocations_MAPSERIES_JAC_A3P_V05.mxd | 14/03/2019

Legend

- Monitoring location - Control (Jacobs 2018)
- Monitoring location - Impact (Jacobs 2018)
- Draft project boundary (v12A, PC Dec 2017)
- Clearing boundary (PC 2018)
- National Park (DFSI Oct 2018)

Imagery Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community, Pacific Complete 2011, Nov 2017

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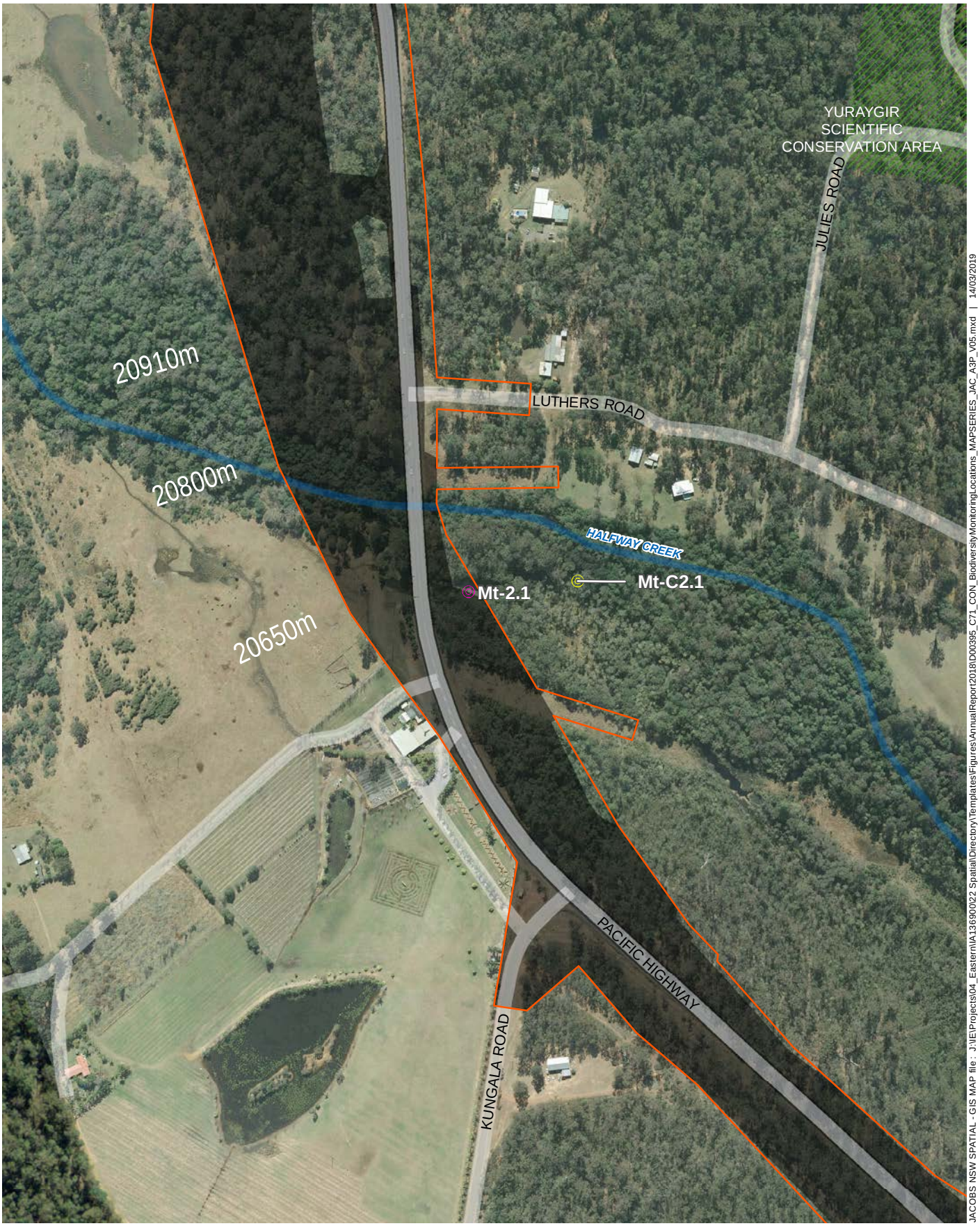
Figure A-5 | Threatened flora monitoring locations



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Legend

- Monitoring location - Control (Jacobs 2018)
- Monitoring location - Impact (Jacobs 2018)
- Draft project boundary (v12A, PC Dec 2017)
- Clearing boundary (PC 2018)
- Waterway (DFSI Mar 2018)
- National Park (DFSI Oct 2018)

Imagery Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community, Pacific Complete 2011, Nov 2017

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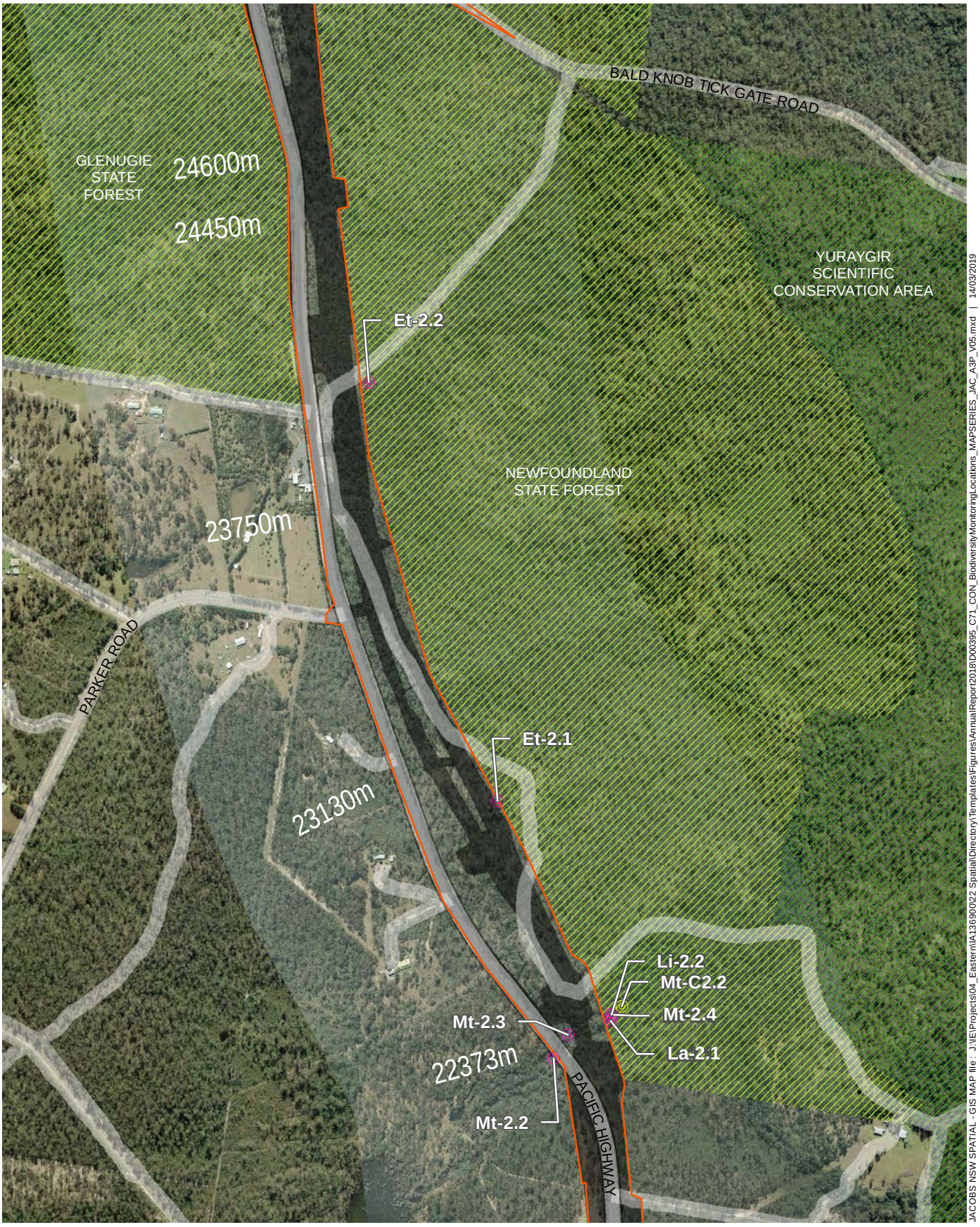
Figure A-6 | Threatened flora monitoring locations



JACOBS NSW SPATIAL - GIS MAP file : J:\E\Projects\04_Eastern\A136900\22 Spatial\Directory\Templates\Figures\AnnualReport2018\D00395_C71_CON_BiodiversityMonitoringLocations_MAPSERIES_JAC_A3P_V05.mxd | 14/03/2019

Legend

- Monitoring location - Control (Jacobs 2018)
- Monitoring location - Impact (Jacobs 2018)
- Draft project boundary (v12A, PC Dec 2017)
- Clearing boundary (PC 2018)
- State Forest (DFSI Mar 2018)
- National Park (DFSI Oct 2018)

Imagery Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community, Pacific Complete 2011, Nov 2017

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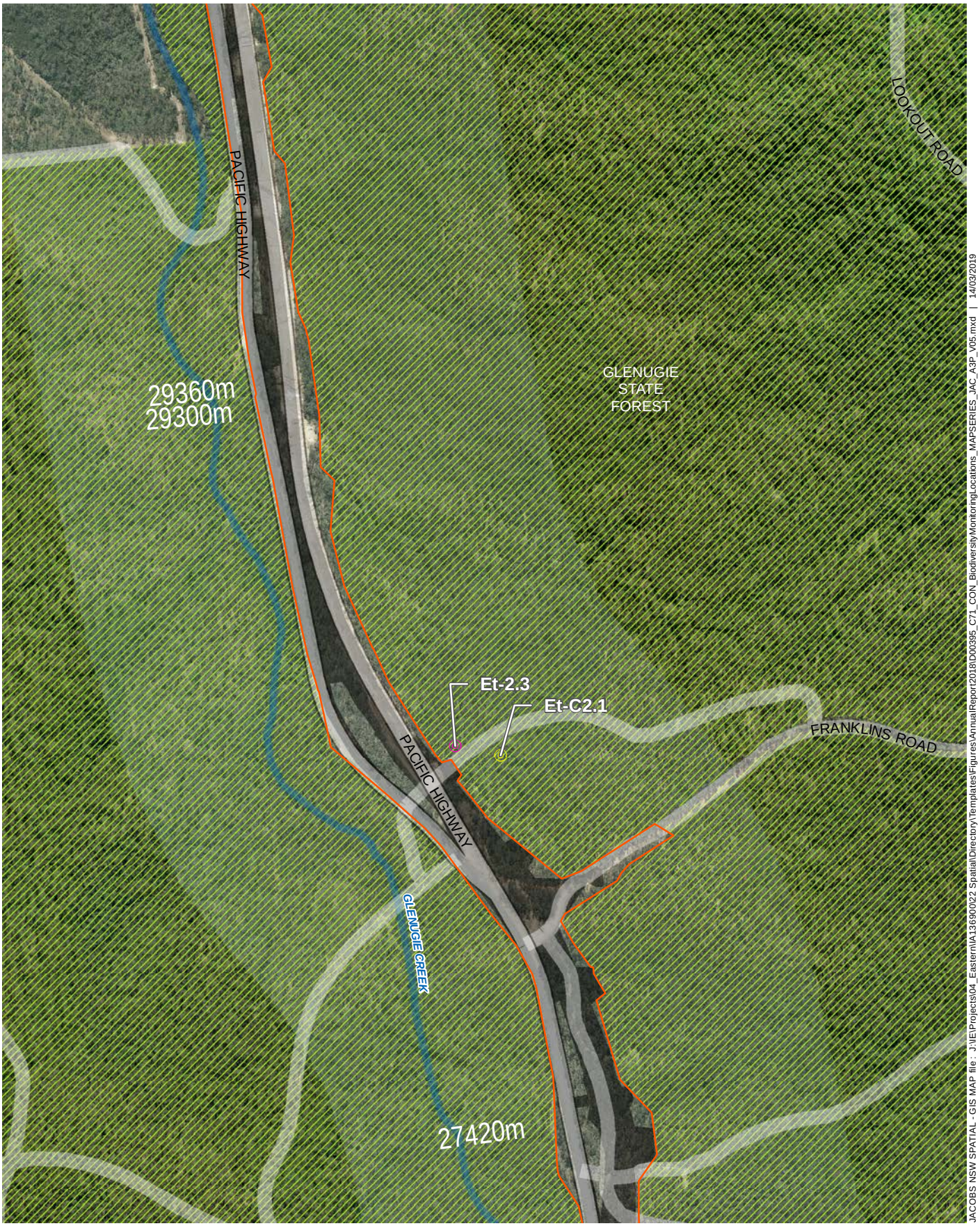
0 100 200m

Figure A-7 | Threatened flora monitoring locations



JACOBS NSW SPATIAL - GIS MAP file : J:\IE\Projects\04_Eastern\A136900\22 Spatial\Directory\Templates\Figures\AnnualReport2018\D00395_C71_CON_BiodiversityMonitoringLocations_MAPSERIES_JAC_A3P_V05.mxd | 14/03/2019

Legend

- Monitoring location - Control (Jacobs 2018)
- Monitoring location - Impact (Jacobs 2018)
- Draft project boundary (v12A, PC Dec 2017)
- Clearing boundary (PC 2018)
- Waterway (DFSI Mar 2018)
- State Forest (DFSI Mar 2018)

Imagery Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community, Pacific Complete 2011, Nov 2017

N

1:12,500 @ A3

0 100 200m

Figure A-8 | Threatened flora monitoring locations

JACOBS NSW SPATIAL - GIS MAP file : J:\E\Projects\04_Eastern\A136900\22 Spatial\Directory\Templates\Figures\AnnualReport2018\D00395_C71_CON_BiodiversityMonitoringLocations_MAPSERIES_JAC_A3P_V05.mxd | 14/03/2019

Legend

- Monitoring location - Impact (Jacobs 2018)
- Waterway (DFSI Mar 2018)
- Draft project boundary (v12A, PC Dec 2017)
- Clearing boundary (PC 2018)

Imagery Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community, Pacific Complete 2011, Nov 2017

N

1:5,000 @ A3

0 100 200m

Figure A-9 | Threatened flora monitoring locations

JACOBS NSW SPATIAL - GIS MAP file : J:\IE\Projects\04_Eastern\A136900\22 Spatial\Directory\Templates\Figures\AnnualReport2018\D00395_C71_CON_BiodiversityMonitoringLocations_MAPSERIES_JAC_A3P_V05.mxd | 14/03/2019

Legend

- Monitoring location - Control (Jacobs 2018)
- Monitoring location - Impact (Jacobs 2018)
- Draft project boundary (v12A, PC Dec 2017)
- Clearing boundary (PC 2018)
- Waterway (DFSI Mar 2018)

Imagery Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community, Pacific Complete 2011, Nov 2017

N

1:12,500 @ A3

0 100 200m

Figure A-10 | Threatened flora monitoring locations

JACOBS NSW SPATIAL - GIS MAP file : J:\E\Projects\04_Eastern\A136900\22 Spatial\Directory\Templates\Figures\AnnualReport2018\D00395_C71_CON_BiodiversityMonitoringLocations_MAPSERIES_JAC_A3P_V05.mxd | 14/03/2019

Legend

- Monitoring location - Control (Jacobs 2018)
- Waterway (DFSI Mar 2018)

Imagery Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community, Pacific Complete 2011, Nov 2017

N

1:10,000 @ A3

0 100 200m

Figure A-11 | Threatened flora monitoring locations

JACOBS NSW SPATIAL - GIS MAP file : J:\E\Projects\04_Eastern\A136900\22 Spatial\Directory\Templates\Figures\AnnualReport2018\D00395_C71_CON_BiodiversityMonitoringLocations_MAPSERIES_JAC_A3P_V05.mxd | 14/03/2019

Legend

- Monitoring location - Impact (Jacobs 2018)
- Draft project boundary (v12A, PC Dec 2017)
- Clearing boundary (PC 2018)

Imagery Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community, Pacific Complete 2011, Nov 2017

N

1:7,500 @ A3

0 100 200m

Figure A-12 | Threatened flora monitoring locations

JACOBS NSW SPATIAL - GIS MAP file : J:\E\Projects\04_Eastern\A136900\22 Spatial\Directory\Templates\Figures\AnnualReport2018\D00395_C71_CON_BiodiversityMonitoringLocations_MAPSERIES_JAC_A3P_V05.mxd | 14/03/2019

Legend

- Monitoring location - Impact (Jacobs 2018)
- Waterway (DFSI Mar 2018)
- Draft project boundary (v12A, PC Dec 2017)
- Clearing boundary (PC 2018)

Imagery Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community, Pacific Complete 2011, Nov 2017

N

1:5,000 @ A3

0 100 200m

Figure A-13 | Threatened flora monitoring locations

JACOBS NSW SPATIAL - GIS MAP file : J:\E\Projects\04_Eastern\A136900\22 Spatial\Directory\Templates\Figures\AnnualReport2018\D00395_C71_CON_BiodiversityMonitoringLocations_MAPSERIES_JAC_A3P_V05.mxd | 14/03/2019

Legend

- Monitoring location - Impact (Jacobs 2018)
- Waterway (DFSI Mar 2018)
- Draft project boundary (v12A, PC Dec 2017)
- Clearing boundary (PC 2018)

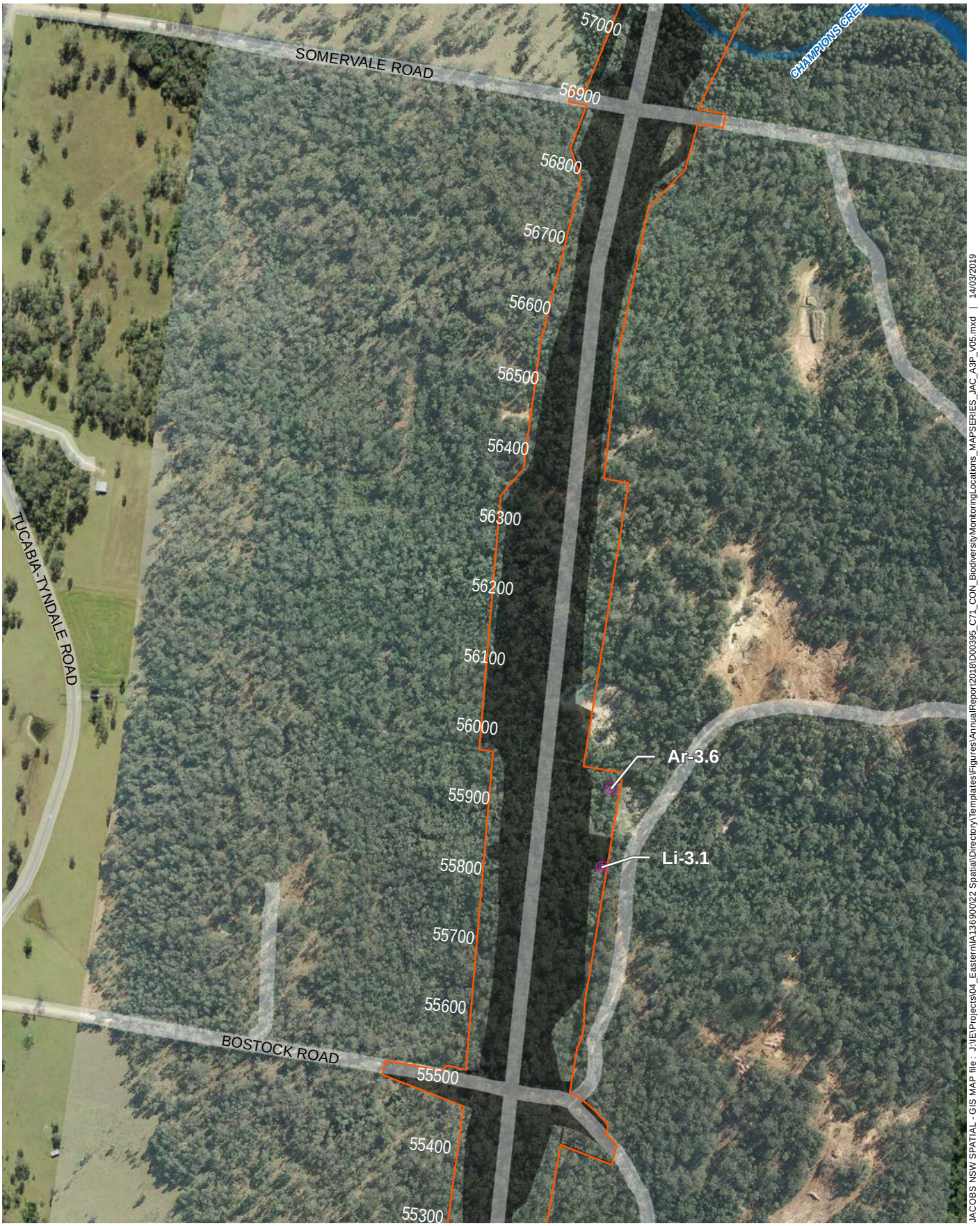
Imagery Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community, Pacific Complete 2011, Nov 2017

N

1:7,500 @ A3

0 100 200m

Figure A-14 | Threatened flora monitoring locations



JACOBS NSW SPATIAL - GIS MAP file : J:\E\Projects\04_Eastern\A136900\22 Spatial\Directory\Templates\Figures\AnnualReport2018\D00395_C71_CON_BiodiversityMonitoringLocations_MAPSERIES_JAC_A3P_V05.mxd | 14/03/2019

Legend

- Monitoring location - Impact (Jacobs 2018)
- Waterway (DFSI Mar 2018)
- Draft project boundary (v12A, PC Dec 2017)
- Clearing boundary (PC 2018)

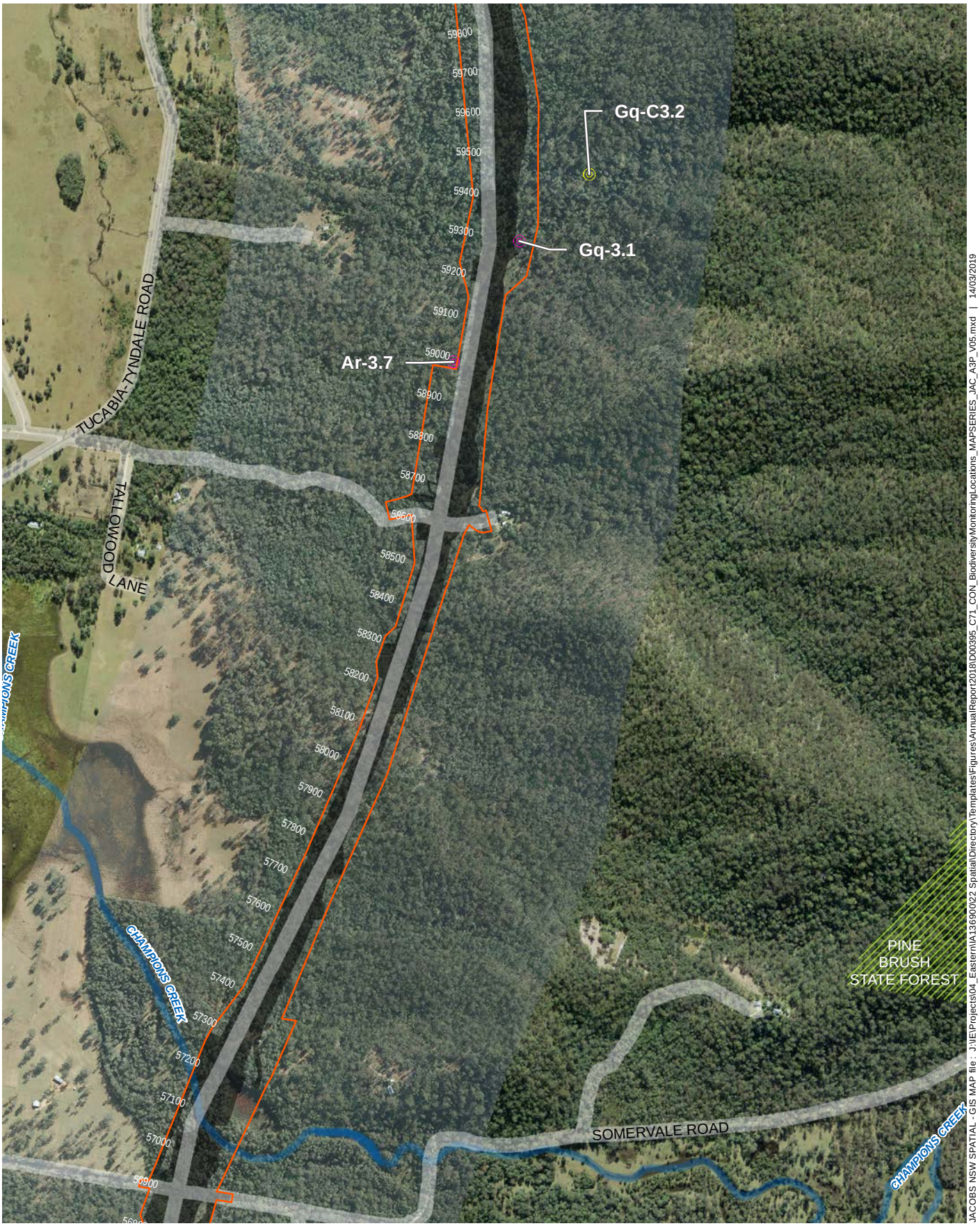
Imagery Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community, Pacific Complete 2011, Nov 2017

N

1:7,500 @ A3

0 100 200m

Figure A-15 | Threatened flora monitoring locations



JACOBS NSW SPATIAL - GIS MAP file : J:\E\Projects\04_Eastern\A136900\22 Spatial\Directory\Templates\Figures\AnnualReport2018\D00395_C71_CON_BiodiversityMonitoringLocations_MAPSERIES_JAC_A3P_V05.mxd | 14/03/2019

Legend

- Monitoring location - Control (Jacobs 2018)
- Monitoring location - Impact (Jacobs 2018)
- Draft project boundary (v12A, PC Dec 2017)
- Clearing boundary (PC 2018)
- Waterway (DFSI Mar 2018)
- State Forest (DFSI Mar 2018)

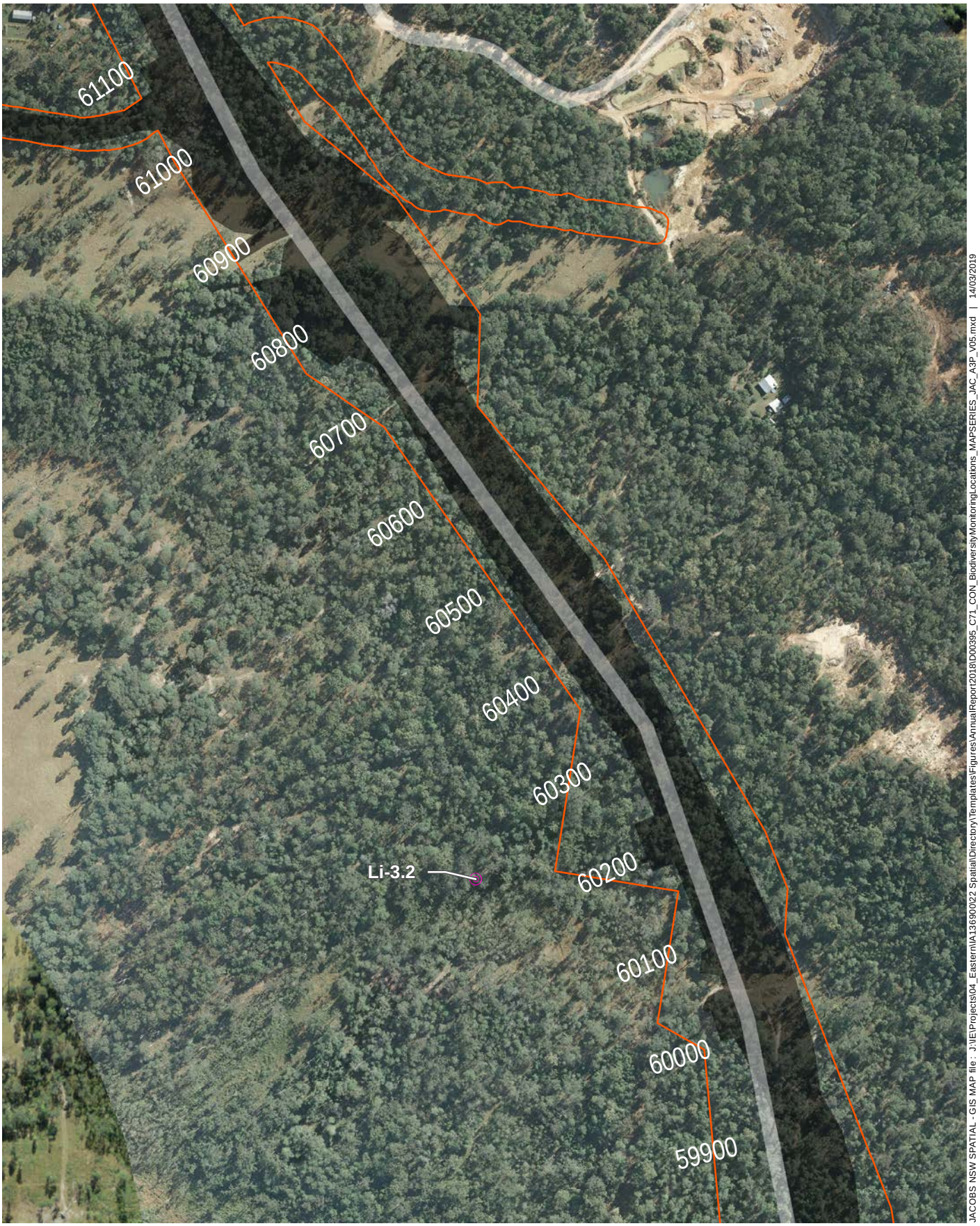
Imagery Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community, Pacific Complete 2011, Nov 2017

N

1:12,500 @ A3

0 100 200m

Figure A-16 | Threatened flora monitoring locations



JACOBS NSW SPATIAL - GIS MAP file : J:\E\Projects\04_Eastern\A136900\22 Spatial\Directory\Templates\Figures\AnnualReport2018\D00395_C71_CON_BiodiversityMonitoringLocations_MAPSERIES_JAC_A3P_V05.mxd | 14/03/2019

Legend

- Monitoring location - Impact (Jacobs 2018)
- Draft project boundary (v12A, PC Dec 2017)
- Clearing boundary (PC 2018)

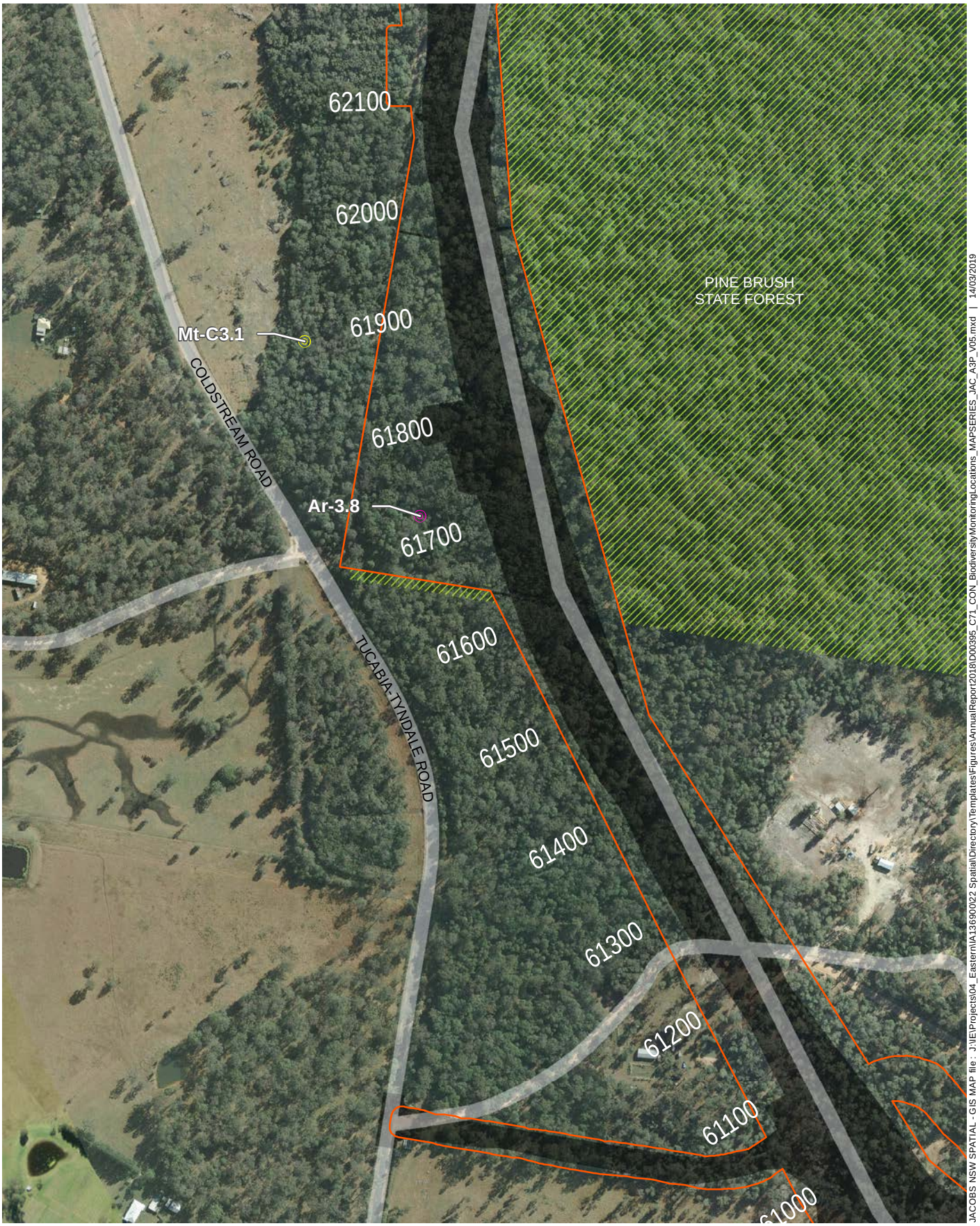
Imagery Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community, Pacific Complete 2011, Nov 2017

N

1:5,000 @ A3

0 100 200m

Figure A-17 | Threatened flora monitoring locations



JACOBS NSW SPATIAL - GIS MAP file : J:\E\Projects\04_Eastern\A136900\22 Spatial\Directory\Templates\Figures\AnnualReport2018\D00395_C71_CON_BiodiversityMonitoringLocations_MAPSERIES_JAC_A3P_V05.mxd | 14/03/2019

Legend

- Monitoring location - Control (Jacobs 2018)
- Monitoring location - Impact (Jacobs 2018)
- Draft project boundary (v12A, PC Dec 2017)
- Clearing boundary (PC 2018)
- State Forest (DFSI Mar 2018)

Imagery Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community, Pacific Complete 2011, Nov 2017

N

1:5,000 @ A3

0 100 200m

Figure A-18 | Threatened flora monitoring locations

JACOBS NSW SPATIAL - GIS MAP file : J:\E\Projects\04_Eastern\A136900\22 Spatial\Directory\Templates\Figures\AnnualReport2018\D00395_C71_CON_BiodiversityMonitoringLocations_MAPSERIES_JAC_A3P_V05.mxd | 14/03/2019

Legend

- Monitoring location - Impact (Jacobs 2018)
- Draft project boundary (v12A, PC Dec 2017)
- Clearing boundary (PC 2018)
- State Forest (DFSI Mar 2018)

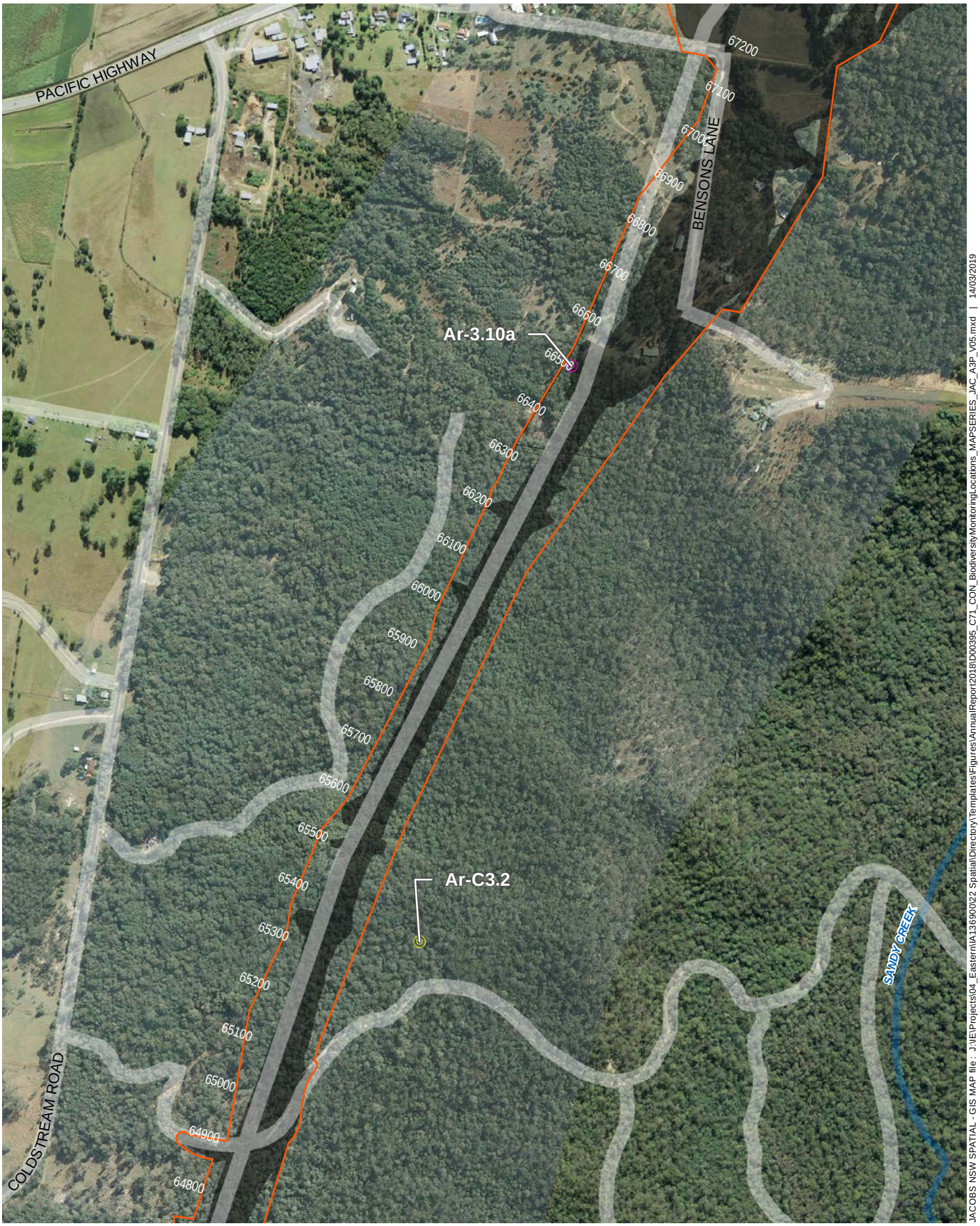
Imagery Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community, Pacific Complete 2011, Nov 2017

N

1:10,000 @ A3

0 100 200m

Figure A-19 | Threatened flora monitoring locations



JACOBS NSW SPATIAL - GIS MAP file : J:\E\Projects\04_Eastern\A136900\22 Spatial\Directory\Templates\Figures\AnnualReport2018\D00395_C71_CON_BiodiversityMonitoringLocations_MAPSERIES_JAC_A3P_V05.mxd | 14/03/2019

Legend

- Monitoring location - Control (Jacobs 2018)
- Monitoring location - Impact (Jacobs 2018)
- Draft project boundary (v12A, PC Dec 2017)
- Clearing boundary (PC 2018)
- Waterway (DFSI Mar 2018)

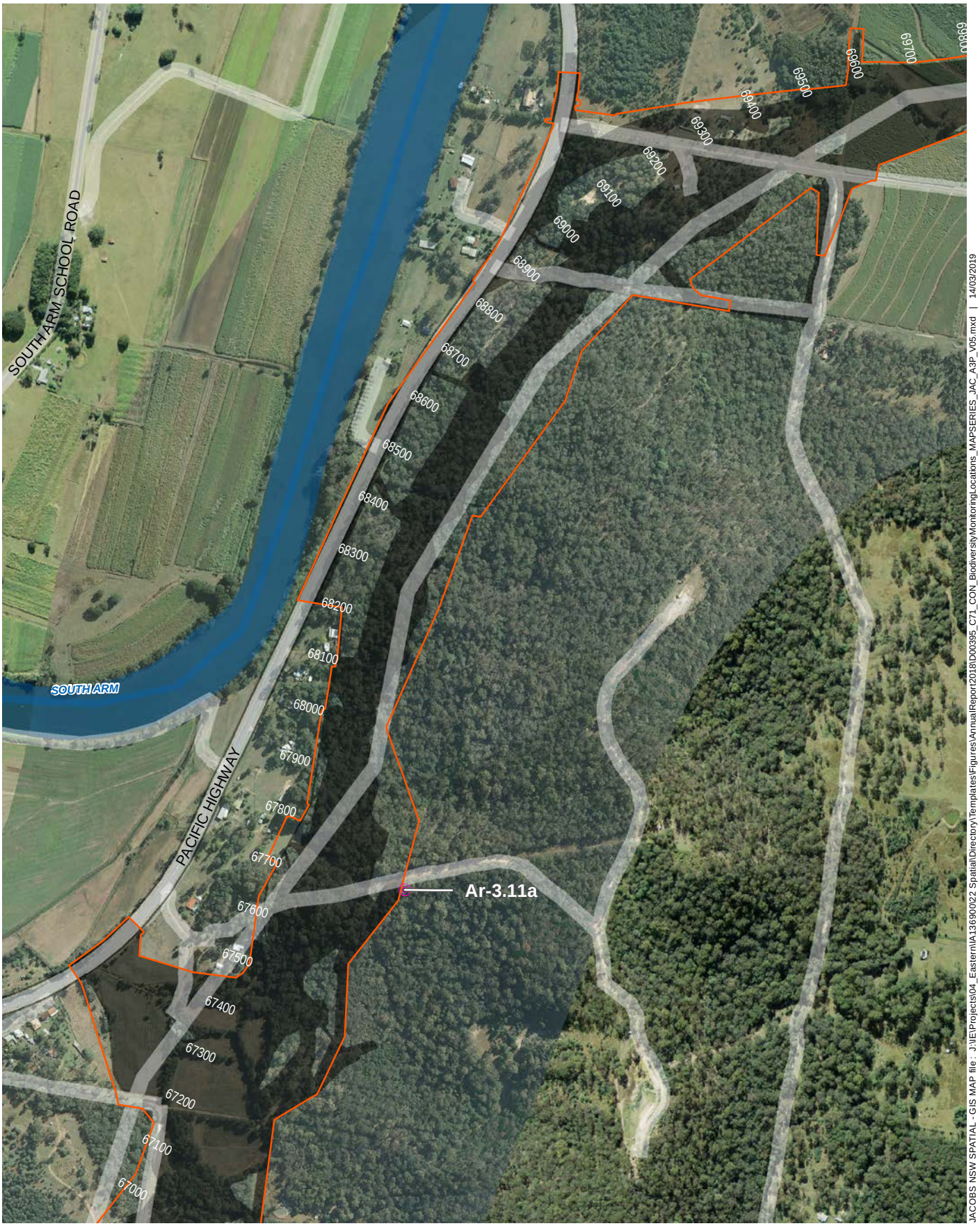
Imagery Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community, Pacific Complete 2011, Nov 2017

N

1:10,000 @ A3

0 100 200m

Figure A-20 | Threatened flora monitoring locations



JACOBS NSW SPATIAL - GIS MAP file : J:\E\Projects\04_Eastern\A136900\22 Spatial\Directory\Templates\Figures\AnnualReport2018\D00395_C71_CON_BiodiversityMonitoringLocations_MAPSERIES_JAC_A3P_V05.mxd | 14/03/2019

Legend

- Monitoring location - Impact (Jacobs 2018)
- Waterway (DFSI Mar 2018)
- Draft project boundary (v12A, PC Dec 2017)
- Clearing boundary (PC 2018)

Imagery Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community, Pacific Complete 2011, Nov 2017

N

1:10,000 @ A3

0 100 200m

Figure A-21 | Threatened flora monitoring locations

JACOBS NSW SPATIAL - GIS MAP file : J:\EI\Projects\04_Eastern\IA136900\22 Spatial\Directory\Templates\Figures\AnnualReport2018\D00395_C71_CON_BiodiversityMonitoringLocations_MAPSERIES_JAC_A3P_V05.mxd | 14/03/2019

Legend

- Monitoring location - Control (Jacobs 2018)
- Monitoring location - Impact (Jacobs 2018)
- Draft project boundary (v12A, PC Dec 2017)
- Clearing boundary (PC 2018)
- Waterway (DFSI Mar 2018)

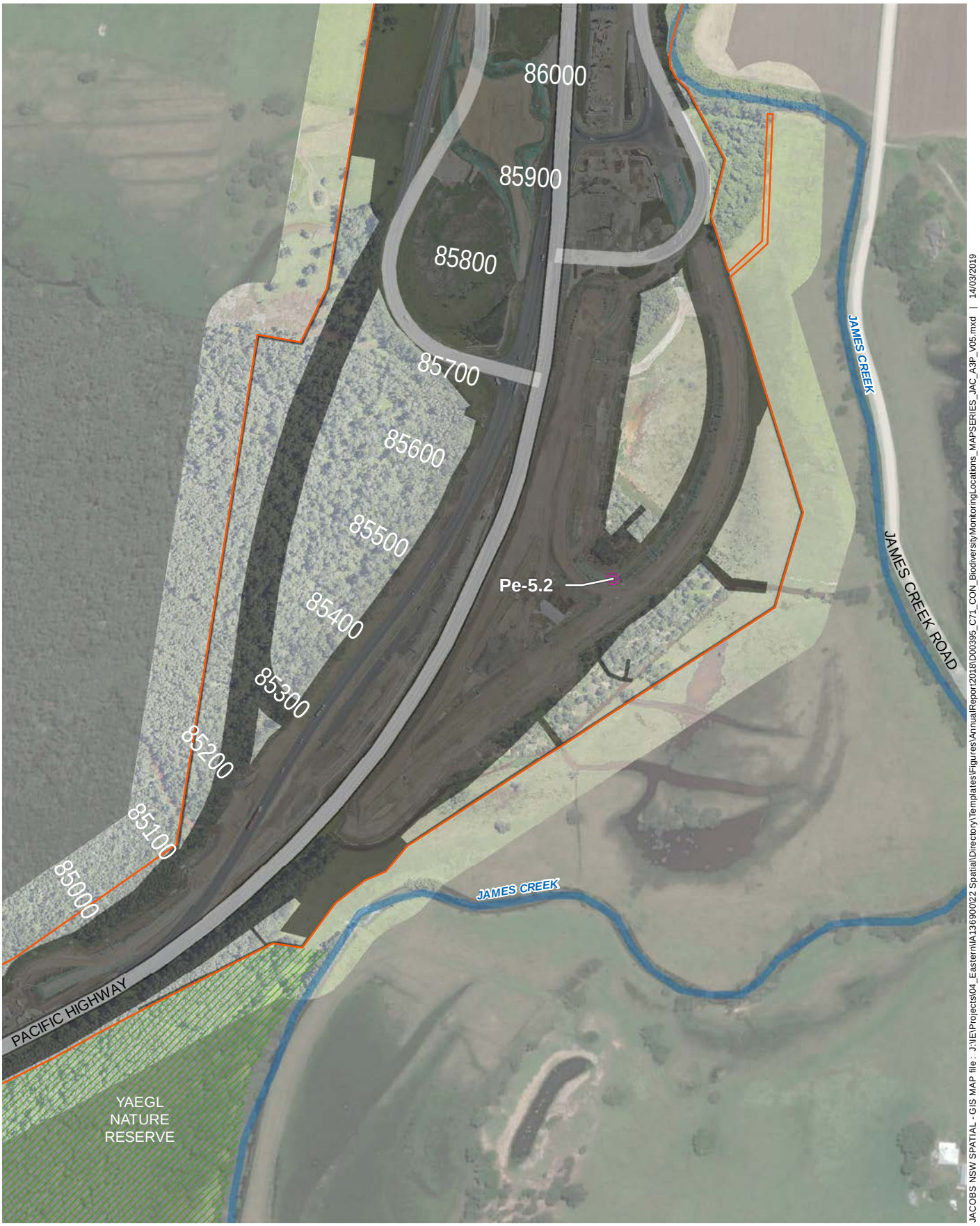
Imagery Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community, Pacific Complete 2011, Nov 2017

N

1:12,500 @ A3

0 100 200m

Figure A-22 | Threatened flora monitoring locations



JACOBS NSW SPATIAL - GIS MAP file : J:\E\Projects\04_Eastern\A136900\22 Spatial\Directory\Templates\Figures\AnnualReport2018\D00395_C71_CON_BiodiversityMonitoringLocations_MAPSERIES_JAC_A3P_V05.mxd | 14/03/2019

Legend

- Monitoring location - Impact (Jacobs 2018)
- Draft project boundary (v12A, PC Dec 2017)
- Clearing boundary (PC 2018)
- Waterway (DFSI Mar 2018)
- National Park (DFSI Oct 2018)

Imagery Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community, Pacific Complete 2011, Nov 2017

N

1:5,000 @ A3

0 100 200m

Figure A-23 | Threatened flora monitoring locations

JACOBS NSW SPATIAL - GIS MAP file : J:\E\Projects\04_Eastern\A136900\22 Spatial\Directory\Templates\Figures\AnnualReport2018\D00395_C71_CON_BiodiversityMonitoringLocations_MAPSERIES_JAC_A3P_V05.mxd | 14/03/2019

Legend

- Monitoring location - Control (Jacobs 2018)
- Monitoring location - Impact (Jacobs 2018)
- Draft project boundary (v12A, PC Dec 2017)
- Clearing boundary (PC 2018)
- State Forest (DFSI Mar 2018)
- National Park (DFSI Oct 2018)

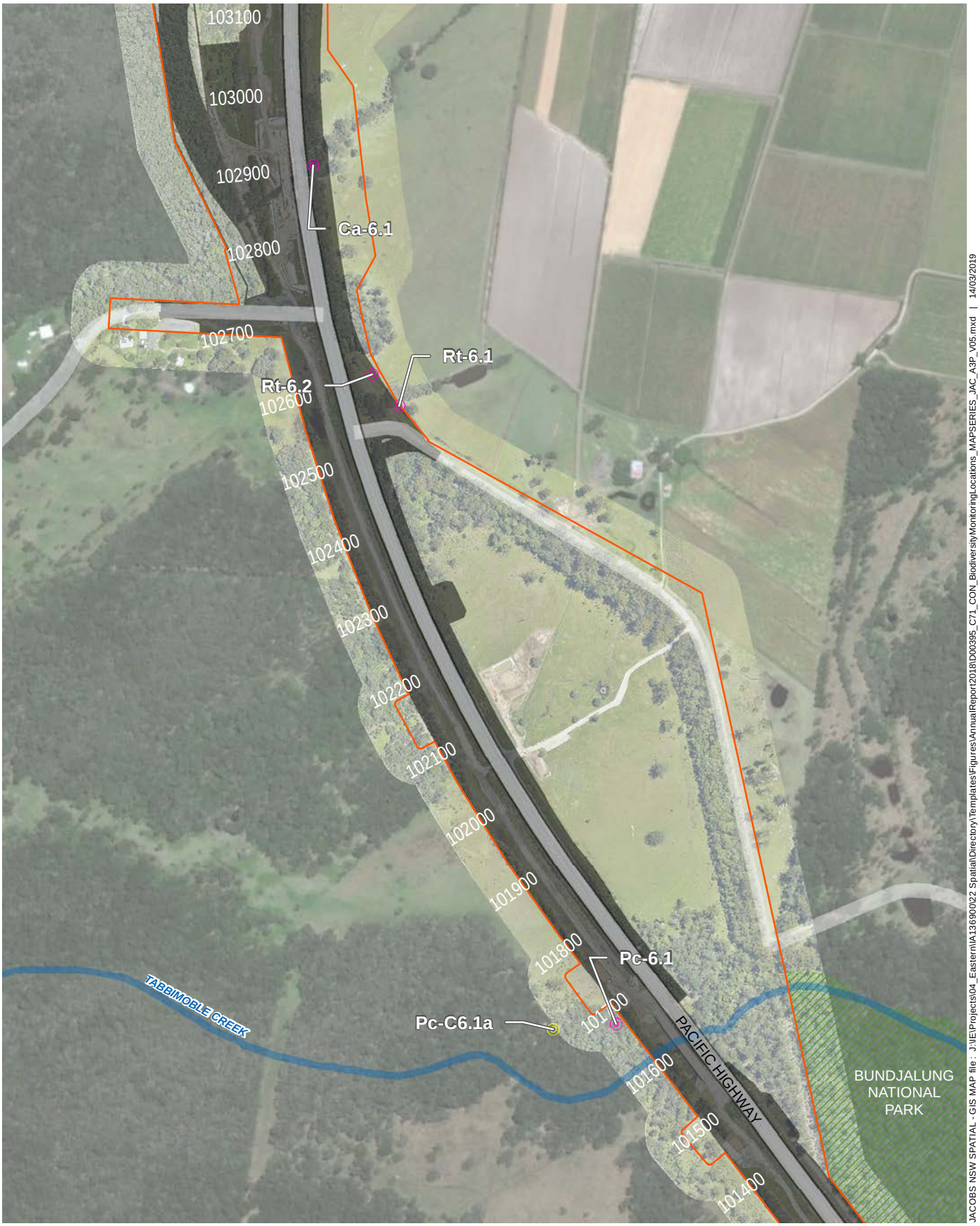
Imagery Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community, Pacific Complete 2011, Nov 2017

N

1:5,000 @ A3

0 100 200m

Figure A-24 | Threatened flora monitoring locations



JACOBS NSW SPATIAL - GIS MAP file : J:\E\Projects\04_Eastern\A136900\22 Spatial\Directory\Templates\Figures\AnnualReport2018\D00395_C71_CON_BiodiversityMonitoringLocations_MAPSERIES_JAC_A3P_V05.mxd | 14/03/2019

Legend

- Monitoring location - Control (Jacobs 2018)
- Monitoring location - Impact (Jacobs 2018)
- Draft project boundary (v12A, PC Dec 2017)
- Clearing boundary (PC 2018)
- Waterway (DFSI Mar 2018)
- National Park (DFSI Oct 2018)

Imagery Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community, Pacific Complete 2011, Nov 2017

N

1:7,000 @ A3

0 100 200m

Figure A-25 | Threatened flora monitoring locations

JACOBS NSW SPATIAL - GIS MAP file : J:\IE\Projects\04_Eastern\A136900\22 Spatial\Directory\Templates\Figures\AnnualReport2018\D00395_C71_CON_BiodiversityMonitoringLocations_MAPSERIES_JAC_A3P_V05.mxd | 14/03/2019

Legend

- Monitoring location - Impact (Jacobs 2018)
- State Forest (DFSI Mar 2018)
- Draft project boundary (v12A, PC Dec 2017)
- Clearing boundary (PC 2018)

Imagery Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community, Pacific Complete 2011, Nov 2017

N

1:5,000 @ A3

0 100 200m

Figure A-26 | Threatened flora monitoring locations

JACOBS NSW SPATIAL - GIS MAP file : J:\E\Projects\04_Eastern\A136900\22 Spatial\Directory\Templates\Figures\AnnualReport2018\D00395_C71_CON_BiodiversityMonitoringLocations_MAPSERIES_JAC_A3P_V05.mxd | 14/03/2019

Legend

- Monitoring location - Impact (Jacobs 2018)
- Draft project boundary (v12A, PC Dec 2017)
- Clearing boundary (PC 2018)
- State Forest (DFSI Mar 2018)
- National Park (DFSI Oct 2018)

Imagery Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community, Pacific Complete 2011, Nov 2017

N

1:5,000 @ A3

0 100 200m

Figure A-27 | Threatened flora monitoring locations

JACOBS NSW SPATIAL - GIS MAP file : J:\E\Projects\04_Eastern\A136900\22 Spatial\Directory\Templates\Figures\AnnualReport2018\D00395_C71_CON_BiodiversityMonitoringLocations_MAPSERIES_JAC_A3P_V05.mxd | 14/03/2019

Legend

- Monitoring location - Impact (Jacobs 2018)
- Draft project boundary (v12A, PC Dec 2017)
- Clearing boundary (PC 2018)

Imagery Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community, Pacific Complete 2011, Nov 2017

N

1:10,000 @ A3

0 100 200m

Figure A-28 | Threatened flora monitoring locations

JACOBS NSW SPATIAL - GIS MAP file : J:\E\Projects\04_Eastern\A136900\22 Spatial\Directory\Templates\Figures\AnnualReport2018\D00395_C71_CON_BiodiversityMonitoringLocations_MAPSERIES_JAC_A3P_V05.mxd | 14/03/2019

Legend

- Monitoring location - Impact (Jacobs 2018)
- Draft project boundary (v12A, PC Dec 2017)
- Clearing boundary (PC 2018)

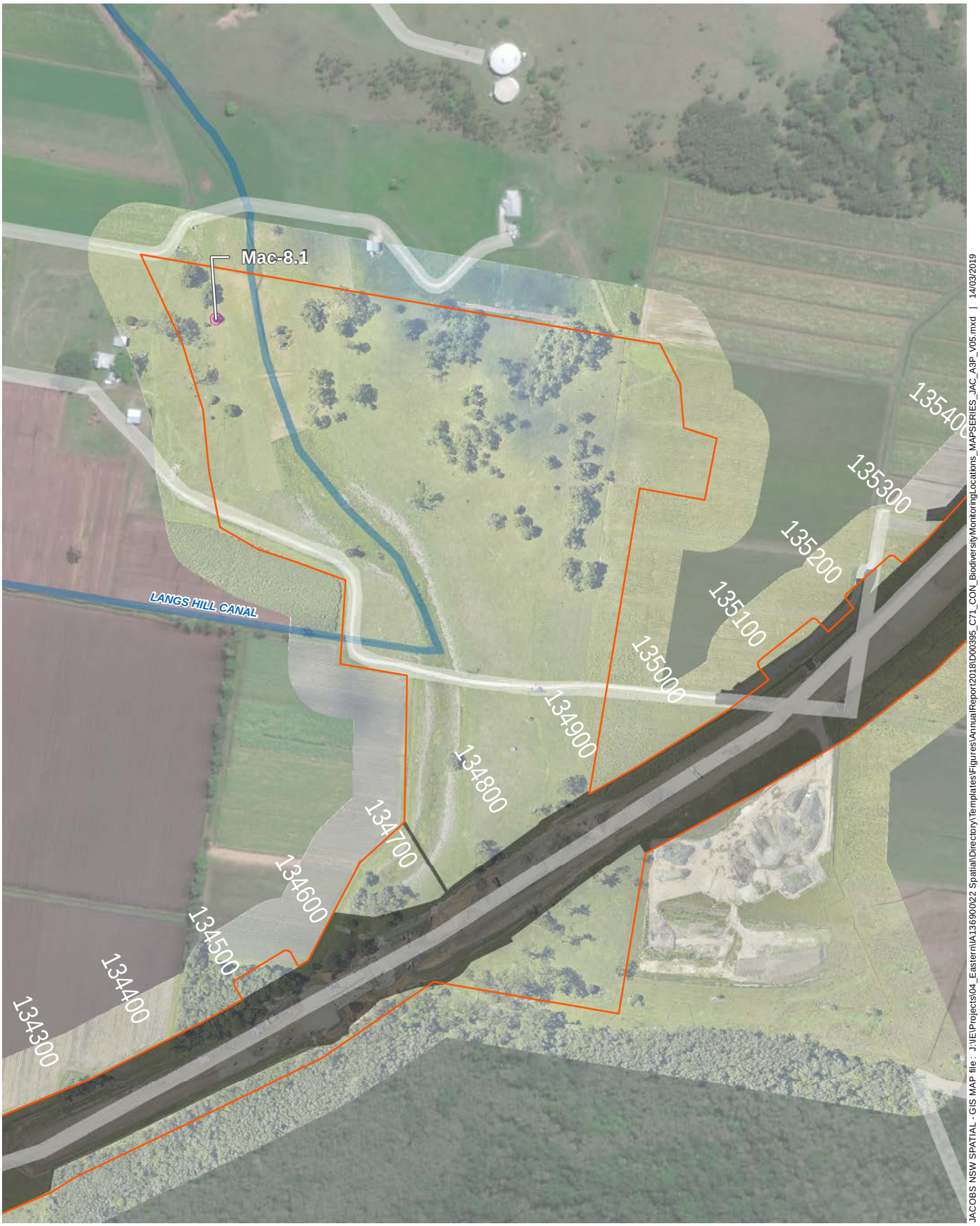
Imagery Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community, Pacific Complete 2011, Nov 2017

N

1:5,000 @ A3

0 100 200m

Figure A-29 | Threatened flora monitoring locations



JACOBS NSW SPATIAL - GIS MAP file : J:\E\Projects\04_Eastern\A136900\22 Spatial\Directory\Templates\Figures\AnnualReport2018\D00395_C71_CON_BiodiversityMonitoringLocations_MAPSERIES_JAC_A3P_V05.mxd | 14/03/2019

Legend

- Monitoring location - Impact (Jacobs 2018)
- Waterway (DFSI Mar 2018)
- Draft project boundary (v12A, PC Dec 2017)
- Clearing boundary (PC 2018)

Imagery Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community, Pacific Complete 2011, Nov 2017

N

1:5,000 @ A3

0 100 200m

Figure A-30 | Threatened flora monitoring locations

JACOBS NSW SPATIAL - GIS MAP file : J:\E\Projects\04_Eastern\A136900\22 Spatial\Directory\Templates\Figures\AnnualReport2018\D00395_C71_CON_BiodiversityMonitoringLocations_MAPSERIES_JAC_A3P_V05.mxd | 14/03/2019

Legend

- Monitoring location - Control (Jacobs 2018)
- Monitoring location - Impact (Jacobs 2018)
- Draft project boundary (v12A, PC Dec 2017)
- Clearing boundary (PC 2018)

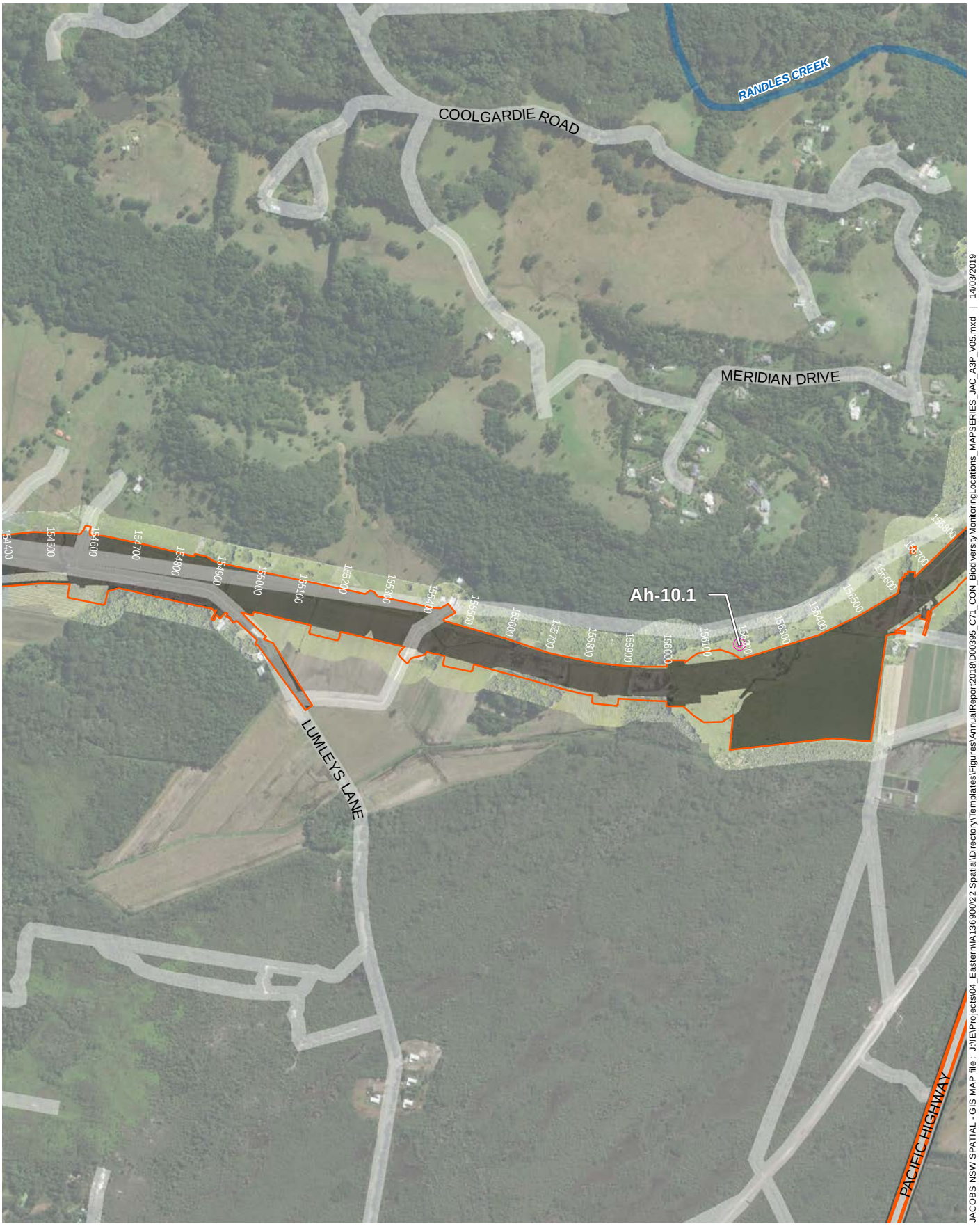
Imagery Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community, Pacific Complete 2011, Nov 2017

N

1:5,000 @ A3

0 100 200m

Figure A-31 | Threatened flora monitoring locations



JACOBS NSW SPATIAL - GIS MAP file : J:\E\Projects\04_Eastern\A136900\22 Spatial\Directory\Templates\Figures\AnnualReport2018\D00395_C71_CON_BiodiversityMonitoringLocations_MAPSERIES_JAC_A3P_V05.mxd | 14/03/2019

Legend

- Monitoring location - Impact (Jacobs 2018)
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Imagery Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community, Pacific Complete 2011, Nov 2017

N

1:12,500 @ A3

0 100 200m

Figure A-32 | Threatened flora monitoring locations

Legend

- Monitoring location - Control (Jacobs 2018)
- Monitoring location - Impact (Jacobs 2018)
- Draft project boundary (v12A, PC Dec 2017)
- Clearing boundary (PC 2018)
- Waterway (DFSI Mar 2018)

Imagery Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community, Pacific Complete 2011, Nov 2017

N

1:7,000 @ A3

0 100 200m

JACOBS NSW SPATIAL - GIS MAP file : J:\E\Projects\04_Eastern\A136900\22 Spatial\Directory\Templates\Figures\AnnualReport2018\D00395_C71_CON_BiodiversityMonitoringLocations_MAPSERIES_JAC_A3P_V05.mxd | 14/03/2019

Figure A-33 | Threatened flora monitoring locations

Appendix B. Differences in EIS vs Current Clearing Boundary for Threatened Flora (Year 2 reset)

Common name	Scientific name	Location	Direct								Indirect within 10m								Indirect with 10 to 20m							
			EIS/SPIR boundary/impact (points)	EIS/SPIR boundary/impact + Additional finds & GIS consolidation (points)	Current boundary/impact + Additional finds & GIS consolidation (points)	**Net Change (points)**	EIS/SPIR boundary/impact approval (area)	EIS/SPIR boundary/impact + Additional finds & GIS consolidation (area)	Current boundary/impact + Additional finds & GIS consolidation (area)	**Net Change (area)**	EIS/SPIR boundary/impact (points)	EIS/SPIR boundary/impact + Additional finds & GIS consolidation (points)	Current boundary/impact + Additional finds & GIS consolidation (points)	**Net Change (points)**	EIS/SPIR boundary/impact approval (area)	EIS/SPIR boundary/impact + Additional finds & GIS consolidation (area)	Current boundary/impact + Additional finds & GIS consolidation (area)	**Net Change (area)**	EIS/SPIR boundary/impact (points)	EIS/SPIR boundary/impact + Additional finds & GIS consolidation (points)	Current boundary/impact + Additional finds & GIS consolidation (points)	**Net Change (points)**	EIS/SPIR boundary/impact approval (area)	EIS/SPIR boundary/impact + Additional finds & GIS consolidation (area)	Current boundary/impact + Additional finds & GIS consolidation (area)	**Net Change (area)**
Rough-barked Apple	Angophora robur	S3	6443	6443	5890	-553	87.895	89.115	77.521	-11.594	1146	1146	1463	317	20.691	21.137	25.863	4.726	1208	1208	1141	-67	19.572	21.056	23.570	2.514
		S4	108	108	34	-74	2.618	2.561	1.204	-1.357	3	3	35	32	0.462	0.550	1.147	0.597	8	8	34	26	0.425	0.480	0.986	0.506
		Total	6551	6551	5924	-627	90.513	91.676	78.725	-12.951	1149	1149	1498	349	21.153	21.687	27.010	5.323	1216	1216	1175	-41	19.997	21.536	24.556	3.020
Broad-leaved Apple	Angophora subvelutina	S1				0		0.290	0.291	0.001			1	1		0.050	0.051	0.001				0		0.054	0.054	0.000
		Total	0	0	0	0	0	0.290	0.291	0.001	0	0	1	1	0	0.050	0.051	0.001	0	0	0	0	0	0.054	0.054	0.000
White laceflower	Archidendron hendersonii	S10	1	3	4	1				0.000	4	8	1	-7				0.000	18	18	17	-1				0.000
		Total	1	3	4	1	0	0.000	0.000	0.000	4	8	1	-7	0	0.000	0.000	0.000	18	18	17	-1	0	0.000	0.000	0.000
Veiny Lace Flower	Archidendron muellerianum					0				0.000				0				0.000				0				0.000
			0	0	0	0	0	0.000	0.000	0.000	0	0	0	0	0	0.000	0.000	0.000	0	0	0	0	0	0.000	0.000	0.000
	Artanema fimbriatum	S1		5	5	0				0.000				0				0.000				0				0.000
		Total	0	5	5	0	0	0.000	0.000	0.000	0	0	0	0	0	0.000	0.000	0.000	0	0	0	0	0	0.000	0.000	0.000
Hairy-joint grass	Arthraxon hispidus	S1	2	2	2	0				0.000				0				0.000				0				0.000
		S3	1	1	1	0				0.000				0				0.000				0				0.000
		S8	38	38	16	-22	0.238	1.244	0.097	-1.147	2	2	17	15		0.020	0.115	0.095	8	8	20	12	0.038	0.038	0.101	0.062
		S10	347	347	376	29	1.232	0.256	1.575	1.320	47	47	52	5	0.697	0.697	0.861	0.164	53	53	35	-18	0.846	0.858	0.811	-0.046
		Total	388	388	395	7	1.47	1.500	1.672	0.172	49	49	69	20	0.697	0.717	0.976	0.259	61	61	55	-6	0.884	0.896	0.912	0.016
Stinking laurel	Cryptocarya foetida	S10	41	51		-51				0.000	1	1	6	5				0.000	6	7	3	-4				0.000
		Total	41	51	0	-51	0	0.000	0.000	0.000	1	1	6	5	0	0.000	0.000	0.000	6	7	3	-4	0	0.000	0.000	0.000
Water nutgrass	Cyperus aquatilis	S1	1	1	1	0	0.021	0.021	0.030	0.009				0		0.013	0.004	-0.009				0			0.000	0.000
		S2	6	6	6	0	0.003	0.003	0.003	0.000				0				0.000				0				0.000
		S6	113	121	111	-10				0.000				0				0.000			10	10				0.000
		S7	8	3	3	0				0.000	2	1		-1				0.000	1		1	1				0.000
		Total	128	131	121	-10	0.024	0.024	0.033	0.009	2	1	0	-1	0	0.013	0.004	-0.009	1	0	11	11	0	0.000	0.000	0.000
Davidson's Plum	Davidsonia jerseyana					0				0.000			1	1				0.000				0				0.000
			0	0	0	0	0	0.000	0.000	0.000	0	0	1	1	0	0.000	0.000	0.000	0	0	0	0	0	0.000	0.000	0.000
Square-stemmed spike-rush	Eleocharis tetraquetra	S1	253	58	235	177	0.815	0.787	0.889	0.101	43	178	58	-120	0.118	0.135	0.144	0.009	48	44	11	-33	0.12	0.122	0.114	-0.007
		Total	253	58	235	177	0.815	0.787	0.889	0.101	43	178	58	-120	0.118	0.135	0.144	0.009	48	44	11	-33	0.12	0.122	0.114	-0.007
Green-leaved rose walnut	Endiandra muelleri ssp. bracteata	S4			1	1				0.000		1		-1				0.000	2	1	1	0				0.000
		S10	3	4	4	0				0.000	10	11	2	-9				0.000	3	4	10	6				0.000
		Total	3	4	5	1	0	0.000	0.000	0.000	10	12	2	-10	0	0.000	0.000	0.000	5	5	11	6	0	0.000	0.000	0.000
Square-fruited Ironbark	Eucalyptus tetrapleura	S2	822	868	823	-45	20.285	20.990	22.838	1.849	193	188	200	12	6.337	7.205	9.110	1.905	115	102	105	3	4.87	6.585	7.975	1.390
		S3				0				0.000				0		0.743		-0.743				0		0.720	4.178	3.458
		Total	822	868	823	-45	20.285	20.990	22.838	1.849	193	188	200	12	6.337	7.948	9.110	1.162	115	102	105	3	4.87	7.305	12.153	4.848
Four-tailed grevillea	Grevillea quadricauda	S3	3	3	5	2		0.020	0.020	0.000	35	35	34	-1	0.017	0.018	0.018	0.000	14	14	13	-1		0.003	0.003	0.000
		Total	3	3	5	2	0	0.020	0.020	0.000	35	35	34	-1	0.017	0.018	0.018	0.000	14	14	13	-1	0	0.003	0.003	0.000
Noah's false chickweed	Lindernia alsinoides	S1	1811	958	1035	77				0.000	18	72	17	-55				0.000	91	17	31	14				0.000
		S2				0				0.000				0				0.000	4	2		-2				0.000
		Total	1811	958	1035	77	0	0.000	0.000	0.000	18	72	17	-55	0	0.000	0.000	0.000	95	19	31	12	0	0.000	0.000	0.000
Slender screw fern	Lindsaea incisa	S1		1470	1470	0	0.013	0.013	0.013	0.000		250	250	0		0.001	0.001	0.000		330	330	0	0.003	0.003	0.003	0.000
		S2		409	409	0		0.024	0.024	0.000		1	1	0		0.003	0.003	0.000		2	2	0		0.004	0.003	0.000
		S3			1	1			0.005	0.005			2	2			0.007	0.007			1	1		0.001	0.003	0.002
		S6		11437	3409	-8028	0.37	0.370	0.281	-0.089		1501	3903	2402	0.058	0.058	0.137	0.078		3221	186	-3035	0.148	0.152	0.346	0.194
		Total	0	13316	5289	-8027	0.383	0.406	0.323	-0.084	0	1752	4156	2404	0.058	0.062	0.148	0.086	0	3553	519	-3034	0.151	0.159	0.355	0.196
Macadamia Nut	Macadamia integrifolia	S10				0				0.000			2	2				0.000			2	2				0.000
		Total	0	0	0	0	0	0.000	0.000	0.000	0	0	2	2	0	0.000	0.000	0.000	0	0	2	2	0	0.000	0.000	0.000
Rough-shelled Bush Nut	Macadamia tetraphylla	S5		3	2	-1				0.000			1	1				0.000			0	0				0.000
		S8			2	2				0.000	2	2		-2				0.000				0				0.000
		S10	10	10	10	0				0.000				0				0.000	3	3	11	8				0.000
		Total	10	13	14	1	0	0.000	0.000	0.000	2	2	1	-1	0	0.000	0.000	0.000	3	3	11	8	0	0.000	0.000	0.000
Maundia	Maundia triglochinoides	S1	5	4	6	2	0.075	0.103	0.117	0.014	5	1	1	0	0.038	0.044	0.042	-0.001		1	1	0		0.032	0.032	0.000
		S2	34	28	20	-8	0.075	0.069	0.052	-0.017	45	43	41	-2	0.072	0.082	0.058	-0.023	16	6	8	2	0.073	0.065	0.073	0.008
		S3	3	3	1	-2	0.016	0.050	0.020	-0.029			1	1		0.006	0.026	0.020	1	1	2	1		0.034	0.068	0.035
		S7	11	10	8	-2	0.023	0.023	0.018	-0.005	16	18	4	-14		0.008	0.003	-0.005	1	3	1	-2		0.018	0.002	-0.016
		Total	53	45	35	-10	0.189	0.245	0.207	-0.038	66	62	47	-15	0.11	0.140	0.130	-0.010	18	11	12	1	0.073	0.148	0.175	0.028
Weeping paperbark	Melaleuca irbyana	S7	1582	1582	1169	-413	2.761	2.761	2.714	-0.047	132	132	165	33	0.322	0.322	0.413	0.091	41	42	68	26	0.203	0.246	0.250	0.004
		Total	1582	1582	1169	-413	2.761	2.761	2.714	-0.047	132	132	165	33	0.322	0.322	0.413	0.091	41	42	68	26	0.203	0.246	0.250	0.004
Yellow-Flowered King of the Fairies	Oberonia complanata	S8	18	20	18	-2	0.033	0.033	0.038	0.005	1	2	8	6	0.013	0.013	0.011	-0.002	6	7	1	-6		0.003		-0.003
		Total	18	20	18	-2	0.033	0.033	0.038	0.005	1	2	8	6	0.013	0.013	0.011	-0.002	6	7	1	-6	0	0.003	0.000	-0.003
	Oberonia titania	S10				0				0.000				0				0.000		13	13	0				0.000
		Total	0	0	0	0	0	0.000	0.000	0.000	0	0	0	0	0	0.000	0.000	0.000	0	13	13	0	0	0.000	0.000	0.000
	Olax angulata	S2		1	1	0				0.000				0				0.000				0				0.000
		Total	0	1	1	0	0	0.000	0.000	0.000	0	0	0	0	0	0.000	0.000	0.000	0	0	0	0	0	0.000	0.000	0.000
Birdwing Butterfly Vine	Pararistolochia praevenosa	S10		40	50	10				0.000		10		-10				0.000		1	1	0				0.000
		Total	0	40	50	10	0	0.000	0.000	0.000	0	10	0	-10	0	0.000	0.000	0.000	0	1	1	0	0	0.000	0.000	0.000
Tall knotweed	Persicaria elatior	S4	53	53	49	-4	0.153	0.153	0.137	-0.016	3	8	108	100		0.042	0.521	0.479	1	3	64	61	0.006	0.006	0.436	0.430
		S5	23	23	97	74	0.047	0.057	0.154	0.097	25	25	30	5	0.069	0.077	0.060	-0.017	68	68	29	-39	0.084	0.098	0.057	-0.041
		Total	76	76	146	70	0.2	0.210	0.291	0.081	28	33	138	105	0.069	0.120	0.581	0.462	69	71	93	22	0.09	0.104	0.493	0.389
Singleton mint bush	Prostanthera cineolifera	S6	609	616	653	37	0.424	0.424	0.438	0.015	260	258	228	-30	0.188	0.188	0.177	-0.011	106	106	99	-7	0.229	0.229	0.204	-0.026
		Total	609	616	653	37	0.424	0.424	0.438	0.015	260	258	228	-30	0.188	0.188	0.177	-0.011	106	106	99	-7	0.229	0.229	0.204	-0.026
Moonee Quassia	Quassia sp. Moonee Creek	S1	73	133	73	-60	0.08	0.152	0.080	-0.073	137	173	137	-36	0.105	0.091	0.107	0.016	250	185	243	58	0.126	0.106	0.120	0.014
		Total	73	133	73	-60	0.08	0.152	0.080	-0.073	137	173	137	-36	0.105	0.091	0.107	0.016	250	185	243	58	0.126	0.106	0.120	0.014
	Rotala tripartia	S6			2	2				0.000				0				0.000	2	6		-6				0.000
		Total	0	0	2	2	0	0.000	0.000	0.000	0	0	0	0	0	0.000	0.000	0.000	2	6	0	-6	0	0.000	0.000	0.000
	ROTAP Trichosanthes subvelutina	S10				0				0.000		1	1	0				0.000				0				0.000
		Total	0	0	0	0	0	0.000	0.000	0.000	0	1	1	0	0	0.000	0.000	0.000	0	0	0	0	0	0.000	0.000	0.000
Siah's Backbone	Streblus pendulinus	S10	4	4	3	-1				0.000	1	1	4	3				0.000	2	2		-2				0.000
		S4				0				0.000			1	1				0.000	1	1	1	0				0.000
		S8				0				0.000				0				0.000		2	1	-1				0.000
		Total	4	4	3	-1	0	0.000	0.000	0.000	1	1	5	4	0	0.000	0.000	0.000	3	5	2	-3	0	0.000	0.000	0.000
Smooth-bark Rose Apple, Red Lilly Pilly	Syzygium hodgkinsoniae	S10	6	6	2	-4				0.000	4	4		-4				0.000		6	8	2				0.000
		Total	6	6	2	-4	0	0.000	0.000	0.000	4	4	0	-4	0	0.000	0.000	0.000	0	6	8	2	0	0.000	0.000	0.000