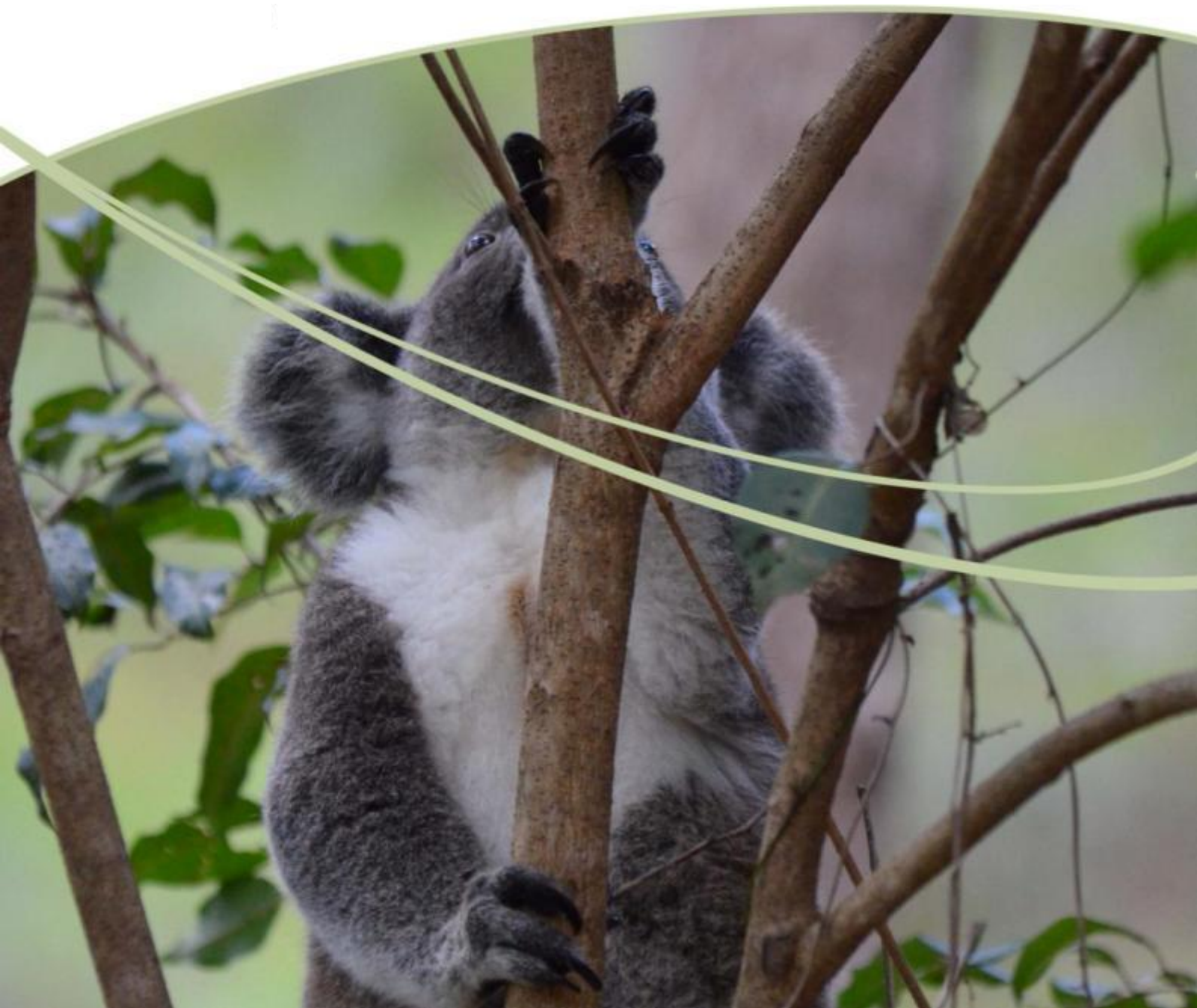
Koala Habitat Rehabilitation Monitoring Report – 2nd Monitoring Period – Yarrabilba

EPBC Number:	2013/6791
Project Name:	Yarrabilba
Proponent's ACN:	103 578 436
Proposed Action:	To construct the Yarrabilba residential development and associated infrastructure approximately 40 kilometres south east of Brisbane, Queensland (see EPBC Act referral 3013/6791 and request to vary proposal dated 5 August 2013)
Prepared for:	Lendlease
Prepared by:	Dr M.N. Runkowski, J. Pittard, B. Steinrücken, M. Brett, K. Richardt
Date:	27 December 2017



Natura Consulting – Document Control Sheet

Project	
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Revision History

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Signed

Full name (please print)

Robert Mervyn Ball

Organisation (please print)

Lendlease Communities (Yarrabilba) Pty Ltd

Date

25 / 01 / 2018

All the information contained within this report is provided in good faith in the belief that no information or recommendations made are misleading. All comments and opinions provided in this report have been based upon a limited survey of the study sites and/or on information supplied by the client, their agents and/or third parties.

All the assessments of site biology, ecology, geomorphology and the extent and nature of and to this study site is limited to the terms of reference stated within this report; and by the limited timeframe of study. Therefore the results presented herein cannot be considered absolute without additional long-term follow-up studies.

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1 Executive summary

Natura Consulting has developed this *Habitat Rehabilitation Monitoring Report* as the 2nd monitoring period for rehabilitation within the Yarrabilba Koala Habitat Areas as prescribed in the *Habitat Rehabilitation and Management Plan* (Natura Consulting, March 2015) and the Approval Conditions set out under the *Environmental Protection and Biodiversity Conservation Act 1999* dated 13 Novemebr 2014.

The intent of this plan is to provide 2nd monitoring period information to direct the rehabilitation works associated with koala habitat within the 'koala habitat areas to be protected and managed' on the Yarrabilba site. These areas are to be rehabilitated, ensuring that koala habitat outside of the offset sites areas are protected and managed. This report provides 2nd monitoring period data for the rehabilitation of these areas, with 59 sites to be monitored (see later). Each monitoring site is located within a Koala Habitat Rehabilitation Unit (HRU1 to HRU31) including Road Crossing Rehabilitation Units (CRU2, CRU4 to CRU7 and CRU9 to CRU14), with the pre-clearing Regional Ecosystem, management type and corridor type tabulated.

Each rehabilitation unit is to be rehabilitated to a vegetation structure and species composition that is in line with that of the appropriate pre-clearing Regional Ecosystem (RE). This is derived from the vegetation structure and species composition of the appropriate pre-clearing RE. The Final Benchmark for rehabilitation is derived from the definition of remnant vegetation under the *Vegetation Management Act 1999* (canopy is 70% of the height, 50% of the cover and similar species composition of the appropriate pre-clearing RE). Interim Benchmarks are also provided whereby an assessment at regular intervals will be made on the progress of the rehabilitation / revegetation efforts towards achieving this plan's outcomes. For Interim Benchmark years 1 to 10, vegetation structure has been quantified from a cumulative growth curve (CGC). The reference benchmark, Interim Benchmarks and Final Benchmarks have been tabulated for each RE, with the relevant rehabilitation unit also identified. A species list for each RE, including dominant species within each stratum, has also been provided.

Provision of contingency measures and corrective actions will account for instances of when Interim Benchmarks are not being met. 'As constructed' data and surveyed boundaries will also be provided for each rehabilitation unit to test and demonstrate compliance with the requirement to maintain and protect existing koala habitat.

The monitoring methodology that is applied has been detailed, where a minimum of two monitoring sites per rehabilitation unit will be surveyed in order to document and assess rehabilitation through time. All final locations of the 59 monitoring sites have been mapped. Monitoring includes photo point monitoring and transect and quadrat monitoring to monitor changes in species richness, percentage foliage cover for the ground layer, shrub and canopy layers, canopy height, and weed prevalence.

An assessment of site species richness and structure was undertaken to determine the baseline condition against the benchline values. A number of sites already meet the Final Benchmark for some individual parameters. Rehabilitation efforts need to ensure that the full suite of species represented in the pre-RE for each rehabilitation unit are planted where possible, with a strong focus on eradicating exotic weeds.

A total of 19 (32%) sites meet a benchmark for canopy tree cover (down from 28 (44%) sites in 1st monitoring period), 21 (35%) sites meet a benchmark for canopy tree height (proportionally the same as 21 (33%) sites in 1st monitoring period), 57 (97%) sites meet a benchmark for small tree cover (slightly down from 60 (98%) in 1st monitoring period), 57 (97%) sites meet a benchmark for small tree height (proportionally the same as 60 (94%) in 1st monitoring period), 12 (20%) sites meet a benchmark for shrub cover (slightly down from 14 (22%) sites in 1st monitoring period), 29 (49%) sites

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meet a benchmark for shrub height (down from 42 (66%) sites in 1st monitoring period), 57 (97%) sites meet a benchmark for ground-cover (proportionally the same as 62 (97%) sites in 1st monitoring period) and 20 (34%) sites meet a benchmark for weed cover of the ground-layer (up from 13 (20%) in 1st monitoring period).

Overall, this assessment reveals that rehabilitation works need to prioritise weed control of the ground-layer in order to provide opportunity for native species richness and shrub cover to increase proportionally. Furthermore, strategic rehabilitation of the ground, shrub and tree layers will ensure that weeds are outcompeted and shaded out over time. A number of sites do not yet meet a benchmark for tree and shrub structure, and so these sites will need to be prioritised for rehabilitation within the next 6 months to ensure that they meet the IMO-2 year benchmark.

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2 Introduction

2.1 Background

The Yarrabilba development site is located on the eastern side of Waterford - Tamborine Road, and to the south of Logan Village (refer to Figure 1). It is bounded by rural residential areas to the north, Plunkett Road to the south and the Plunkett Conservation Park to the east. The site consists of approximately 2,200 ha, of which 1,931 ha is controlled by Lendlease Communities (Yarrabilba) Pty Ltd. The land has been historically used for pine forestry, a military training camp in WWII and for live stock grazing, when first cleared. Yarrabilba is predominately vegetated with areas of regrowth native vegetation, regenerating pines and exotic grasslands. Some limited areas of native remnant and regrowth vegetation exist but they are mostly confined to creeks, drainage channels and wetlands.

The site is currently in the early stages of development with the growth of Yarrabilba projected to span approximately 30 years. The long-term master-planned development incorporates an extensive network of dedicated open space (in excess of 25% of the site). A significant component of the open space is dedicated to the conservation of habitat for koalas (*Phascolarctos cinereus*).

Habitat rehabilitation is intended to improve koala habitat quality within the site in order to significantly increase the site's koala carrying capacity in the medium to long term. In addition, the configuration of key elements of the open space system (Fauna Corridor, Greenspace Corridor and Environmental Protection Zone) will enhance the site's contribution to koala movement opportunities within the context of larger areas of koala habitat to the east and west of the site (Austecology 2012). Under the development of Yarrabilba, all existing fragments of remnant vegetation which have value for koalas will be retained (approximately 5.4% of the total site area) (Austecology 2012). The rehabilitation of the Fauna Corridor, Greenspace Corridor and Environmental Protection Zone will significantly expand on these values by providing additional koala habitat (Natura Consulting 2011).

Natura Consulting has developed this *Habitat Rehabilitation Monitoring Report – 2nd Monitoring Period within Koala Habitat Areas* prior to the commencement of habitat rehabilitation in Koala Habitat Areas in the Yarrabilba Residential Development. This report provides data for the 2nd monitoring period for the rehabilitation of Koala Habitat Areas within the development site, with 66 sites monitored. It is noted, however, that Slash pine (*Pinus elliottii*) control has already occurred throughout 90% of the site.

2.2 Objectives

The intent of this report is to provide 2nd monitoring period data with which to assess the rehabilitation of koala habitat within the 'koala habitat to be protected and managed'.

This report is consistent with the *Habitat Rehabilitation and Management Plan* (Natura Consulting 2015), *Offset Management Plan* (Austecology 2015), *Koala Management Plan* (Austecology 2012) and *Fauna Corridor Infrastructure Master Plan* (Natura Consulting 2011). Specifically the objectives of this report are to:

- describe the rehabilitation areas and clear and concise rehabilitation outcomes and performance indicators against which achievement of the rehabilitation will be measured
- identify contingency measures and appropriate corrective actions that will be undertaken if the performance indicators or outcomes are not being met
- outline the monitoring methodology including monitoring site locations
- present the 2nd monitoring period results
- assess whether rehabilitation is on-track to meet the next interim performance indicator

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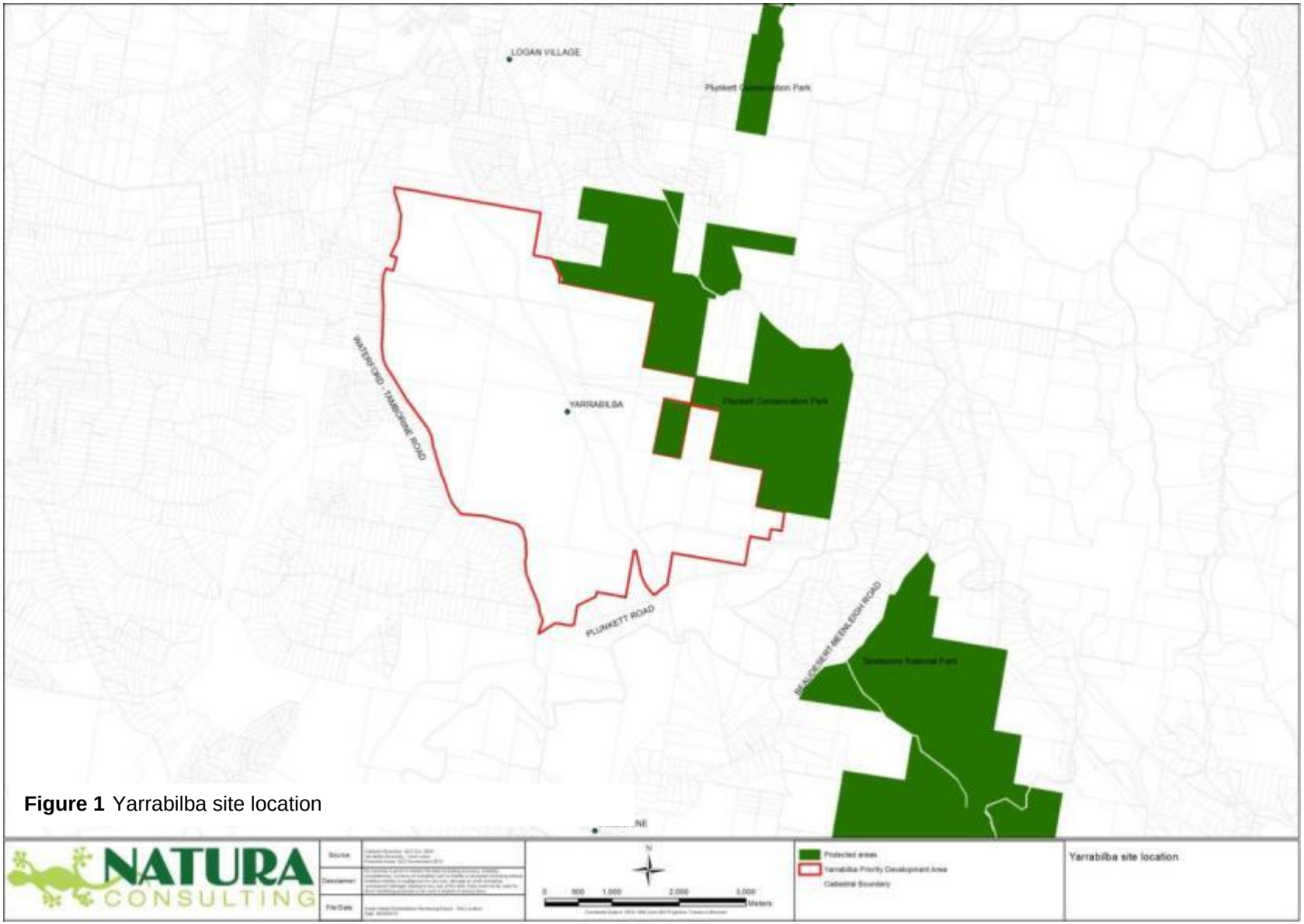

Figure 1 Yarrabilba site location

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3 Rehabilitation areas

3.1 Purpose of habitat rehabilitation

Koala habitat rehabilitation is to be undertaken within *Existing Assessable Koala Habitat to be protected and managed* within Fauna Corridors, Greenspace Corridors and Environmental Protection Zones. This totals an area of 754,657 m^2 (75.5 ha) within *Existing Assessable Koala Habitat* areas outside of Offset areas (195 ha), comprising a combined area of 2,736,428 m^2 (273.6 ha).

The koala habitat rehabilitation area has been divided into Offset Rehabilitation and Habitat Rehabilitation Units and Crossing Rehabilitation Units. This report is relevant to the Habitat Rehabilitation Units and Crossing Rehabilitation Units.

3.2 Habitat Rehabilitation Units (HRU)

Koala habitat rehabilitation is to occur within Habitat Rehabilitation Units as shown in Figure 2. Each rehabilitation unit (HRU1 to HRU31) is a mapped polygon, where the polygon boundaries are the mapped Pre-Clearing Regional Ecosystems. The Regional Ecosystem (RE) code applicable to each unit was determined by overlapping Pre-Clearing Regional Ecosystem mapping (Queensland Government 2015b) with maps of *Existing Assessable Koala Habitat – to be protected and managed* within the Fauna Corridors, Greenspace Corridors and Environmental Protection Zones.

The following table (Table 1) presents a summary of rehabilitation unit attributes, including the:

- area of the rehabilitation unit in square metres
- corridor within which the rehabilitation unit is located
- RE code for pre-clearing vegetation within the rehabilitation unit and the landzone / geology of the rehabilitation unit

It is noted that the minimum rehabilitation unit size is ~2,500 m^2 to reflect the mapping limitation of the Pre-Clearing Regional Ecosystems mapping dataset (Queensland Government 2015a). However, there are two rehabilitation units with areas of slightly less than 2,500 m^2, which were retained due to their immediate proximity to adjacent rehabilitation units.

3.3 Crossing Rehabilitation Units (CRU)

Rehabilitation and monitoring is also being undertaken where road and infrastructure traverses a Habitat Rehabilitation Unit. Crossing Rehabilitation Units have been identified by overlaying the proposed internal road network with the Pre-Clearing Regional Ecosystem mapping (Queensland Government 2015a) and Koala Habitat Rehabilitation Unit mapping. Each Crossing Rehabilitation Unit (CRU1 to CRU15) is a mapped polygon. It is noted that these locations are indicative and may change with the final alignment of roads. Table 2 presents a summary of the Crossing Rehabilitation Units, which are subject to rehabilitation actions outlined in this report.

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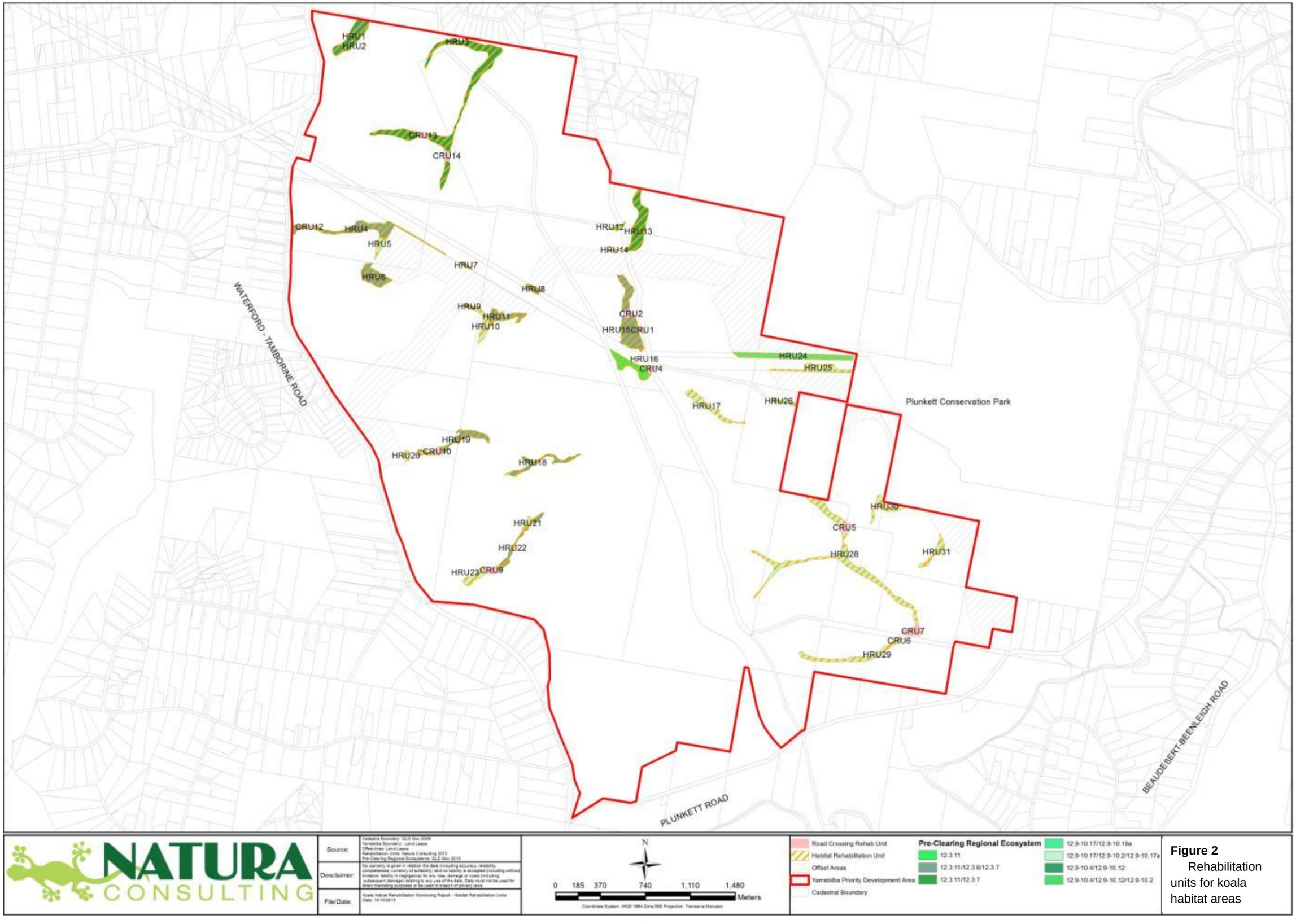

Figure 2 Rehabilitation units for koala habitat areas

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Table 1 Habitat Rehabilitation Units (HRU) within the corridor network

Rehab. Unit	Area (m^2)	Corridor Type	RE Code(s)	Landzone / Geology
HRU1	31,875	Greenspace Corridor	12.9-10.4/12.9-10.12	Fine grained sedimentary rocks – Undulating country on fine grained sedimentary rocks
HRU2	2,947	Greenspace Corridor	12.9-10.4/12.9-10.12/12.9-10.2	Fine grained sedimentary rocks – Undulating country on fine grained sedimentary rocks
HRU3	116,097	Greenspace Corridor	12.3.11/12.3.7	Recent quaternary alluvial systems – Alluvial river and creek flats
HRU4	47,894	Fauna Corridor Greenspace Corridor	12.3.11/12.3.6/12.3.7	Recent quaternary alluvial systems – Alluvial river and creek flats
HRU5	6,788	Greenspace Corridor	12.9-10.17/12.9-10.2	Recent quaternary alluvial systems – Alluvial river and creek flats
HRU6	26,102	Greenspace Corridor	12.3.11/12.3.6/12.3.7	Recent quaternary alluvial systems – Alluvial river and creek flats
HRU7	1,684	Fauna Corridor	12.3.11/12.3.6/12.3.7	Recent quaternary alluvial systems – Alluvial river and creek flats
HRU8	5,206	Fauna Corridor	12.3.11/12.3.6/12.3.7	Recent quaternary alluvial systems – Alluvial river and creek flats
HRU9	2,935	Greenspace Corridor	12.3.11/12.3.6/12.3.7	Recent quaternary alluvial systems – Alluvial river and creek flats
HRU10	13,511	Greenspace Corridor	12.9-10.17/12.9-10.2	Fine grained sedimentary rocks – Undulating country on fine grained sedimentary rocks
HRU11	19,528	Greenspace Corridor	12.3.11/12.3.6/12.3.7	Recent quaternary alluvial systems – Alluvial river and creek flats
HRU12	3,128	Greenspace Corridor	12.9-10.4/12.9-10.12/12.9-10.2	Fine grained sedimentary rocks – Undulating country on fine grained sedimentary rocks
HRU13	42,093	Greenspace Corridor	12.3.11/12.3.6/12.3.7	Recent quaternary alluvial systems – Alluvial river and creek flats
HRU14	910	Greenspace Corridor	12.3.11/12.3.6/12.3.7	Recent quaternary alluvial systems – Alluvial river and creek flats
HRU15	62,944	Fauna Corridor Greenspace Corridor	12.3.11/12.3.6/12.3.7	Recent quaternary alluvial systems – Alluvial river and creek flats
HRU16	29,486	Fauna Corridor Greenspace Corridor	12.3.11	Recent quaternary alluvial systems – Alluvial river and creek flats
HRU17	19,638	Greenspace Corridor	12.9-10.17/12.9-10.2	Fine grained sedimentary rocks – Undulating country on fine grained sedimentary rocks
HRU18	19,604	Fauna Corridor Greenspace Corridor	12.3.11/12.3.6/12.3.7	Recent quaternary alluvial systems – Alluvial river and creek flats
HRU19	29,070	Fauna Corridor	12.3.11/12.3.6/12.3.7	Recent quaternary alluvial systems – Alluvial river and creek flats
HRU20	3,784	Fauna Corridor	12.9-10.17/12.9-10.2	Fine grained sedimentary rocks – Undulating country on fine grained sedimentary rocks
HRU21	5,688	Greenspace Corridor	12.9-10.17/12.9-10.2	Fine grained sedimentary rocks – Undulating country on fine grained sedimentary rocks
HRU22	14,158	Greenspace Corridor	12.3.11/12.3.6/12.3.7	Recent quaternary alluvial systems – Alluvial river and creek flats

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Rehab. Unit	Area (m^2)	Corridor Type	RE Code(s)	Landzone / Geology
HRU23	15,932	Greenspace Corridor	12.9-10.17/12.9-10.2	Fine grained sedimentary rocks – Undulating country on fine grained sedimentary rocks
HRU24	38,783	Environmental Protection	12.9-10.17/12.9-10.19	Fine grained sedimentary rocks – Undulating country on fine grained sedimentary rocks
HRU25	22,618	Environmental Protection	12.9-10.17/12.9-10.2/12.9-10.19	Fine grained sedimentary rocks – Undulating country on fine grained sedimentary rocks
HRU26	2,818	Environmental Protection	12.9-10.17/12.9-10.19	Fine grained sedimentary rocks – Undulating country on fine grained sedimentary rocks
HRU27	15,379	Greenspace Corridor	12.9-10.17/12.9-10.2	Fine grained sedimentary rocks – Undulating country on fine grained sedimentary rocks
HRU28	99,585	Fauna Corridor Greenspace Corridor	12.9-10.17/12.9-10.2	Fine grained sedimentary rocks – Undulating country on fine grained sedimentary rocks
HRU29	27,237	Greenspace Corridor	12.9-10.17/12.9-10.2	Fine grained sedimentary rocks – Undulating country on fine grained sedimentary rocks
HRU30	15,378	Greenspace Corridor	12.9-10.17/12.9-10.2	Fine grained sedimentary rocks – Undulating country on fine grained sedimentary rocks
HRU31	11,857	Greenspace Corridor	12.9-10.17/12.9-10.2	Fine grained sedimentary rocks – Undulating country on fine grained sedimentary rocks
Total	**754,657**			

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Table 2 Road and infrastructure crossing rehabilitation units (CRU) traversing Habitat Rehabilitation Units (HRU)

Crossing Rehab. Unit	Area (m^2)	Traversing ORU	Corridor Type	RE Code(s)	Landzone / Geology
CRU1	1,369	HRU15	Greenspace Corridor	12.3.11/12.3.6/12.3.7	Fine grained sedimentary rocks – Undulating country on fine grained sedimentary rocks
CRU2	3,670	HRU15	Fauna Corridor Greenspace Corridor	12.3.11/12.3.6/12.3.7	Fine grained sedimentary rocks – Undulating country on fine grained sedimentary rocks
CRU4	3,347	HRU16	Greenspace Corridor	12.11.3	Metamorphic rocks - hills and lowlands on metamorphic rocks
CRU5	6,013	HRU28	Fauna Corridor	12.9-10.17/12.9-10.2	Fine grained sedimentary rocks – Undulating country on fine grained sedimentary rocks
CRU6	731	HRU29	Greenspace Corridor	12.9-10.17/12.9-10.2	Fine grained sedimentary rocks – Undulating country on fine grained sedimentary rocks
CRU7	10,045	HRU28	Greenspace Corridor	12.9-10.17/12.9-10.2	Fine grained sedimentary rocks – Undulating country on fine grained sedimentary rocks
CRU9	5,542	HRU22, HRU23	Greenspace Corridor	12.9-10.17/12.9-10.2	Fine grained sedimentary rocks – Undulating country on fine grained sedimentary rocks
CRU10	3,555	HRU19	Fauna Corridor	12.3.11/12.3.6/12.3.7	Fine grained sedimentary rocks – Undulating country on fine grained sedimentary rocks
CRU12	1,775	HRU4	Greenspace Corridor	12.3.11/12.3.6/12.3.7	Fine grained sedimentary rocks – Undulating country on fine grained sedimentary rocks
CRU13	3,766	HRU3	Greenspace Corridor	12.3.11//12.3.7	Fine grained sedimentary rocks – Undulating country on fine grained sedimentary rocks
CRU14	3,496	HRU3	Greenspace Corridor	12.3.11//12.3.7	Fine grained sedimentary rocks – Undulating country on fine grained sedimentary rocks
Total	**43,309**				

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3.4 Pre-clearing Regional Ecosystems Rehabilitation Units

A short description of the pre-clearing Regional Ecosystems identified in the Koala Habitat Rehabilitation Units and Crossing Rehabilitation Units is provided in Table 3.

Table 3 Summary of pre-clearing Regional Ecosystems within Offset Rehabilitation Units and Crossing Rehabilitation Units

RE Code	RE short description (extract from Qld Herbarium) RE Description Database	Vegetation Management Act class	Biodiversity status
12.3.6	*Eucalyptus tereticornis*, *Casuarina cunninghamiana* subsp. *cunninghamiana* +/- *Melaleuca* spp. fringing woodland	Least concern	No concern at present
12.3.7	*Melaleuca quinquenervia* +/- *Eucalyptus tereticornis*, *Lophostemon suaveolens* open forest on coastal alluvial plains	Least concern	No concern at present
12.3.11	*Eucalyptus tereticornis* +/- *Eucalyptus siderophloia*, *Corymbia intermedia* open forest on alluvial plains	Of concern	Of concern
12.9-10.2	*Corymbia citriodora* subsp. *variegata* +/- *Eucalyptus crebra* open forest on sedimentary rocks	Least concern	No concern at present
12.9-10.4	*Eucalyptus racemosa* subsp. *racemosa* woodland on sedimentary rocks	Least concern	No concern at present
12.9-10.12	*Eucalyptus seeana*, *Corymbia intermedia*, *Angophora leiocarpa* woodland on sedimentary rocks	Endangered	Endangered
12.9-10.17	*Eucalyptus acmenoides*, *E. major*, *E. siderophloia* +/- *Corymbia citriodora* subsp. *variegata* woodland on sedimentary rocks	Least concern	No concern at present
12.9-10.19	*Eucalyptus fibrosa* subsp. *fibrosa* woodland on sedimentary rocks	Least concern	No concern at present
12.11.3	*Eucalyptus siderophloia*, *E. propinqua* +/- *E. microcorys*, *Lophostemon confertus*, *Corymbia intermedia*, *E. acmenoides* open forest on metamorphics +/- interbedded volcanics	Least concern	No concern at present

Source: QLD Government 2015a

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4 Rehabilitation performance indicators

In accordance with the *EPBC Act 1999* decision notice, the *Koala Habitat Rehabilitation Management Plan* (Natura Consulting 2015) was formulated reflecting the onsite rehabilitation requirements of Fauna and Green Space Corridors, Regional Ecosystems, drainage lines and post development fauna movement pathways within Offset Areas on the site. This plan identifies koala habitat rehabilitation benchmarks and determines restoration actions to meet these benchmarks.

Each rehabilitation unit is to be rehabilitated to a vegetation structure and species composition that is in line with that of the appropriate pre-clearing RE (identified in Table 5 and Table 6). The reference benchmark for rehabilitation of each rehabilitation unit is derived from the vegetation structure and species composition of the appropriate pre-clearing Regional Ecosystem (RE) (refer to Table 5 and Table 6). These benchmarks quantify average canopy cover, shrub cover, ground cover, species richness and average height of the canopy and have been sourced from the Queensland Herbarium (Queensland Government 2015b). These technical descriptions are a compilation of data from multiple sites for canopy cover, shrub cover, and average stem density for each strata, groundcover and average species richness (Queensland Government 2015b). Through establishing these benchmarks, a reasonable comparison can be made between the floristic composition and vegetation structure of a given rehabilitation unit and the appropriate pre-clearing RE.

4.1 Performance indicators

The Final Benchmark for rehabilitation is derived from the definition of remnant vegetation under the *Vegetation Management Act 1999.* Vegetation can be mapped as remnant vegetation and associated essential habitat for koalas if the canopy is 70% of the height, 50% of the cover and similar species composition of the appropriate pre-clearing RE (Queensland Government 2015b). Therefore, the Final Benchmark for rehabilitation is 70% of the reference benchmark cover (for canopy, shrub and ground-layer) and 50% of the reference benchmark height (for canopy and shrub layer) of the appropriate RE.

Six rehabilitation performance indicators were selected:

1. average canopy cover
2. average height of canopy
3. dominant canopy species
4. average shrub cover
5. average groundcover
6. species richness
7. weed cover

Weed cover needs to be considered for rehabilitation benchmarks for this site, particularly in the canopy where numerous exotic pine trees exist. Throughout the life of the development a weed cover of ≤5% is to be maintained.

The reference and Final Benchmark vegetation structure and species composition for each of the pre-clearing REs identified within the mapped rehabilitation units is identified in Table 5 and Table 6 respectively. Note that exotic species identified in Table 6 are to assist with identification purposes only and are to be controlled and managed, not planted or assisted.

Rehabilitation units are to be managed and restored until they reach the Final Benchmark condition as identified in Table 4 and Table 5, along with the objectives of the Habitat Rehabilitation and Management Plan. The objectives of this plan are long term and are likely to require more than 15 years to be achieved, within each rehabilitation unit, after implementation is commenced.

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Interim Benchmarks are also provided whereby an assessment at regular intervals can be made on the progress of the rehabilitation / revegetation efforts towards achieving this plan's outcomes. Given this, adaptive management approaches can also be employed to redirect restoration approaches, in the event that Interim Benchmarks are not being met. Table 5 provides a summary of the timeframe to achieve the Interim and Final Benchmarks.

For Interim Benchmark years 1 to 10, vegetation structure has been quantified from a cumulative growth curve (CGC), which for biological organisms, including trees and shrubs, is sigmoidal (Brack and Wood 1996). As the reference benchmarks applied for this report are at the Regional Ecosystem level, and site data and long term tree and shrub growth curves are not available for Yarrabilba, we have derived general growth curves for each Regional Ecosystem. This is based on a sigmoidal growth curve, the average reference benchmark height of the stratum, the minimum height at which regrowth vegetation is considered to be of equivalent height as the RE (50% of reference benchmark height), and the average height of tubestock (20 cm) that is predominately used for revegetation in southeast Queensland.

The Final Benchmark at year 15 is 70% of the reference benchmark cover (for canopy, shrub and ground-layer) and 50% of the reference benchmark height (for canopy and shrub layer) of the appropriate pre-clearing RE. See Appendix A for species composition of Final Benchmark Regional Ecosystems.

4.2 Contingency measures and corrective actions

4.2.1 Meeting benchmarks

During the course of monitoring, if Interim Benchmarks are not being met, the timeframes to achieve the Final Benchmarks will be reviewed and extended, whereby Lendlease will continue to undertake rehabilitation works with continued monitoring until the Final Benchmarks are met. The review of the success of meeting Interim Benchmarks will be undertaken at each monitoring event and reported on. Where the extension of rehabilitation works is required for particular Rehabilitation Units, discussions will be undertaken with the Department of Environment, to ensure that any additional requirements are also highlighted and addressed.

4.2.2 As constructed data

Constructed data and surveyed boundaries will be provided for each Rehabilitation Unit, within three months of completion of earthworks. This will be undertaken to test and demonstrate compliance within the offset area (195 ha) requirement.

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Table 4 Reference, Interim and Final Benchmark vegetation structure for each pre-clearing RE detailed for rehabilitation units (HRU) and crossing rehabilitation units (CRU)

Benchmark Condition (where rehabilitation units are treated individually, at least 70% of height and 50% of cover values to be attained within first 15 years of commencement of rehabilitation works)											
RE Code	**Name**	**VMA Status**	**Biodiversity**	**Habitat Rehabilitation Unit**				**Crossing Rehabilitation Unit**			
12.3.6	***Melaleuca quinquenervia* +/- *Eucalyptus tereticornis, Lophostemon suaveolens* open forest on coastal alluvial plains**	Least concern	No concern at present	HRU4, HRU6, HRU7, HRU8, HRU9, HRU11, HRU13, HRU14, HRU15, HRU18, HRU19, HRU22							
				Average Canopy Cover (%)	**Average Canopy Height (m)**	**Average T2-T3 Canopy Cover (%)**	**Average T2-T3 Canopy Height (m)**	**Average Shrub Cover (%)**	**Average Shrub Height (m)**	**Average Ground cover (%)**	**Species Richness (av. +/- SD)**
			Interim Benchmark by 1 year	10.0	1.5			1.5	0.5	6.0	
			Interim Benchmark by 2 years	14.0	3.0			2.0	0.8	10.0	
			Interim Benchmark by 3 years	16.0	4.0			2.5	1.2	15.0	
			Interim Benchmark by 5 years	22.0	6.0			3.0	1.4	20.0	
			Interim Benchmark by 10 years	28.0	9.2			4.0	1.5	25.0	
			Final Benchmark by 15 years	**30.5**	**10.7**			**4.5**	**1.6**	**29.2**	**-**
			Reference Benchmark (Pre-Clearing RE)	**60.9**	**15.3**			**8.9**	**2.3**	**58.4**	**33.3 +/- 10.5**
12.3.7	***Eucalyptus tereticornis*, *Casuarina cunninghamiana* subsp. *cunninghamiana* +/- *Melaleuca* spp. fringing woodland**	Least concern	No concern at present	HRU3, HRU4, HRU6, HRU7, HRU8, HRU9, HRU11, HRU13, HRU14, HRU15, HRU18, HRU19, HRU22							
				Average Canopy Cover (%)	**Average Canopy Height (m)**	**Average T2-T3 Canopy Cover (%)**	**Average T2-T3 Canopy Height (m)**	**Average Shrub Cover (%)**	**Average Shrub Height (m)**	**Average Ground cover (%)**	**Species Richness (av. +/- SD)**
			Interim Benchmark by 1 year	5.5	1.6	2.0	0.8	2.5	0.5	6.0	
			Interim Benchmark by 2 years	6.0	2.9	3.0	2.7	3.0	0.8	7.0	
			Interim Benchmark by 3 years	7.0	4.1	4.0	3.7	3.5	1.2	8.0	
			Interim Benchmark by 5 years	9.0	6.2	5.9	5.2	4.0	1.4	10.0	

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Benchmark Condition (where rehabilitation units are treated individually, at least 70% of height and 50% of cover values to be attained within first 15 years of commencement of rehabilitation works)												
RE Code	**Name**	**VMA Status**	**Biodiversity**	**Habitat Rehabilitation Unit**				**Crossing Rehabilitation Unit**				
		Interim Benchmark by 10 years		12.0	10.1	9.3	7.3	6.0	1.5	12.0		
		Final Benchmark by 15 years		**13.3**	**13.6**	**11.5**	**8.2**	**6.6**	**1.6**	**14.4**	**-**	
		Reference Benchmark (Pre-Clearing RE)		**26.6**	**19.4**	**15.3**	**9.0**	**13.2**	**2.3**	**28.7**	**52.8 +/- 7.5**	
12.3.11	***Eucalyptus tereticornis* +/- *Eucalyptus siderophloia*, *Corymbia intermedia* open-forest on alluvial plains**	Of concern	Of concern	HRU3, HRU4, HRU6, HRU7, HRU8, HRU9, HRU11, HRU13, HRU14, HRU15, HRU16, HRU18, HRU19								
				Average Canopy Cover (%)	**Average Canopy Height (m)**	**Average T2-T3 Canopy Cover (%)**	**Average T2-T3 Canopy Height (m)**	**Average Shrub Cover (%)**	**Average Shrub Height (m)**	**Average Ground cover (%)**	**Species Richness (av. +/- SD)**	
		Interim Benchmark by 1 year		7.0	1.6	2.0	0.8	2.0	0.4	1.5		
		Interim Benchmark by 2 years		10.0	3.0	3.0	2.8	4.0	0.7	2.0		
		Interim Benchmark by 3 years		12.0	4.2	4.2	3.8	5.0	1.1	3.0		
		Interim Benchmark by 5 years		18.0	6.4	6.4	5.5	7.0	1.3	4.5		
		Interim Benchmark by 10 years		22.0	10.7	10.7	8.2	9.0	1.5	7.0		
		Final Benchmark by 15 years		**25.6**	**16.7**	**13.9**	**9.6**	**10.9**	**1.9**	**8.5**	**-**	
		Reference Benchmark (Pre-Clearing RE)		**51.1**	**23.8**	**23.9**	**11.3**	**21.7**	**2.7**	**17**	**40.6 +/- 8.5**	
12.9-10.2	***Corymbia citriodora* subsp. *variegata* +/- *Eucalyptus crebra* open forest on sedimentary rocks**	Least concern	No concern at present	HRU2, HRU5, HRU10, HRU12, HRU17, HRU20, HRU21, HRU23, HRU27, HRU28, HRU29, HRU30, HRU31				CRU5, CRU6, CRU9				
				Average Canopy Cover (%)	**Average Canopy Height (m)**	**Average T2-T3 Canopy Cover (%)**	**Average T2-T3 Canopy Height (m)**	**Average Shrub Cover (%)**	**Average Shrub Height (m)**	**Average Ground cover (%)**	**Species Richness (av. +/- SD)**	
		Interim Benchmark by 1 year		6.0	1.6	2.0	0.8	6.0	0.4	6.0	3.0	
		Interim Benchmark by 2 years		10.0	2.9	2.9	2.8	6.5	0.7	7.0	4.0	
		Interim Benchmark by 3 years		12.0	4.2	4.0	3.8	7.0	1.1	12.0	5.0	
		Interim Benchmark by 5 years		18.0	6.3	6.0	5.3	8.5	1.3	18.0	7.0	

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Benchmark Condition (where rehabilitation units are treated individually, at least 70% of height and 50% of cover values to be attained within first 15 years of commencement of rehabilitation works)											
RE Code	**Name**	**VMA Status**	**Biodiversity**	**Habitat Rehabilitation Unit**				**Crossing Rehabilitation Unit**			
		Interim Benchmark by 10 years		22.0	10.5	9.6	7.7	11.4	1.5	22.0	9.0
		Final Benchmark by 15 years		**26.8**	**15.5**	**11.9**	**8.9**	**15.1**	**1.8**	**23.6**	**10.8**
		Reference Benchmark (Pre-Clearing RE)		**53.5**	**22.2**	**16.5**	**10.1**	**21.6**	**2.5**	**47.2**	**21.6**
12.9-10.17	***Eucalyptus acmenoides, Eucalyptus major, Eucalyptus siderophloia +/- Corymbia citriodora subsp. variegata* woodland on sedimentary rocks**	Least concern	No concern at present	HRU5, HRU10, HRU17, HRU20, HRU21, HRU23, HRU24, HRU25, HRU26, HRU27, HRU28, HRU29, HRU30, HRU31				CRU5, CRU6, CRU7, CRU9			
				Average Canopy Cover (%)	**Average Canopy Height (m)**	**Average T2-T3 Canopy Cover (%)**	**Average T2-T3 Canopy Height (m)**	**Average Shrub Cover (%)**	**Average Shrub Height (m)**	**Average Ground cover (%)**	**Species Richness (av. +/- SD)**
		Interim Benchmark by 1 year		6.0	1.6	2.0	0.8	6.0	0.6	10.0	
		Interim Benchmark by 2 years		10.0	3.0	3.0	2.8	7.0	1.0	20.0	
		Interim Benchmark by 3 years		12.0	4.2	4.3	3.9	10.0	1.5	25.0	
		Interim Benchmark by 5 years		18.0	6.4	6.5	5.7	14.0	1.8	30.0	
		Interim Benchmark by 10 years		22.0	10.9	11.3	8.9	16.0	2.2	35.0	
		Final Benchmark by 15 years		**27.2**	**18.2**	**15.0**	**10.4**	**20.0**	**2.8**	**43.9**	-
		Reference Benchmark (Pre-Clearing RE)		**54.3**	**26.0**	**30.5**	**12.9**	**40.0**	**4.0**	**87.8**	**36.5 +/- 15.1**
12.9-10.19	***Eucalyptus fibrosa subsp. fibrosa* woodland on sedimentary rocks**	Least concern	No concern at present	HRU24, HRU25, HRU26							
				Average Canopy Cover (%)	**Average Canopy Height (m)**	**Average T2-T3 Canopy Cover (%)**	**Average T2-T3 Canopy Height (m)**	**Average Shrub Cover (%)**	**Average Shrub Height (m)**	**Average Ground cover (%)**	**Species Richness (av. +/- SD)**
		Interim Benchmark by 1 year		6.0	1.6	2.0	0.8	2.5	0.4	2.5	
		Interim Benchmark by 2 years		7.0	3.0	2.9	2.7	4.0	0.7	3.0	
		Interim Benchmark by 3 years		9.0	4.2	4.0	3.7	5.0	1.1	4.0	

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Benchmark Condition (where rehabilitation units are treated individually, at least 70% of height and 50% of cover values to be attained within first 15 years of commencement of rehabilitation works)											
RE Code	**Name**	**VMA Status**	**Biodiversity**	**Habitat Rehabilitation Unit**				**Crossing Rehabilitation Unit**			
		Interim Benchmark by 5 years		12.0	6.3	6.0	5.2	7.0	1.3	6.0	
		Interim Benchmark by 10 years		15.0	10.5	9.6	7.3	9.0	1.5	8.0	
		Final Benchmark by 15 years		**20.9**	**15.8**	**11.9**	**8.2**	**9.6**	**1.7**	**8.2**	-
		Reference Benchmark (Pre-Clearing RE)		**41.8**	**22.5**	**16.4**	**9.0**	**19.1**	**2.4**	**16.4**	**30.1 +/- 4.6**
12.9-10.4	***Eucalyptus racemosa* subsp. *racemosa* woodland on sedimentary rocks**	Least concern	No concern at present	HRU1, HRU3							
				Average Canopy Cover (%)	**Average Canopy Height (m)**	**Average T2-T3 Canopy Cover (%)**	**Average T2-T3 Canopy Height (m)**	**Average Shrub Cover (%)**	**Average Shrub Height (m)**	**Average Ground cover (%)**	**Species Richness (av. +/- SD)**
		Interim Benchmark by 1 year		6.0	1.6	2.0	0.8	2.5	0.6	6.0	
		Interim Benchmark by 2 years		7.0	3.0	2.5	2.7	4.0	0.9	10.0	
		Interim Benchmark by 3 years		9.0	4.2	3.8	3.7	5.0	1.5	15.0	
		Interim Benchmark by 5 years		12.0	6.3	5.3	5.2	7.0	1.8	20.0	
		Interim Benchmark by 10 years		15.0	10.5	7.4	7.3	9.0	2.1	25.0	
		Final Benchmark by 15 years		**20.9**	**15.8**	**10.4**	**8.2**	**9.6**	**2.6**	**29.2**	-
		Reference Benchmark (Pre-Clearing RE)		**38**	**23.2**	**11.8**	**8.9**	**15.7**	**4.1**	**59.9**	**35.4 +/- 5.2**

Adapted from Queensland Government (2015).* No pre-defined benchmarks for this RE are provided within the RE technical descriptions (Queensland Government 2015a) and therefore, these numbers have been based on data collected in the field from previous assessments and reference sites within this RE type.

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5 Monitoring methodology

The following monitoring program was implemented to capture baseline data prior to rehabilitation treatments being applied. Adaptive management strategies will be used where a rehabilitation treatment does not produce the desired result. When this occurs, the treatment will be identified and/or modified.

For this monitoring program, a minimum of two monitoring sites per rehabilitation unit is sufficient to identify any major changes and to provide a 'snap shot' of ecological conditions. Monitoring in this way will allow the ongoing collection of information to demonstrate the effectiveness of habitat rehabilitation efforts, and the frequency of monitoring activities will enable management prescriptions to be adjusted to bring about any necessary changes and corrective actions (adaptive management).

5.1 Sites

Vegetation monitoring for the 2nd monitoring period occurred in a network of 59 sample sites with:

- 2 sample sites Crossing Rehabilitation Units and within Rehabilitation Units <50,000 m^2
- 3 sample sites within Rehabilitation Units >50,000 m^2 but <150,000 m^2
- 4 sample sites within Rehabilitation Units >200,000 m^2

The final location of each monitoring site within its representative rehabilitation unit was identified by GPS coordinates and direction (compass bearing). Monitoring site locations are identified in Figure 3.

Site locations have been permanently marked by two steel pickets with yellow safety caps, placed approximately 100 m apart. Metal tags were attached to each picket, identifying site number and picket number (i.e. 0 m and 100 m). Where there was insufficient space to locate the 100 m transect due to proximity of the site to the edge of the Offset Area, the site was 50 m long.

Five sites were not sampled during the 2nd monitoring period. These were site 71 (was completely flooded during the sampling period and posed a health and safety risk for access), site 76 (a road corridor has been constructed through this sample site), site 106 (replaced by site 109 which is a Koala Offset Area sampling site that occupies the same area, i.e. < 100 m separation), site 125 (this was mistakenly sampled before, when it is in fact a Koala Offset Area sampling site) and site 146 (a fence-line has been established through the centre of this sample site).

The following methodology will be applied to monitoring at each of the sampled sites.

5.2 Photo point monitoring

For each site, a permanently marked photo point has been established at the first marker picket with a photograph taken towards a second marker picket at 10 m along the relevant compass bearing. A metal tag was attached to the picket, identifying site number and picket number (i.e. 10 m). All photos were taken such that the 0 m picket was located in the bottom left hand corner of the photo.

The photos were saved with the following information recorded for each file:

- site number
- survey (i.e. baseline)
- date

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Figure 3 Koala Habitat Rehabilitation Units monitoring locations

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5.3 Transect and quadrat monitoring

Quantitative site data, including the attributes of species richness, percentage foliage cover for the ground layer, shrub and canopy layers, canopy height, and weed cover are to be collected from field transects and quadrats established at each of the monitoring sites:

- A 100 or 50 m transect was placed between the first and third metal pickets (0 m and 100 m).

- Quadrats were placed along the transect:
  - 50 x 10 m plot positioned at the transect start at 0 m on the left hand side of the transect.
  - 1 x 1 m subplots positioned at 0 m, 10 m, 20 m, 30 m and 40 m. Adjustments were made for each subplot if its positioning was placed over a trunk, fallen tree or roots. Where this occurred, the location of the quadrat along transects was identified such that the quadrat is consistently placed at this location during future monitoring.

Given the above, each monitoring site had the same information collected (detailed in Table 5). This benchmark monitoring process will be undertaken at 10 succeeding intervals from baseline roughly 6 months apart until the 3rd year, upon which monitoring becomes annual.

Table 5 Data collected at monitoring sites

Method of collection	Data collected
50 m x 10 m quadrat (plot)	Species richness, tubestock survival, height of each canopy species
100 m transect	Canopy species cover and height, shrub cover
Five 1 x 1 m quadrats (subplot)	Percentage cover in ground layer (including regenerating native canopy cohorts)

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6 Results

6.1 Photo-point monitoring

Photo monitoring results are reported in the following table (Table 6), showing the variety of vegetation types and their condition. The vegetation varies from exotic grass pasture with sparse regenerating shrubs and trees to eucalypt forest with intact structure and species composition. Note that a number of sites show evidence of dense *Lantana camara* infestations. These sites are typically at an advanced state of natural regeneration with common canopy tree sized eucalypts and abundant acacias.

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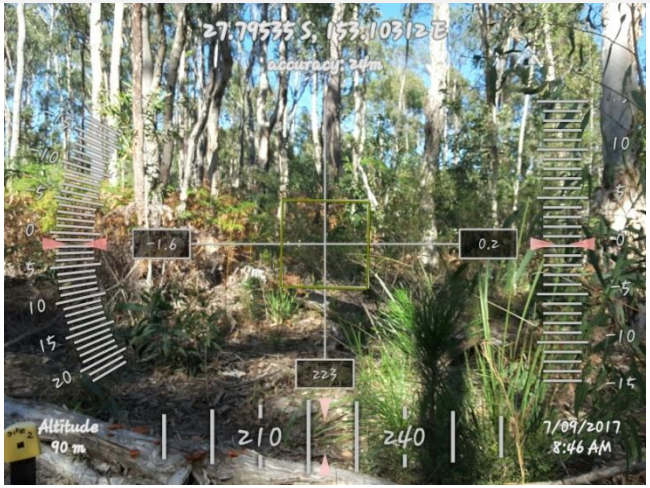
Table 6 Photo monitoring images

Site 1 (08/09/2017)

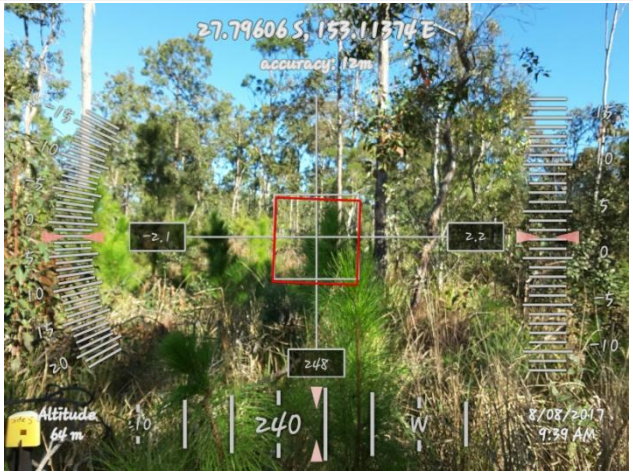
Site 2 (07/09/2017)



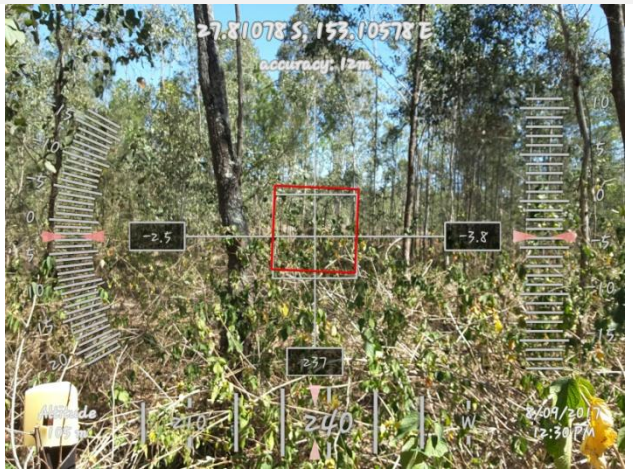
Site 3 (08/09/2017)

Site 4 (08/09/2017)

Site 5 (08/08/2017)



Site 6 (08/09/2017)



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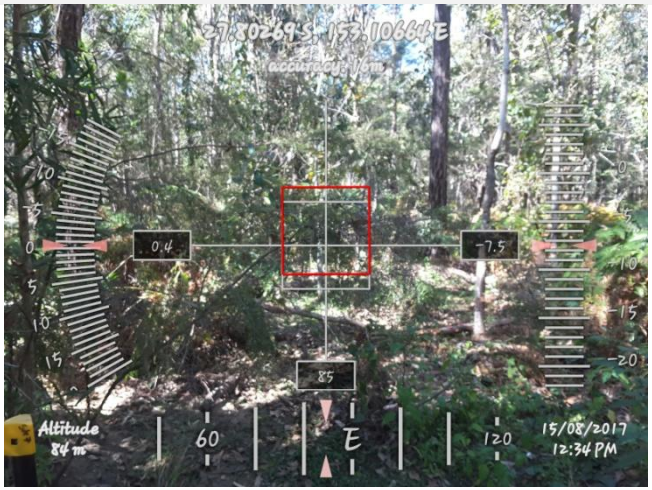
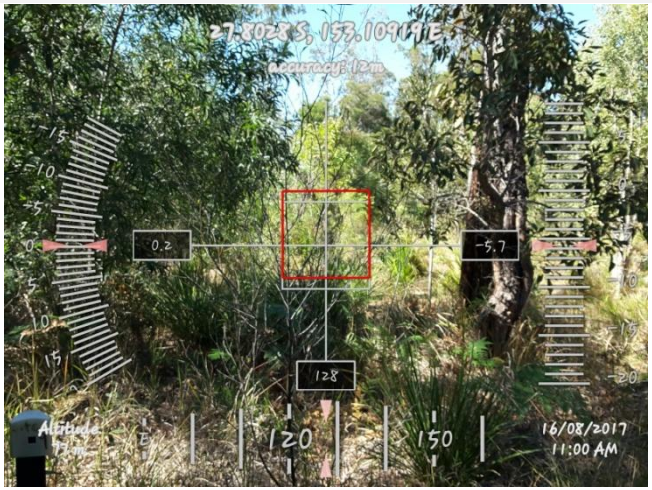
Site 7 (15/08/2017)

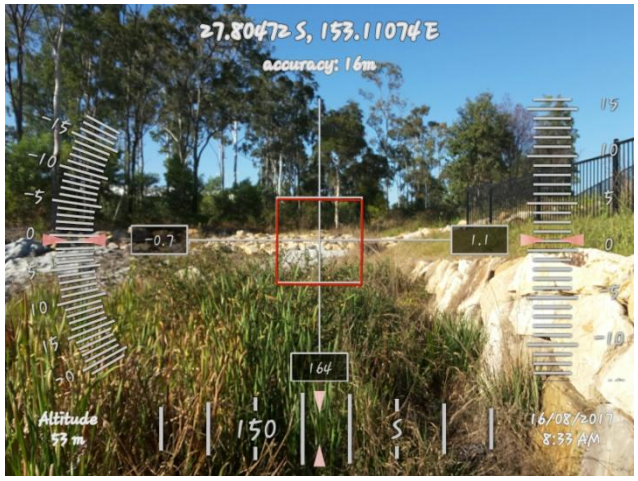


Site 8 (31/10/2017)

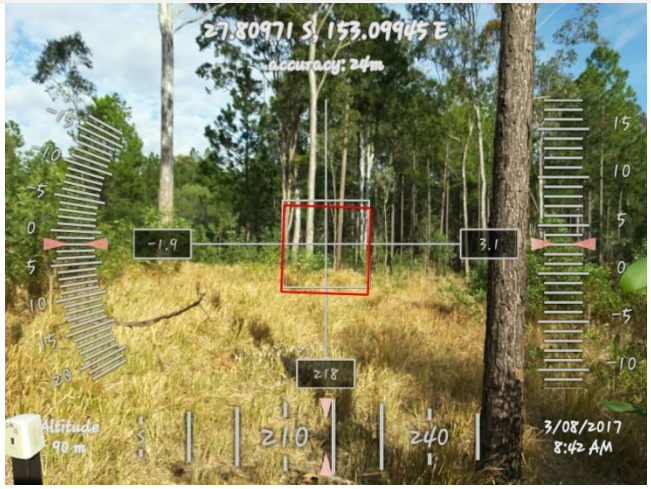
Site 9 (16/08/2017)



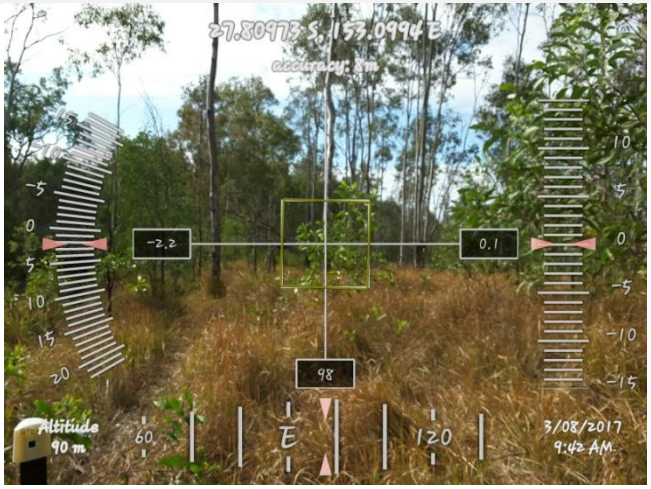
Site 11 (16/08/2017)



Site 12 (03/08/2017)



Site 13 (13/08/2017)



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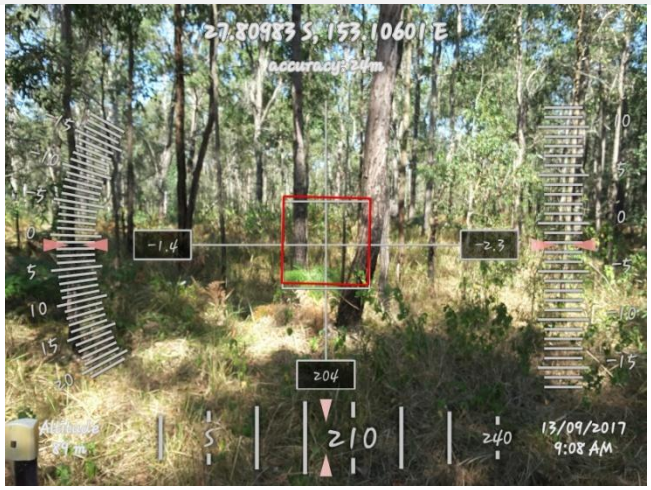
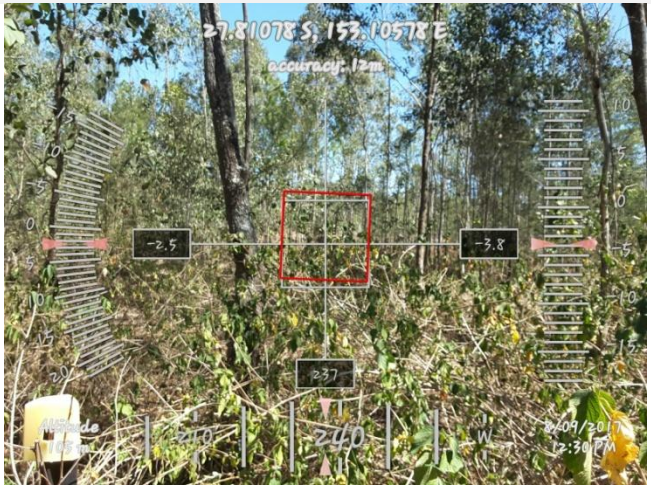
Site 14 (03/08/2017)

Site 15 (13/09/2017)

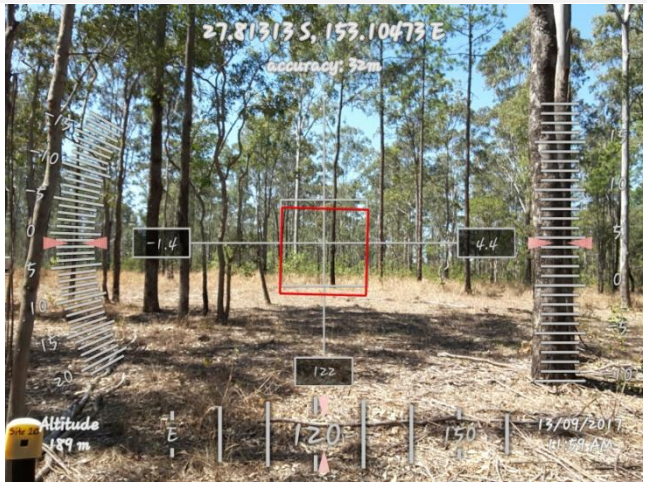


Site 16 (13/09/2017)

Site 17 (08/09/2017)



Site 20 (13/09/2017)



Site 21 (13/09/2017)

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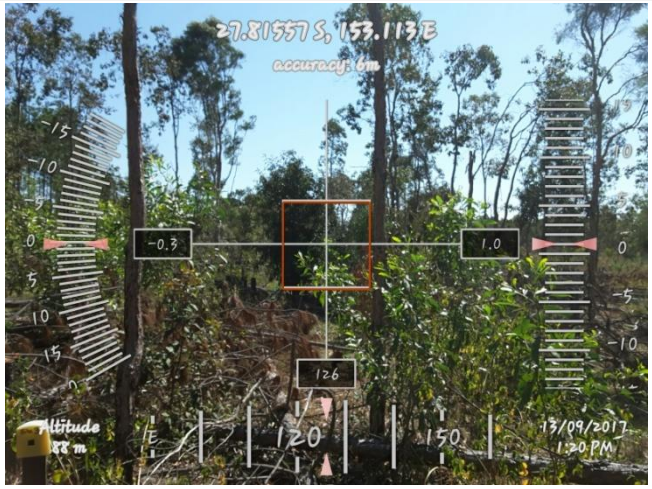
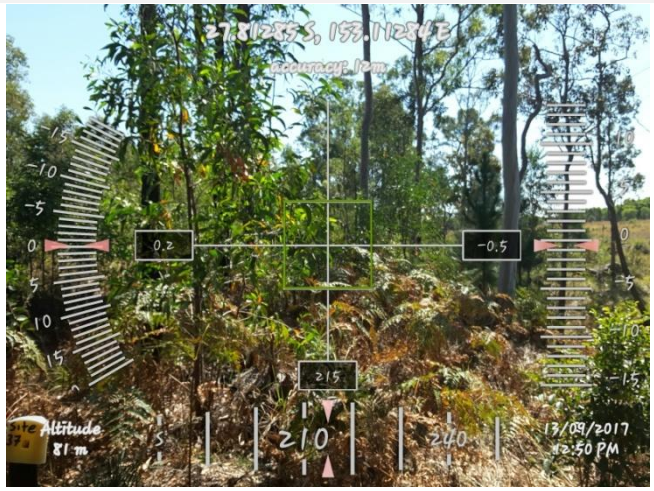
Site 35 (13/09/2017)

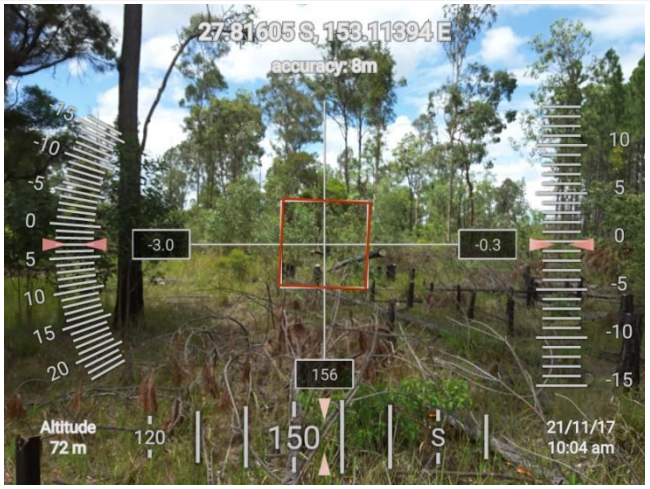


Site 36 (13/09/2017)

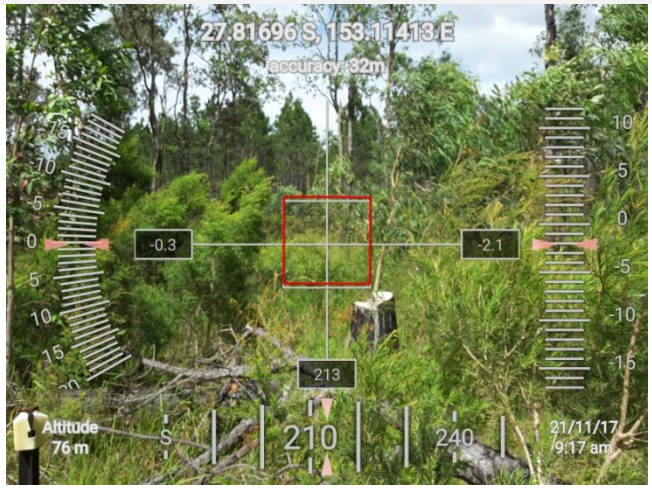
Site 37 (13/09/2017)



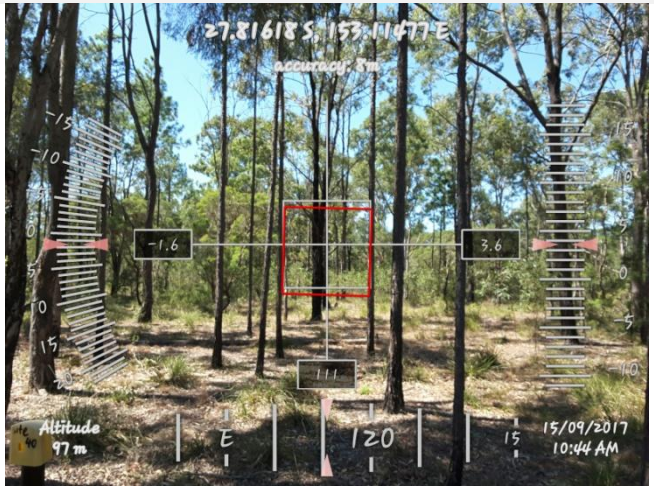
Site 38 (21/11/2017)



Site 39 (21/11/2017)



Site 40 (15/09/2017)



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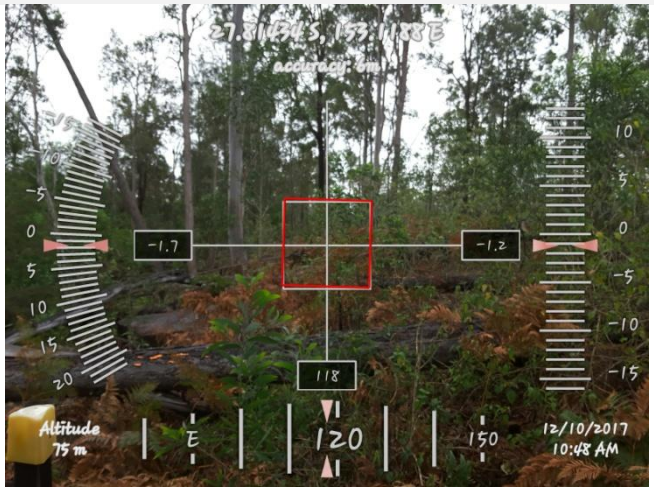
Site 41 (15/09/2017)

Site 42 (12/10/2017)

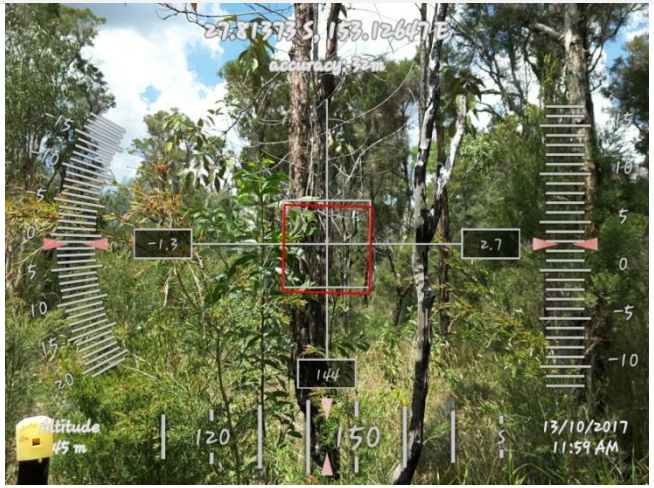
Site 43 (12/10/2017)



Site 50 (SITE REMOVED)

Site 52 (NO PHOTO)

Site 70 (13/10/2017)



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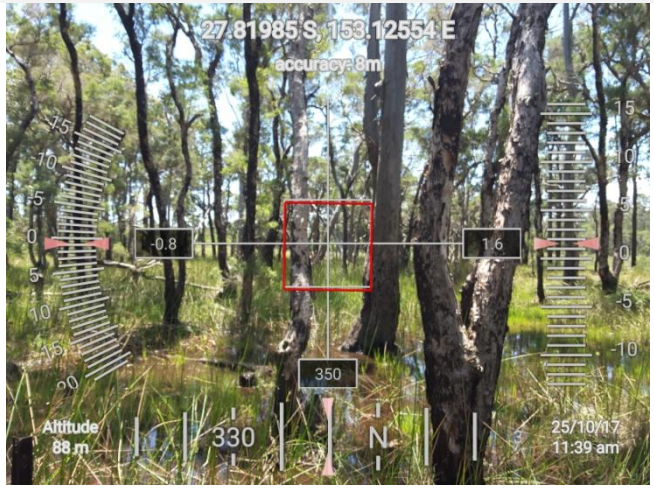
Site 71 (NOT SAMPLED)

Site 72 (11/10/2017)

Site 73 (11/10/2017)

Site 77 (25/10/2017)

Site 78 (25/10/2017)



Site 81 (29/09/2017)

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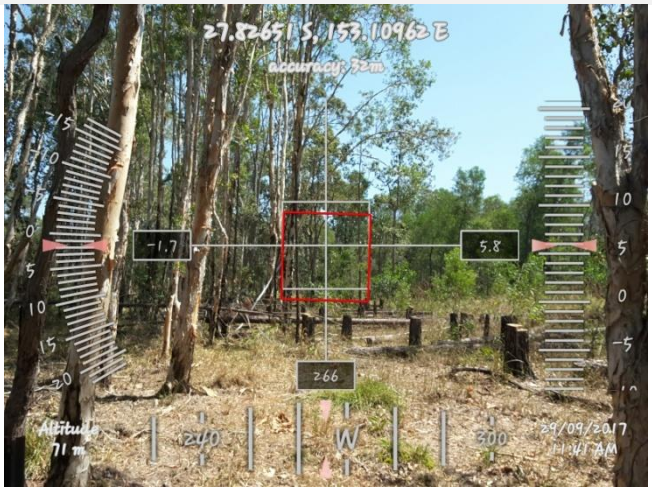
Site 83 (29/09/2017)

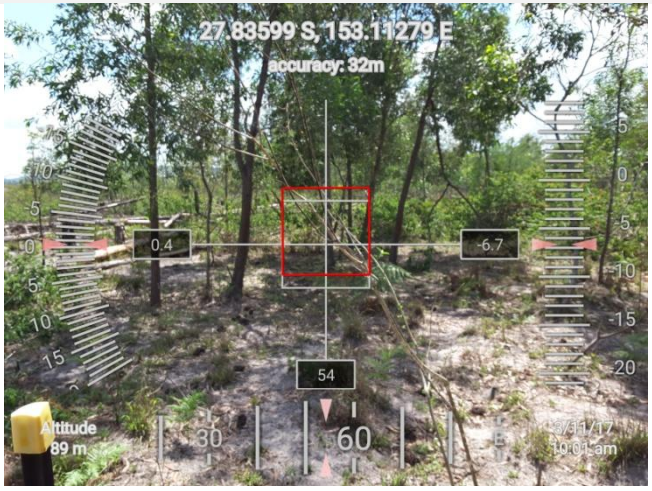


Site 84 (29/09/2017)

Site 85 (29/09/2017)

Site 87 (04/10/2017)

Site 89 (03/11/2017)



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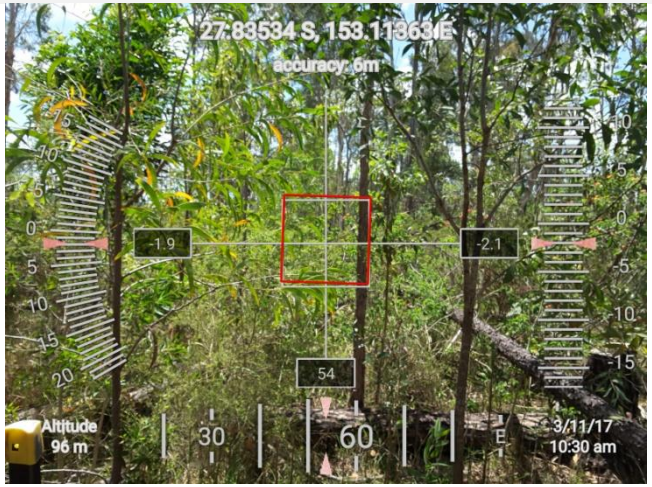

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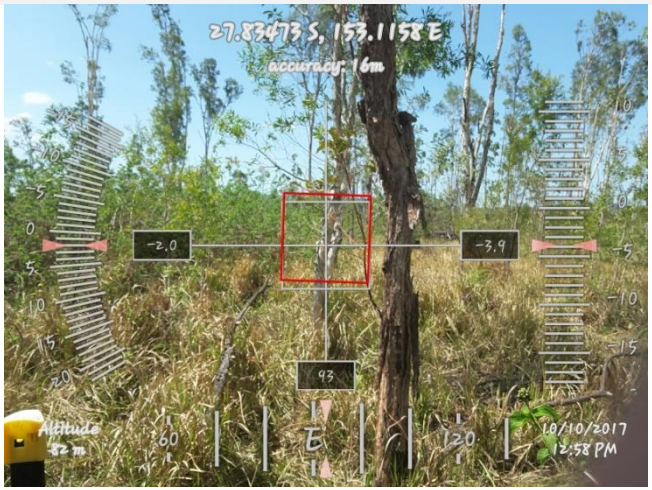
Site 92 (10/10/2017)

Site 93 (10/10/2017)



Site 94 (03/11/2017)

Site 95 (28/09/2017)

Site 96 (28/09/2017)

Site 105 (28/09/2017)

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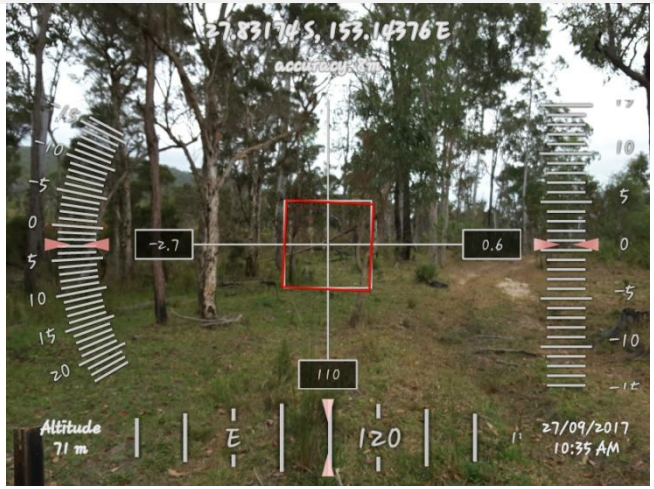
Site 106 (NOT SAMPLED)

Site 116 (NO PHOTO)

Site 117 (22/09/2017)

Site 118 (31/10/2017)

Site 120 (27/09/2017)



Site 121 (25/10/2017)

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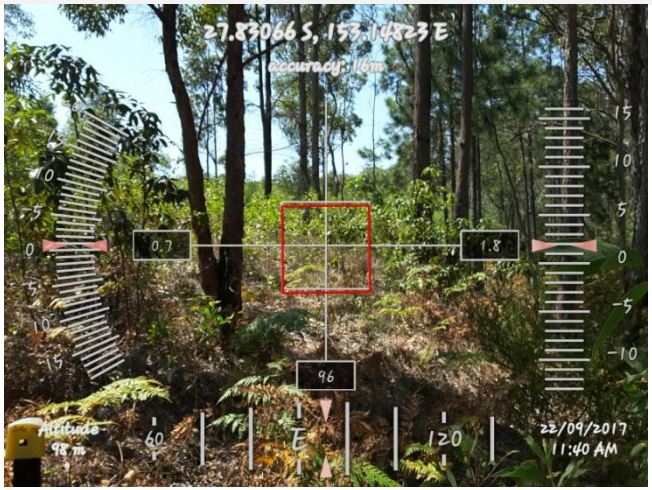
Site 122 (22/09/2017)



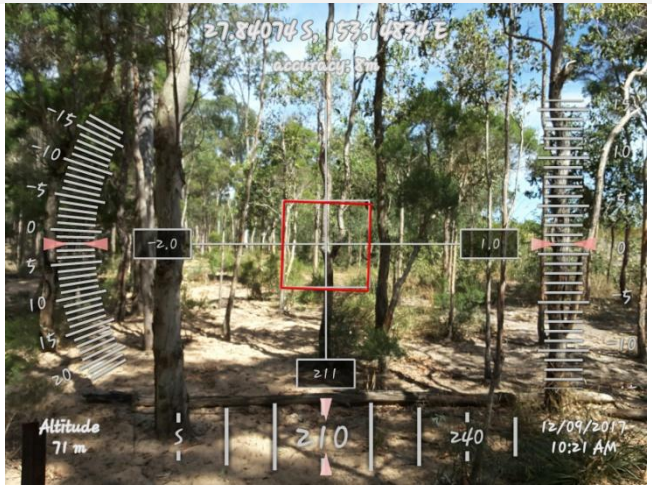
Site 125 (NOT SAMPLED)

Site 126 (17/08/2017)

Site 139 (12/09/2017)

Site 140 (21/11/2017)

Site 141 (12/09/2017)



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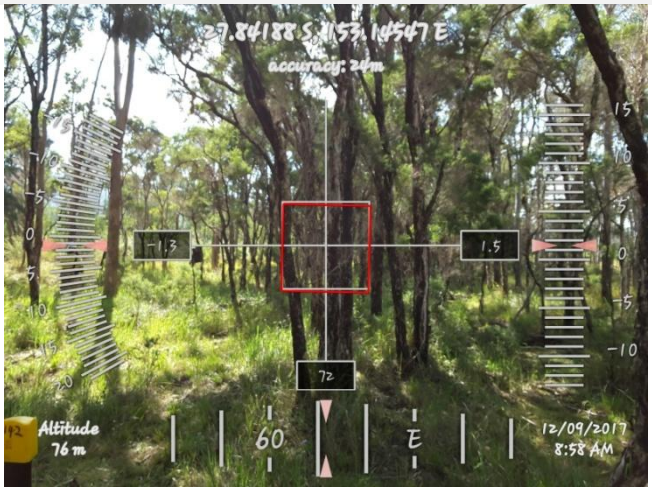
Site 142 (12/09/2017)



Site 146 (NOT SAMPLED)

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6.2 Transect and quadrat monitoring

6.2.1 Species richness

At baseline in May 2016, a total of 339 species were recorded within the 62 monitoring sites in the koala habitat areas (Habitat Area). During the 1st monitoring period a total of 313 species were recorded within the 64 monitoring sites. During this 2nd monitoring period a total of 334 species were recorded within the 59 monitoring sites (an increase since 1st monitoring period of 21 species).

Species richness within sites ranged from 20 to 61 species, with an average of 34.6 species per site (4.3 species less than 1st monitoring period). As in the 1st monitoring period, the largest number of species was observed in sites adjacent to Yarrabilba Drive within greenspace areas that have been retained (sites 8, 11 and 38), as well as in sites to the south of Wal's Block (similar to baseline results and 1st monitoring period) (sites 85 and 120).

The lowest number of species was observed in sites 16 and 17 (20 species) located in Precinct 4 next to the Energex easement, and site 80 located in Precinct 5 near the "Five Way" intersection.

Canopy tree species (T1 stratum) common across the Habitat Area include *Eucalyptus tereticornis, Pinus elliottii* (exotic weed), *E. siderophloia* and *Corymbia intermedia* (from highest to lower abundance). Canopy tree species that were rare across the Habitat Area include *Corymbia tesselaris* (1 site)*, C. henryi* (1 site), *Eucalyptus acmenoides* (1 site), *Allocasuarina torrulosa* (1 site) and *A. cunninghamiana* (1 site).

Small tree species (T2-T3) common across the Habitat Area include *Lophostemon suaveolens, Eucalyptus tereticornis, Melaleuca linariifolia, L. confertus, E. seeana and Alphitonia excelsa* (from highest to lower abundance). Small tree species that were rare across the Habitat Area include *Angophora subvelutina, Corymbia citriodora subsp. variegata, C. trachyphloia, Macaranga tanarius, Eucalyptus propinqua and Melaleuca salicina* (1 site each).

Shrub species (S1 stratum) that were commonly observed across the Habitat Area include *Lantana camara* (exotic weed), *Alphitonia excelsa* and *Acacia falcata* (from highest to lower abundance). Shrub species that were rare across the Habitat Area include *Trema tomentosa, Pultenaea flexilis, Persoonia cornfolia, Ochna serrulata* (exotic weed), *Melaleuca thymifolia, Leptospermum juniperinum, Jacksonia scoparia, Hovea acutifolia, Diospyros australis, Daviesia ulicifolia* and *Clerodendrum floribundum* (1 site each).

Of the species recorded, 60 are exotic (8 less species than 1st monitoring period and 2 less than baseline). Several of these were significant across the Offset Area, being present at a large number of sites. This includes *Pinus elliottii* (41 sites; down 9), *Lantana camara* (44 sites; same), *Andropogon virginicus* (42 sites, down 1), *Conyza bonariense* (35 sites), *Sida cordifolia* (24 sites), *Senecio madagascariensis* (19 sites; down 8) *Ageratum houstonianum* (33 sites; down 3) and *Ambrosia artemisifolia* (17 sites; down 5).

6.2.2 Tree canopy cover and height (T1)

Of the sites with canopy trees present (T1 stratum), tree canopy cover varied from 6% to 37% cover, with average canopy cover of 7.6% (up 1.1% from 1st monitoring period). Canopy species with high net cover in the T1 stratum were *Eucalyptus tindalieae, E. siderophloia, Corymbia trachyphloia* subsp. *trachyphloia, E. seeana, E. resinifera, E. moluccana* and *C. intermedia* (in order of highest to lower). Note that *Pinus elliottii* was not observed in the T1 stratum this monitoring period thanks to eradication efforts.

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Several of the sites did not have any canopy trees present, including sites 6 (HRU3), 7 (CRU13) 8 (CRU13), 9 (CRU13), 11 (CRU14), 13 (CRU12), 15 (HRU5) (canopy present in baseline), 20 (HRU6), 21 (HRU6) (canopy present in baseline), 35 (HRU9), 36 (HRU7) (canopy present in baseline), 40 (HRU11), 41 (HRU11) (canopy present in baseline), 42 (HRU8), 43 (HRU8), 52 (HRU13), 70 (HRU15), 72 (HRU15), 73 (HRU15), 77 (HRU16), 80 (HRU16), 81 (HRU16), 83 (HRU20), 84 (HRU19), 85 (CRU10), 87 (HRU18), 88 (HRU18), 89 (HRU23) (canopy present in baseline), 93 (HRU22) (canopy present in baseline), 94 (HRU22), 95 (HRU17), 116 (CRU5), 117 (HRU28) (canopy present in baseline), 118 (HRU28), 139 (CRU8), 140 (CRU8), 141 (CRU8) and 142 (HRU29). A total of 17 sites overall had lost T1 canopy cover since the 1st monitoring period and only 6 had improved since this time.

Canopy tree height varied from 6.6 m to 20 m, with the average tree height 15.9 m (down 0.6 m from 1st monitoring period). Canopy species with high average canopy height were *Eucalyptus tereticornis, E. siderophloia, E. seeana, Corymbia trachyphloia* subsp*. trachyphloia, C. intermedia* and *E. moluccana* (in order of highest to lowest average canopy height).

6.2.3 Small tree cover and height (T2-T3)

Of the sites with small trees present (T2 –T3 stratum), cover varied from 1% to 81%, with average cover 28.4% (up 18.7% from 1st monitoring period). Small tree species with high net cover in the T2-T3 strata were *Lophostemon suaveolens, Melaleuca linariifolia, Eucalyptus siderophloia, E. tereticornis* and *E. moluccana* (from highest to lower). Note that *Pinus elliottii* was absent from the surveys thanks to eradication programs. Small tree height varied from 6.6 m to 14.5 m high, with an average of 9.9 m (down 0.3 m from 1st monitoring period).

Only 2 sites did not have any small trees present; sites 16 (HRU5) and 121 (HRU30). However, both of these sites do have T1 canopy tree strata present. Overall T2-T3 small tree cover and height is doing well.

6.2.4 Shrub cover and height (S1)

Of the sites with shrubs present, shrub cover varied from 0.5% to 14% with an average cover 3.2% (up 1.1% from 1st monitoring period). Shrub height varied from 4 m to 5 m with an average height of 4.5 m (up 0.6 m from 1st monitoring period). Shrub species with high net cover in the shrub layer across sites were *Lophostemon suaveolens* regrowth, *Acacia disparrima, Melaleuca linariifolia, Leptopspermum polygalifolium* and *M. quinquenervia* (in order of highest to lower average cover).

Several of the sites did not have any shrubs present, including sites 1 (HRU1) (shrubs present in baseline), 3 (HRU1) (shrubs present in baseline), 5 (HRU3), 6 (HRU3) (shrubs present in baseline), 11 (CRU14) (shrubs present in baseline), 12 (CRU13), 13 (CRU13), 15 (HRU5), 21 (HRU6) (shrubs present in baseline), 35 (HRU9), 40 (HRU11), 41 (HRU11), 70 (HRU15), 73 (HRU15), 77 (HRU15), 78 (HRU16) (shrubs present in baseline), 81 (HRU20), 83 (HRU20) (shrubs present in baseline), 84 (HRU19) (shrubs present in baseline), 85 (CRU10) (shrubs present in baseline), 89 (HRU23) (shrubs present in baseline), 93 (HRU22) (shrubs present in baseline), 94 (HRU23), 105 (HRU22), 116 (HRU28) (shrubs present in baseline), 121 (HRU30) (shrubs present in baseline) and 140 (HRU29) (shrubs present in baseline). A total of 8 sites overall had lost shrub cover since the 1st monitoring period and 9 had improved since this time, while the remaining 42 sites remained the same (with many lacking shrub cover at all as in 1st monitoring period).

6.2.5 Ground cover (G1)

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All of the sites surveyed have a living ground layer, varying in average ground cover across the 5 quadrats per site from 1.6% (site 81 (HRU20)) to 65.6% (site 118 (HRU28)), with an average cover of 31.1% (down 3.9% from 1st monitoring period). Ground cover was dominated by graminoid species with high cover within sites of *Imperata cylindrica* (which had at least 3 times higher cover across sites than any other species), *Andropogon virginicus* (exotic weed grass), *Setaria sphacelata* (exotic weed grass), *Leersia hexandra, Lomandra longifolia, Cynodon dactylon,* regenerating *Lantana camara* (exotic shrub), *Entolasia stricta* and *Pteridium esculentum* (in order of highest to lower). Note that regenerating *Pinus elliottii* comprises a relatively large portion of vegetative cover across sites (roughly 1% of whole sampling area (295 m^2)). A focus should now be on targeting regenerating *P. elliottii* and *L. camara* within the ground-layer to reduce its vigour and chance of compromising the long-term regeneration of these habitat areas.

6.2.6 Weed incursion

There were a total of 60 species of weeds identified across the sites. Weeds were present at all sites. In sites where weeds were present, weed cover in the ground layer varied from 0.8% (sites 77 and 78 (HRU16)) to 42.8% (site 95 – HRU17) with average cover 12.5% (down 1.9% from 1st monitoring period). Weed species in the ground layer with high cover were predominantly graminoids including *Andropogon virginicus, Setaria sphacelata,* regenerating *Lantana camara, Conyza bonariense, Paspalum urvillei* and *Pinus elliottii* saplings (from highest to lower abundance).

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Table 7 2nd Monitoring period species richness, average canopy height within the canopy (T1), sub-canopy (T2-T3) and shub layer (S1) and total overlapping cover within the canopy (T1), sub-canopy (T2-T3), shub layer (S1) and ground layer (G1). Purple shading indicates non-visited sites

	Species Richness						Average Height (m)			Total Crown Cover (m)					Ground Cover (%)	
Site	Canopy (T1)	Sub - Canopy (T2 and T3)	Shrubs (S1)	Ground Layer (G1)	Total	Total weeds	Canopy (T1)	Sub - Canopy (T2 and T3)	Shrubs (S1)	Canopy (T1)	Sub - Canopy (T2 and T3)	Shrubs (S1)	Total Weed Crown Cover	Total Native Crown Cover	Native Shrub and Ground Layer (S1 -G1)	Total Weed Ground Cover
1	9	2	3	13	27	6	15.5	10.4	0	13	26	0	0	39	17.6	16.4
2	1	3	4	20	28	5	14.5	8.8	5	22	45	0.5	0	67.5	13.6	16.8
3	8	2	2	16	28	7	16	9.6	0	3	33	0	0	36	11.6	40.4
4	3	3	2	19	27	3	16	8.4	5	37	19	4	0	60	14	14.4
5	7	2	3	24	36	11	15.1	7	0	6	31	0	0	37	54.8	4.8
6	1	7	4	36	48	10	16	9	0	0	11	0	0	11	31.2	14.4
7	2	6	3	35	46	11	0	10.4	4.3	0	53.5	13	0	66.5	52	10.8
8	0	9	10	42	61	16	0	10.3	4.2	0	12	5	0	17	28.8	12.8
9	1	5	5	27	38	8	0	9.2	4.6	0	24	7	0	31	29.6	4.4
11	5	5	5	43	58	18	0	7.3	0	0	5	0	0	5	36	33.2
12	5	2	5	24	36	15	0	12.5	0	20	18	0	0	38	32.4	17.6
13	0	4	6	24	34	9	0	9.5	0	0	28	0	0	28	38.8	11.6
14	4	4	4	29	41	13	19	14.5	5	5	81	2	0	88	26.4	5.6
15	0	9	7	31	47	11	0	7.7	0	0	74	0	0	74	58.4	12.8
16	1	4	2	13	20	3	15.7	0	4.8	16	0	4	0	20	24.8	4
17	0	7	2	11	20	3	16	7.8	5	7	18	4	0	29	6.8	6
20	0	5	4	14	23	5	0	12.9	5	0	37	1	0	38	17.2	6
21	0	4	6	16	26	5	0	11.2	0	0	10	0	0	10	18.4	10
35	0	6	2	26	34	11	0	6.7	0	0	8	0	0	8	18	37.6
36	0	8	2	24	34	6	0	10.2	4	0	63	1	0	64	38.4	7.2
37	1	6	6	30	43	7	20	11.3	4.5	18	11	3	0	32	33.2	4.8
38	2	6	6	32	46	12	14.5	9.6	4	25	14	2	0	41	29.6	14.8
39	0	2	2	32	36	8	15	9.7	0	7	42	1	0	50	46	10
40	0	9	4	23	36	4	0	12.7	0	0	47	0	0	47	14.8	6.4
41	0	13	1	25	39	5	0	11.7	0	0	56	0	0	56	34	4.4
42	9	6	3	21	39	10	0	11.4	0	0	20	14	0	34	18	4
43	2	6	4	26	38	8	0	13	4	0	30	1	0	31	10.8	6
50								0								
52	0	5	8	24	37	4	0	9.7	4	0	20	2		22	36	3.6
53								0								
70	0	3	5	30	38	5	0	7.9	0	0	16	0	0	16	32.4	4.8
71																
72	0	8	1	26	35	5	0	9.1	4	0	47	2	0	49	15.2	2.4
73	0	9	1	34	44	7	0	10.5	0	0	65	0	0	65	20.4	14.8
76								0								
77	0	6	1	19	26	2	0	9.5	0	0	23	0	0	23	33.2	0.8
78	1	2	4	24	31	8	20	8.3	0	10	9	0	0	19	24.8	0.8
80	8	2	2	9	21	5	0	12.4	4	0	68	3	0	71	19.2	1.6

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	Species Richness						Average Height (m)			Total Crown Cover (m)					Ground Cover (%)	
Site	Canopy (T1)	Sub - Canopy (T2 and T3)	Shrubs (S1)	Ground Layer (G1)	Total	Total weeds	Canopy (T1)	Sub - Canopy (T2 and T3)	Shrubs (S1)	Canopy (T1)	Sub - Canopy (T2 and T3)	Shrubs (S1)	Total Weed Crown Cover	Total Native Crown Cover	Native Shrub and Ground Layer (S1 -G1)	Total Weed Ground Cover
81	0	4	8	21	33	9	0	9.5	0	0	37	0	0	37	1.6	10
83	0	5	3	23	31	10	0	12	0	0	57	0	0	57	18.4	12.8
84	0	4	4	22	30	6	0	14.2	0	0	27	0	0	27	63.2	4.8
85	0	8	8	30	46	9	0	14.5	0	0	38	0	0	38	29.4	2.8
87	0	4	2	26	32	10	0	10.6	5	0	36	1	0	37	51.6	18
88	0	4	4	34	42	10	0	10.1	4	0	28	2	0	30	39.6	16.4
89	0	5	0	18	23	5	0	9.3	0	0	13	0	0	13	14.8	36.4
90	1	4	2	27	34	6	15.2	7.6	4.7	15	13	3	0	31	56	8.8
92	2	5	0	22	29	6	14.3	9.6	5	6	23	1	0	30	26.8	29.2
93	0	4	0	22	26	6	0	7	0	0	5	0	0	5	44.8	9.6
94	1	2	3	22	28	4	0	11	0	0	7	0	0	7	40	18.4
95	0	4	6	21	31	7	0	9.2	4	0	13	1	0	14	22	42.8
96	7	4	3	16	30	5	15.3	8.6	5	24	23	1	0	48	32.4	10.4
105	2	5	9	14	30	3	14.9	9.9	0	33	22	0	0	55	13.6	0
106																
116	6	3	1	33	43	11	0	10.4	0	0	47.5	0	0	47.5	62	14.4
117	4	2	2	25	33	12	0	9.1	0	0	25	0	0	25	45.2	6
118	0	3	2	24	29	9	0	9.9	0	0	49	2	0	51	65.6	2.4
120	2	7	5	36	50	13	15.7	8.3	4.5	26	17	2.5	0	45.5	33.2	42
121	4	2	5	14	25	6	16.2	0	0	29	0	0	0	29	29.2	1.2
122	10	2	6	9	27	4	14.5	10	5	18	8	3	0	29	29.2	1.6
125																
126	6	0	11	18	35	2	15.7	11.2	4	29	11	1	0	41	23.6	0
139	0	4	0	25	29	9	0	0	5	0	1	5	0	6	44	18.8
140	0	9	4	26	39	10	0	8	0	0	4	0	0	4	28.8	30.8
141	1	4	3	15	23	8	0	6.6	4	0	23	7	0	30	18.4	3.6
142	0	2	1	40	43	11	0	7.8	5	0	30	1	0	31	62.4	6.4
146																
2nd Mon. Average	**2.0***	**4.7***	**3.7***	**24.2***	**34.6***	**7.7***	**15.9***	**9.9***	**4.5***	**17.6***	**28.4***	**3.2***	**0****	**35.4****	**31.1***	**12.5***
1st Mon. Average	**2.6***	**3.6***	**5.9***	**25.6***	**37.8***	**16.7***	**16.5***	**10.2***	**3.9***	**16.5***	**9.7***	**2.1***	**3.2****	**39.5****	**34***	**14.4***
Baseline Average	**1.8***	**2.3***	**5.1***	**20.5***	**29.6***	**6.5***	**17.2***	**10.2***	**2.8***	**22.5***	**10.1***	**3.1***	**8.0****	**42.4****	**41.1***	**10***

* Note total average values for 2nd Monitoring period (2nd Mon.), 1st Monitoring period (1st Mon.) and Baseline, are calculated across sites, only including sites where each respective strata was present and not including sites where they were absent (value = 0).
** Note total average values for 2nd Monitoring period (2nd Mon.), 1st Monitoring period (1st Mon.) and Baseline for Total Weed Crown Cover and Total Native Crown Cover are calculated across all sites, irrespective of presence/absence.

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7 Discussion

An assessment of site species richness and structure was undertaken to determine the 2nd monitoring period condition against the benchmark, 1st monitoring period and baseline values (Table 8).

A number of sites already meet the Final Benchmark for some individual parameters. Sites 1, 2, 4, 37 and 120 met consistently high benchmarks across the different community parameters, with the first 3 sites located in greenspace corridors and the latter in the fauna corridors, or adjacent to Wal's Block in the east of the site which is an area of conservation land. All of these top-scoring sites had improved since baseline surveys.

For species richness, as per the 1st monitoring period there has been a severe decline in total diversity with only 3 sites reaching final benchmark. Almost all other sites remain low in the total number of native species, while the number of exotic species in proportion remains relatively high at most sites. Indeed, 39 sites had higher than acceptable cover of exotic weeds in the ground and shrub layers (this figure has reduced from 80% in 1st monitoring period to 66% in current monitoring period, however). Rehabilitation efforts need to ensure that targeted weed control is now undertaken across all sites that fail to reach a benchmark for weed cover, in order to allow improvement of inter-site native species richness. Key attention should be paid to regenerating *Pinus elliottii* and *Lantana camara*. This may include a suite of species represented in the pre-clearing Regional Ecosystem species lists for each rehabilitation unit being planted where possible in an assisted regeneration effort.

A total of 19 (32%) sites meet a benchmark for canopy tree cover (down from 28 (44%) sites in 1st monitoring period), 21 (35%) sites meet a benchmark for canopy tree height (proportionally same as 21 (33%) sites in 1st monitoring period), 57 (97%) sites meet a benchmark for small tree cover (slightly down from 60 (98%) in 1st monitoring period), 57 (97%) sites meet a benchmark for small tree height (proportionally same as 60 (94%) sites in 1st monitoring period), 12 (20%) sites meet a benchmark for shrub cover (slightly down from 14 (22%) sites in 1st monitoring period), 29 (49%) sites meet a benchmark for shrub height (down from 42 (66%) sites in 1st monitoring period), 57 (97%) sites meet a benchmark for ground-cover (proportionally same as 62 (97%) sites in 1st monitoring period) and 20 (34%) sites meet a benchmark for weed cover of the ground-layer (up from 13 (20%) in 1st monitoring period).

In terms of general trends of net values across all sites since baseline surveys, canopy tree cover and height tend to be slightly decreasing, small tree height and cover tend to be around the same as baseline values, shrub cover is decreasing and shrub height remaining stable, total ground-cover is around the same, but of that, the proportion of weeds has increased per site since baseline, but since 1st monitoring period seems to be dropping slightly. Overall native species richness has declined.

Overall, this assessment reveals that rehabilitation needs to prioritise the ground-layer by targeting widespread weed removal across sites. Ground-layer weed control is required in order to bring weed cover to below 5% before IMO-3 year in August 2018. The remaining prevelance of weeds across sites has likely contributed to the decline in native species richness and shrub cover. This may be a result of the increasing isolation of the HRUs as clearing of the surrounding land-use matrix has intensified for pastoral and arable agriculture. Primary weed species needing to be targeted are *Pinus elliottii* regrowth (exotic pine tree), *Andropogon virginicus* (exotic weed grass), *Lantana camara* regrowth (exotic shrub), *Baccharis halimifolia* (exotic shrub), *Setaria sphacelata* (exotic weed grass), *Ageratum houstonianum* (exotic herb), *Cenchrus ciliaris* (exotic weed grass), *Ambrosia artemisifolia* (native shrub), *Conyza sumatrensis* (exotic herb) and *Megathyrsus maximus* (exotic weed grass).

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The felling removal of *Pinus elliottii* on a whole-of-site scale has been primarily successful in reducing the presence and cover of this species as an invasive in the canopy and sub-canopy strata. Average cover and the number of sites this species is present, have both reduced significantly. However, the increased light penetration resulting from this has likely caused the substantial invasion of key exotic weeds such as *Baccharis halimifolia*, *Lantana camara* and *Andropogon virginicus*. It is suggested that further felling of *P. elliottii* is done slowly and sequentially so that some form of canopy is retained at each period to reduce invasion of the ground-layer which in turn compromises native species richness and shrub parameter benchmarks. This will also help reduce the prevalence of regenerating *Pinus* seedlings.

A number of sites are lacking a canopy (T1) layer or have a very poor canopy layer at present and so fall far short of the canopy height and cover benchmarks, with a large number decreasing or remaining in poor condition since baseline surveys. These sites should be carefully monitored during succeeding monitoring periods to determine if canopy layers are 'recovering'.

Sites that only meet low benchmarks (IMO-1 or IMO-2) or no benchmarks at all, widely across canopy, shrub and ground-layers include sites 21 (HRU6), 35 (HRU9), 40 (HRU11), 72 (HRU15), 81 (HRU16), 83 (HRU20), 84 (HRU19), 89 (HRU23), 93 (HRU22), 94 (HRU22), 95 (HRU22) and 139 (CRU6). So in summary, the following rehabilitation units require the most urgent management attention: HRU6, HRU9, HRU15, HRU16, HRU19, HRU20, HRU22, HRU23 and CRU6.

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Table 8 2nd Monitoring period species species richness, canopy height within the canopy (T1), sub-canopy (T2-T3) and shub layer (S1) and cover within the canopy (T1), sub-canopy (T2-T3), shub layer (S1) and ground layer (G1)

Site	Rehabilitation Unit	Pre-Clearing Regional Ecosystem	Native Species Richness	Canopy Cover (T1)	Canopy Height (T1)	Small Tree Height (T2-T3)	Small Tree Cover (T2-T3)	Shrub Cover (S1)	Shrub Height (S1)	Native Ground Cover (G1)	Weed Cover (<5%)
1	HRU1	12.9-10.4/12.9-10.12	X (S)	IMO-5 (I)	IMO-10 (S)	FINAL (S)	FINAL (S)	X (S)	X (S)	IMO-3 (D)	N (S)
2	HRU1	12.9-10.4/12.9-10.12	X (S)	FMO-15 (I)	IMO-5 (I)	FINAL (S)	FINAL (S)	X (S)	FINAL (I)	IMO-2 (D)	N (S)
3	HRU3	12.9-10.4/12.9-10.12/12.9-10.2	X (S)	X (S)	IMO-10 (I)	FINAL (I)	FINAL (I)	X (S)	X (S)	IMO-2 (D)	N (S)
4	HRU1	12.9-10.4/12.9-10.12	X (S)	FMO-15 (S)	IMO-10 (S)	FMO-15 (S)	FINAL (S)	IMO-2 (I)	FINAL (I)	IMO-2 (D)	N (S)
5	HRU3	12.9-10.4/12.9-10.12/12.9-10.2	X (S)	IMO-1 (D)	IMO-10 (S)	IMO-5 (D)	FINAL (S)	X (D)	FINAL (I)	FMO-15 (S)	Y (I)
6	HRU3	12.3.11/12.3.7	X (S)	X (S)	IMO-10 (I)	IMO-10 (D)	IMO-10 (S)	X (S)	X (S)	FINAL (S)	N (S)
7	CRU13	12.3.11/12.3.7	X (S)	X (D)	X (D)	FMO-15 (I)	FINAL (S)	FMO-15 (I)	FINAL (S)	FINAL (S)	N (D)
8	CRU13	12.3.11/12.3.7	FINAL (I)	X (S)	X (S)	FMO-15 (I)	IMO-10 (D)	IMO-3 (I)	FINAL (S)	FINAL (S)	N (S)
9	CRU13	12.3.11/12.3.7	X (S)	X (S)	X (S)	IMO-10 (S)	FINAL (I)	IMO-5 (I)	FINAL (S)	FINAL (S)	Y (I)
11	CRU14	12.3.11/12.3.7	FINAL (I)	X (S)	X (S)	IMO-5 (S)	IMO-3 (D)	X (S)	X (S)	FINAL (S)	N (S)
12	CRU12	12.3.11/12.3.6/12.3.7	X (S)	IMO-5 (I)	X (D)	FINAL (S)	FMO-15 (D)	X (S)	X (D)	FINAL (S)	N (S)
13	CRU12	12.3.11/12.3.6/12.3.8	X (S)	X (S)	X (S)	IMO-10 (S)	FINAL (S)	X (S)	X (D)	FINAL (S)	N (S)
14	HRU4	12.3.11/12.3.6/12.3.7	X (S)	X (D)	FMO-15 (I)	FINAL (S)	FINAL (S)	IMO-1 (I)	FINAL (S)	FINAL (S)	N (S)
15	HRU4	12.3.11/12.3.6/12.3.7	X (S)	X (S)	X (S)	IMO-5 (D)	FINAL (S)	X (S)	X (D)	FINAL (S)	N (S)
16	HRU5	12.9-10.17/12.9-10.2	X (S)	IMO-3 (S)	IMO-10 (S)	X (D)	X (D)	X (S)	FINAL (S)	IMO-2 (D)	Y (I)
17	HRU5	12.9-10.17/12.9-10.2	X (S)	IMO-1 (D)	IMO-10 (S)	IMO-5 (D)	FMO-15 (S)	X (S)	FINAL (I)	X (D)	N (D)
20	HRU6	12.3.11/12.3.6/12.3.7	X (S)	X (S)	X (D)	FINAL (I)	FINAL (S)	X (S)	FINAL (I)	FINAL (S)	N (S)
21	HRU6	12.3.11/12.3.6/12.3.7	X (S)	X (S)	X (S)	FINAL (S)	IMO-5 (D)	X (S)	X (S)	FINAL (S)	N (S)
35	HRU9	12.3.11/12.3.6/12.3.7	X (S)	X (S)	X (S)	IMO-5 (D)	IMO-5 (D)	X (S)	X (S)	FINAL (I)	N (S)
36	HRU7	12.3.11/12.3.6/12.3.7	X (S)	X (S)	X (S)	FMO-15 (S)	FINAL (S)	X (D)	FINAL (I)	FINAL (S)	N (S)
37	HRU7	12.3.11/12.3.6/12.3.7	X (S)	IMO-5 (D)	FMO-15 (S)	FINAL (I)	IMO-10 (D)	IMO-1 (I)	FINAL (S)	FINAL (S)	Y (I)

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Site	Rehabilitation Unit	Pre-Clearing Regional Ecosystem	Native Species Richness	Canopy Cover (T1)	Canopy Height (T1)	Small Tree Height (T2-T3)	Small Tree Cover (T2-T3)	Shrub Cover (S1)	Shrub Height (S1)	Native Ground Cover (G1)	Weed Cover (<5%)
38	HRU10	12.9-10.17/12.9-10.2	X (S)	IMO-10 (D)	IMO-10 (S)	IMO-10 (S)	IMO-10 (D)	X (S)	FINAL (I)	IMO-3 (D)	N (S)
39	HRU10	12.9-10.17/12.9-10.2	X (S)	IMO-1 (D)	IMO-10 (D)	IMO-10 (I)	FINAL (S)	X (S)	X (D)	FMO-15 (S)	N (S)
40	HRU11	12.3.11/12.3.6/12.3.7	X (S)	X (S)	X (S)	FINAL (S)	FINAL (S)	X (S)	X (D)	FMO-15 (D)	N (S)
41	HRU11	12.3.11/12.3.6/12.3.7	X (D)	X (S)	X (S)	FINAL (S)	FINAL (S)	X (D)	X (D)	FINAL (S)	Y (S)
42	HRU8	12.3.11/12.3.6/12.3.7	X (S)	X (D)	X (D)	FINAL (I)	FMO-15 (D)	FMO-15 (I)	X (D)	FINAL (S)	Y (I)
43	HRU8	12.3.11/12.3.6/12.3.7	X (S)	X (D)	X (D)	FINAL (S)	FINAL (S)	X (D)	FINAL (S)	FMO-15 (D)	N (S)
50	HRU12	12.9-10.4/12.9-10.12/12.9-10.2									
52	HRU13	12.3.11/12.3.6/12.3.7	X (S)	X (S)	X (S)	FMO-15 (S)	FMO-15 (S)	IMO-1 (S)	FINAL (S)	FINAL (S)	Y (I)
53	HRU13	12.3.11/12.3.6/12.3.7									
70	HRU15	12.3.11/12.3.6/12.3.7	X (S)	X (S)	X (S)	IMO-5 (D)	FMO-15 (S)	X (D)	X (S)	FINAL (S)	Y (S)
71	HRU15	12.3.11/12.3.6/12.3.7									
72	HRU15	12.3.11/12.3.6/12.3.7	X (S)	X (S)	X (S)	IMO-10 (D)	FINAL (S)	IMO-1 (I)	FINAL (S)	FMO-15 (D)	Y (I)
73	HRU15	12.3.11/12.3.6/12.3.7	X (S)	X (S)	X (S)	FMO-15 (S)	FINAL (S)	X (D)	X (D)	FINAL (S)	N (S)
76	CRU1	12.3.11/12.3.6/12.3.7									
77	HRU16	12.3.11	X (S)	X (D)	X (D)	FMO-15 (D)	FMO-15 (D)	X (S)	X (D)	FINAL (S)	Y (S)
78	HRU16	12.3.11	X (S)	IMO-2 (I)	FMO-15 (I)	IMO-10 (S)	IMO-5 (D)	X (S)	X (S)	FINAL (S)	Y (I)
80	CRU4	12.3.11	X (S)	X (S)	X (D)	FINAL (S)	FINAL (S)	IMO-1 (S)	FINAL (S)	FINAL (S)	Y (I)
81	HRU20	12.9-10.17/12.9-10.2	X (S)	X (D)	X (D)	IMO-10 (I)	FINAL (S)	X (S)	X (D)	X (S)	N (S)
83	HRU20	12.3.11/12.3.6/12.3.7	X (S)	X (S)	X (S)	FINAL (S)	FINAL (S)	X (S)	X (S)	FINAL (S)	N (S)
84	HRU19	12.3.11/12.3.6/12.3.7	X (S)	X (S)	X (S)	FINAL (S)	FINAL (S)	X (S)	X (S)	FINAL (S)	Y (I)
85	CRU10	12.3.11/12.3.6/12.3.7	X (S)	X (S)	X (D)	FINAL (S)	FINAL (S)	X (S)	X (S)	FINAL (S)	Y (I)
87	HRU18	12.3.11/12.3.6/12.3.7	X (S)	X (S)	X (S)	FINAL (S)	FINAL (S)	X (S)	FINAL (I)	FINAL (S)	N (S)
88	HRU18	12.3.11/12.3.6/12.3.7	X (S)	X (S)	X (S)	FINAL (S)	FINAL (S)	IMO-1 (S)	FINAL (S)	FINAL (S)	N (S)
89	HRU23	12.9-10.17/12.9-10.2	X (S)	X (S)	X (S)	IMO-10 (I)	IMO-10 (S)	X (S)	X (S)	IMO-1 (I)	N (S)

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90	CRU9	12.9-10.17/12.9-10.2	X (S)	IMO-3 (D)	IMO-5 (D)	IMO-5 (S)	IMO-10 (D)	X (S)	FINAL (I)	FMO-15 (I)	N (S)
92	HRU22	12.9-10.17/12.9-10.2	X (S)	IMO-1 (S)	IMO-10 (S)	IMO-10 (D)	FINAL (I)	X (S)	FINAL (I)	IMO-3 (D)	N (S)
93	HRU22	12.3.11/12.3.6/12.3.7	X (S)	X (S)	X (S)	IMO-5 (D)	IMO-3 (I)	X (D)	X (D)	FINAL (S)	N (S)
94	HRU22	12.3.11/12.3.6/12.3.7	X (S)	X (S)	X (S)	FMO-15 (I)	IMO-5 (I)	X (S)	X (D)	FINAL (S)	N (S)
95	HRU17	12.9-10.17/12.9-10.2	X (S)	X (S)	X (S)	IMO-10 (I)	IMO-10 (I)	X (D)	FINAL (I)	IMO-2 (D)	N (S)
96	HRU17	12.9-10.17/12.9-10.2	X (S)	IMO-10 (I)	IMO-10 (S)	IMO-5 (D)	FMO-15 (D)	X (S)	FINAL (S)	IMO-5 (D)	N (S)
105	HRU26	12.9-10.17/12.9-10.19	X (S)	FMO-15 (I)	IMO-10 (S)	IMO-10 (D)	FMO-15 (D)	X (S)	X (D)	IMO-1 (S)	Y (S)
106	HRU26	12.9-10.17/12.9-10.19									
116	HRU28	12.9-10.17/12.9-10.2	X (S)	X (D)	X (D)	FMO-15 (S)	FINAL (S)	X (S)	X (S)	FMO-15 (I)	N (S)
117	HRU28	12.9-10.17/12.9-10.2	X (S)	X (S)	X (S)	IMO-10 (D)	FMO-15 (S)	X (S)	X (D)	FMO-15 (S)	N (S)
118	HRU28	12.9-10.17/12.9-10.2	X (S)	X (S)	X (S)	IMO-10 (D)	FINAL (S)	X (S)	X (S)	FMO-15 (I)	Y (I)
120	CRU8	12.9-10.17/12.9-10.2	FINAL (I)	IMO-10 (D)	IMO-10 (S)	IMO-5 (D)	FMO-15 (D)	X (S)	FINAL (S)	IMO-5 (I)	N (S)
121	HRU30	12.9-10.17/12.9-10.2	X (S)	FMO-15 (S)	IMO-10 (S)	X (S)	X (D)	X (S)	X (S)	IMO-3 (D)	Y (I)
122	HRU30	12.9-10.17/12.9-10.2	X (S)	IMO-5 (D)	IMO-10 (S)	IMO-10 (D)	IMO-5 (D)	X (S)	FINAL (I)	IMO-3 (D)	Y (S)
125	HRU31	12.9-10.17/12.9-10.2									
126	HRU31	12.9-10.17/12.9-10.2	X (S)	FMO-15 (S)	IMO-10 (S)	FMO-15 (S)	IMO-5 (D)	X (S)	FINAL (I)	IMO-2 (D)	Y (S)
139	CRU7	12.9-10.17/12.9-10.2	X (S)	X (D)	X (D)	X (D)	X (D)	X (S)	FINAL (I)	FMO-15 (I)	N (S)
140	CRU7	12.9-10.17/12.9-10.2	X (S)	X (S)	X (D)	IMO-5 (S)	IMO-2 (D)	X (S)	X (D)	IMO-3 (I)	N (S)
141	HRU29	12.9-10.17/12.9-10.2	X (S)	X (D)	X (D)	IMO-2 (D)	FMO-15 (S)	IMO-1 (I)	FINAL (S)	IMO-1 (D)	Y (S)
142	HRU29	12.9-10.17/12.9-10.2	X (S)	X (S)	X (D)	IMO-5 (D)	FINAL (S)	X (S)	FINAL (I)	FMO-15 (S)	N (D)
146	HRU21	12.9-10.17/12.9-10.2									
Total meeting a benchmark			**3**	**19**	**21**	**57**	**57**	**12**	**29**	**57**	**20**
Total meeting a benchmark (1st monitor. period)			**1**	**28**	**21**	**60**	**64**	**14**	**42**	**62**	**13**
Total meeting a benchmark (in baseline survey)			**65**	**45**	**49**	**60**	**61**	**47**	**62**	**65**	**12**

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Site	Rehabilitation Unit	Pre-Clearing Regional Ecosystem	Native Species Richness	Canopy Cover (T1)	Canopy Height (T1)	Small Tree Height (T2-T3)	Small Tree Cover (T2-T3)	Shrub Cover (S1)	Shrub Height (S1)	Native Ground Cover (G1)	Weed Cover (<5%)
Total improving (since 1st monitor. period)			**3**	**6**	**5**	**11**	**6**	**9**	**15**	**7**	**14**
Total declining (since 1st monitor. period)			**1**	**17**	**16**	**20**	**20**	**8**	**15**	**18**	**3**
Total same (since 1st monitor. period)			**55**	**36**	**38**	**28**	**33**	**42**	**29**	**34**	**42**
Overall trend			**=**	**=**	**=**	**≤**	**≤**	**=**	**=**	**=**	**=**
Total sites surveyed (excl. removed) = 59											

Note: the site meets the following benchmarks: IMO - 1 year; IMO – 2 year, IMO – 3 year, IMO- 4 year, IMO – 5 year, IMO – 10 year, FMO – 15 year, FINAL Benchmark condition, and X – does not meet any benchmark i.e. poorer than IMO-1 year condition.
* D = Decrease, S = Same, I = Increase in all values

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8 Bibliography

Agricultural Management Company (2011) *Interim Land Management Plan, Yarrabilba Stage 2: Business Plan*. Agricultural Management Company, for Lendlease

Austecology (2012) *Koala Management Plan*. Austecology for Lendlease

Austecology (2015) *Offset Management Plan*. Austecology for Lendlease

Batianoff, G.N. and Butler, D.W. (2002) Assessment of invasive naturalised plants of southeast Queensland. *Plant Protection Quarterly* **17**:1

Big Scrub Rainforest Landcare Group (2000) *Common Weeds of Northern NSW Rainforest: A practical manual on their identification and control.* Big Scrub Rainforest Landcare Group, Bangalow, NSW

Big Scrub Rainforest Landcare Group (2005) *Subtropical Rainforest Restoration 2nd Edition*. Big Scrub Rainforest Landcare Group, Bangalow, NSW

Brack, C.L. and Wood, G.B. (1996) *Tree Growth Increment*. Australian National University, Fenner School
Url: http://fennerschool-associated.anu.edu.au/mensuration/BrackandWood1998/T_GROWTH.HTM. (Accessed 24/01/2015)

Brisbane City Council (2010) *Ecological Assessment Guidelines – Appendix 3*. Url: http://www.brisbane.qld.gov.au/documents/building_development/pages%20from%20285065_bcc_eco_guidelines_final.part1.pdf (Accessed 01/06/2015)

Buchanan, R.A. (1999) *Bush Regeneration: Recovering Australian Landscapes*. Open Training and Education Network

Buchanan, R.A. (2009) *Restoring Natural Areas: Open Training and Education Network*. Local College New South Wales and Department of Industry and Investment

Bushland Protection Systems (2012) *Draft Pre-Development Bushfire Mitigation Concept for the Yarrabilba Site: A Complete Town, A Better Outcome.* Bushland Protection Systems for Lendlease

Department of Infrastructure, Planning and Natural Resources (2004) *Wildlife Corridors.* Url: http://www.environment.nsw.gov.au/resources/nature/landholderNotes15WildlifeCorridors.pdf (Accessed 03/06/2016)

Design Flow (2012) *Yarrabilba Stormwater Infrastructure Master Plan.* Design Flow, for Lendlease

Dight, G.A., Huggins, J.A., Lucy, M.J. and Zerner, G.R. (2003) *Wild Plants of Greater Brisbane*. Queensland Museum

Environmental Protection Agency (2003) *Regional Ecosystem Map: Based on 2003 Landsat TM Imagery*. Queensland Government, Brisbane

Franks, A. and Franks, S. (2003) *Nest Boxes for Wildlife, A Practical Guide*. Blooming Books, Melbourne, Australia

Lendlease (2011) *Yarrabilba Draft Land Management Plan*. Lendlease

Logan River Branch SGAP (Qld Region) Inc. (2008) *Mangroves to Mountains Revised Edition: A field guide to the native plants of South-east Queensland*. Logan River Branch, Browns Plains Queensland

McDonald, M.C. (1996) *Resilience and the Restoration of Damaged Plant Communities: A discussion focusing on Australian Plant Communities*. PhD. Dissertation. University of Western Sydney, Hawkesbury, NSW

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McDonald, R. C., Isbell, R. F., Speight., J. G., Walker J. and Hopkins M. S. (2005) *Australian Soil and Land Survey Handbook*. Department of Agriculture, Fisheries and Forestry, Canberra

Natura Consulting (2011) *Fauna Corridor Infrastructure Master Plan*. Natura Consulting for Lendlease

New South Wales Department of Primary Industries (2011) *Noxious and Environmental Weed Control Handbook: A guide to weed control in non-crop, aquatic and bushland situations, Fifth Edition*. DPI NSW

Parsons, W.T. and Cuthbertson, E.G. (2001) *Noxious Weeds of Australia, Second Edition*. CSIRO Publishing

Primary Industries Department Queensland (2003) *Weeds of Southern Queensland. 2nd Edition*. Department of Primary Industries Brisbane

Queensland Herbarium (2015a) *Mapping regional ecosystems*. Queensland Government. Url: https://www.qld.gov.au/environment/plants-animals/plants/herbarium/mapping-ecosystems/ (Accessed 06/12/2014)

Queensland Government (2015b) *Pre-clearing Broad Vegetation Groups of Queensland*. Queensland Government, Department of Science, Information Technology, Innovation and the Arts. URL: https://data.qld.gov.au/dataset/pre-clearing-broad-vegetation-groups-of-queensland/resource/1d49665c-cbc0-4935-a5b5-380c162ff42b (Accessed: 06/12/2014)

Ross, Y. (1998) *Hollow Bearing Trees in Permanent Plots in Southeast Queensland*. Department of Natural Resources, Natural Sciences Precinct, Indooroopilly, Qld. DNRQ980146/

Transport and Main Roads (TMR) (2002) *Fauna Sensitive Road Design. Volume 1, Past and Existing Practices*. Queensland Department of Main Roads, Planning, Design and Environment Division

Urban Ecology Australia (2006) *Wildlife Corridors*. Url: http://www.urbanecology.org.au/topics/wildlifecorridors.html (Accessed 03/06/2016)

Urban Land Development Authority (2011a) *Draft ULDA Guideline 14 – Environment and Natural Resources Sustainability*. Urban Land Development Authority

Urban Land Development Authority (2011b) *ULDA Guideline 17 – Remnant Vegetation and Koala Habitat Obligations in Greater Flagstone and Yarrabilba UDA's*

van der Ree, R., Clarkson, D.T., Holland, K., Gulle, N. and Budden M. (2008*) Review of Mitigation Measures used to deal with the Issue of Habitat Fragmentation by Major Linear Infrastructure*. Department of Environment, Water, Heritage and the Arts

Yurrah (2009) *Yarrabilba Vegetation Management Plan. Yurrah,* for Lendlease

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