Koala Habitat Rehabilitation Monitoring Report - ORU 1st Monitoring Period Yarrabilba

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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)

Natura Consulting – Document Control Sheet

Project	
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1 Executive summary

Natura Consulting has developed this *Habitat Rehabilitation Monitoring Report* as the 1st monitoring report after initial baseline surveys for rehabilitation within the Yarrabilba offset requirement 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 monitoring information to direct the rehabilitation works associated with Koala habitat within the Fauna Corridor, Greenspace Corridor and Environmental Protection Zones of the Yarrabilba site. In this case, pine tree removal and assisted natural regeneration was commenced six months prior to this report. The areas to be rehabilitated are offset requirement areas, ensuring that Koala habitat is specifically maintained within the 195 ha offset area. This report provides 6 month monitoring data for the rehabilitation of the offset areas, with 63 sites (results of 59 are presented here, as 4 sites had issues surrounding monitoring – see Table 6) to be monitored within an area of 1,981,771 m^2 (198.2 ha). Each monitoring site is located within an offset area rehabilitation (ORU1 to ORU23) including road crossing rehabilitation units (CRU8, CRU11 and CU15), with the pre-clearing Regional Ecosystem (RE), 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 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.

Contingency measures and corrective actions have also been provided to 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 within the offset area (195 ha) requirement.

The monitoring methodology that is applied has been detailed, where a minimum of two monitoring sites per rehabilitation unit has been surveyed in order to document and assess rehabilitation through time. The 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 1st monitoring period condition against the baseline and benchline values. A number of sites already meet the final benchmark for some individual parameters including an improvement in native species richness across 20 sites. Rehabilitation efforts need to ensure that the full suite of species represented in the pre-RE for each rehabilitation unit are planted where possible.

A total of 37 of the sites meet a benchmark for canopy tree cover, 37 of the sites meet a benchmark for canopy tree height, 57 of the sites meet a benchmark for small tree cover, all (59) sites meet a

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benchmark for small tree height, 45 sites meet a benchmark for shrub cover, 53 sites meet a benchmark for shrub height, all (59) sites meet a benchmark for ground cover and 27 sites meet a benchmark for weed cover of the ground layer.

Overall, this assessment reveals that rehabilitation needs to prioritise weed control and infill planting. Furthermore, strategic rehabilitation of the tree layer will ensure that weeds are outcompeted and shaded out. Tree layers (T1, T2 and T3) need to be targeted as many sites have declined in the progress towards IMO-1 year target benchmarks. There needs to be more consistent sampling of these strata in order to avoid false trends. Shrub and ground-layers seem to be progressing well towards IMO-1 year target benchmarks across sites, with sites 127 – 144 doing exceptionally well; all located in the far south-east of the site adjacent to the Plunkett Reserve.

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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 Lend Lease 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 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 – 1st monitoring within Offset Areas* prior to the commencement of habitat rehabilitation within Offset Areas in the Yarrabilba Residential Development. This report provides the 1st monitoring data for the rehabilitation of offset areas in the development site, with 54 sites to be 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 baseline data with which to assess the rehabilitation of Koala habitat within the Offset Requirement area, which includes Fauna Corridor, Greenspace Corridor and Environmental Protection Zone.

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). In particular the objectives of this report are to:

- describe the rehabilitation areas and provide 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 6 month monitoring results
- assess whether rehabilitation is on-track to meet the next interim performance indicator

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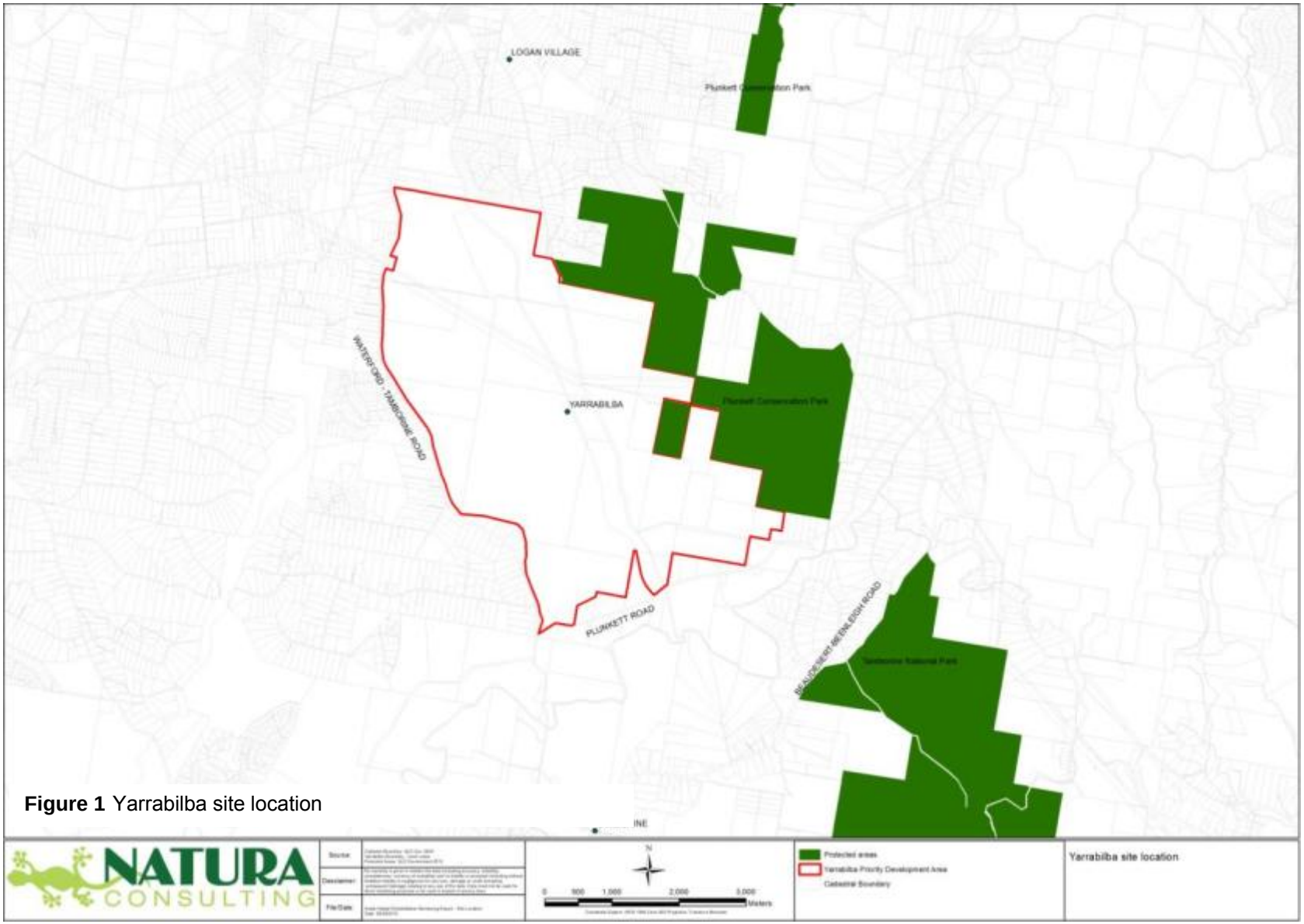

Figure 1 Yarrabilba site location

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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" and "Offset Areas" within Fauna Corridors, Greenspace Corridors and Environmental Protection Zones. This totals an area of 1,981,771 m^2 (198.2 ha) in the offset areas and an additional 754,657 m^2 (75.5 ha) within existing assessable Koala habitat areas outside of offset areas, comprising a combined area of 2,736,428 m^2 (273.6 ha) to be rehabilitated.

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 offset rehabilitation units only.

3.2 Offset rehabilitation units (ORU)

Koala habitat rehabilitation is to occur within offset rehabilitation units as shown in Figure 2. Each rehabilitation unit (ORU1 to ORU23) 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 Offset Requirement area mapping within the Fauna Corridors, Greenspace Corridors and Environmental Protection Zones.

The following table presents a summary of rehabilitation units attributes, including:

- the area of the rehabilitation unit in square metres
- the corridor within which the rehabilitation unit is located
- the 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 will also be undertaken where road and infrastructure traverses an Offset Requirement area. Crossing rehabilitation units have been identified by overlaying the proposed internal road network with the Pre-Clearing Regional Ecosystem mapping (Queensland Government 2015a) and Offset Requirement area mapping. Each crossing rehabilitation unit (CRU1 to CRU15) is a mapped polygon overlayed over offset rehabilitation units. 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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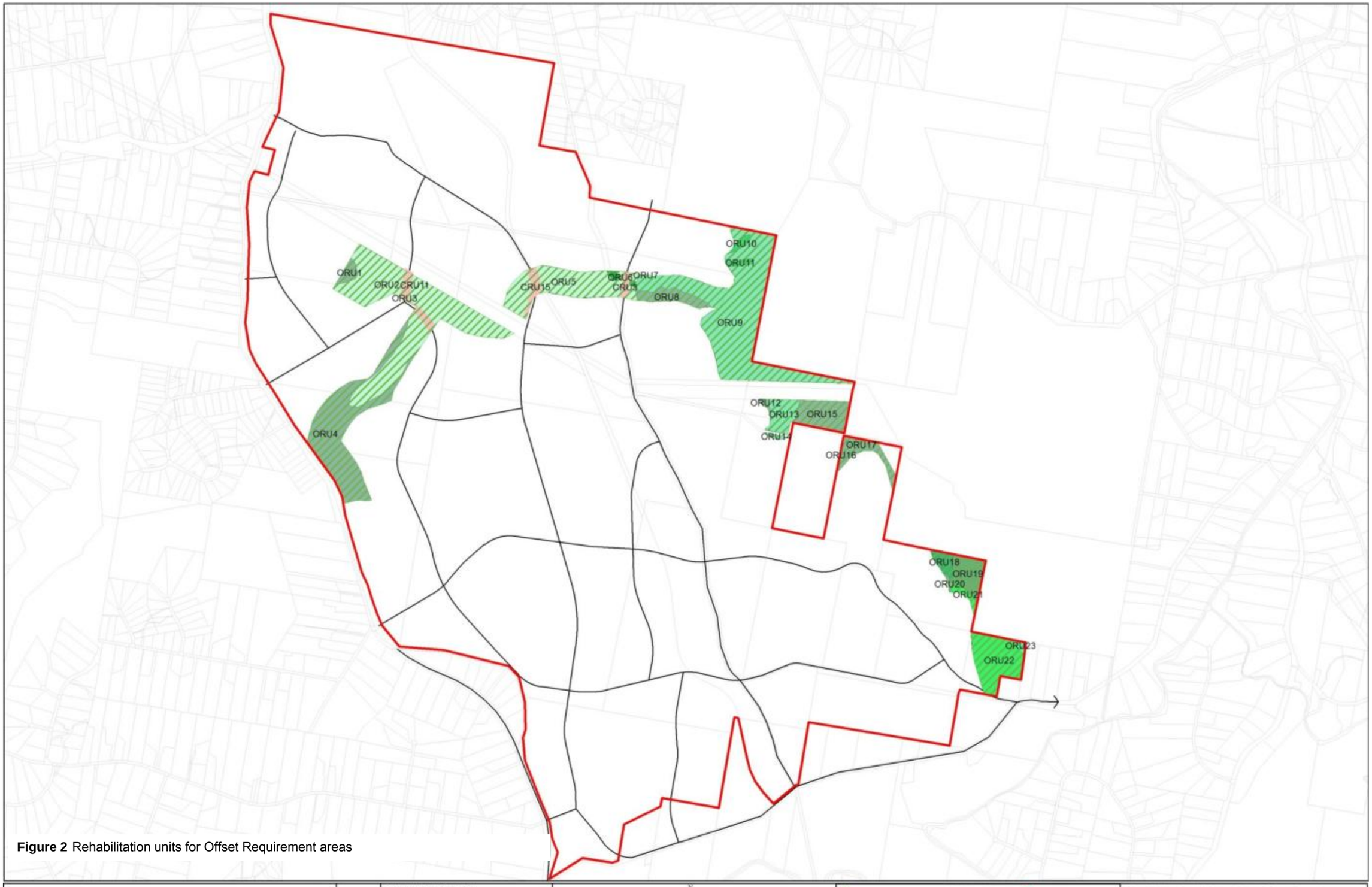

Figure 2 Rehabilitation units for Offset Requirement areas

Source:	Rehabilitation Units: Natura Consulting 2015 Cadastre Boundary: QLD Gov 2005 Corridors: Land Lease / Audeology Internal Roads: Land Lease
Desclaimer:	No warranty is given in relation the data (including accuracy, reliability, completeness, currency of suitability) and no liability is accepted (including without limitation liability in negligence) for any loss, damage or costs (including subsequent damage) relating to any use of the data. Data must not be used for direct marketing purposes or be used in breach of privacy laws.
File/Date:	Koala Habat Rehabilitation Report - Baseline Map Date: 26/08/2015

Coordinate System: WGS 1984 Zone 56S Projection: Transverse Mercator

Reahbilitation Units within Offset Requirement areas (OR1-OR23) and road crossings (CRU3, CRU11 and CRU15)

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Table 1 Offset rehabilitation units (ORU) within the corridor network

Rehab. Unit	Area (m^2)	Corridor Type	RE Code(s)	Landzone / Geology
ORU1	16,933	Greenspace Corridor	12.9-10.17 / 12.9-10.2	Fine grained sedimentary rocks – undulating country on fine grained sedimentary rocks
ORU2	439,297	Fauna Corridor / GreenSpace Corridor	12.3.11 / 12.3.6 / 12.3.7	Recent quaternary alluvial systems – alluvial river and creek flats
ORU3	1,451	Fauna Corridor	12.9-10.17 / 12.9-10.2	Fine grained sedimentary rocks - undulating country on fine grained sedimentary rocks
ORU4	269,317	Fauna Corridor	12.3.11 / 12.3.6 / 12.3.7 12.9-10.17 / 12.9-10.2	Recent quaternary alluvial systems – alluvial river and creek flats and Fine grained sedimentary rocks – undulating country on fine grained sedimentary rocks
ORU5	201,530	Fauna Corridor	12.3.11 / 12.3.6 / 12.3.7	Recent quaternary alluvial systems – alluvial river and creek flats
ORU6	10,205	Fauna Corridor	12.3.11 / 12.3.7	Recent quaternary alluvial systems – alluvial river and creek flats
ORU7	7,264	Fauna Corridor	12.3.11 / 12.3.6 / 12.3.7	Recent quaternary alluvial systems – alluvial river and creek flats
ORU8	46,711	Fauna Corridor	12.9-10.17 / 12.9-10.2	Fine grained sedimentary rocks – undulating country on fine grained sedimentary rocks
ORU9	513,080	Environmental Protection / Fauna Corridor	12.9-10.17 / 12.9-10.19	Fine grained sedimentary rocks – undulating country on fine grained sedimentary rocks
ORU10	8777	Environmental Protection	12.9-10.17	Fine grained sedimentary rocks – undulating country on fine grained sedimentary rocks
ORU11	8,324	Environmental Protection	12.9-10.17	Fine grained sedimentary rocks – undulating country on fine grained sedimentary rocks
ORU12	46,711	Environmental Protection	12.9-10.17 / 12.9-10.2	Fine grained sedimentary rocks – undulating country on fine grained sedimentary rocks
ORU13	49,644	Environmental Protection	12.9-10.17 / 12.9-10.19 / 12.9-10.2	Fine grained sedimentary rocks – undulating country on fine grained sedimentary rocks
ORU14	4,286	Environmental Protection	12.9-10.17 / 12.9-10.19 / 12.9-10.2	Fine grained sedimentary rocks – undulating country on fine grained sedimentary rocks
ORU15	80,800	Environmental Protection	12.9-10.17 / 12.9-10.2	Fine grained sedimentary rocks – undulating country on fine grained sedimentary rocks
ORU16	4,708	Environmental Protection	12.9-10.17 / 12.9-10.19	Fine grained sedimentary rocks – undulating country on fine grained sedimentary rocks
ORU17	47,475	Environmental Protection	12.9-10.17 / 12.9-10.2	Fine grained sedimentary rocks – undulating country on fine grained sedimentary rocks
ORU18	24,352	Environmental Protection	12.9-10.17	Fine grained sedimentary rocks – undulating country on fine grained sedimentary rocks
ORU19	59,917	Environmental Protection	12.11.5 / 12.11.3	Recent quaternary alluvial systems – alluvial river and creek flats
ORU20	3,154	Environmental Protection	12.9-10.17 / 12.9-10.2	Fine grained sedimentary rocks - undulating country on fine grained sedimentary rocks
ORU21	13,374	Environmental Protection	12.11.5 / 12.11.3	Recent quaternary alluvial systems – alluvial river and creek flats
ORU22	118,260	Environmental Protection	12.11.5 / 12.11.3	Recent quaternary alluvial systems – alluvial river and creek flats
ORU23	6,201	Environmental Protection	12.11.5	Recent quaternary alluvial systems – alluvial river and creek flats
Area	**1,981,771**			

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Table 2 Road and infrastructure crossing rehabilitation units (CRU) traversing offset rehabilitation units (ORU)

Crossing Rehab. Unit	Area (m^2)	Traversing ORU	Corridor Type	RE Code(s)	Landzone/ Geology
CRU3	12,578	ORU5, ORU6, ORU7, ORU9	Fauna Corridor	12.3.11 / 12.3.6 / 12.3.7	Fine grained sedimentary rocks – undulating country on fine grained sedimentary rocks
CRU11	31,324	ORU2	Fauna Corridor	12.3.11 / 12.3.7	Fine grained sedimentary rocks – undulating country on fine grained sedimentary rocks
CRU15	22,138	ORU5	Greenspace Corridor / Fauna Corridor	12.3.11 / 12.3.6 / 12.3.7	Fine grained sedimentary rocks – undulating country on fine grained sedimentary rocks
Area	**66,040**				

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3.4 Pre-clearing Regional Ecosystems rehabilitation units

A short description of the pre-clearing Regional Ecosystems (RE) identified in the offset rehabilitation units and crossing rehabilitation units is provided in Table 3.

Table 3 Summary of pre-clearing Regional Ecosystems (RE) 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
12.11.5	*Corymbia citriodora* subsp. *variegata, Eucalyptus siderophloia, E. major* 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) has been 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 (Table 5). 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) (Table 5). 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 2015a). 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 2015a). 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 2015a). 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 RE's identified within the mapped rehabilitation units is identified in Table 5. Note that exotic species identified in Table 5 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 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 commencement of implementation.

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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. 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.

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 Lend Lease 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 (ORU and 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**	**Status (VMA)**	**Biodiversity Status**	**Habitat Rehabilitation Unit**				**Crossing Rehabilitation Unit**			
				ORU2, ORU4, ORU5, ORU7				CRU3, CRU15			
12.3.6	***Melaleuca quinquenervia* +/- *Eucalyptus tereticornis, Lophostemon suaveolens* open forest on coastal alluvial plains**	Least concern	No concern at present	**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	ORU2, ORU4, ORU5, ORU6, ORU7				CRU3, CRU11, CRU15			
				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	
			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**

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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	Status (VMA)	Biodiversity Status	Habitat Rehabilitation Unit				Crossing Rehabilitation Unit			
				ORU2, ORU4, ORU5, ORU6, ORU7				CRU3, CRU11, CRU15			
12.3.11	***Eucalyptus tereticornis* +/- *Eucalyptus siderophloia*, *Corymbia intermedia* open-forest on alluvial plains**	Of concern	Of concern	**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**

				ORU1, ORU3, ORU4, ORU8, ORU12, ORU13, ORU14, ORU15, ORU17, ORU20							
12.9-10.2	***Corymbia citriodora* subsp. *variegata* +/- *Eucalyptus crebra* open forest on sedimentary rocks**	Least concern	No concern at present	**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
	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**

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Benchmark Condition
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RE Code	Name	Status (VMA)	Biodiversity Status	Habitat Rehabilitation Unit				Crossing Rehabilitation Unit			
12.9-10.17	***Eucalyptus acmenoides, Eucalyptus major, Eucalyptus siderophloia +/- Corymbia citriodora subsp. variegata* woodland on sedimentary rocks**	Least concern	No concern at present	ORU1, ORU3, ORU4, ORU8, ORU9, ORU10, ORU11, ORU12, ORU13, ORU14, ORU15, ORU16, ORU17, ORU18, ORU20							
				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	ORU9, ORU14, ORU16							
				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	
	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**

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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	Status (VMA)	Biodiversity Status	Habitat Rehabilitation Unit				Crossing Rehabilitation Unit			
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	ORU19, ORU21, ORU22							
				Average T1 Canopy Cover (%)	**Average T1 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	1.6	1.0	1.5	0.4	3.0	
	Interim Benchmark by 2 years			10.0	3.0	3.0	2.7	2.0	0.7	5.0	
	Interim Benchmark by 3 years			14.0	4.2	4.2	3.6	2.5	1.1	7.0	
	Interim Benchmark by 5 years			20.0	6.4	6.5	4.9	4.0	1.3	10.0	
	Interim Benchmark by 10 years			25.0	10.8	11.2	6.8	4.5	1.5	12.0	
	Final Benchmark by 15 years			**31.1**	**17.6**	**14.9**	**7.5**	**5.3**	**1.7**	**15.4**	-
	Reference Benchmark (Pre-Clearing RE)			**62.1**	**25.2**	**30.0**	**8.0**	**10.5**	**2.4**	**30.8**	**55.1 +/ 15.4**
12.11.5	***Corymbia citriodora* subsp. *variegata*, *Eucalyptus siderophloia*, *E. major* open forest on metamorphics +/- interbedded volcanics**	Least concern	No concern at present	ORU19, ORU21, ORU22, ORU23							
				Average T1 Canopy Cover (%)	**Average T1 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	1.6	1.0	0.5	0.4	8.0	
	Interim Benchmark by 2 years			9.0	3.0	2.8	2.7	1	0.7	10.0	
	Interim Benchmark by 3 years			12.0	4.2	3.8	3.7	1.5	1.1	14.0	
	Interim Benchmark by 5 years			15.0	6.4	5.4	5.3	2	1.3	18.0	
	Interim Benchmark by 10 years			18.0	10.8	7.9	7.7	2.5	1.5	20.0	
	Final Benchmark by 15 years			**21.8**	**15.8**	**9.2**	**8.7**	**2.9**	**1.6**	**23.0**	-
	Reference Benchmark (Pre-Clearing RE)			**43.5**	**22.5**	**10.6**	**9.9**	**5.8**	**2.3**	**46.0**	**48.0 +/ 12.3**

Adapted from Queensland Government (2015).* No pre-defined benchmarks for this RE are provided within the RE technical descriptions (Queensland Government 2015) 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 1st monitoring period occurred in a network of 54 monitoring 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.

The following methodology will be applied to monitor at each site.

5.2 Photo point monitoring

For each site, a permanently marked photo point has been established at the first marker picket and photographing 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. 6 month)
- date

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Figure 3

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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 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 is 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 information collected as detailed in (Table 5) This benchmark monitoring process will also be undertaken at 1 year, 18 months, 2 years, 2.5 years, 3 years, 4 years, 5 years, 10 years and 15 years. Reporting from each of the monitoring events shall be provided to the Department of Environment within 4 weeks of completion of monitoring.

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 Table 6, showing the variety of vegetation types and 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 18 – 29/09/2016	Site 19 – 29/09/2016	Site 23 – 29/09/2016
		
Site 24 – 29/09/2016	Site 25 – 21/07/2016	Site 26 – 29/09/2016
		

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Site 27 – 28/07/2016

Site 28 – 22/07/2016

Site 29 – 6/8/2015

Site 30 – 29/09/2016

Site 31 – 27/07/2016

Site 32 – No site access due to site conditions

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Site 33 – 27/07/2016

Site 44 – 02/08/2016

Site 45 – 17/06/2016

Site 46 – 29/09/2016

Site 47 – 29/09/2016

Site 48 – No data, to be replaced next monitoring

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Site 49 – 17/06/2016

Site 54 – 29/09/2016

Site 55 – 29/09/2016

Site 56 – 29/09/2016

Site 57 – 16/06/2016

Site 58 – 29/09/2016

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Site 59 – 29/09/2016

Site 60 – 16/06/2016

Site 61 – 29/09/2016

Site 62 – 29/09/2016

Site 63 – 29/09/2016

Site 64 – 02/08/2016

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Site 65 – 02/08/2016

Site 66 – 29/09/2016

Site 67 – 29/09/2016

Site 68 – 29/09/2016

Site 69 – 28/06/2016

Site 101 – No data, to be replaced next monitoring

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Site 102 – 29/09/2016

Site 103 – 28/06/2016

Site 104 – 28/06/2016

Site 107 – No data, removed from monitoring

Site 109 – 29/07/2016

Site 110 – 02/12/2016

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Site 111 – 29/06/2016

Site 112 – 29/06/2016

Site 113 – 29/06/2016

Site 114 – 29/06/2016

Site 115 – 02/08/2016

Site 123 – 07/07/2016

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Site 124 – 07/07/2016

Site 127 – 14/07/2016

Site 128 – 14/07/2016

Site 129 – 14/07/2016

Site 130 – 29/07/2016

Site 131 – 07/07/2016

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Site 132 – 30/09/2016

Site 133 – 30/09/2016

Site 134 – 13/07/2016

Site 135 – 29/07/2016

Site 136 – 13/07/2016

Site 137 – 13/07/2016

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Site 138 – 13/07/2016

Site 143 – 12/07/2016

Site 144 – 12/07/2016

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6.2 Transect and quadrat monitoring

6.2.1 Species richness

NB: Sites 32, 48, 101 and 107 had issues surrounding monitoring during this report. For site 32 access was not possible due to land management actions being undertaken. Site 48 was removed as it was within 1m of a vehicular passage way and was being damaged, it will be replaced in the next monitoring period > 20m from the previous location into vegetation. Site 101 was incorrectly geolocated outside of ORU and will be reinstated in the next monitoring period within nearby ORU. Site 107 was re-mapped and identified as not being within an ORU offset area and so has been removed from subsequent reports.

At the 1st monitoring period in August 2016, a total of 270 species were recorded within the 59 monitoring sites in the Offset Area.

Species richness within sites ranged from 20 to 70 species, with 42.6 species per site observed on average. As in the baseline surveys conducted in August 2015, the largest number of species observed in the 6 month survey was in sites adjacent to Plunkett Conservation Park in the south east of the site and sites adjacent to Wall's Block, also in the south east of the site. Species richness was also high in the north east of the site near Plunkett Conservation Park, in Precinct 3 (Site 65). Species richness in these sites ranged from 26 to 70 species per site.

Canopy tree species (T1 stratum) totalled 22 species. Those common across the offset area included *Eucalyptus acmenoides*, *Eucalyptus seeana*, *Eucalyptus siderophloia* and *Eucalyptus tereticornis* (from highest to lower abundance).

Small tree species (T2-T3) totalled 32 species. Those common across the offset area include *Lophostemon confertus, Lophostemon suaveolens, Pinus elliottii, Angophora woodsiana* and *Corymbia intermedia* (from highest to lower abundance).

Shrub species (S1 stratum) totalled 65 species. Those that were commonly observed across the offset area include *Alphitonia excelsa*, *Acacia disparrima*, *Lantana camara*, *Acacia leiocalyx*, *Daviesia umbellulata* and *Melichrus adpressus* (from highest to lower abundance).The latter two species have increased in abundance since the baseline survey.

Of all the species recorded, 42 are exotic (14%). This included one T1 species (*Pinus elliottii*), one T2-T3 species (*Cinnamomum camphora*), two shrub species (*Lantana camara* and *Solanum seaforthianum*) and 38 ground-layer species including 26 herbaceous species and 12 graminoids. Several of these were significant across the offset area, present at a large number of sites. This includes *Lantana camara* (38 sites), *Pinus elliottii* (24 sites), *Passiflora suberosa* (20 sites), *Andropogon virginicus* (20 sites) and *Ageratum houstonianum* (15 sites).

6.2.2 Tree canopy cover and height (T1)

Of the sites with canopy trees present (T1 stratum), tree canopy cover varied from 7% to over 100% overlapping cover, with average total canopy cover of 50%, 0.4% less than baseline levels. Canopy species with high canopy cover were *Corymbia trachyphloia*, *Eucalyptus fusiformis, Eucalyptus siderophloia* and *Cormybia citriodora* subsp. *variegata* (in order of highest to lower).

Several of the sites did not have any canopy trees present, including sites 23, 24, 26, 27, 28, 33, 44, 47, 49, 54, 56, 57, 59, 60, 61, 111, 112, 113, 114, 115 and 144. Many of these sites may have

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'canopy cover' present however the accuracy in measuring the height of these trees may have differed between surveys thus recategorising some trees from T1 into the T2-T3 threshold. Ten sites deemed as having canopy trees absent in baseline surveys also had canopy trees absent in the 6 month current survey. This included sites 23 (CRU11), 27 (ORU2), 49 (CRU15), 57 (CRU3), 54 (ORU6), 56 (CRU3), 59 (ORU7), 61 (ORU8) and sites 112 and 113 (ORU16). Seven sites, sites 18 (ORU1), 45 (ORU5), 57 (CRU3), 60 (ORU8) and 110 (ORU15) however had no T1 canopy cover present in the 6 month survey, but did during the baseline survey. For site 32 access was denied by the land-manager during monitoring, while site 107 was re-surveyed as being outside of the offset areas and removed.

Of the sites with canopy trees present (T1 stratum), tree height varied from 13 m to 22 m, with the average tree height 17.1 m, which was 3.4m higher average tree height than in the baseline survey. Canopy species with high average canopy height were *Eucalyptus planchoniana*, *E. microcorys, E. crebra*, *E. resinifera, E. moluccana* and *Corymbia citriodora* subsp. *variegate* (in order of highest to lower 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 80% overlapping cover, with average total canopy cover of 38.5%, which was 12.8% higher than in the baseline survey. Small tree species with high average cover were *Eucalyptus moluccana*, *Acacia disparrima, Lophostemon confertus, Melaleuca decora and Lophostemon suaveolens* (from highest to lower). Small tree height varied from 1 m to 19 m high, with an average of 10.1 m, 2.4 m greater than was recorded in the baseline surveys.

One site did not have any small trees present, including site 54 (ORU6). Site 54 had small trees absent in the baseline survey as well. Site 101 was not surveyed due to relocation of the site to nearby ORUs and 107 was removed as it was re-surveyed as being outside of the offset areas.

6.2.4 Shrub cover and height (S1)

Of the sites with shrubs present, shrub cover varied from 0.5% to 50% overlapping cover, with average total canopy cover of 16.9%. Shrub height varied from 1 m to 9 m with an average height of 3.2 m, up by 0.3m since baseline surveys. Shrub species with high cover within sites were *Lantana camara*, *Acacia aulacocarpa*, regenerating *Lophostemon suaveolens*, *Allocasuarina littoralis*, regenerating *L. confertus*, *Pultenaea villosa* and *Alphitonia excelsa* (in order of highest to lower average cover).

Several of the sites did not have any shrubs present, including sites 30 (ORU4), 45 (ORU5), 46 (ORU5), 56 (CRU3) and 64 (ORU11). Sites 30 and 46 had absent shrub cover during the baseline surveys as well. Site 101 was not surveyed due to relocation of the site to nearby ORUs and 107 was removed as it was re-surveyed as being outside of the offset areas. Sites 56 and 64 however experienced a large reduction in shrub cover since baseline surveys.

6.2.5 Ground cover (G1)

Most of the sites have living ground-layer cover, except for sites 45, 49, 57, 60 and 110. This is a drop in ground-layer cover since the baseline surveys where all sites had living ground-layers. Ground-layer cover ranged from 10 to 90%.

Of the sites with an extant living ground layer, average total living cover (excluding litter, fallen debris, bare ground, water and shrubs) ranged from 10% (2.4% lower than in baseline surveys, but same

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site, site 102 – ORU13) to 90% (also 2.4% lower than in baseline surveys, but different site, site 61 – ORU8 instead of site 26 – ORU2). Average living ground-layer cover was 46%, which was 2.7% lower than in baseline surveys. Ground cover species with high cover within sites were *Imperata cylindrica, Entolasia stricta,* the weed grass *Andropogon virginicus, Lomandra confertifolia* and *Lobelia purpurascens* (in order of highest to lower average cover).

6.2.6 Weed incursion

Weeds were present at 50 of the 59 of the sites (86%) (14% higher than in the baseline surveys) with 9 sites containing no weed presence (14%). In sites where weeds were present, weed cover in the ground layer varied from 0.4% (site 127 – ORU20 and site 135 – ORU22) to 63.6% (site 61 – ORU8), 59% (site 60 – ORU8) and 49.2% (site 59 – ORU7) which, for the maximum values, is an increase of 23.6% and 8.8%, respectively from the baseline surveys (same sites). All of these sites are located in the Fanua Corridor within Precinct 3. Average weed cover in the ground-layer overall was 13.2% (a 6.9% rise from baseline surveys).

Weed species in the ground layer with high cover were *Andropogon virginicus*, *Passiflora suberosa*, *Lantana montevidensis*, *Setaria sphacelata*, regenerating *Pinus elliottii* and *Ageratum houstonianum*. *Lantana camara* was also a common regenerating shrub in these sites.

Sites where weeds were absent included sites 56, 58, 62, 63, 64, 68, 69,123 and 144, most of which were located in the far east of the site bordering Plunkett Reserve and the conservation areas.

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Table 7 1st monitoring period species richness, average canopy height within the canopy (T1), sub-canopy (T2-T3) and shub layer (S1) and average total cover within the canopy (T1), sub-canopy (T2-T3), shub layer (S1) and ground layer (G1). Purple shading indicates removed sites.

	Species Richness (incl. weeds)					Height (m)			Overlapping Crown Cover (m)					Ground Cover (%)	
Site	*Canopy (T1)*	*Sub - Canopy (T2 and T3)*	*Shrubs (S1)*	Ground Layer (G1)	Total (excl. weeds)	*Canopy (T1)*	*Sub - Canopy (T2 and T3)*	*Shrubs (S1)*	*Canopy (T1)*	*Sub - Canopy (T2 and T3)*	*Shrubs (S1)*	*Total Weed Crown Cover*	*Total Crown Cover*	*Ground Layer (S1 -G1)*	*Total Weed Ground Cover*
18	3	2	5	31	45	16.5	13	3.1	31	7	18	0	38	62.5	11.6
19	1	3	5	23	40	18	9.6	1.9	28	7	18	6	35	42	6.4
23	0	2	4	26	32	0	8.9	2	0	20	1	2	20	80	10.8
24	0	4	4	22	34	0	9.5	4.5	0	28	3	10	28	75.2	42.8
25	2	2	6	29	49	19.2	10.9	4.3	41	59	8	4	100	52	0
26	3	3	5	27	41	0	13	2.6	0	69	13.5	8	69	89.2	27.2
27	3	3	4	21	38	0	5.6	1.7	0	16.5	48	0	16.5	41.2	8.4
28	0	5	5	21	36	0	9.7	2.9	0	31	13	0	31	73.6	12.8
29	3	2	2	27	36	14.6	12	2.9	39	15	24.5	0	54	82.8	30.4
30	0	1	5	32	36	15.7	11.2	0	68	28	0	0	96	48.4	6
31	1	3	5	25	41	14.5	10	3	31	47	24	0	78	26	9.6
32	0		0	0	0	0	0	0	0	0	0	0	0	0	0
33	2	3	4	25	37	0	10.1	3.1	0	48	35	0	48	44.4	23.6
44	4	6	4	29	53	0	7.2	3.6	0	14	68	4	14	43.6	14.4
45	6	4	11	21	34	21.5	30	0	32	12.7	0	5	62	56	6.4
46	2	3	4	30	44	20.7	13.2	0	22	40	0	4	62	60	9.6
47	3	3	6	13	36	0	9	2.7	0	3.5	12.5	0	3.5	33.2	2
48	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
49	2	4	2	26	31	0	10	1.5	0	5.5	0.5	0	0	72.4	3.9
54	3	1	5	23	38	0	0	3	0	0	1	12	0	50	11.2
55	4	4	6	19	45	19	14.5	4.8	10	70.5	8.5	0	80.5	50.4	2
56	0	4	4	10	26	0	9.7	0	0	41	0	0	41	37.6	49.2
57	1	4	4	14	21	0	9.7	2.2	0	36.5	16.4	0	0	59.8	78
58	1	2	6	10	28	21	8.9	2.8	7	9.5	12	0	16.5	49.2	0
59	1	3	7	22	42	0	10.7	3.3	0	16.5	5.5	0	16.5	71.6	49.2
60	1	2	6	15	23	0	9	2.6	0	1.5	4.5	0	0	59.2	59
61	1	2	10	24	47	0	9.3	2.3	0	14	35.5	0	14	90	63.6
62	1	4	9	9	37	17.8	10.7	4.8	28	29	15.5	0	57	21.2	0
63	3	4	11	6	42	21.8	7.7	5	43.5	16	7.5	0	59.5	35.6	0
64	2	4	5	8	30	18.7	9.5	0	37	15.5	0	0	52.5	40	0
65	3	5	19	12	66	16.9	10	3.5	43.5	41	2	0	84.5	30.4	0
66	1	5	12	11	47	17.5	7.9	3.4	16	29.5	25	0	45.5	29.6	0
67	3	2	11	14	46	15.5	8.7	5	44	16	1	0	60	23.2	0
68	0	2	9	7	29	0	0	0	0	0	0	0	0	27.6	0
69	4	1	15	6	46	17.1	12.1	3.9	78	38.5	9.5	0	116.5	24	0
101	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
102	5	4	15	5	51	19.3	9.6	3.3	144	45	6	0	189	10	0
103	1	4	14	18	54	15.4	10.9	2.6	70	40	16	0	110	28.8	2.4
104	3	2	17	8	52	15.3	11.6	2.3	73	44.5	5	0	117.5	21.2	0
107	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
109	6	3	9	11	46	16.3	8.4	3.2	88	44	7	0	132	25.6	0.8

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Site	Species Richness (incl. weeds)					Height (m)			Overlapping Crown Cover (m)					Ground Cover (%)	
	Canopy (T1)	*Sub - Canopy (T2 and T3)*	*Shrubs (S1)*	Ground Layer (G1)	Total (excl. weeds)	*Canopy (T1)*	*Sub - Canopy (T2 and T3)*	*Shrubs (S1)*	*Canopy (T1)*	*Sub - Canopy (T2 and T3)*	*Shrubs (S1)*	*Total Weed Crown Cover*	*Total Crown Cover*	*Ground Layer (S1 -G1)*	*Total Weed Ground Cover*
110	3	2	6	28	29	16.3	9.5	3	29	7	2	0	0	61.6	3.2
111	2	3	3	21	33	0	10.6	3.4	0	86.5	20.5	0	86.5	41.2	19.2
112	0	3	7	28	42	0	7.5	3.2	0	8.5	17	0	8.5	81.2	28
113	0	5	4	18	30	0	8.5	3.6	0	5	17	0	5	76	24.8
114	0	4	2	19	24	0	10	1.8	0	3.5	6.5	0	3.5	83.6	40
115	2	2	4	18	30	0	13	1.5	0	2	2.5	0	2	69.2	10.8
123	4	5	13	10	54	12.7	9.8	3.3	87	60.5	13.5	0	147.5	32.8	0
124	3	2	8	8	35	18.5	10.6	4.5	64	35	8.5	0	99	11.2	0
127	3	4	12	17	54	15.6	12.1	1.7	84	36	10	0	120	17.6	0.4
128	4	3	5	15	37	19.2	10.8	2.9	56	43	14	0	99	64.4	8
129	3	5	12	30	64	18.1	12.8	2.2	67	48	47	16	115	63.6	10.8
130	3	4	8	22	49	16.7	6.8	3.7	80	17	7.5	4	97	32	1.6
131	3	5	9	16	50	20.3	10.4	3.8	33	165.5	15	0	198.5	27.2	0
132	4	6	8	20	54	15.2	9.1	2.5	36	33	10	4	69	52.4	13.2
133	2	4	3	24	39	15.7	10.9	3	33	87	9	2	120	54.4	4.8
134	1	2	7	18	37	17.3	8.5	3.8	70	130.5	33	0	200.5	28.8	1.2
135	6	5	7	21	56	16.6	10.8	3.2	64	122.5	15	4	186.5	15.2	0.4
136	3	3	5	8	30	16.7	10	2.9	58	77.5	6	2	135.5	26.0	0
137	2	3	2	12	20	15.1	11.3	7.5	51	40	45	0	91	35.6	21.6
138	3	4	4	10	30	15.5	10.6	3	43	54.5	50	16	97.5	54.8	12.4
143	3	3	6	13	35	14.9	9.2	3.7	31	46	3	2	77	44.8	17.6
144	3	2	6	6	28	0	11.6	3.9	0	72	5	0	72	60.8	0
	1.9	**2.8**	**6.4**	**15.6**	**35.7**	**9.5**	**8.4**	**2.6**	**28.6**	**33.8**	**13.1**	**1.8**	**62.3**	**40.4**	**11**

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7 Discussion

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

A number of sites already meet the final benchmark for some individual parameters. As in the baseline surveys, sites 123 to 144 (ORU18 to ORU23 and CRU8) met consistently high benchmarks.

For species richness, 21 sites reached the final benchmark, which is vastly improved on baseline surveys which only saw 1 site 129 (ORU21) meet the reference final benchmark. Rehabilitation efforts need to continue to encourage this increase in native species richness.

A total of 37 of the sites meet a benchmark for canopy tree cover (decline since previous monitoring period (45)), 37 of the sites meet a benchmark for canopy tree height (decline since previous monitoring period (47)), 57 of the sites meet a benchmark for small tree cover (increase since previous monitoring period (37)), 59 sites meet a benchmark for small tree height (increase since previous monitoring period (57)), 44 sites meet a benchmark for shrub cover (increase since previous monitoring period (37)), 54 sites meet a benchmark for shrub height (increase since previous monitoring period (47)), all sites met a benchmark for ground cover (same as baseline), and 27 sites meet a benchmark for weed cover of the ground layer (1 less than baseline).

Overall, this assessment reveals that rehabilitation needs to prioritise weed control and canopy planting in order to bring weed cover to below the 5% benchmark for all sites. Furthermore, strategic rehabilitation of the ground, shrub and tree layer will ensure that weeds are outcompeted and shaded out. It is noted that *Pinus elliotii* control has already occurred throughout 90% of the site, which is providing lower cover of this species than observed during preliminary assessments. There has also been follow-up felling of *P. elliottii* across the sites and this may have resulted in the decrease in canopy cover and height across sites in general. There needs to be special attention paid to T1 canopy cover and height as this strata seems to be declining in standards relating benchmarks and not improving, specifically in native cohorts.

Sites that do not yet meet at least 4 benchmarks for tree and shrub structure include site 54 (ORU6), site 60 (ORU8) and site 68 (ORU9). These sites are primarily exotic grass pasture (especially *Andropogon virginicus*) with scattered trees and shrubs. These sites will need to be prioritised for rehabilitation within the next 6 months.

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Table 8 1st 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). Purple shading indicates removed sites.

Site	Rehabilitation Unit	Pre-Clearing Regional Ecosystem	Species Richness (native)	Canopy Cover (T1)	Canopy Height (T1)	Small Tree Height (T2-T3)	Small Tree Cover (T2-T3)	Shrub Cover (S1)	Shrub Height (S1)	Ground Cover (G1)	Weed Cover (5%?)
18	ORU1	12.9-10.17/12.9-10.2	FINAL	FMO-15	IMO-10	FINAL	IMO-5	IMO10	FMO-15	FMO-15	X
19	ORU1	12.9-10.17/12.9-10.2	FINAL	FMO-15	IMO-10	IMO-10	IMO-5	IMO-10	IMO-5	IMO-10	X
23	CRU11	12.3.11/12.3.6/12.3.7	X	X	X	IMO-10	FMO-15	X	FMO-15	FINAL	X
24	CRU11	12.3.11/12.3.6/12.3.7	X	X	X	IMO-10	FINAL	IMO-1	FINAL	FINAL	X
25	ORU2	12.3.11/12.3.6/12.3.7	X	FMO-15	FMO-15	FMO-15	FINAL	IMO-5	FINAL	FINAL	FINAL
26	ORU2	12.3.11/12.3.6/12.3.7	FINAL	X	X	FMO-15	FINAL	FMO-15	FMO-15	FINAL	X
27	ORU2	12.3.11/12.3.6/12.3.7	X	X	X	IMO-10	FMO-15	FINAL	IMO-10	FINAL	X
28	ORU2	12.3.11/12.3.6/12.3.7	X	X	X	FMO-15	FINAL	FMO-15	FINAL	FINAL	X
29	ORU4	12.9-10.17/12.9-10.2	FINAL	FMO-15	IMO-10	FMO-15	FMO-15	FMO-15	FMO-15	FMO-15	X
30	ORU4	12.9-10.17/12.9-10.2	FINAL	FINAL	IMO-10	FMO-15	FMO-15	X	X	FMO-15	X
31	ORU4	12.9-10.17/12.9-10.2	FINAL	FMO-15	IMO-10	IMO-10	FINAL	FMO-15	FMO-15	IMO-3	X
32	ORU4	12.9-10.17/12.9-10.2									
33	ORU4	12.9-10.17/12.9-10.2	FINAL	X	X	IMO-10	FINAL	FMO-15	FMO-15	IMO-5	X
44	ORU5	12.3.11/12.3.6/12.3.7	FINAL	X	X	IMO-5	FMO-15	FINAL	FINAL	FINAL	X
45	ORU5	12.3.11/12.3.6/12.3.7	X	FINAL	FINAL	FINAL	FINAL	X	X	FINAL	X
46	ORU5	12.3.11/12.3.6/12.3.7	FINAL	IMO-10	FMO-15	FINAL	FINAL	X	X	FINAL	X
47	ORU5	12.3.11/12.3.6/12.3.7	X	X	X	IMO-10	IMO-2	FMO-15	FINAL	FINAL	FINAL
48	CRU15	12.3.11/12.3.6/12.3.7									
49	CRU15	12.3.11/12.3.6/12.3.7	X	X	X	FMO-15	IMO-3	X	IMO-10	FINAL	FINAL
54	ORU6	12.3.11/12.3.7	X	X	X	X	X	X	FINAL	FINAL	X
55	ORU6	12.3.11/12.3.7	FINAL	IMO-2	FMO-15	FINAL	FINAL	IMO-5	FINAL	FINAL	FINAL
56	CRU3	12.3.11/12.3.7	X	X	X	FMO-15	FINAL	X	X	FINAL	X
57	CRU3	12.3.11/12.3.6/12.3.7	X	X	X	FMO-15	FINAL	FMO-15	FMO-15	FINAL	X
58	ORU7	12.3.11/12.3.6/12.3.7	X	IMO-1	FMO-15	IMO-10	IMO-5	FMO-15	FINAL	FINAL	FINAL
59	ORU7	12.3.11/12.3.6/12.3.7	FINAL	X	X	FMO-15	FMO-15	IMO-3	FINAL	FINAL	X

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Site	Rehabilitation Unit	Pre-Clearing Regional Ecosystem	Species Richness (native)	Canopy Cover (T1)	Canopy Height (T1)	Small Tree Height (T2-T3)	Small Tree Cover (T2-T3)	Shrub Cover (S1)	Shrub Height (S1)	Ground Cover (G1)	Weed Cover (5%?)
60	ORU8	12.9-10.17/12.9-10.2	X	X	X	IMO-10	X	X	IMO-10	FMO-15	X
61	ORU8	12.9-10.17/12.9-10.2	FINAL	X	X	IMO-10	IMO-10	FMO-15	IMO-10	FINAL	X
62	ORU9	12.9-10.17/12.9-10.19	FINAL	FMO-15	IMO-10	FMO-15	FMO-15	IMO-5	FINAL	IMO-2	FINAL
63	ORU10	12.9-10.17	FINAL	FMO-15	FMO-15	IMO-5	FMO-15	IMO-2	FINAL	IMO-10	FINAL
64	ORU11	12.9-10.17	X	FMO-15	FMO-15	IMO-10	FMO-15	X	X	IMO-10	FINAL
65	ORU10	12.9-10.17	FINAL	FMO-15	FMO-15	IMO-10	IMO-10	X	FMO-15	IMO-5	FINAL
66	ORU9	12.9-10.17/12.9-10.19	FINAL	IMO-3	IMO-10	IMO-5	FMO-15	FMO-15	FMO-15	IMO-3	FINAL
67	ORU9	12.9-10.17/12.9-10.19	FINAL	FMO-15	IMO-10	IMO-5	FMO-15	X	FINAL	IMO-2	FINAL
68	ORU9	12.9-10.17/12.9-10.19	X	X	X	X	X	X	X	IMO-3	FINAL
69	ORU9	12.9-10.17/12.9-10.19	FINAL	FINAL	IMO-10	FMO-15	FINAL	IMO-2	FMO-15	IMO-2	FINAL
101	ORU12	12.9-10.17/12.9-10.2									X
102	ORU13	12.9-10.17/12.9-10.19	FINAL	FINAL	FMO-15	IMO-10	FINAL	IMO-1	FMO-15	IMO-1	FINAL
103	ORU13	12.9-10.17/12.9-10.19	FINAL	FINAL	IMO-10	FMO-15	FINAL	IMO-10	IMO-10	IMO-3	FINAL
104	ORU13	12.9-10.17/12.9-10.19	FINAL	FINAL	IMO-10	FMO-15	FINAL	IMO-1	IMO-10	IMO-2	FINAL
107	ORU14	12.9-10.17/12.9-10.19									
109	ORU15	12.9-10.17/12.9-10.2	FINAL	FINAL	IMO-10	IMO-5	FINAL	IMO-2	FMO-15	IMO-3	FINAL
110	ORU15	12.9-10.17/12.9-10.2	X	FMO-15	IMO-10	IMO-10	IMO-5	X	FMO-15	FMO-15	FINAL
111	ORU15	12.9-10.17/12.9-10.2	X	X	X	FMO-15	FINAL	FMO-15	FMO-15	IMO-10	X
112	ORU16	12.9-10.17/12.9-10.19	FINAL	X	X	IMO-5	IMO-5	IMO-10	FMO-15	FMO-15	X
113	ORU16	12.9-10.17/12.9-10.19	X	X	X	IMO-5	IMO-5	IMO-10	FMO-15	FMO-15	X
114	ORU17	12.9-10.17/12.9-10.2	X	X	X	IMO-10	IMO-2	IMO-1	IMO-5	FMO-15	X
115	ORU17	12.9-10.17/12.9-10.2	X	X	X	FINAL	IMO-1	X	IMO-3	FMO-15	X
123	ORU18	12.9-10.17	FINAL	FINAL	IMO-10	IMO-10	FINAL	IMO-3	FMO-15	IMO-5	FINAL
124	ORU18	12.9-10.17	X	FINAL	FMO-15	FMO-15	FINAL	IMO-2	FINAL	IMO-1	FINAL
127	ORU20	12.9-10.17/12.9-10.2	FINAL	FINAL	IMO-10	FMO-15	FINAL	IMO-3	IMO-3	IMO-1	FINAL
128	ORU20	12.9-10.17/12.9-10.2	FINAL	FINAL	FMO-15	FMO-15	FINAL	IMO-5	FMO-15	FMO-15	X
129	ORU21	12.11.5/12.11.3	FINAL	FINAL	FMO-15	FINAL	FINAL	FINAL	FMO-15	FINAL	X

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Site	Rehabilitation Unit	Pre-Clearing Regional Ecosystem	Species Richness (native)	Canopy Cover (T1)	Canopy Height (T1)	Small Tree Height (T2-T3)	Small Tree Cover (T2-T3)	Shrub Cover (S1)	Shrub Height (S1)	Ground Cover (G1)	Weed Cover (5%?)
130	ORU21	12.11.5/12.11.3	FINAL	FINAL	FMO-15	IMO-5	FINAL	FINAL	FINAL	FMO-15	FINAL
131	ORU19	12.11.5/12.11.3	FINAL	FMO-15	FMO-15	FMO-15	FINAL	FINAL	FINAL	FMO-15	X
132	ORU19	12.11.5/12.11.3	FINAL	FMO-15	IMO-10	IMO-10	FINAL	FINAL	FINAL	FINAL	X
133	ORU19	12.11.5/12.11.3	FINAL	FMO-15	IMO-10	FINAL	FINAL	FINAL	FINAL	FINAL	FINAL
134	ORU22	12.11.5/12.11.3	X	FINAL	FMO-15	IMO-10	FINAL	FINAL	FINAL	FMO-15	FINAL
135	ORU22	12.11.5/12.11.3	FINAL	FINAL	FMO-15	FINAL	FINAL	FINAL	FINAL	IMO-3	FINAL
136	ORU22	12.11.5/12.11.3	X	FINAL	FMO-15	FMO-15	FINAL	FINAL	FINAL	FMO-15	FINAL
137	ORU23	12.11.5	X	FINAL	IMO-10	FINAL	FINAL	FINAL	FINAL	FMO-15	X
138	ORU23	12.11.5	X	FMO-15	IMO-10	FINAL	FINAL	FINAL	FINAL	FINAL	X
143	CRU8	12.11.5/12.11.3	X	FMO-15	IMO-10	FMO-15	FINAL	FMO-15	FINAL	FMO-15	X
144	CRU8	12.11.5/12.11.3	X	X	X	FINAL	FINAL	FMO-15	FINAL	FINAL	FINAL
		Total meeting a benchmark	**21**	**37**	**37**	**ALL**	**57**	**45**	**53**	**ALL**	**27**
		Total meeting a benchmark (in baseline survey)	**1**	**45**	**47**	**57**	**37**	**37**	**47**	**ALL**	**28**
		Total improving (since baseline)	**32**	**10**	**16**	**37**	**51**	**32**	**32**	**22**	**27**
		Total declining (since baseline)	**0**	**14**	**9**	**8**	**2**	**10**	**9**	**17**	**4**
		Total same (since baseline)	**18**	**37**	**34**	**14**	**6**	**17**	**18**	**20**	**28**
					Total sites (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.

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