# 2020 Annual Monitoring Report

## Karuah East Quarry Biodiversity Offset Area and Lot 12

## 20212186

15 December 2020





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# 1 INTRODUCTION

## 1.1 BACKGROUND

The Karuah East Quarry (KEQ) Project was subject to an assessment under part 3A of the NSW Environmental Planning and Assessment Act 1979 (EP&A Act). The project was approved by the Planning Assessment Commission on 17 June 2014 subject to conditions set out in Schedules 2 to 5 of the Project Approval (09\_0175). Subsequent modification was approved on 27 April 2018 (Modification 1) and 19 December 2018 (Modification 2) under Section 75J of the EP&A Act (Modification 1). A referral under the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) for the project was also lodged with the Department of the Environment (DotE) on 29 July 2014 (EPBC 2014/7282). On 25 August 2014 the project was determined as a Controlled Action under the EPBC Act requiring further assessment subject to the controlling provision 'listed threatened species and communities'. The action was approved by DotE on 20 March 2015 subject to 17 conditions of approval.

Condition 33 of the NSW Project Approval and Condition 9 of the EPBC Act approval require the implementation of a Biodiversity Offset Area Management Plan (BOAMP) for the KEQ biodiversity offset area (BOA), which is a 138.22 ha consolidated land parcel adjoining the western boundary of the project disturbance area (**Figure 1**). The BOAMP was prepared by Kleinfelder (2015) and subsequently approved by the NSW Department of Planning and Environment (DP&E) on 14 December 2015, and approved by the DotE on 16 March 2016. The BOAMP has since been updated in consideration of Modification 1 (February 2019) and will be further updated following approval of Modification 2. Establishment of a Conservation Agreement for the BOA is currently in progress (with the Biodiversity Conservation Trust) as required under the project approval - Condition 29.

Baseline ecological surveys and monitoring were undertaken in October 2015 prior to commencement of clearing and construction as required under Section 3 of the BOAMP. The baseline monitoring surveys involved the establishment of 13 permanent monitoring sites within the Karuah East BOA in accordance with the BOAMP. An additional five permanent monitoring sites were also established on the adjoining Lot 12 DP 1024564 as per Sections 3.2 and 4.1 of the Statement of Commitments in accordance with Section 11.1.3 of the Landscape and Rehabilitation Management Plan (L&RMP) (SLR 2015). In addition to establishing the permanent monitoring sites, the surveys also involved baseline assessment of fencing, access tracks, erosion, weeds and vertebrate pests in accordance with Section 3 of the BOAMP. The baseline ecological surveys and monitoring report (Kleinfelder 2016) was submitted as an addendum to the BOAMP in January 2016 (available from http://hunterquarries.com.au/karuah-east-documents/).

The first year of annual monitoring of the BOA and Lot 12 was undertaken in October 2016. This report provides the results of the fifth annual monitoring event undertaken in October 2020. Monitoring including analysis of monitoring data to date to evaluate changes in vegetation condition and threatened flora populations in the BOA.

This report also provides a summary of management actions completed within the BOA to date, and recommendations for implementation of management actions in Year 6 of the BOAMP implementation to ensure compliance with relevant performance criteria.



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## **1.2 S**COPE

Section 3 of the BOAMP details the annual monitoring requirements for the Karuah East BOA. Additionally, Section 12.1 of the L&RMP details the ecological monitoring requirements for the Karuah East Quarry project area, adjoining vegetation within 50 m of the project area boundary on Lots 12 and 13, and along Yalimbah Creek (Lot 12). A summary of the Karuah East annual ecological monitoring requirements is provided in Error! Reference source not found.. It is noted that not all monitoring activities listed in Error! Reference source not found (refer to the timing / frequency).

#### Table 1 Summary of annual monitoring requirements for Karuah East Quarry BOA and Lot 12

Monitoring Requirements	BOAMP / L&RMP Section(s)	Timing / Frequency	Completed in 2020
Vegetation and Threatened Flora Monitoring The 18 permanent monitoring sites established in the BOA and Lot 12 during the baseline are to be surveyed annually in accordance with Section 3.13 of the BOAMP and Section 12.1.3 of the L&RMP. Monitoring is to be undertaken during spring to coincide with the flowering times of threatened flora species in the BOA.	Section 3.13 of BOAMP Section 12.1.3 of L&RMP	Annually for life of quarry (LOQ)	Completed
Fencing Inspections of boundary fencing will be undertaken as part of annual monitoring to identify maintenance requirements and record fencing activities undertaken in previous year. The effectiveness of fencing in excluding stock and unauthorised activities (e.g. rubbish dumping) will also be evaluated during annual monitoring and any additional controls will be identified if required.	Section 3.2 of BOAMP Section 12.1.2 of L&RMP	Annually for LOQ	Outstanding. Boundary fencing around the BOA commenced prior to the 2018 monitoring round, and requires completion. Inaccessibility has largely limited fence installation. To date, there has been no evidence of stock or unauthorised entry across the surveyed areas.
Tracks Inspections of retained and redundant access tracks will be undertaken as part of annual monitoring to identify maintenance requirements and record maintenance activities undertaken in previous year.	Section 3.3 of BOAMP	Annually for LOQ	Completed
Erosion Inspections of erosion sites will be undertaken as part of annual monitoring to identify maintenance requirements and record maintenance activities undertaken in previous year. Erosion and sediment control structures installed within the project disturbance area to protect retained vegetation will be inspected as part of annual ecological monitoring.	Section 3.4 of BOAMP Section 12.1.2 of L&RMP	Annually for LOQ	Completed
Existing Dwellings Inspections of the dwellings, access tracks, and asset protection zones (APZs) will be undertaken as part of annual monitoring to identify maintenance requirements. These inspections will focus on fencing, weeds, and unauthorised access / disturbance.	Section 3.5 of BOAMP	Annually for LOQ	Completed

Monitoring Requirements	BOAMP / L&RMP Section(s)	Timing / Frequency	Completed in 2020
Habitat Augmentation and Nest BoxesNest boxes will be inspected and maintained (or replaced) every two years following installation:Nest boxes 1 – 30 installed in April 2016Nest boxes 31 – 125 installed in February 2018Nest boxes 126 – 318 installed in July-August 2020	Section 3.8 of BOAMP	Boxes 1-30 and 31 – 125 monitoring required in 2020.	Monitoring completed for nest boxers 1 – 30 in 2018. Monitoring completed for nest boxes 1 – 125 in 2020.
Weeds Target weed species will be mapped on an annual basis within the Project Disturbance Area and adjoining vegetation on Lots 12 and 13 (within 50 m of the project disturbance area boundary). Additionally, weed mapping along Yalimbah Creek will also be undertaken as part of the ecological monitoring program. Weed mapping for the BOA will be undertaken every two years and compared to the previous mapping to assess changes in the extent and density of target weeds. Monitoring results will be used to develop a control strategy for the following two years, identifying target locations and timing for primary and follow-up control.	Section 12.1.1 of L&RMP Section 3.10 of BOAMP	Annually (KEQ, 50 m buffer and Yalimbah Creek) Every 2 years from baseline survey for LOQ (BOA)	Completed (KEQ, 50 m buffer, Yalimbah Creek) Weed mapping for BOA updated in 2020.
Vertebrate Pest Assessment Monitoring of vertebrate pests will be undertaken using the same methods, locations and effort as the baseline assessment unless otherwise recommended in the annual monitoring reports. This will enable results to be accurately compared to the baseline assessment.	Section 3.11	Every 2 years from baseline survey for LOQ (BOA)	Outstanding
Aerial Fauna Crossings A 12-month monitoring program of the two aerial fauna crossings will be undertaken using remote motion sensing cameras mounted on each pole (four cameras in total) once the crossings have been installed.	Section 12.1.4 of L&RMP	12 months from installation of the crossings	Aerial fauna crossings installed. Monitoring commenced by quarry staff.
Threatened Flora Translocation – refer to Tetratheca juncea Translocation Management Plan (TjMP; Firebird 2015).	Refer to TjMP	Refer to TjMP	Completed – refer to Tj Translocation Monitoring Report (Firebird 2018)

## 1.3 KARUAH EAST QUARRY PROGRESS

The Karuah East Quarry (KEQ) Project commenced operations in May 2019 after construction of the plant in 2018. Vegetation clearing commenced in April 2016 and the majority of the KEQ project area was primarily cleared between April and June 2016, with some additional clearing also occurring in November 2016, May 2018, July 2018, October 2019, November 2019 and September 2020. The majority of the disturbance area has been cleared to-date. Major earthworks have also been completed including construction of the haul road, detention basins, and other infrastructure areas.

The current extent of clearing within the KEQ project area is shown in Figure 2.





## 1.4 **BIODIVERSITY VALUES**

Section 2.3 of the BOAMP provides a detailed description of the biodiversity values identified in the Karuah East BOA during previous assessments (RPS Australia Pty Ltd 2013; Eco Logical Australia (ELA) 2013, 2014). Additional baseline ecological surveys were also undertaken within the BOA in October 2016 (Kleinfelder 2016). A summary of the key biodiversity values present (or previously recorded) within the site are provided in Error! Reference source not found.. The locations of threatened flora species and the distribution of vegetation communities across the BOA are shown in **Figure 3**.

	Biodiversity Values	Area (ha) / No. of individuals
	Spotted Gum – Grey Ironbark open forest on the foothills of the Central Coast, Sydney Basin.	69.98
	Sydney Peppermint – Smooth barked Apple shrubby open forest on coastal hills and plains of the southern North Coast and northern Sydney Basin.	3.96
Vegetation Communities	Smooth-barked Apple - Red Bloodwood open forest on coastal plains on the Central Coast, Sydney Basin.	26.58
	Blackbutt - Turpentine - Tallowwood shrubby open forest of the coastal foothills of the central North Coast.	28.30
	Brush Box - Turpentine shrubby open forest of the coastal ranges of the North Coast.	2.62
	*^Tetratheca juncea (Black-eyed Susan)	6,907
Threatened Flora Species	*^Grevillea parviflora subsp. parviflora (Small-flower Grevillea)	100+
	*^Asperula asthenes (Trailing Woodruff)	399
	*Eastern Falsistrelle (Falsistrellus tasmaniensis)	-
	*Little Bent-winged Bat (Miniopterus australis)	-
	*Eastern Bent-winged Bat (Miniopterus orianae oceanensis)	-
	*Eastern Coastal Free-tailed Bat (Mormopterus norfolkensis)	-
Threatened and Migratory	*Southern Myotis (Myotis macropus)	-
Fauna Species	*Eastern Cave Bat (Vespadelus troughtoni)	-
	*Glossy Black-Cockatoo (Calyptorhynchus lathami)	-
	*Varied Sittella (Daphoenositta chrysoptera)	-
	*Powerful Owl (Ninox strenua)	-
	+Rufous Fantail (Rhipidura rufifrons)	

#### Table 2 Key biodiversity values recorded within the Karuah East BOA

\* = listed as Vulnerable under the BC Act 2016

^ = listed as Vulnerable under the EPBC Act 1999

+ = listed as Migratory under the EPBC Act 1999

## ANCHL Legend Project Disturbance Area **Biodiversity Offset Area** Major Roads Local Roads Threatened Species Locations Asperula asthenes $\circ$ Grevillea parviflora subsp. parviflora 0 Tetratheca juncea 0 Vegetation Communities Blackbutt - Turpentine - Tallowwood shrubby open forest Brush Box - Turpentine shrubby open forest Smooth-barked Apple - Red Bloodwood open forest Spotted Gum - Grey Ironbark open forest Sydney Peppermint - Smooth-barked Apple shrubby open forest Unvegetated HIWS CIFIC-HW FIGURE: PROJECT REFERENCE: 20212186 Metres 0 50 100 300 400 500 **Vegetation Types and** 200 DATE DRAWN: 2020/12/08 16:33 Version 1 N **Threatened Flora Locations** DRAWN BY: GJoyce 3 DATA SOURCE: NSW DFSI - 2018 ADW Johnson - 2015 Nearmap - 2020 Karuah East Quarry Pty Ltd KLEINFELDER 2020 Annual Monitoring Report Karuah East Quarry Project Bright People. Right Solutions

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## 2 METHODS



A total of 18 monitoring sites were established in October 2015 including 13 sites within the Biodiversity Offset Area (BOA), and five sites on Lot 12 DP 1024564 within 50 m of the project disturbance area and along Yalimbah Creek. The location of each monitoring site was recorded with a handheld GPS (TrimbleTM Juno 5S unit) and permanently marked with a capped star picket (see **Figure 4**).

Baseline surveys were completed across the 18 monitoring sites in October 2015 and subsequently surveyed in October 2016, 2017, 2018, 2019, and 2020 (7<sup>th</sup> and 8<sup>th</sup> October 2020). Vegetation condition monitoring (**Section 0**) was conducted across all 18 monitoring sites. Threatened flora monitoring (**Section 2.1.2**) was completed at nine of the monitoring sites (see **Table 3**).

Monitoring Site	Location	Vegetation Community	Threatened Flora Species Monitored
MP 1	BOA – Lot 5	Spotted Gum - Grey Ironbark open forest	-
MP 2	BOA – Lot 5	Spotted Gum - Grey Ironbark open forest	•
MP 3	BOA – Lot 5	Brush Box - Turpentine shrubby open forest	Asperula asthenes
MP 4	BOA – Lot 13	Brush Box - Turpentine shrubby open forest	Asperula asthenes
MP 5	BOA – Lot 14	Blackbutt - Turpentine - Tallowwood shrubby open forest	-
MP 6	BOA – Lot 13	Blackbutt - Turpentine - Tallowwood shrubby open forest	-
MP 7	BOA – Lot 13	Smooth-barked Apple - Red Bloodwood open forest	Tetratheca juncea
MP 8	BOA – Lot 13	Smooth-barked Apple - Red Bloodwood open forest	Tetratheca juncea and Grevillea parviflora subsp. parviflora
MP 9	BOA – Lot 13	Smooth-barked Apple - Red Bloodwood open forest	-
MP 10	BOA – Lot 14	Sydney Peppermint - Smooth-barked Apple shrubby open forest	-
MP 11	BOA – Lot 14	Sydney Peppermint - Smooth-barked Apple shrubby open forest	Grevillea parviflora subsp. parviflora
MP 12	BOA – Lot 14	Smooth-barked Apple – Red Bloodwood open forest	Grevillea parviflora subsp. parviflora
MP 13	BOA – Lot 14	Spotted Gum – Grey Ironbark open forest	-
MP 14	Lot 12	Smooth-barked Apple - Red Bloodwood open forest	-
MP 15	Lot 12	Blackbutt - Turpentine - Tallowwood shrubby open forest	Tetratheca juncea
MP 16	Lot 12	Spotted Gum – Grey Ironbark open forest	-
MP 17	Lot 12	Brush Box - Turpentine shrubby open forest	Asperula asthenes
MP 18	Lot 12	Brush Box - Turpentine shrubby open forest	Asperula asthenes

#### Table 3 Summary of vegetation and threatened flora monitoring sites



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## 2.1.1 Vegetation Condition Assessment

A qualitative assessment of vegetation condition and photo monitoring was undertaken at each of the 18 monitoring points, involving collection of the following data:

- Vegetation type and structure, including dominant species and estimated percentage foliage cover of each stratum (within 20 m radius of monitoring point);
- General health and condition of vegetation, including evidence of foliage die-off;
- Weed species and abundance; and
- Any management issues or indirect impacts from the project area or adjoining lands.
- Four photographs (north, south, east and west) were taken at each of the monitoring points.

## 2.1.2 Threatened Flora Monitoring

Monitoring of threatened flora species was undertaken at nine of the monitoring sites as per the BOAMP and L&RMP. At these sites, all threatened flora individuals within 10 m of the monitoring point were recorded. The bearing and distance of each clump / individual from the star picket recorded during the baseline survey was used to accurately re-locate known individuals in the survey area. The bearing (degrees) for each clump was measured using a Suunto compass and the distance was determined using a tape measure attached to the star picket. Additionally, each clump / individual was permanently marked with a steel peg (positioned 20 cm to the south of each clump / individual to avoid damaging plants); a metal tag was attached to each peg which provides a unique ID number. Note separate individual plants were delineated based on criteria described in **Table 4**.

Species	Definition of "individual"
Asperula asthenes	Individual plants were delineated based on the methodology used by ELA (2014) during previous targeted surveys to ensure a consistent approach for population surveys and monitoring across the BOA. Based on this method, stems (or groups of stems) of <i>Asperula asthenes</i> occurring 40 cm or more apart are considered separate individuals.
Tetratheca juncea	Individuals or 'clumps' were delineated and counted in accordance with the standardised method described by Payne et al. (2002), in which individual clumps occurring 30 cm or more apart are considered separate, individual plants.
Grevillea parviflora subsp. parviflora	Stems occurring 30 cm or more apart were considered separate individuals.

 Table 4
 Criteria for delineation of "individual" plants

For each individual identified in the survey area, the following information was recorded:

- Clump/individual ID number;
- Distance and bearing from centre star-picket to the clump;
- The size of the clump measured across the widest and narrowest points (cm) (for A. asthenes and *T. juncea*) or max height (for *G. parviflora* subsp. *parviflora*);
- Presence or absence of flowers (for *A. asthenes* and *G. parviflora* subsp. *parviflora*). The number of flowers and fruit on *T. juncea* plants were recorded to enable monitoring of reproductive output of this species; and
- Notes on general health of the plant, including any die-back or disease.

Following assessment of all previously recorded individuals, an additional survey of the area was performed at each site to identify any new individuals. For all new individuals identified within the survey area, the above listed information was collected.

## 2.2 SITE WALKOVER AND INSPECTION

Inspection of key management features was undertaken across the BOA and Lot 12 (within 50 m of the project area and along Yalimbah Creek) in October 2020 in accordance with Section 3 of the BOAMP. The following features were inspected and assessed:

- Internal and external fencing;
- Access tracks and gates;
- Areas of active erosion and sedimentation;
- Areas surrounding the two existing dwellings within the BOA;
- Redistribution of habitat resources salvaged during clearing for the KEQ Project;
- Extent and density of priority and environmental weeds within the project disturbance area, adjoining vegetation within 50 m of the disturbance area boundary on Lots 12 and 13, and along Yalimbah Creek.

### 2.2.1 Weed Mapping

Weeds for which detailed mapping was undertaken (i.e. target weed species) are those:

- Listed under the Biosecurity Act 2015 as priority weeds within the Mid Coast Council control area;
- Identified as a Weed of National Significance (WoNS); and / or
- Environmental weeds which represent major infestations and / or have the potential to adversely affect ecological values within the BOA.

The most widespread and abundant weed species across the site is Lantana camara (Lantana). Four categories were used during field surveys to map areas of different Lantana density based on the percentage foliage cover:

- Nil: no Lantana observed;
- Scattered: ≤20% Lantana cover;
- Moderate: 21-60% Lantana cover; and
- High: >60% Lantana cover.

Other target weed species occurring outside moderate to high Lantana areas were mapped separately (i.e. weeds which may not be identified and treated as part of Lantana control).

#### **RESULTS AND DISCUSSION** 3



#### 3.1 **ENVIRONMENTAL CONDITIONS**

Field surveys were conducted on the 7th and 8th October 2020. Rainfall in the preceding months was variable with lower than average rainfall occurring in August and September and above average rainfall occurring in July (Table 5, Plate 1). Heavy rainfall totals experienced in October occurred after fieldwork was completed (25th-27th October). Rainfall was generally higher in 2020 when compared to the very dry conditions recorded throughout 2019, which recorded an annual rainfall total (597.8 mm) half of the annual long-term average (1063.7 mm) and was the driest year since baseline monitoring was completed in 2015.

Year	Jan	Feb	Mar	Apr	Мау	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
2015	134.2	32.0	128.2	451.8	130.6	54.0	25.2	35.6	85.6	48.6	162.8	147.4	1436.0
2016	472.2	38.6	36.4	43.0	14.8	113.0	54.6	68.2	55.0	50.0	64.6	83.6	1094.0
2017	62.4	88.8	218.0	91.2	14.8	121.6	8.6	17.4	8.0	91.0	41.2	53.2	816.2
2018	16.2	79.2	149.2	83.4	15.4	153.6	1.0	28.4	49.8	143.2	90.2	87.0	896.6
2019	23.4	73.6	152.0	53.8	36.0	77.6	16.8	36.0	85.0	19.6	21.0	3.0	597.8
2020	78.0	274.0	110.0	26.8	82.4	56.6	141.8	44.0	34.6	169.2			
Mean	104.3	111.5	122.9	100.4	86.6	101.6	68.3	60.3	61.9	68.9	78.2	99.3	1063.7

Local Rainfall Data in mm (Clarence Town (Prince Street) Station – BOM Station 61161) (BOM 2020) Table 5



Clarence Town (Prince Street) (BOM Station Number: 61161) (19.5km from MOC site)



Williamtown RAAF (BOM Station Number: 061078) (20.2km from MOC site)

Plate 1 Local Rainfall Data (BOM 2020) - Columns (2019/2020 rainfall data), Line (Long-term mean rainfall)



## 3.2 VEGETATION AND THREATENED SPECIES MONITORING

### 3.2.1 Vegetation Condition

The 2020 KEQ vegetation condition assessment was completed over two days (7<sup>th</sup> and 8<sup>th</sup> October 2020) across all 18 monitoring sites and represents the fifth annual inspection of vegetation condition within the KEQ BOA and Lot 12, with baseline data collected in 2015.

Vegetation condition, exotic species cover and records of disturbance are summarised in the results below. Site specific results and photo monitoring results are detailed further in **Appendix A** and **Appendix B**.

#### General health of vegetation

Vegetation condition across KEQ BOA and Lot 12 monitoring sites remain relatively stable since the previous monitoring event in 2019, with almost all monitoring sites recording signs of regeneration across both canopy and mid-storey species.

Canopy condition, measured as Projected Foliage Cover (PFC%) shows little change since 2019, or since baseline results collected in 2015 (see **Plate 2**), beyond natural variation likely in response to prevailing weather conditions (**Plate 1**). The only exception was a reduction in Canopy PFC within *Spotted Gum – Grey Ironbark open forest* sites which declined in mean PFC from 47% to 38%, much of this influenced by variation at MP 13 (from 50% to 25%). Canopy dieback was observed within the monitoring site, however the decline in conditions, exacerbated by the sites shallow soils, rocky surface and exposed landscape position. Whilst signs of minor dieback was observed at monitoring sites; MP 1, MP 2, MP 4, MP 5, MP 6, MP 7, MP 12, and MP 18 these trees also show signs of recovering, with new growth recorded in 2020. It is expected that recent improved conditions will likely lead to an improvement in canopy PFC over the next year and be recorded during the 2021 annual monitoring.

There has been no discernable change in PFC across mid-storey or shrub strata from baseline records in 2015 or between 2019 and 2020 (current survey)(see **Plate 3** and **Plate 4**). The only exception to this was an increase in shrub cover within *Brush Box – Turpentine shrubby open forest* sites (**Plate 4**), with MP 4 recording an increase from 3% to 20% since 2019. This increase in shrub PFC is largely attributed to a high cover of native shrub saplings (*Glochidion ferdinandi* var. *ferdinandi* and *Pittosporum multiflorum*) which have likely taken advantage of a recent opening in the dense canopy (greater access to light) and improved conditions since 2019 (**Plate 1**).

Groundcover PFC has remained relatively stable since baseline surveys in 2015, with only a small decline occurring across most vegetation communities since the 2019 annual monitoring (**Plate 5** and **Plate 6**). This is unlikely to be the result of any direct or indirect impacts of quarry operations, instead is more likely a combination of natural variability and increasing competition from shrub/mid-storey species, disturbance from heavy rain events, as well as small variability expected from changes in surveyors.

#### Exotics

Exotic species cover has declined marginally across all five vegetation communities (**Plate 7**). The highest level of exotic species cover continues to occur within *Brush Box – Turpentine shrubby open forest* sites and includes large thickets of *Lantana camara* var. *camara*. Weed coverage across the BOA and Lot 12 is further discussed and mapped in **Section 3.3**.





Plate 2 Mean Canopy Projected Foliage Cover (%) by vegetation community (2015-2020)









Plate 4 Mean Shrub Projected Foliage Cover (%) by vegetation community (2015-2020)











Plate 7 Mean Exotics Projected Foliage Cover (%) by vegetation community (2015-2020)



#### Disturbance

Minor disturbance was recorded at a number of monitoring sites. These are detailed in **Appendix A**, however, the following key observations are noted below:

- Minor scouring of creek bank was recorded at MP 18, MP 17 within a gully to the west of the quarry. This is likely the result of high rainfall events during the preceding months.
- Siltation is occurring along a drainage channel just outside of monitoring site MP 14, previously installed sediment fencing has collapsed requiring replacement (further discussed in **Section 3.3.2**)
- Wild pigs were observed within the vicinity of monitoring site MP 4. Recent erosion and disturbance to the groundcover within this area is likely the result of the pest species Impacts of vertebrate pests are further discussed in **Section 3.3.4**.
- Past clearing at MP 12 is beginning to show signs of regeneration.
- High levels of dust were observed on foliage (see Photo 1) and on the ground at monitoring sites MP 6 and MP 7 along the eastern boundary of quarry operations. Minor dust cover was recorded at MP 18 and MP 15 along the quarry's western boundary. Whilst rainfall events following the 2020 monitoring event have likely reduced dust levels, monitoring of this disturbance should be continued in future years to assess any potential impacts to remnant vegetation.



Photo 1 Dust cover on foliage recorded at MP 4



### 3.2.2 Threatened Flora

The 2020 threatened species monitoring identified a total of 86 individual *Asperula asthenes* plants, 34 clumps of *Tetratheca juncea*, and 24 *Grevillea parviflora* subsp. *parviflora* shrubs, representing an increase in threatened flora abundance for most species and at a majority of the monitoring locations.

Species specific results are discussed below, for more detailed threatened flora results including site specific observations on abundance and condition see **Appendix C.** 

#### Asperula asthenes

Monitoring for *A.asthenes* was completed at four monitoring sites; MP 3, MP 4, MP 17, and MP 18, all of which recorded increases in *A.asthenes* abundance since 2019, with a mean increase of 98% within this period (**Plate 8**) and majority of plants recording flowers. The greatest increase within this period was recorded at MP 4 where abundance doubled from 17 plants in 2019 to 38 plants in 2020 (see **Plate 8**). It is important to note that many of the new individuals recorded at MP 4 were young seedlings establishing across areas of bare soil exposed from recent heavy rains. Whilst these are ideal conditions, the inevitable return of other groundcover species will likely begin to out compete the new *A.asthenes* returning abundance to pre-2020 levels.

The increase in abundance for the species across the monitoring sites continues a pattern of fluctuating abundance results for the species since 2015 and is likely due to improved conditions over winter, including higher rainfall (see **Plate 1**). There is no discernible pattern indicating impacts from quarry operations with *A.asthenes* abundance approximately 55% greater than the 2015 baseline.







#### Tetratheca juncea

Monitoring for *T. juncea* was completed at three monitoring sites; MP 7, MP 8, and MP 15. The population remains stable with only a small decline in abundance was recorded between 2019 and 2020 at MP 7 (15 to 14 plants) and at MP 15 (13 to 9 plants), whilst an increase was recorded at MP 8 (10 to 11 plants) (see **Plate 9**). *T. juncea* abundance has declined across the three monitoring sites by approximately 11% since the 2015 baseline monitoring event (**Plate 9**). The majority of this decline since 2015 has occurred within MP 15, which similar to MP 7 and MP 8 is in close proximity to quarry operations (see **Figure 4**). No major disturbances were recorded within MP 15 during the 2020 monitoring event, however dust was observed on foliage throughout the area.

Flowering was recorded for the species across all three monitoring plots (MP 7, MP 8, and MP 15) during the 2020 monitoring event. Of the 15 plants recorded at MP 7, nine were in flower (60%) with a mean of 5.8 flowers, compared to 67% flowering and 5.2 flowers in 2019. MP 8 saw an increase from 60% flowering and 2.6 flowers to 92% flowering and 6.27 flowers. MP 15 also increased from only 54% flowering and 2.4 flowers in 2019 to 100% and 2.3 flowers in 2020. These results indicate the species is in good reproductive condition, likely due to favourable conditions (i.e. rainfall) over winter and into spring.





Monitoring for *G.parviflora* subsp. *parviflora* was completed at three monitoring sites; MP 8, MP 11 and MP 12. The population remains stable with a small increase in abundance recorded between 2019 and 2020 at MP 11 (12 to 14 plants) and at MP 12 (8 to 9 plants) (see **Plate 10**). However, despite the increase in abundance at MP 11 four plants were found to have died since 2019 with minor dieback recorded on three others. Overall, there is little change in abundance for the species since the 2015 baseline indicating minimal impact from quarry operations.



Plate 10 Grevillea parviflora subsp. parviflora abundance at monitoring sites (2015-2020)

## 3.3 SITE WALKOVER AND INSPECTION

#### 3.3.1 Weed Infestations

Weed mapping was conducted across during field surveys on the 7<sup>th</sup> and 8<sup>th</sup> of October 2020 the BOA, within the project disturbance area, within 50 m of the project disturbance area, and along Yalimbah Creek on Lot 12. The resulting weed map (**Figure 5**) illustrates the cover of the most abundant weed species across the site, *Lantana camara* var. *camara* (Lantana) (Priority Weed within the Mid Coast LGA). As with previous monitoring events, major infestations occur throughout the site, with the majority of infestations occurring on the northern part of the BOA and localized within gullies and disturbed edges (**Figure 5**).

Two other Priority Weed species have also been identified in the BOA: *Asparagus aethiopicus* (Ground Asparagus) and *Senecio madagascariensis* (Fireweed) are both listed as Priority Weeds within the Mid Coast LGA. These two species only occur as small discrete patches in a few locations in the BOA.

Notable areas of exotic perennial grasses previously mapped along road and track sides were recorded again in 2020 and are mapped in **Figure 5**. The dominant exotic grass species in these areas include *Setaria sphacelata* (South African Pigeon Grass), *Andropogon virginicus* (Whisky Grass), and *Axonopus fissifolius* (Narrow-leafed Carpet Grass), as well as a variety of annual and perennial exotic herbs. The areas dominated by exotic grasses are primarily restricted to the power line easement, around existing dwellings, track edges, perimeter of quarry disturbance area and previously cleared regrowth areas on the southern part of Lot 14.

While the dense areas of exotic grasses have been mapped, they are not considered target weed species at this stage as they represent a relatively low threat to the integrity of ecological values within the site. The exotic grasses occurring in the areas of native regrowth are also likely to be shaded out over time as the canopy and midstorey cover continue to regenerate. However, the distribution of exotic grasses will continue to be monitored, and any increases will be evaluated to determine if management is required.

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It is recommended weed control works for the next 12 months should focus on the Lantana infestations in the south-west portion of Lot 5 and north-east part of Lot 13, especially within the vicinity of MP 3 and MP 4 to protect *Asperula asthenes* individuals. These weed control activities must be undertaken in spring in accordance with the procedures detailed in Section 3.10 of the BOAMP due to the presence of threatened flora (*Asperula asthenes*) in these areas.

A combined list of weed species from the surveys completed by ELA (2013) and Kleinfelder (2017) across the BOA is provided in **Appendix 4**. No additional weed species were added during the 2019 surveys.

## 3.3.2 Fencing and Tracks

The layout of existing and required fencing, gates and tracks across the BOA is shown in **Figure 6**. Boundary fencing is required around the entire KEQ project area. Fencing of KEQ project area / BOA boundary has commenced (approximately 70% completed in 2017). A new fence was installed along the eastern boundary of the BOA adjoining Lot 10 in 2017. Fencing along the remaining 30% of project area / BOA boundary, and Lot 5 / Lot 14 boundary is required. Internal fencing is also required around the existing dwellings on Lot 5 and Lot 14. It is noted that that the dwelling in Lot 5 is not currently occupied. This internal fencing must be installed prior to this dwelling being occupied. All fencing works shall be undertaken in accordance with Section 3.2 of the BOAMP.

Several redundant sections of tracks within the southern part of the BOA are being successfully rehabilitated following the placement of branches, hollow logs / sections and other organic debris salvaged from the KEQ disturbance area during vegetation clearing.

Maintenance is recommended at the access track along the south-western boundary of Lot 14 to remove a small tree that has recently fallen over (see **Photo 2** and **Figure 6**). Works along the powerline easement track have improved accessibility and should continue to be maintained.



Photo 2 Fallen Tree along access track in Lot 14



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### 3.3.3 Erosion

No areas of major active erosion were identified within the BOA during the 2020 monitoring. Areas of bare ground previously identified on the access tracks within the BOA still appeared to be stable with no substantial active erosion or sedimentation observed. Minor scouring was still evident in several locations along the drainage lines within Lot 5 and within the vicinity of monitoring sites MP 17 and MP 18 in Lot 12. However, this scouring is considered to be natural stream bank erosion, likely exacerbated by recent heavy rainfall events, as there was no evidence of unnatural disturbance in these areas, and overall the streams have relatively high ground vegetation cover and appear stable.

Certain areas of the BOA (primarily the steep slopes on Lot 5) have the potential to develop erosion following Lantana control works. The need for erosion or soil stabilisation measures following initial treatment of moderate and high density Lantana areas on steep slopes will be assessed at each maintenance / monitoring event. No weed control had taken place throughout Lot 5 over the previous monitoring round, therefore no change to conditions was observed. The creek line area, where Lantana control activities have taken place in Lot 14 was observed to have dense vegetation re-invading the areas where Lantana has died off, therefore no erosion control is currently required for this area.

Sediment fencing and bund walls / diversion drains were in place in all areas downslope of disturbed areas except for the area north of Dam 1. However, the sediment fences installed along the eastern side of the overburden stockpile and the area south east of Dam 1 had failed at the time of the 2018, 2019, and 2020 inspection. Active erosive processes are evident in several locations where rill erosion can be observed along the wall of Dam 1 and the overburden stockpile wall. These processes are washing away sediments and rocks overtopping the sediment fence and spilling over the surrounding bushland. Many of these areas have begun to stabilise in some areas through the spread of exotic grass species over the disturbed areas including road sides and dam walls.

Key erosion and sedimentation issues were observed at three areas surrounding the quarry disturbance area:

- In three locations the installed sediment fencing was overtopping (observed in 2018, 2019 and 2020) and, therefore, no longer provided active sediment control (**Figure 6**). It was observed in these locations that some sediment had been deposited within the surrounding environment. The overtopping sediment fencing along the western boundary of the quarry, within Lot 12, and adjacent to monitoring site MP 14 shows evidence of resulting sedimentation of the drainage channel and dam located to the immediate west of the fencing (see **Photo 3**).
- It was noted during the 2017 monitoring event that the overflow for Dam 3 was depositing small amounts of sediment into the receiving environment with water being retained in the bushland east of the basin for a period. It was noted during the 2018 monitoring event that a small trough had been dug to allow the overflow from the dam to drain out of the area and into Bulga Creek. While some minor erosion and sedimentation was observed on the discharge side of the dam wall, it was still contained within the project disturbance area. This management action has remediated the waterlogging issue and no die-back or change in vegetation structure and composition was observed in 2018. No further changes were noted in 2019 or 2020. Ongoing annual monitoring will be required to assess the effectiveness of the drainage and ensure no die-back or change in vegetation structure and composition structure and composition occurs.



Photo 3 Sediment fencing down and overtopping within Lot 12

### 3.3.4 Vertebrate Pests

Feral pigs were recorded during the 2020 site inspections along the powerline easement in Lot 5 and in close proximity to monitoring site MP 4, supporting previous observations of suspected Feral Pig diggings recorded in the southern half of the BOA area during previous site inspections (**Figure 6**). Karuah East Quarry conducted Feral Pig trapping in Lot 14 in March 2019 and is in the process of implementing a broader feral animal control programme in the BOA (December 2020).

## 3.3.5 Habitat Resources

Section 6.3.1 of the L&RMP and Section 3.8 of the BOAMP detail the protocol and requirements for salvaging habitat resources (i.e. logs, hollows and other large organic debris) during the KEQ project and redistributing into the rehabilitation or offset areas. Vegetation clearing undertaken in 2016 for the KEQ project has included the salvage of a large quantity of organic material (primarily large trees and logs). These resources were stockpiled on the boundaries of the KEQ project area (see **Figure 7**).

In addition to this, a total of 77 hollows and hollow log sections were previously salvaged and set aside for redistribution into the BOA. The location of the hollow logs to be redistributed throughout the BOA is shown on **Figure 7**. Recent inspections indicated that most hollows are unsuitable for reinstallation due to cracks in hollow walls or the requirement to substantially modify the hollow for reinstallation. As such, in July/August 2020, 193 nest boxes were installed to compensated for the loss of 116 hollows and also compensate for the need to reinstall 77 salvaged hollows. It is recommended that the 77 salvaged hollows be redistributed terrestrially within the BOA to provide habitat for terrestrial fauna species.

Tree hollows removed as part of clearing works completed on site in November 2016, May and August 2018, and October and November 2019, have now been sufficiently replaced as per the requirements of the BOAMP. Details on nest box installation are covered below.

#### Nest Boxes

Since 2016 a total of 318 nest boxes have been installed within the Karuah East Quarry BOA. Details of nest boxes installed are outlined in **Table** 6.

Installation Date	Installation Details	Box Types Installed
April 2016	30 nest boxes boxes were installed within the BOA in April 2016 as per Section 3.8 of the BOAMP.	<ul><li>20 Glider boxes</li><li>10 Microchiropteran bat boxes</li></ul>
February 2018	93 nest boxes were installed between the 3rd and 6th of February 2018 and two large owl boxes were installed by quarry staff on 14 February 2018 (totaling 125) offsetting the original clearing works and loss of hollows at a 1:1 ratio assuming the 77 salvaged hollows are distributed throughout the BOA.	<ul> <li>62 Glider boxes</li> <li>31 Microchiropteran bat boxes</li> <li>Two owl nest boxes</li> </ul>
July-August 2020	193 nest boxes were installed within the BOA to replace hollows removed during clearing undertaken on site in May and August 2018 at a ratio 1:1 as per the requirements of the L&RP and the BOAMP.	<ul> <li>70 Glider boxes</li> <li>33 Possum boxes</li> <li>25 Antechinus boxes</li> <li>33 Microchiropteran bat boxes</li> <li>23 Feathertail Glider boxes</li> <li>Nine Owlet Nightjar boxes</li> </ul>

#### Table 6 Nest box installation details across KEQ BOA (2016-2020)

Biennial nest box monitoring was completed by Kleinfelder in 2018 and in 2020, results from these inspections are summarized below in **Table 7**. Nest box monitoring is due to be completed again in 2022.

Installation Date	Usage Rate	Details
2018 Inspection	<ul> <li>2016 Install of 30 nest boxes (2yrs old) = 27% usage.</li> </ul>	<ul> <li>30 boxes were deemed to be available for use</li> <li>No boxes recorded as damaged or unusable.</li> <li>Eight Glider boxes showed signs of use including one being actively occupied by two Sugar Gliders (<i>Petaurus breviceps</i>).</li> <li>None of the Microchiropteran bat exhibited signs of use during the survey.</li> </ul>
2020 Inspection	<ul> <li>2016 Install of 30 nest boxes (4yrs old) = 47% usage.</li> <li>2018 Install of 95 nest boxes (2yrs old) = 28% usage.</li> </ul>	<ul> <li>122 boxes were deemed to be available for use</li> <li>Two boxes were found to be damaged and one unusable box (termite infested).</li> <li>40 Glider boxes showed signs of occupation, this included, three boxes occupied by Sugar Gliders (<i>Petaurus breviceps</i>) and 37 other boxes showing signs of use either from Sugar Gliders, Brown Antechinus (<i>Antechinus stuartii</i>) and Feathertail Gliders (<i>Acrobates pygmaeus</i>).</li> <li>Almost half of all the glider nest boxes have either been utilised by or contain fauna species (usage rate of 49%).</li> <li>None of the Microchiropteran bat boxes exhibited signs of use</li> </ul>

## Table 7Nest box monitoring results (2018-2020)



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## 4 PERFORMANCE CRITERIA EVALUATION

BOAMP performance criteria and an evaluation of the current status, relevant management actions completed or further works required are detailed below in **Table 8**. It is noted that the BOAMP was endorsed by all consent authorities (i.e. Council, NSW DP&E and Commonwealth DotE) as of March 2016. As such, all Year 1 management actions were due to be completed before March 2017 to ensure compliance with the relevant performance criteria.

#### Table 8 Current status of BOAMP performance criteria

Action	Performance Criteria	Current Status (2020)
Fencing, Gates and S	Signage	
Fence mapping	Completed by end of year 1	Baseline fence mapping completed in October 2015.
Boundary fencing, gates and signage installation / repairs	Completed by end of year 1	Outstanding Ongoing installation of boundary fencing, gates and signage required. Mostly restricted due to access (e.g. around uncleared areas of the extraction area).
Redundant fencing removal	Completed by end of year 3	N/A – no redundant fencing identified during baseline fence mapping.
Fencing inspections	Completed annually	Annual inspection completed.
Fencing maintenance	Maintain boundary fencing as direct by annal inspection	Repair of boundary fencing, gates and signage is undertaken as required. No Maintenance required following 2020 inspection.
Access Tracks		
Access track mapping and assessment	Completed by end of year 1	Baseline track mapping and assessment completed in October 2015.
Access track repairs	Completed by end of year 3 Track repair does not impact on ecological values and is restricted to defined limits	No major track repair requirements identified. Access tracks assessed as being in suitable condition for 4WD access during the 2020 monitoring. The Lot 13/Lot 14 access track requires the removal of a fallen tree to ensure safe access.
Redundant access track rehabilitation	Completed by end of year 3	Rehabilitation of redundant tracks completed and natural regeneration occurring.
Access track inspections	Completed annually	Annual inspection completed.

#### Erosion, Sedimentation and Soil Management

Erosion and sedimentation mapping	Completed by end of year 1	Baseline assessment completed in October 2015.
Erosion repair and management	Completed by end of year 3 Repair of erosion within BOA does not impact on ecological values	The 2020 survey identified areas requiring repair and/or management, these actions should be undertaking immediately. The effectiveness of erosion and sediment control measures within the Karuah East Quarry project area ,such as silt fencing and diversion drains, should be inspected and maintained regularly and after rain events.

Action	Performance Criteria	Current Status (2020)
Erosion inspections	Completed annually	Annual inspection completed in October 2020.
Existing Dwellings		
Exclusion of existing dwellings from Conservation Agreement	Completed by end of year 1	The survey plan excluded the two existing dwellings.
Fencing and signage installation	Completed by end of year 1	Outstanding Installation of fencing, gates and signage required.
Inspections	Completed annually	Annual inspection completed in October 2020.
Maintenance and weed control	No noxious weeds present within excised areas. No unauthorised disturbance outside of excised areas in the BOA.	No environmental weeds impacting on the integrity of the BOA were identified in excised areas during 2020 monitoring. No unauthorised disturbance observed outside of excised areas in the BOA during 2020 monitoring.

### Revegetation and Regeneration\*

Confirm extent of revegetation areas	Completed by end of year 1	Completed. No revegetation works were assessed as being required within the BOA during the 2015, 2016, 2017, 2018, 2019 or 2020 monitoring events. The requirement for revegetation works within the BOA will be reassessed each year.
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#### Habitat Augmentation

Salvage and redistribution of habitat resources	Redistribution of salvaged resources by end of Year 3 Redistribution of salvaged resources does not impact on ecological values of BOA, including threatened flora	The 77 salvaged hollows were determined to be unsuitable for reinstallation. The installation of 193 nest boxes in July/August 2020 compensates for the loss of these hollows and recent clearing works undertaken on site.
Nest box installation	30 nest boxes installed in BOA prior to commencement of clearing. Remaining nest boxes installed within three months following completion of clearing.	Completed. A total of 318 nest boxes have been installed within the BOA. This includes' Thirty nest boxes installed in the southern part of the BOA in April 2015 prior to commencement of clearing, an additional 95 were installed in February 2018, and the installation of 193 nest boxes in July-August 2020 which were required for clearing completed in November 2019.
Nest box monitoring and maintenance	Nest boxes inspected every two years. Repairs / maintenance implemented within 6 months of biennial inspection.	Monitoring of nest box 1-30 was carried in April 2018. Monitoring of boxes 1-125 was carried out in June 2020.

#### Threatened Flora Translocation

Tetratheca juncea translocation	Translocation completed by end of year 1 Maintenance and monitoring undertaken in accordance with the TjMP	Refer to Tj Translocation Monitoring Report (Firebird 2018).

#### Weed Control

Baseline weed mapping	Completed by end of year 1	Baseline assessment completed in October 2015 (Kleinfelder 2015).
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Action	Performance Criteria	Current Status (2020)
Delineation of threatened flora prior to weed control works	No impacts on threatened flora populations within BOA from weed control activities.	N/A – no weed control works undertaken surrounding threatened species locations to date.
Weed control	20% reduction in extent or density (cover) of target weeds per year compared to baseline mapping by end of Year 3. Weed control activities do not impact on ecological values.	Outstanding There has been little change in weed density over the Lot 5 area since the 2018 monitoring round. Small area of Lantana along the creek line in Lot 14 was sprayed in September 2018. Substantial amount of dieback in this area has occurred by February 2019. Additional weed control was undertaken in February 2019. Further dieback was recorded in November 2019, so that only scattered individuals now occur. Weed control has been undertaken along the boundary fence of Lot 12 in February 2019, and along the entire parimeter of Lot 42 in November 2019.
		Further weed control is recommended to prevent the establishment of Lantana (low density areas) or control established patches (medium/high density areas).
Weed monitoring	Completed biennially (every two years) (for BOA). Completed annually (KEQ, 50 m buffer and Yalimbah Creek).	Weed mapping revisited for KEQ project area, adjoining vegetation within 50 m of the project area boundary on Lots 12 and 13, along Yalimbah Creek (Lot 12) and BOA in October 2020.

### Vertebrate Pest Management

Baseline vertebrate pest assessment	Completed by end of year 1	Baseline assessment completed in October 2015 (Kleinfelder 2015).
Vertebrate pest control	No non-target species affected by control works. Reduction in abundance of target species across BOA compared to baseline assessment.	Feral animal control was undertaken in February 2019.
Monitoring	Completed biennially (every two years).	Outstanding 2017 biennially vertebrate pest monitoring required. 1080 baiting is planned be undertaken within Lot 5 during December 2020.

### Fire Management

Fire management strategy	Completed by end of year 1	Outstanding A fire management strategy is to be prepared for the BOA.
Bushfire mitigation	Bushfire mitigation measures in the L&RMP adhered to at all times	Refer to KEQ Annual Environmental Report.

### Aerial Fauna Crossing

Installation of aerial fauna crossings	Installed upon completion of Haul Road. A 12-month monitoring program of the two aerial fauna crossings will be undertaken using remote motion sensing cameras mounted on each pole (four cameras in total) once the crossings have been installed.	Completed Aerial fauna crossings installed at Karuah Hardrock Quarry in 2019, and KEQ in 2020. Remote Camera monitoring programmes for both crossings have commenced.
	installed.	

Action	Performance Criteria	Current Status (2020)
Ecological Monitoring		
Additional baseline surveys	Completed prior to clearing	Baseline surveys completed (refer to Kleinfelder 2016).
Vegetation and threatened flora monitoring	Baseline ecological monitoring undertaken prior to clearing in year 1. Less than 10% decline in Tetratheca juncea, Grevillea parviflora subsp. parviflora and Asperula asthenes population sizes (at monitoring sites) compared to baseline assessment. No major changes in vegetation health or condition across BOA.	Baseline ecological monitoring completed (refer to Kleinfelder 2016). No major changes in vegetation health or condition were observed in the BOA in 2019. An average of 8% decline in threatened flora species at monitoring sites was observed during 2019 survey.

\*Criteria relating to revegetation within the project area is outlined in the Landscape and Rehabilitation Management Plan (L&RMP).


## 5 CONCLUSION

Results from the 2020 KEQ BOA annual monitoring indicate that the vegetation and fauna habitats within the Karuah East Biodiversity Offset Area (BOA) and Lot 12 are in good condition and remain relatively stable since 2019 and the baseline surveys completed in 2015.

The 2020 monitoring programme has identified several key management actions that are required to be completed, which have been highlighted in **Section 4** of this report. Key results from the 2020 monitoring programme include:

- Asperula asthenes, Tetratheca juncea and Grevillea parviflora subsp. parviflora populations are in good condition and have increased in size since annual monitoring in 2019, likely due to recent favourable weather conditions.
- Key disturbances recorded within the KEQ BOA and Lot 12 include minor sedimentation due to overtopping
  of a small number of sediment fences, and the occurrence of dust on foliage within close proximity to quarry
  operations.
- Weed coverage across the KEQ BOA and Lot 12 have remained largely stable management is required to reduce Lantana cover, especially within the northern portion of the site.
- Maintenance required to repair sediment fencing and remove fallen tree currently blocking access to a track in the south eastern corner of the site (Lot 13/Lot 14).
- Feral pigs were observed along the powerline easement in the northern portion of the site, along with signs of feral pig diggings near monitoring sites MP 3 and MP 4. Vertebrate pest management required, although it is understood that 1080 baiting is scheduled for December 2020.
- A total of 318 nest boxes have been installed to date across the KEQ BOA. Monitoring of nest boxes have been carried out in 2018 and 2020.



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# APPENDIX A VEGETATION CONDITION ASSESSMENT RESULTS





#### Table A1 Vegetation condition and threatened flora monitoring results summary (2020)

Site	Vegetation Community	Vegetation and Habitat Condition	Evidence of Disturbance	Threatened Flora Monitoring
MP3	Brush Box – Turpentine shrubby open forest	<ul> <li>No evidence of foliage die-back.</li> <li>All vegetation strata in healthy condition.</li> <li>Canopy and midstory regeneration present.</li> <li>High structural complexity of vegetation.</li> <li>Light-Moderate cover of fallen timber.</li> <li>No ephemeral pools within stream.</li> <li>Reduction in <i>Lantana camara</i> cover within the monitoring site.</li> <li>Scattered <i>Ageratina riparia</i> (Mistflower) within creek</li> </ul> Conclusion: No significant or notable changes in vegetation and habitat condition since the previous survey (2019).	<ul> <li>No evidence of erosion and sedimentation.</li> <li>No recent evidence of disturbance from grazing, pest animals, rubbish dumping, or rock / timber removal.</li> <li>Dust cover on foliage observed (see Section 3.2.1)</li> <li>No signs of recent fire.</li> </ul> Conclusion: No new disturbance or changes in existing disturbance severity were observed since the previous survey (2019).	<ul> <li>There was an increase in number of <i>Asperula asthenes</i> individuals within the monitoring site from 11 in 2019 to 19 in 2020.</li> <li>Three new <i>Asperula asthenes</i> plants were recorded in 2020.</li> <li>Seven <i>Asperula asthenes</i> plants were recorded flowering during monitoring.</li> <li>All <i>Asperula asthenes</i> plants within the monitoring site were observed to be in healthy condition.</li> <li>The population at MP 3 remains relatively stable since 2015 baseline (16 individuals recorded) and has likely benefited from recent more favourable weather conditions.</li> </ul>
MP4	Brush Box – Turpentine shrubby open forest	<ul> <li>Evidence of minor dieback in <i>Eucalyptus microcorys</i> (Tallowwood)</li> <li>Apart from the minor Tallowwood dieback all vegetation strata within the monitoring site in healthy condition.</li> <li>Canopy and midstory regeneration present.</li> <li>High structural complexity of vegetation.</li> <li>Reduction in groundcover due to recent disturbance likely from heavy rain events and feral pig diggings,</li> <li>High fallen timber.</li> <li>Weed cover (<i>Lantana</i> and <i>Tradescantia</i>) within the monitoring site and surrounds remains high.</li> </ul>	<ul> <li>Feral pigs observed within the vicinity of the monitoring site.</li> <li>Evidence of ground disturbance likely from recent heavy rains and feral pig diggings. Some minor erosion and reduction of groundcover occurring.</li> <li>No recent evidence of disturbance from grazing, rubbish dumping, rock / timber removal, or dust.</li> <li>No signs of recent fire.</li> </ul> Conclusion: Feral pigs and recent heavy rains have likely resulted in a reduction of groundcover and an increase in erosion on site. Feral pest control required.	<ul> <li>There was an increase in number of <i>Asperula asthenes</i> individuals recorded within the monitoring site, from 17 in 2019 to 38 in 2020.</li> <li>23 new <i>Asperula asthenes</i> individuals were recorded in 2020.</li> <li>Five <i>Asperula asthenes</i> plants were recorded flowering during monitoring.</li> <li>All <i>Asperula asthenes</i> plants within the monitoring site were observed to be in healthy condition.</li> <li>The population at MP 4 remains stable since 2015 baseline (15 individuals recorded) with recent large increase in population likely the result of recent more favourable weather conditions.</li> </ul>

Site	Vegetation Community	Vegetation and Habitat Condition	Evidence of Disturbance	Threatened Flora Monitoring
MP5	Blackbutt – Turpentine – Tallowwood shrubby open forest	<ul> <li>No evidence of foliage die-back was observed in the canopy or ground layer</li> <li>Canopy and midstory regeneration present.</li> <li>Moderate fallen logs / timber.</li> <li>Moderate/dense ground cover.</li> <li>Small reduction in mid-storey and groundcover PFC recorded within monitoring site.</li> </ul>	<ul> <li>No evidence of erosion and sedimentation.</li> <li>No recent evidence of disturbance from grazing, pest animals, rubbish dumping, rock / timber removal, or dust.</li> <li>No signs of recent fire.</li> </ul> Conclusion: No new disturbance or changes in existing disturbance severity were observed since the previous survey (2019).	N/A
MP6	Blackbutt – Turpentine – Tallowwood shrubby open forest	<ul> <li>Some evidence of foliage die-back in the midstory.</li> <li>Canopy in healthy condition.</li> <li>Canopy and midstory regeneration present.</li> <li>Moderate/High fallen logs / timber.</li> <li>Moderate level of groundcover.</li> <li>Standing pools within creek.</li> </ul> Conclusion: No significant changes in vegetation and habitat condition since the previous survey (2019).	<ul> <li>No evidence of erosion and sedimentation.</li> <li>Disturbance from tree falling (<i>Glochidion ferdinandi</i>) within western half of MP6.</li> <li>No recent evidence of disturbance from grazing, pest animals, rubbish dumping, or rock / timber removal was observed.</li> <li>Dust cover observed on foliage.</li> <li>No signs of recent fire.</li> </ul> Conclusion: Dust cover on foliage was observed within the monitoring site in 2020, previously not recorded.	N/A

Site	Vegetation Community	Vegetation and Habitat Condition	Evidence of Disturbance	Threatened Flora Monitoring
MP7	Smooth-barked Apple - Red Bloodwood open forest	<ul> <li>Minor evidence of foliage die-back in canopy or midstory.</li> <li>All vegetation strata in healthy condition.</li> <li>Canopy and midstory regeneration present.</li> <li>Regrowth vegetation to the north and east (previously cleared).</li> <li>Moderate litter cover within monitoring site, fallen timber present.</li> <li>Decrease in groundcover recorded within the monitoring site since 2019 (see Appendix B).</li> <li>Conclusion: There were only minor changes in vegetation and habitat condition since the previous survey (2019).</li> </ul>	<ul> <li>No evidence of erosion and sedimentation.</li> <li>No recent evidence of disturbance from grazing, pest animals, rubbish dumping, or rock / timber removal.</li> <li>Dust cover observed on foliage.</li> <li>No signs of recent fire.</li> </ul> Conclusion: Dust cover on foliage was observed within the monitoring site in 2020, previously not recorded.	<ul> <li>There was a small decrease in the number of <i>Tetratheca juncea</i> clumps recorded within the monitoring site, from 15 in 2019 to 14 in 2020.</li> <li>Two new <i>Tetratheca juncea</i> clumps were recorded in 2020.</li> <li>Nine <i>Tetratheca juncea</i> plants were recorded flowering during monitoring.</li> <li>Eight <i>Tetratheca juncea</i> plants were recorded with fruits during monitoring.</li> <li>All <i>Tetratheca juncea</i> plants within the monitoring site were observed to be in healthy condition.</li> <li>The <i>Tetratheca juncea</i> population at MP 7 remains stable since 2015 baseline (14 individuals recorded) with decrease of one individual is likely a natural occurrence.</li> </ul>
MP8	Smooth-barked Apple - Red Bloodwood open forest	<ul> <li>No dieback of canopy stratum was observed.</li> <li>Evidence of some die back in midstory stratum, especially Allocasuarina littoralis was observed.</li> <li>Canopy and midstorey regeneration present including regeneration of Eucalyptus eugenioides.</li> <li>Moderate fallen timber</li> <li>Dense ground cover and midstory</li> <li>Estimated foliage cover decreased for ground cover (Appendix B)</li> <li>Conclusion: Minor changes in vegetation and habitat condition since the previous survey (2019).</li> </ul>	<ul> <li>No evidence of erosion and sedimentation</li> <li>No recent evidence of disturbance from grazing, pest animals, rubbish dumping, rock / timber removal, or dust</li> <li>No signs of recent fire</li> <li>Old track to north-east</li> </ul> Conclusion: No new disturbance or changes in existing disturbance severity were observed since the previous survey (2019).	<ul> <li>There was a small increase in the number of <i>Tetratheca juncea</i> clumps recorded within the monitoring site, from 10 in 2019 to 11 in 2020.</li> <li>Two new <i>Tetratheca juncea</i> clumps were recorded in 2020.</li> <li>11 <i>Tetratheca juncea</i> plants were recorded flowering during monitoring.</li> <li>One <i>Tetratheca juncea</i> plant was recorded with fruits during monitoring.</li> <li>All <i>Tetratheca juncea</i> plants within the monitoring site were observed to be in healthy condition.</li> <li>The <i>Tetratheca juncea</i> population at MP 8 has increased slightly since 2015 baseline (eight individuals recorded).</li> <li>The one <i>Grevillea parviflora</i> subsp. <i>parviflora</i> individual occurring within MP 8 was recorded in 2020 to be in healthy condition and flowering during monitoring.</li> </ul>

Site	Vegetation Community	Vegetation and Habitat Condition	Evidence of Disturbance	Threatened Flora Monitoring
MP9	Smooth-barked Apple - Red Bloodwood open forest	<ul> <li>There was no sign of foliage die-back in the understory.</li> <li>Dead wood was observed throughout the canopy.</li> <li>Canopy and midstory regeneration present.</li> <li>Moderate/high fallen timber.</li> <li>Moderate ground cover present.</li> </ul>	<ul> <li>No evidence of erosion and sedimentation.</li> <li>No recent evidence of disturbance from grazing, pest animals, rock / timber removal, or dust.</li> <li>No recent evidence of rubbish dumping was present; however, some rubbish was present in the area.</li> <li>No signs of recent fire.</li> <li>Old track to south.</li> </ul> Conclusion: No new disturbance or changes in existing disturbance severity were observed since the previous survey (2019).	N/A
MP10	Sydney Peppermint - Smooth-barked Apple shrubby open forest	<ul> <li>Two <i>Eucalyptus piperita</i> were observed to have some natural foliage die-back in canopy cover.</li> <li>All vegetation strata in healthy condition.</li> <li>Canopy and midstory regeneration present.</li> <li>Low-moderate fallen timber and moderate litter coverage</li> <li>Moderate to dense ground cover.</li> </ul> Conclusion: No major changes in vegetation and habitat condition since the previous survey (2019).	<ul> <li>No evidence of erosion and sedimentation.</li> <li>No recent evidence of disturbance from grazing, pest animals, rubbish dumping, rock / timber removal, or dust.</li> <li>No signs of recent fire.</li> <li>Several old dead stags present.</li> <li>Some canopy gaps (from past clearing/logging).</li> <li>Conclusion: No new disturbance or changes in existing disturbance severity were observed since the previous survey (2019).</li> </ul>	N/A

Site	Vegetation Community	Vegetation and Habitat Condition	Evidence of Disturbance	Threatened Flora Monitoring
MP11	Sydney Peppermint - Smooth-barked Apple shrubby open forest	<ul> <li>No evidence of foliage die-back.</li> <li>All vegetation strata in healthy condition.</li> <li>Canopy and midstory regeneration present.</li> <li>Low fallen timber.</li> <li>Moderate Dense ground cover.</li> </ul> Conclusion: No significant or notable changes in vegetation and habitat condition since the previous survey (2019).	<ul> <li>No evidence of erosion and sedimentation.</li> <li>Previous disturbance from tree falling along North-North/East 20 metre buffer boundary.</li> <li>No recent evidence of disturbance from grazing, pest animals, rubbish dumping, rock / timber removal, or dust.</li> <li>No signs of recent fire.</li> </ul> Conclusion: No recent disturbance was observed since the previous survey (2019).	<ul> <li>There was a small increase in the number of <i>Grevillea parviflora</i> subsp. <i>parviflora</i> plants recorded within the monitoring site, from 12 in 2019 to 13 in 2020.</li> <li>Five new <i>Grevillea parviflora</i> subsp. <i>parviflora</i> plants were recorded in 2020.</li> <li>The majority of <i>Grevillea parviflora</i> subsp. <i>parviflora</i> plants within the monitoring site were observed to be in healthy condition.</li> <li>Two <i>Grevillea parviflora</i> subsp. <i>parviflora</i> plants were recorded as having moderate dieback.</li> <li>The <i>Grevillea parviflora</i> subsp. <i>parviflora</i> population at MP 11 has declined slightly since 2015 baseline (16 individuals recorded).</li> <li>One new <i>Tetratheca juncea</i> clump was recorded in MP 11 during the 2020 monitoring event.</li> <li>The one <i>Tetratheca juncea</i> clump recorded at MP 11 was in a healthy condition with two flowers and 16 fruit.</li> </ul>
MP12	Smooth-barked Apple – Red Bloodwood open forest	<ul> <li>Evidence of minor canopy die-back.</li> <li>Canopy and midstorey regeneration present.</li> <li>Midstorey reduced compared to surroundings.</li> <li>Very high levels of fallen timber (from clearing).</li> <li>Moderate ground cover.</li> <li>There has been a decrease in estimated foliage cover for each vegetation stratum (Appendix B).</li> </ul> Conclusion: Felled timber remains (from previous impact due to fence maintenance), however, no significant changes have occurred to vegetation and habitat condition since the previous survey (2019).	<ul> <li>No evidence of erosion and sedimentation.</li> <li>No recent evidence of disturbance from pest animals, rubbish dumping, rock / timber removal or dust, however area has been previously subject to clearing due to fence line maintenance.</li> <li>Some evidence of herbivory on shrub and ground layer.</li> <li>No signs of recent fire.</li> <li>Cleared grazing land 20 m to east adjacent to BOA with exotic grasses, but no weeds within BOA in this area.</li> </ul>	<ul> <li>There was a small increase in the number of <i>Grevillea parviflora</i> subsp. <i>parviflora</i> plants recorded within the monitoring site, from 8 in 2019 to 9 in 2020.</li> <li>All <i>Grevillea parviflora</i> subsp. <i>parviflora</i> plants within the monitoring site were observed to be in healthy condition.</li> <li>Five <i>Grevillea parviflora</i> subsp. <i>parviflora</i> plants were recorded with flowers in 2020.</li> <li>The <i>Grevillea parviflora</i> subsp. <i>parviflora</i> plants were recorded with flowers in 2020.</li> <li>The <i>Grevillea parviflora</i> subsp. <i>parviflora</i> population at MP 11 has increased slightly since 2015 baseline (seven individuals recorded).</li> </ul>

Site	Vegetation Community	Vegetation and Habitat Condition	Evidence of Disturbance	Threatened Flora Monitoring
MP13	Spotted Gum – Grey Ironbark open forest	<ul> <li>Moderate to high level of dieback observed within the canopy and mid-storey.</li> <li>Canopy and midstory regeneration present.</li> <li>Low-Moderate level of fallen logs / timber.</li> <li>Moderate to dense ground cover.</li> <li>Low rock cover.</li> <li>There has been a decrease in estimated foliage cover for each vegetation stratum (Appendix B).</li> </ul>	<ul> <li>No evidence of erosion and sedimentation.</li> <li>No recent evidence of disturbance from grazing, pest animals, rubbish dumping, rock / timber removal, or dust.</li> <li>No signs of recent fire.</li> </ul> Conclusion: No evidence of new disturbance was observed since the previous survey (2019).	N/A
MP14	Smooth-barked Apple - Red Bloodwood open forest	<ul> <li>Minor recovery observed to previous die-back of foliage in one <i>Eucalyptus eugenioides</i> and one <i>Eucalyptus paniculata</i>.</li> <li>All vegetation strata in healthy condition.</li> <li>Canopy and midstorey regeneration present.</li> <li>Low fallen/ timber.</li> <li>Dense ground cover.</li> <li>No changes in estimated foliage cover for any of the vegetation stratum. (Appendix B).</li> </ul> Conclusion: No significant or notable changes in vegetation and habitat condition since the previous survey (2019).	<ul> <li>No evidence of erosion and sedimentation.</li> <li>No recent evidence of disturbance from grazing, pest animals, rubbish dumping, or rock / timber removal.</li> <li>No signs of recent fire.</li> <li>Exotic grasses around dam to south and along access track.</li> </ul> Conclusion: No evidence of new disturbance was observed since the previous survey (2019).	N/A

Site	Vegetation Community	Vegetation and Habitat Condition	Evidence of Disturbance	Threatened Flora Monitoring
MP15	Blackbutt - Turpentine - Tallowwood shrubby open forest	<ul> <li>Foliage die-back previously observed in <i>Acacia irrorata</i> not observed during the 2020 monitoring event.</li> <li>All vegetation strata in moderately healthy condition.</li> <li>Canopy and midstorey regeneration present.</li> <li>Regrowth vegetation to the north and east (previously cleared).</li> <li>Moderate-High fallen timber.</li> <li>Moderate ground cover and leaf litter.</li> <li>Rocky areas present.</li> <li>No changes in estimated foliage cover for any of the vegetation stratum. (Appendix B).</li> </ul>	<ul> <li>No evidence of erosion and sedimentation.</li> <li>There are some edge effects from adjacent clearing.</li> <li>No recent evidence of disturbance from grazing, pest animals, rubbish dumping, or rock / timber removal.</li> <li>No signs of recent fire.</li> </ul> Conclusion: Dust cover on foliage was observed within the monitoring site in 2020, previously not recorded.	<ul> <li>There was a small decrease in the number of <i>Tetratheca juncea</i> clumps recorded within the monitoring site, from 13 in 2019 to 9 in 2020.</li> <li>One new <i>Tetratheca juncea</i> clump was recorded in 2020.</li> <li>Nine <i>Tetratheca juncea</i> plants were recorded flowering during monitoring.</li> <li>Eight <i>Tetratheca juncea</i> plants were recorded with fruits during monitoring.</li> <li>All <i>Tetratheca juncea</i> plants within the monitoring site were observed to be in healthy condition.</li> <li>The <i>Tetratheca juncea</i> population at MP 15 has declined since 2015 baseline (30 individuals recorded) with decrease of one individual is likely a natural occurrence. This decline in the <i>T. juncea</i> at MP 15 is most likely due to the lower than average rainfall during the past couple of years, exacerbated by the location of the monitoring point; upper slopes of exposed hill side.</li> </ul>
MP16	Spotted Gum – Grey Ironbark open forest	<ul> <li>All vegetation strata in healthy condition.</li> <li>Canopy and midstory regeneration present.</li> <li>Moderate fallen timber.</li> <li>Dense leaf litter and moderate ground cover.</li> <li>Low rock cover.</li> <li>There has been minor declines in cover for mid-storey and ground cover strata (Appendix B).</li> </ul> Conclusion: Some minor changes in vegetation and habitat condition since the previous survey (2019).	<ul> <li>No evidence of erosion and sedimentation.</li> <li>No recent evidence of disturbance from grazing, pest animals, rubbish dumping, rock / timber removal, or dust.</li> <li>No signs of recent fire.</li> <li>Several old dead stags present.</li> </ul>	N/A

Site	Vegetation Community	Vegetation and Habitat Condition	Evidence of Disturbance	Threatened Flora Monitoring
MP17	Brush Box - Turpentine shrubby open forest	<ul> <li>No evidence of foliage die-back, evidence of midstorey and canopy regeneration.</li> <li>All vegetation strata in healthy condition.</li> <li>Canopy and midstorey regeneration present.</li> <li>High fallen timber.</li> <li>Dense ground cover.</li> <li>Rocky areas along ephemeral creek.No changes in estimated foliage cover for each vegetation stratum (Appendix B).</li> <li>Conclusion: No significant or notable changes in vegetation and habitat condition since the previous survey (2019).</li> </ul>	<ul> <li>Very minor scouring along creek bank.</li> <li>No recent evidence of disturbance from grazing, pest animals, rubbish dumping, rock / timber removal, or dust.</li> <li>No signs of recent fire.</li> </ul> Conclusion: No evidence of new disturbance was observed since the previous survey (2019).	<ul> <li>There was an increase in number of <i>Asperula asthenes</i> individuals within the monitoring site from 7 in 2019 to 19 in 2020.</li> <li>15 new <i>Asperula asthenes</i> plants were recorded in 2020.</li> <li>Five <i>Asperula asthenes</i> plants were recorded flowering during monitoring.</li> <li>All <i>Asperula asthenes</i> plants within the monitoring site were observed to be in healthy condition.</li> <li>The population at MP 17 has increased since 2015 baseline (11 individuals recorded) likely as a result of recent more favourable weather conditions.</li> </ul>
MP18	Brush Box - Turpentine shrubby open forest	<ul> <li>Minor evidence of foliage die-back, however signs of recovery present.</li> <li>All vegetation strata in healthy condition</li> <li>Canopy and midstorey regeneration present</li> <li>Low fallen timber</li> <li>High level of leaf litter present.</li> <li>Moderate ground cover</li> <li>Rocky areas along ephemeral creek.</li> <li>There was a (10%) decrease from the previous year in ground cover.</li> <li>Decline in groundcover estimated foliage cover since the 2019 monitoring event (Appendix B).</li> </ul>	<ul> <li>Very minor scouring along creek bank.</li> <li>No recent evidence of disturbance from grazing, pest animals, rubbish dumping, or rock / timber removal.</li> <li>Minor dust coverage on foliage.</li> <li>No signs of recent fire.</li> </ul> Conclusion: No evidence of new disturbance was observed since the previous survey (2019).	<ul> <li>There was an increase in number of <i>Asperula asthenes</i> individuals within the monitoring site from 8 in 2019 to 9 in 2020.</li> <li>Three new <i>Asperula asthenes</i> plants were recorded in 2020.</li> <li>One <i>Asperula asthenes</i> plant was recorded flowering during monitoring.</li> <li>All <i>Asperula asthenes</i> plants within the monitoring site were observed to be in healthy condition.</li> <li>The population at MP 18 has declined slightly since 2015 baseline (13 individuals recorded). Previous years of below average rainfall have likely impacted this population, however with signs of plants reshooting and flowering, as well as plants sighted outside the monitoring point, this population has potential to recover.</li> </ul>

# APPENDIX B VEGETATION MONITORING DATA





### Table B1 Projected Foliage Cover results summary (2015-2020)

Monitoring		Dominant Floristics		Pro	jected Foli	age Cover	· (%)	
Site			2015	2016	2017	2018	2019	2020
	Canopy	<i>Eucalyptus propinqua</i> (Small-fruited Grey Gum), <i>E. microcorys</i> (Tallowwood), <i>E. acmenoides</i> (White Mahogany) and <i>Corymbia maculata</i> (Spotted Gum)	50%	50%	50%	50%	50%	40%
	Midstorey	Allocasuarina torulosa (Forest Oak), Glochidion ferdinandi var. ferdinandi (Cheese Tree) and Breynia oblongifolia (Coffee Bush)	40%	40%	40%	40%	40%	15%
MP 1	Shrub	<i>Leucopogon juniperinus</i> (Prickly Beardheath), <i>Hibbertia aspera</i> (Rough Guinea Flower) and <i>Breynia oblongifolia</i> (Coffee Bush)	5%	5%	5%	5%	5%	5%
	Ground (grass)	Imperata cylindrica (Blady Grass), Oplismenus aemulus (Australian Basket Grass), Poa labillardierei (Tussock) and Themeda triandra (Kangaroo Grass)	60%	60%	60%	60%	40%	20%
	Ground (other)	Lomandra longifolia (Spiny-headed Mat- rush), Carex longebrachiata and Adiantum aethiopicum (Common Maidenhair)	50%	50%	50%	50%	50%	20%
	Exotic	Lantana camara (Lantana)	30%	30%	25%	25%	20%	10%
	Canopy	Corymbia maculata (Spotted Gum), Eucalyptus microcorys (Tallowwood), E. canaliculata (Grey Gum) and E. paniculata subsp. paniculata (Grey Ironbark)	40%	40%	40%	40%	40%	40%
	Midstorey	Allocasuarina torulosa (Forest Oak), Bursaria spinosa (Blackthorn) and Exocarpos cupressiformis (Cherry Ballart)	40%	35%	35%	35%	35%	30%
MP 2	Shrub	Leucopogon juniperinus (Prickly Beardheath) and Acacia ulicifolia (Prickly Moses)	5%	5%	5%	5%	5%	10%
	Ground (grass)	Themeda triandra (Kangaroo Grass) and Poa labillardierei (Tussock)	50%	50%	50%	50%	40%	25%
	Ground (other)	Lomandra longifolia (Spiny-headed Mat- rush), Gonocarpus tetragynus and Eustrephus latifolius (Wombat Berry)	20%	20%	20%	20%	40%	5%
	Exotic	Lantana camara (Lantana)	5%	5%	1%	1%	1%	0%
	Canopy	Lophostemon confertus (Brush Box), Syncarpia glomulifera (Turpentine), Eucalyptus propinqua (Small-fruited Grey Gum) and E. microcorys (Tallowwood)	40%	40%	40%	40%	40%	35%
MP 3	Midstorey	Melaleuca styphelioides (Prickly-leaved Tea Tree), Livistona australis (Cabbage Palm), Allocasuarina torulosa (Forest Oak) and Elaeocarpus obovatus (Hard Quandong)	60%	60%	60%	60%	60%	40%
	Shrub	<i>Pittosporum multiflorum</i> (Orange Thorn), <i>Diospyros australis</i> (Black Plum) and Bursaria spinosa (Boxthorn)	40%	40%	50%	50%	60%	60%
	Ground (grass)	<i>Oplismenus aemulus</i> (Australian Basket Grass)	<5%	<5%	<5%	<5%	<5%	<5%

Monitoring	Dominant Floristics		Projected Foliage Cover (%)					
Site			2015	2016	2017	2018	2019	2020
	Ground (other)	Doodia aspera (Prickly Rasp Fern), Carex longebrachiata, Adiantum hispidulum (Rough Maidenhair Fern) and Cissus antarctica (Kangaroo Vine)	90%	90%	90%	90%	90%	65%
	Exotic	Lantana camara (Lantana) and Ageratina riparia (Mistflower)	50%	50%	50%	50%	40%	20%
MP 4	Canopy	Lophostemon confertus (Brush Box), Syncarpia glomulifera (Turpentine), and Eucalyptus propinqua (Small-fruited Grey Gum)	30%	30%	30%	30%	40%	25%
	Midstorey	Glochidion ferdinandi var. ferdinandi (Cheese Tree), Melaleuca styphelioides (Prickly-leaved Tea Tree), Acmena smithii (Lilly Pilly) and Elaeocarpus obovatus (Hard Quandong)	60%	60%	60%	60%	60%	60%
	Shrub	Pittosporum multiflorum (Orange Thorn)	5%	5%	3%	3%	3%	20%
	Ground (grass)	<i>Oplismenus aemulus</i> (Australian Basket Grass)	5%	5%	5%	5%	5%	15%
	Ground (other)	Doodia aspera (Prickly Rasp Fern), Morinda jasminoides (Sweet Morinda) and Carex longebrachiata	90%	90%	90%	90%	90%	20%
	Exotic	Lantana camara (Lantana), Asparagus aethiopicus (Ground Asparagus) and Tradescantia fluminensis (Wandering Jew)	35%	35%	25%	30%	30%	30%
MP 5	Canopy	Eucalyptus pilularis (Blackbutt), E. microcorys (Tallowwood), Angophora costata (Smooth-barked Apple) and E. globoidea (White Stringybark)	40%	40%	40%	40%	40%	40%
	Midstorey	Allocasuarina torulosa (Forest Oak), Glochidion ferdinandi var. ferdinandi (Cheese Tree), Persoonia linearis (Narrow- leaved Geebung) and Melaleuca linariifolia (Flax-leaved Paperbark)	60%	60%	60%	60%	60%	40%
	Shrub	Leptospermum polygalifolium (Tantoon), Breynia oblongifolia (Coffee Bush) and Phyllanthus hirtellus (Thyme Spurge)	5%	5%	10%	10%	10%	10%
	Ground (grass)	<i>Entolasia stricta</i> (Wiry Panic) and <i>Oplismenus imbecillis</i> (Creeping Beard Grass)	60%	60%	60%	60%	60%	40%
	Ground (other)	Doryanthes excelsa (Gymea Lily), Pteridium esculentum (Common Bracken) and Lomandra longifolia (Spiny-headed Mat-rush)	50%	50%	50%	50%	50%	50%
	Exotic	Nil	-	-	-	-	-	-
MP 6	Canopy	Eucalyptus microcorys (Tallowwood), E. propinqua (Small-fruited Grey Gum), Corymbia gummifera (Red Bloodwood) and Eucalyptus pilularis (Blackbutt)	50%	50%	50%	50%	50%	45%

Monitoring	Dominant Floristics		Projected Foliage Cover (%)					
Site			2015	2016	2017	2018	2019	2020
	Midstorey	Melaleuca styphelioides (Prickly-leaved Tea Tree), Allocasuarina torulosa (Forest Oak), Acmena smithii (Lilly Pilly), Zieria smithii (Sandfly Zieria) and Backhousia myrtifolia (Grey Myrtle), Acacia sp.	60%	60%	50%	55%	30%	20%
	Shrub	<i>Hibbertia aspera</i> (Rough Guinea Flower), <i>Breynia oblongifolia</i> (Coffee Bush)	<5%	<5%	<5%	5%	1%	5%
	Ground (grass)	Imperata cylindrica (Blady Grass), Oplismenus imbecillis (Creeping Beard Grass) and Poa labillardierei (Tussock)	20%	20%	20%	20%	20%	20%
	Ground (other)	Lomandra longifolia (Spiny-headed Mat- rush), Doryanthes excelsa (Gymea Lily), Adiantum aethiopicum (Common Maidenhair) and Morinda jasminoides (Sweet Morinda)	30%	30%	30%	30%	30%	30%
	Exotic	Lantana camara (Lantana)	-	-	-	-	-	-
MP 7	Canopy	Angophora costata (Smooth-barked Apple), <i>Eucalyptus eugenioides</i> (Thin- leaved Stringybark) and <i>Corymbia</i> <i>gummifera</i> (Red Bloodwood)	35%	35%	35%	35%	35%	40%
	Midstorey	Allocasuarina littoralis (Black She-oak), Leptospermum polygalifolium (Tantoon) and Allocasuarina torulosa (Forest Oak)	40%	40%	40%	40%	40%	40%
	Shrub	Pultenaea euchila (Orange Pultenaea)	5%	5%	5%	5%	5%	5%
	Ground (grass)	Themeda triandra (Kangaroo Grass) and Entolasia stricta (Wiry Panic)	50%	50%	50%	50%	40%	25%
	Ground (other)	Lomandra longifolia (Spiny-headed Mat- rush) and Gahnia radula	70%	60%	60%	60%	60%	35%
	Exotic	Setaria sphacelata (South African Pigeon Grass)	5%	5%	5%	5%	2%	2%
MP 8	Canopy	Angophora costata (Smooth-barked Apple), <i>Eucalyptus eugenioides</i> (Thin- leaved Stringybark) and <i>Corymbia</i> <i>gummifera</i> (Red Bloodwood)	30%	30%	30%	30%	30%	30%
	Midstorey	Allocasuarina littoralis (Black She-oak), Leptospermum polygalifolium (Tantoon) and Acacia longifolia (Sydney Golden Wattle)	50%	50%	50%	50%	30%	40%
	Shrub	Pultenaea paleacea (Chaffy Bush-pea), Pultenaea euchila (Orange Pultenaea), Phyllanthus hirtellus (Thyme Spurge), Hibbertia riparia (Erect Guinea-flower) and Hibbertia aspera (Rough Guinea Flower)	20%	20%	20%	20%	15%	15%
	Ground (grass)	Entolasia stricta (Wiry Panic) and Themeda triandra (Kangaroo Grass)	50%	50%	50%	50%	40%	40%
	Ground (other)	Lomandra longifolia (Spiny-headed Mat- rush), Ptilothrix deusta, Patersonia sericea (Silky Purple-flag) and Lomandra obliqua	50%	50%	50%	50%	50%	40%
	Exotic	Nil	-	-	-	-	-	-

Monitoring	Dominant Floristics		Projected Foliage Cover (%)					
Site			2015	2016	2017	2018	2019	2020
MP 9	Canopy	Angophora costata (Smooth-barked Apple), Corymbia gummifera (Red Bloodwood), Eucalyptus microcorys (Tallowwood) and E. eugenioides (Thin- leaved Stringybark)	40%	40%	40%	40%	40%	40%
	Midstorey	Allocasuarina littoralis (Black She-oak), Dodonaea triquetra (Large-leaf Hop-bush) and Persoonia linearis (Narrow-leaved Geebung), Polyscias sambucifolia (Elderberry Panax)	50%	50%	50%	50%	50%	40%
	Shrub	Leptospermum polygalifolium (Tantoon), Pultenaea euchila (Orange Pultenaea), Logania albiflora and Polyscias sambucifolia (Elderberry Panax)	10%	10%	10%	10%	7%	7%
	Ground (grass)	Imperata cylindrica (Blady Grass), Entolasia stricta (Wiry Panic) and Themeda triandra (Kangaroo Grass)	30%	30%	40%	40%	40%	30%
	Ground (other)	Lomandra longifolia (Spiny-headed Mat- rush), Pteridium esculentum (Common Bracken) and Ptilothrix deusta	60%	60%	60%	50%	40%	40%
	Exotic	Nil	-	-	-	-	-	-
MP 10	Canopy	Eucalyptus piperita (Sydney Peppermint), Angophora costata (Smooth-barked Apple), Corymbia gummifera (Red Bloodwood) and Eucalyptus microcorys (Tallowwood)	40%	40%	40%	35%	35%	40%
	Midstorey	Allocasuarina littoralis (Black She-oak), Persoonia linearis (Narrow-leaved Geebung) and A. torulosa (Forest Oak)	10%	10%	10%	10%	10%	10%
	Shrub	Pultenaea euchila (Orange Pultenaea), Leptospermum polygalifolium (Tantoon), Pultenaea paleacea (Chaffy Bush-pea) and Acacia ulicifolia (Prickly Moses)	5%	5%	5%	5%	5%	3%
	Ground (grass)	Entolasia stricta (Wiry Panic), Themeda triandra (Kangaroo Grass) and Imperata cylindrica (Blady Grass)	40%	40%	40%	40%	30%	40%
	Ground (other)	Gahnia radula, Doryanthes excelsa (Gymea Lily), Lomandra longifolia (Spiny- headed Mat-rush) and Ptilothrix deusta	60%	60%	60%	60%	50%	40%
	Exotic	Nil	-	-	-	-	-	-
MP 11	Canopy	Angophora costata (Smooth-barked Apple), Corymbia gummifera (Red Bloodwood) and Eucalyptus capitellata (Brown Stringybark)	35%	35%	35%	35%	35%	35%
	Midstorey	Allocasuarina littoralis (Black She-oak), Glochidion ferdinandi var. ferdinandi (Cheese Tree), Leptospermum polygalifolium (Tantoon) and Banksia spinulosa (Hairpin Banksia)	40%	40%	40%	40%	40%	40%
	Shrub	Pultenaea paleacea (Chaffy Bush-pea) and Boronia pinnata	5%	5%	5%	5%	5%	5%

Monitoring		Dominant Floristics	Projected Foliage Cover (%)							
Site			2015	2016	2017	2018	2019	2020		
	Ground (grass)	Entolasia stricta (Wiry Panic), Imperata cylindrica (Blady Grass) and Themeda triandra (Kangaroo Grass)	35%	35%	40%	40%	30%	25%		
	Ground (other)	Xanthorrhoea latifolia, Pteridium esculentum (Common Bracken) and Ptilothrix deusta, Doryanthes excelsa (Gymea Lily)	60%	60%	60%	60%	50%	40%		
	Exotic	Nil	-	-	-	-	-	-		
MP 12	Canopy	Eucalyptus pilularis (Blackbutt), Angophora costata (Smooth-barked Apple), E. globoidea (White Stringybark), Corymbia gummifera (Red Bloodwood), E. microcorys (Tallowwood) and E. piperita (Sydney Peppermint)	40%	40%	40%	40%	40%	35%		
	Midstorey	Leptospermum polygalifolium (Tantoon), Allocasuarina littoralis (Black She-oak), Glochidion ferdinandi var. ferdinandi (Cheese Tree) and Exocarpos cupressiformis (Cherry Ballart)	30%	30%	30%	30%	30%	15%		
	Shrub	Pultenaea euchila (Orange Pultenaea), Boronia pinnata and Banksia spinulosa (Hairpin Banksia)	10%	10%	10%	5%	10%	5%		
	Ground (grass)	Themeda triandra (Kangaroo Grass), Entolasia stricta (Wiry Panic), and Austrostipa sp.	40%	40%	40%	30%	30%	20%		
	Ground (other)	Xanthorrhoea latifolia and Ptilothrix deusta	40%	40%	40%	30%	30%	10%		
	Exotic	Nil	-	-	-	-	-	-		
MP 13	Canopy	<i>Eucalyptus sparsifolia</i> (Narrow-leaved Stringybark), <i>Corymbia maculata</i> (Spotted Gum), <i>E. paniculata</i> (Grey Ironbark) and <i>E. microcorys</i> (Tallowwood)	40%	40%	40%	40%	50%	25%		
	Midstorey	Allocasuarina torulosa (Forest Oak), Syncarpia glomulifera (Turpentine) and Callistemon salignus (Willow Bottlebrush)	40%	40%	40%	40%	40%	10%		
	Shrub	<i>Hibbertia aspera</i> (Rough Guinea Flower) and <i>Pultenaea euchila</i> (Orange Pultenaea), <i>Breynia oblongifolia</i> (Coffee Bush)	5%	5%	5%	5%	5%	2%		
	Ground (grass)	Imperata cylindrica (Blady Grass), Poa labillardierei (Tussock), Themeda triandra (Kangaroo Grass) and Oplismenus imbecillis (Creeping Beard Grass)	60%	60%	60%	70%	70%	60%		
	Ground (other)	Lomandra longifolia (Spiny-headed Mat- rush), Doryanthes excelsa (Gymea Lily), Lepidosperma laterale and Patersonia sericea, Lomandra multiflora (Many- flowered Mat-rush)	30%	30%	40%	40%	40%	30%		
	Exotic	Nil	-	-	-	-	-	-		

Monitoring		Dominant Floristics	Projected Foliage Cover (%)						
Site			2015	2016	2017	2018	2019	2020	
MP 14	Canopy	Angophora costata (Smooth-barked Apple), Eucalyptus eugenioides (Thin- leaved Stringybark), E. microcorys (Tallowwood), and E. paniculata subsp. paniculata (Grey Ironbark)	35%	40%	40%	40%	40%	40%	
	Midstorey	Allocasuarina torulosa (Forest Oak), Callistemon salignus (Willow Bottlebrush) and Glochidion ferdinandi (Cheese Tree)	25%	25%	25%	25%	25%	25%	
	Shrub	Leucopogon juniperinus (Prickly Beard- heath), Pultenaea villosa (Hairy Bush-pea), Leptospermum polygalifolium (Tantoon) and Hibbertia aspera (Rough Guinea Flower)	10%	15%	15%	15%	15%	15%	
	Ground (grass)	Themeda triandra (Kangaroo Grass), Poa labillardierei (Tussock) and Entolasia stricta (Wiry Panic)	80%	80%	80%	80%	80%	80%	
	Ground (other)	<i>Lomandra longifolia</i> (Spiny-headed Mat- rush), <i>Doryanthes excelsa</i> (Gymea Lily) and <i>Brunoniella pumilio</i> (Dwarf Blue Trumpet)	30%	30%	30%	30%	30%	30%	
	Exotic	Setaria sphacelata (South African Pigeon Grass)	5%	5%	5%	5%	2%	2%	
MP 15	Canopy	Eucalyptus pilularis (Blackbutt), Angophora costata (Smooth-barked Apple), Corymbia gummifera (Red Bloodwood) and E. microcorys (Tallowwood)	45%	45%	45%	45%	45%	45%	
	Midstorey	Allocasuarina littoralis (Black She-oak) and Acacia irrorata (Green Wattle)	20%	20%	15%	15%	15%	15%	
	Shrub	Hibbertia vestita (Hairy Guinea Flower), Breynia oblongifolia (Coffee Bush) and Phyllanthus gunnii (Scrubby Spurge)	10%	10%	10%	10%	10%	10%	
	Ground (grass)	Themeda triandra (Kangaroo Grass), Entolasia stricta (Wiry Panic) and Imperata cylindrica (Blady Grass)	30%	30%	30%	30%	25%	25%	
	Ground (other)	Doryanthes excelsa (Gymea Lily), Lomandra longifolia (Spiny-headed Mat- rush), Pteridium esculentum (Common Bracken), Lepidosperma laterale and Xanthorrhoea macronema	60%	60%	60%	60%	50%	50%	
	Exotic	Lantana camara (Lantana)	5%	5%	1%	1%	1%	1%	
MP 16	Canopy	<i>Eucalyptus pilularis</i> (Blackbutt), <i>E. propinqua</i> (Small-fruited Grey Gum), <i>E. microcorys</i> (Tallowwood) and <i>Angophora costata</i> (Smooth-barked Apple)	50%	50%	50%	50%	50%	50%	
	Midstorey	Allocasuarina torulosa (Forest Oak), Syncarpia glomulifera (Turpentine) and Glochidion ferdinandi var. ferdinandi (Cheese Tree)	30%	30%	30%	30%	30%	30%	
	Shrub	<i>Leucopogon juniperinus</i> (Prickly Beardheath) and <i>Acacia floribunda</i> (White Sally Wattle)	10%	10%	10%	10%	10%	10%	

Monitoring		Dominant Floristics	Projected Foliage Cover (%)							
Site			2015	2016	2017	2018	2019	2020		
	Ground (grass)	Poa labillardierei (Tussock), Imperata cylindrica (Blady Grass), and Oplismenus imbecillis (Creeping Beard Grass)	50%	50%	40%	40%	30%	25%		
	Ground (other)	Carex appressa (Tall Sedge), Doodia aspera (Prickly Rasp Fern), Lomandra longifolia (Spiny-headed Mat-rush) and Calochlaena dubia (Rainbow Fern)	30%	30%	40%	40%	30%	20%		
	Exotic	Lantana camara (Lantana)	30%	30%	30%	40%	30%	30%		
MP 17	Canopy	Eucalyptus pilularis (Blackbutt), E. microcorys (Tallowwood), Syncarpia glomulifera (Turpentine), E. acmenoides (White Mahogany) and E. propinqua (Small-fruited Grey Gum)	40%	40%	40%	40%	40%	45%		
	Midstorey	Backhousia myrtifolia (Grey Myrtle), Lophostemon confertus (Brush Box), Livistona australis (Cabbage Palm), Acmena smithii (Lilly Pilly) and Allocasuarina torulosa (Forest Oak)	50%	50%	50%	50%	50%	50%		
	Shrub	Wilkiea huegeliana (Veiny Wilkiea), Acacia maidenii (Maiden's Wattle), Eupomatia laurina (Bolwarra) and Pittosporum multiflorum (Orange Thorn)	5%	5%	5%	5%	5%	5%		
	Ground (grass)	Poa labillardierei (Tussock), Themeda triandra (Kangaroo Grass) and Entolasia marginata (Bordered Panic)	40%	40%	40%	40%	40%	25%		
	Ground (other)	<i>Doodia aspera</i> (Prickly Rasp Fern), <i>Lomandra longifolia</i> (Spiny-headed Mat- rush) and <i>Gymnostachys anceps</i> (Settlers' Twine)	50%	50%	50%	50%	50%	65%		
	Exotic	Lantana camara (Lantana)	10%	15%	15%	15%	15%	15%		
MP 18	Canopy	<i>Eucalyptus saligna</i> (Sydney Blue Gum), <i>E.</i> <i>microcorys</i> (Tallowwood), <i>Syncarpia</i> <i>glomulifera</i> (Turpentine), and <i>E. acmenoides</i> (White Mahogany)	45%	45%	45%	45%	45%	45%		
	Midstorey	Lophostemon confertus (Brush Box), Backhousia myrtifolia (Grey Myrtle), Cryptocarya glaucescens (Jackwood), Allocasuarina torulosa (Forest Oak) and Acacia irrorata (Green Wattle)	25%	25%	25%	25%	25%	25%		
	Shrub	Acacia maidenii (Maiden's Wattle) and Denhamia silvestris (Narrow-leaved Orangebark), Persoonia linearis (Narrow- leaved Geebung)	5%	5%	5%	5%	5%	5%		
	Ground (grass)	Poa labillardierei (Tussock), Imperata cylindrica (Blady Grass), and Oplismenus imbecillis (Creeping Beard Grass)	50%	50%	50%	50%	40%	15%		
	Ground (other)	<i>Doodia aspera</i> (Prickly Rasp Fern), <i>Lomandra longifolia</i> (Spiny-headed Mat- rush) and <i>Gymnostachys anceps</i> (Settlers' Twine)	50%	50%	50%	50%	40%	30%		
	Exotic	Lantana camara (Lantana)	10%	15%	15%	15%	15%	15%		

### APPENDIX C RESULTS

# THREATENED FLORA MONITORING





### Biodiversity Offset Area Monitoring Sites

### Monitoring Point 3 Asperula asthenes monitoring results

ID	Distance	Bearing			Clump S	ize (cm)			Flowers/Fruit Present	Comments
			2015	2016	2017	2018	2019	2020		
ЗA	160	140	30 x 25	70 x 40	10 x 5	30 x 10	-	-		merged with 3C
3B	280	150	20 x 25	-	5 x 5	-	-	-		not found
3C	160	120	40 x 30	40 x 30	170 x 90	200 x 50	110 x 110	110x110	Flowers and Buds	several large clumps
3D	460	110	50 x 20	30 x 20	-	-	-	-	-	Dense litter
3E	500	110	55 x 30	30 x 30	45 x 40	5 x 5	-	-	None	Found small
3F	530	105	50 x 10	30 x 30	60 x 20	60 x 20	80 x 60	100x60	Fruit and Buds	
3G	590	115	25 x 35	25 x 40	170 x 80	-	10 x 5	10x5	None	New shoots
ЗH	650	110	20 x 20	40 x 20	-	100 x 100	60 x 40	20x40	None	Some dieback and new shoots
31	690	130	40 x 25	30 x 20	-	-	-	-		Not found
3J	780	120	35 x 20	20 x 20	-	80 x 50	-	-		Not found
ЗK	850	120	30 x 30	30 x 30	60 x 15	-	10 x 5	-		Overgrown
3L	900	145	35 x 45	20 x 10	-	-	-	10x10		not found, dense litter
ЗM	680	260	40 x 35	40 x 35	25 x 30	40 x 20	60 x 40	40x2		buds, new shoots
3N	790	270	30 x 25	30 x 20	-	-	120 x 50	20x6		Two stems
30	990	300	55 x 25	-	-	20 x 5	-	50x30		-
3P	240	90	40 x 20	40 x 15	40 x 15	40 x 20	150 x 90	-		-
3Q	590	105	-	40 x 10	-	-	-	50x30	Flowers and Buds	12 Stems
3R	930	115	-	30 x 30	-	-	-	-		not found
3S	700	275	-	20 x 30	5 x 5	-	-	-		not found, dense litter
3T	300	80	-	-	5 x 25	-	-	-		merged with 3P

ID	Distance	Bearing			Clump Si	ize (cm)		Flowers/Fruit Present	Comments	
			2015	2016	2017	2018	2019	2020		
3U	800	280	-	-	30 x 20	50 x 20	30 x 30	30x30	Flowers	
3V	800	105	-	-	-	5 x 5	-	-		not found, fallen branches
3W	780	115	-	-	-	80 x 50	80 x 30	40x30		5 stems, new shoots
3X	770	125	-	-	-	5 x 5	-	-		not found
3Y	85	125	-	-	-	-	40 x 60	30x10	Flowers and Buds	new, multiple stems
3Z	780	280	-	-	-	-	-	20x20		
ЗАА	710	265	-	-	-	-	-	10x10		
3AB	910	235	-	-	-	-	-	30x30		Large plant







### Monitoring Point 4 Asperula asthenes monitoring results

ID	Distance	Bearing			Clump S	ize (cm)			Flowers/Fruit Present	Comments
			2015	2016	2017	2018	2019	2020		
4A	160	195	30 x 20	30 x 20	5 x 5	-	-	-	-	not found
4B	620	215	55 x 20	45 x 25	-	20 x 10	-	-	-	not found
4C	660	215	30 x 15	30 x 30	-	5 x 5	-	10x5	None	not found, dense litter
4D	630	220	20 x 20	20 x 20	-	20 x 10	45 x 45	45x45	None	-
4E	760	220	65 x 20	40 x 20	10 x 5	-	10 x 5	10x5	Buds	-
4F	810	210	70 x 45	70 x 40	10 x 5	-	-	-	-	not found
4G	940	205	40 x 15	50 x 10	30 x 10	5 x 10	70 x 50	40x40	None	-
4H	740	205	50 x 30	50 x 30	20 x 10	40 x 30	50 x 40	50x40	Fruit	-
41	740	200	80 x 15	60 x 40	-	5 x 10	-	-	-	not found
4J	110	325	80 x 30	60 x 30	70 x 10	10 x 70	100 x 80	40x20	-	Multiple Stems
4K	890	25	30 x 30	40 x 30	60 x 60	-	-	-	-	not found
4L	920	20	55 x 35	50 x 25	50 x 30	5 x 3	-	-	-	not found
4M	210	105	115 x 30	90 x 40	90 x 10	-	-	-	-	not found
4N	840	185	110 x 30	100 x 40	50 x 10	40 x 30	40 x 25	15x10	none	one clump remaining
40	590	70	40 x 25	50 x 50	80 x 5	-	-		-	not found, dense litter
4P	850	235	-	20 x 20	40 x 2	-	-	-	-	not found, dense litter
4Q	680	355	-	20 x 30	180 x 80	60 x 20	50 x 20	5x5	None	dieback, 1 stem
4R	155	270	-	-	20 x 5	50 x 10	100 x 40	20x10	-	2 clumps within 30 com, some dieback
4S	590	80	-	-	10 x 15	-	-	-	-	not found, dense litter
4T	890	15	-	-	10 x 5	-	10 x 5	10x5	none	not found

ID	Distance	Bearing			Clump Si	ize (cm)			Flowers/Fruit Present	Comments
			2015	2016	2017	2018	2019	2020		
4U	30	0	-	-	20 x 10	-	-		-	not found
4V	680	225	-	-	80 x 50	-	-		-	not found
4W	770	350	-	-	-	20 x 5	50 x 40	20x5	-	-
4X	640	345	-	-	-	50 x 20	80 x 60	15x5	-	Good Condition
4Y	600	345	-	-	-	50 x 20	-	30x15	Buds and Flowers	merged with 4X
4Z	875	350	-	-	-	30 x 5	70 x 30	30x10	none	multiple shoots, 2 shoots within 30 cm
4Aa	995	345	-	-	-	10 x 10	80 x 50	10x10	none	some dieback
4Ab	700	215	-	-	-	10 x 5	-	-		Not found
4Ac	900	345	-	-	-	-	10 x 5	10x5	none	new. single shoot
4Ad	610	235	-	-	-	-	35 x 20	-	none	not found
4Ae	380	105	-	-	-	-	10 x 5	-	none	not found
4Af	1000	20	-	-	-	-	55 x 30	5x10	none	new
4AG	900	22.5	-	-	-	-	-	20x5	none	-
4AH	150	105	-	-	-	-	-	20x20	none	-
4AI	470	292	-	-	-	-	-	55x30	none	10 new stems
4AJ	570	300	-	-	-	-	-	20x20	none	5 stems
4AK	540	295	-	-	-	-	-	45x45	none	5 stems
4AL	630	285	-	-	-	-	-	50x30	none	15 stems
4AM	650	315	-	-	-	-	-	45x15	none	5 stems
4AN	710	315	-	-	-	-	-	210x15	none	4 stems
4AO	540	330	-	-	-	-	-	5x5	none	1 stem
4AP	660	315	-	-	-	-	-	30x30	none	5 stems

ID	Distance	Bearing			Clump Si	ize (cm)			Flowers/Fruit Present	Comments
			2015	2016	2017	2018	2019	2020		
4AQ	720	320	-	-	-	-	-	10x5	none	2 stem
4AR	720	315	-	-	-	-	-	15x10	none	1 stem
4AS	800	325	-	-	-	-	-	5X10	none	1 stem
4AT	840	320	-	-	-	-	-	50X30	none	Big Clump - lots of stems
4AU	870	320	-	-	-	-	-	30X45	none	5 stems
4AV	840	320	-	-	-	-	-	60X60	none	10 stems
4AW	900	330	-	-	-	-	-	5X5	none	3 stems
4AX	950	330	-	-	-	-	-	30X10	none	3 stems
4AY	760	335	-	-	-	-	-	40X30	none	1 stem
4AZ	880	335	-	-	-	-	-	40x20	none	10 stems
4BA	720	345	-	-	-	-	-	10X10	none	2 stems
4BB	190	245	-	-	-	-	-	10X10	none	2 stems
4BC	610	270	-	-	-	-	-	50X10	none	1 stem





**Monitoring Point 4** 

Asperula asthenes monitoring results

Monitoring Point 7 - Te	etratheca juncea	monitoring results
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ID	Distance	Bearing			Clump S	ize (cm)			Flowers/Fr	uit Present	Comments
			2015	2016	2017	2018	2019	2020	Flowers	Fruits	
7A	480	160	70x40	60x40	60x50	10x60	70x40	20x30	2	0	-
7B	470	155	5x 5	10x5	-	10x10	30x20	30x20	-	-	B merged with C
7C	500	155	35x15	40x15	70x30	60x30	50x20	70x40	18	6	11 buds
7D	800	135	50x20	60x40	90x50	70x40	10x10	10x10	0	0	reshooting but with dieback
7E	730	95	60x50	90x40	100x70	100x50	110x80	30x60	1	3	dieback
7F	800	275	60x10	70x20	20x5	-	40x30	40x20	1	0	-
7G	780	270	40x40	40x40	60x20	-	130x80	100x65	10	15	-
7H	710	270	50x10	50x10	90x20	100x50	70x80	50x20	2	4	-
71	510	265	30x10	30x10	20x5	-	20x5	20x5	0	1	-
7J	460	255	40x20	40x30	90x30	100x50	90x60	80x60	1	2	dieback
7K	420	260	70x45	80x40	70x70	100x80	120x85	120x60	15	20	-
7L	400	240	45x10	50x10	55x10	20x10	25x10	25x10	0	1	not found
7M	570	205	110x70	110x70	110x80	60x20	80x130	30x10	0	0	dieback + reshooting
7N	610	195	45x35	45x35	35x50	80x30	40x25	20x10	0	0	
70	310	240	-	20x20	20x15	-	-	-	0	0	not found
7P	700	195	-	-	-	-	80x60	60x20	0	0	-
7R	505	205	-	-	-	-	30x40	30x40	2	0	2 spent flowers



### Monitoring Point 7 - Tetratheca juncea monitoring results



### Monitoring Point 8 – Tetratheca juncea and Grevillea parviflora monitoring results

ID	Species	Distance	Bearing			Clump S	ize (cm)			Flowers/Fr	uit Present	Comments
				2015	2016	2017	2018	2019	2020	Flowers	Fruits	
8A	Tetratheca juncea	210	235	110x70	110x80	130x80	80x110	110x50	60x30	4	0	-
8B	Tetratheca juncea	480	225	40x 30	60x 30	90x 20	80x 20	50x 50	60x60	7	0	not found
8C	Tetratheca juncea	560	225	120x110	120x100	-	-	-	-	-	-	not found
8D	Tetratheca juncea	650	230	110x110	110x110	120x60	45x 10	30x5	60x60	7	0	new growth
8E	Tetratheca juncea	750	230	65x30	65x30	40x80	60x30	50x 20	40x20	2	0	-
8F	Tetratheca juncea	620	240	80x30	90x30	120x50	120x40	60x 30	20x10	2	0	-
8G	Tetratheca juncea	710	240	100x50	100x50	80x50	100x50	-	-	-	-	not found
8H	Tetratheca juncea	730	250	60x50	60x50	100x40	-	90x 30	90x30	-	-	not found
81	Grevillea parviflora subsp. parviflora	310	280	30	30	30	70	60	60x70	15	0	new shoots coming up
8J	Tetratheca juncea	390	275	50x 10	50x 10	65x 10	60x 20	60x20	30x20	0	0	-
8K	Tetratheca juncea	400	195	60x20	60x20	90x90	170x50	130x60	130x100	37	34	-
8L	Tetratheca juncea	920	280	-	-	70x 70	70x 80	100x90	100x30	2	0	dieback

Flowers/Fr	uit Present	Comments	
Flowers	Fruite		

ID	Species	Distance	Bearing	Clump Size (cm)						Flowers/Fr	uit Present	Comments
				2015	2016	2017	2018	2019	2020	Flowers	Fruits	
8M	Tetratheca juncea	850	280	-	-	-	40x20	-	20x10	2	0	-
8N	Tetratheca juncea	280	235	-	-	-	-	50x 20	20x10	1	0	-
80	Tetratheca juncea	780	230	-	-	-	-	-	50x40	3	0	-
8P	Tetratheca juncea	510	205	-	-	-	-	-	100x40	2	0	New



Monitoring Point 8 – Tetratheca juncea and Grevillea parviflora monitoring results



### Monitoring Point 11 - Grevillea parviflora monitoring results

ID	Species	Distance	Bearing	Flowers/FUPPeent201520162017201820192020Flowers/FUPPeent9090504560600020455014560600020451800055180010065007575410020100020100020100020100020100020100020100020100020100020100020000200002000200020002000200020000 </th <th>Comments</th>				Comments				
				2015	2016	2017	2018	2019	2020	Flowers	Fruits	
11A	Grevillea parviflora subsp. parviflora	560	165	90	90	50	45	60	60	0	0	4 stems 20cm apart, new growth
11B	Grevillea parviflora subsp. parviflora	565	110	20	45	-	-	-	18	0	0	returned
11C	Grevillea parviflora subsp. parviflora	610	105	55	-	-	-	-	-	0	0	not found
11D	Grevillea parviflora subsp. parviflora	650	105	100	65	-	-	-	-	0	0	not found
11E	Grevillea parviflora subsp. parviflora	720	100	75	75	41	-	-	-	0	0	not found
11F	Grevillea parviflora subsp. parviflora	770	100	20	10	-	-	-	-	0	0	not found
11G	Grevillea parviflora subsp. parviflora	830	85	110	110	80	100	90	95	0	0	dieback
11H	Grevillea parviflora subsp. parviflora	900	100	60	60	30	65	70	80	0	0	dieback
111	Grevillea parviflora subsp. parviflora	620	80	50	50	60	60	55	55	0	0	dead
11J	Grevillea parviflora subsp. parviflora	460	70	45	35	40	-	-	-	0	0	not found
11K	Grevillea parviflora subsp. parviflora	620	80	40	40	40	40	-	-	0	0	not found
11L	Grevillea parviflora subsp. parviflora	610	75	45	55	55	65	65	70	0	0	minor dieback
11M	Grevillea parviflora subsp. parviflora	700	75	65	70	65	75	80	-	0	0	2 clumps 10 cm apart, 1 with dieback

ID	Species	Distance	Bearing	Clump Size (cm)						Flowers/Fruit Present		Comments
				2015	2016	2017	2018	2019	2020	Flowers	Fruits	
11N	Grevillea parviflora subsp. parviflora	540	80	35	40	45	45	40	-	0	0	dead
110	Grevillea parviflora subsp. parviflora	630	70	20	30	-	-	-	-	0	0	not found
11P	Grevillea parviflora subsp. parviflora	490	80	45	70	50	30	30	30	0	0	not found
11Q	Grevillea parviflora subsp. parviflora	430	80	-	20	60	-	-	-	0	0	not found
11R	Grevillea parviflora subsp. parviflora	730	80	-	-	-	65	65	40	0	0	-
11S	Grevillea parviflora subsp. parviflora	740	70	-	-	-	-	20	20	0	0	not found
11T	Grevillea parviflora subsp. parviflora	1010	75	-	-	-	-	80	95	0	0	-
11U	Grevillea parviflora subsp. parviflora	710	175	-	-	-	-	40	37	0	0	-
11V	Grevillea parviflora subsp. parviflora	715	90	-	-	-	-	-	55	0	0	new 2 plants 20cm apart, dieback
11W	Grevillea parviflora subsp. parviflora	800	85	-	-	-	-	-	65	0	0	new 2 stems 5cm apart
11X	Grevillea parviflora subsp. parviflora	840	80	-	-	-	-	-	60	0	0	new plant, new growth moderate dieback
11Y	Grevillea parviflora subsp. parviflora	770	85	-	-	-	-	-	25	0	0	new
11Z	Grevillea parviflora subsp. parviflora	720	190	-	-	-	-	-	55	0	0	new
11AA	Tetratheca juncea	865	220	-	-	-	-	-	75x50	2	16	


### Monitoring Point 11 - Grevillea parviflora monitoring results



### Monitoring Point 12 - Grevillea parviflora monitoring results

ID	Distance	Bearing			Clump S	ize (cm)	Flowers/Fruit Present	Comments		
			2015	2016	2017	2018	2019	2020		
12A	430	40	80	80	80	50	-	-	-	not found
12B	570	40	80	90	60	25	50	55	1 flower	-
12C	580	35	65	70	-	50	45	55	none	-
12D	540	35	20	25	40	30	-	70	1 flower	-
12E	710	35	25	30	-	-	-	-	-	not found
12F	660	30	25	25	-	-	-	-		not found
12G	550	25	50	50	40	10	-	-	-	not found
12H	260	110	-	25	55	70	78	78	2 flowers	-
121	430	30	-	-	-	50	60	60	2 flowers. 3 buds	healthy
12J	570	30	-	-	-	25	-	-		not found
12K	590	45	-	-	-	60	50	70	1 flower	dead flowers
12L	550	45	-	-	-	30	50	60	none	-
12M	570	50	-	-	-	55	65	75	11 flowers, 2 buds	-
12N	610	50	-	-	-	-	40	60	-	-



Monitoring Point 12 - Grevillea parviflora monitoring results



### Lot 12 Monitoring Sites

### Monitoring Point 15 - Tetratheca juncea monitoring results

ID	Distance	Bearing			Clump S	ize (cm)	Flowers/Fr	uit Present	Comments		
			2015	2016	2017	2018	2019	2020	Flowers	Fruits	
15A	420	80	20 x 10	30 x 10	-	-	-	-	-		
15B	990	65	5 x 5	10 x 5	-	-	-	-	-		
15C	1000	50	50 x 50	60 x 40	100 x 30	-	-	-	-		
15D	870	45	40 x 40	40 x 40	65 x 20	-	-	-			
15E	960	40	75 x 20	80 x 20	90 x 20	-	40x20	40x30	5	2	
15F	780	45	30 x 15	40 x 15	40 x15	30x40	30x20	-			
15G	800	35	40 x 25	50 x 25	40 x 20	-	-	-			
15H	790	10	5 x 5	10 x 5	-	-	-	-			
151	620	10	60 x 30	60 x 30	-	-	-	-			
15J	730	0	20 x 30	40 x 20	40 x 10	-	-	-			
15K	730	355	50 x 20	40 x 20	-	-	-	-			
15L	480	0	30 x 10	30 x 10	15 x 10	30x20	40x20	30x20	1	4	
15M	270	5	40 x 10	50 x 10	-	50x20	40x30	-			
15N	300	355	40 x 10	40 x 10	50 x 10	-	-	-			
150	100	275	20 x 5	20 x 40	-	-	-	-			
15P	770	270	60 x 20	50 x 30	50 x 30	40x10	40x10	40x20	1	7	
15Q	510	260	60 x 50	70 x 50	90 x 50	90x30	50x40	80x50	1	4	
15R	590	245	70 x 50	70 x 50	80 x 15	-	10x10	-			
15S	910	195	20 x 10	20 x 10	-	-	-	-			
15T	400	230	30 x 10	30 x 10	-	-	-	-			

ID	Distance	Bearing			Clump Si	ize (cm)	Flowers/Fr	uit Present	Comments		
			2015	2016	2017	2018	2019	2020	Flowers	Fruits	
15U	870	190	10 x 10	30 x 10	30 x 5	70x20	100x30	90x70	6	11	
15V	550	180	30 x 15	40 x 20	40 x 10	-	-	-			
15W	670	175	5 x 5	10 x 5	-	-	-	-			
15X	290	155	40 x 10	40 x 10	30 x 5	-	-	-			
15Y	360	170	5 x 5	30 x 5	-	20x5	-	-			
15Z	470	165	30 x 40	50 x 30	60 x 70	60x20	40x20	-			
15AA	570	170	25 x 20	50 x 20	20 x 50	80x20	40x40	-			Merge with 14AD
15AB	810	170	5 x 5	10 x 5	-	-	-	-			
15AC	520	135	40 x 10	50 x 15	15 x 50	40x30	60x10	50x30	3	13	
15AD	560	160	20 x 30	20 x 30	-	-	40x30	50x30	1	5	
15AE	370	130	-	20 x 10	-	-	-	-		-	
15AF	370	310	-	-	-	10x10	50x30	60x40	2	20	
15AG	800	35	-	-	-	-	-	20x20	1	0	
15A	420	80	20 x 10	30 x 10	-	-	-	-	-		



#### Monitoring Point 15 - Tetratheca juncea monitoring results

### Monitoring Point 17 - Asperula asthenes monitoring results

ID	Distance	Bearing			Clump S	ize (cm)	Flowers/Fruit Present	Comments		
			2015	2016	2017	2018	2019	2020		
17A	140	220	20 x 5	20 x 5		-	-	-	-	-
17B	270	235	35 x 15	20 x 10	-	-	-	-	-	-
17C	300	255	40 x 5	30 x 5	-	-	-	-	-	-
17D	340	250	5 x 5	10 x 5	-	-	-	-	-	-
17E	550	230	80 x 80	80 x 80	-	70x90	70x30	50x50	buds and flowers	minor dieback
17F	640	225	20 x 25	20 x 25	30 x 5	30x60	20x10	20x10	none	healthy
17G	870	240	20 x 10	20 x 10	-	-	-	-	-	-
17H	760	265	90 x 35	90 x 35	-	-	-	-	-	-
171	810	245	35 x 20	25 x 10	-	-	-	-	-	-
17J	840	245	40 x 60	40 x 50	-	-	-	-	-	-
17K	710	235	20 x 5	20 x 10	30 x 10	130x55	20x10	-	-	not found
17L	810	265	-	-	-	10x5	-	-	-	not found
17M	605	265	-	-	-	5x5	15x15	-	-	not found
17N	580	250	-	-	-	10x5	10x5	-	-	not found
170	720	235	-	-	-	-	10x5	-	-	-
17P	620	225	-	-	-	-	20x10	-	-	not found
17Q	480	205	-	-	-	-	-	35x10	buds and flowers	•
17R	530	205	-	-	-	-	-	30x20	buds and flowers	-
17S	580	220	-	-	-	-	-	30x10	buds and flowers	-
17T	490	195	-	-	-	-	-	40x30	Flowers / fruit present (2019)	-
17V	500	195	-	-	-	-	-	5x5	-	-

ID	Distance	Bearing			Clump Si	ize (cm)		Flowers/Fruit Present	Comments	
			2015	2016	2017	2018	2019	2020		
17W	760	215	-	-	-	-	-	5x10	buds	-
17X	740	210	-	-	-	-	-	20x20	-	-
17Y	740	195	-	-	-	-	-	5x5	-	-
17Z	810	180	-	-	-	-	-	10x10	-	-
17AA	840	180	-	-	-	-	-	20x10	-	-
17AB	910	215	-	-	-	-	-	10x5	buds	-
17AC	215	900	-	-	-	-	-	5x5	-	-
17AD	220	860	-	-	-	-	-	10x5	-	-
17AE	225	830	-	-	-	-	-	10x10	-	-
17AF	330	850	-	-	-	-	-	10x5	-	-





### Monitoring Point 17 - Asperula asthenes monitoring results



### Monitoring point 18 - Asperula asthenes monitoring results

ID	Distance	Bearing			Clump S	ize (cm)	Flowers/Fruit Present	Comments		
			2015	2016	2017	2018	2019	2020		
18A	610	220	40 x 30	40 x 30	-	-	-			
18B	690	220	100 x 60	100 x 50	-	-	-			
18C	670	225	30 x 20	30 x 20	-	-	-			
18D	880	215	20 x 40	20 x 40	-	-	-			
18E	900	220	100 x 90	90 x 90	10 x 5	-	10x5	10x5	none	
18F	760	225	70 x 80	70 x 90	-	-	-			
18G	820	235	70 x 30	70 x 40	10 x 5	-	-			
18H	890	265	5 x 10	20 x 10	-	-	-			not found
181	820	280	30 x 40	30 x 30	-	-	-			
18J	830	290	55 x 30	50 x 30	5 x 5	-	5x5	1x1	none	
18K	960	235	50 x 10	40 x 15	-	-	-	5x5		
18L	780	215	10 x 10	20 x 20	-	-	-			
18M	980	225	30 x 10	20 x 10	-	-	-			
18N	680	210	-	-	40 x 10	60x10	75x50	70x70	3 flowers, buds present	
18O	700	215	-	-	-	70x16	30x20	30x30	-	
18P	660	310	-	-	-	10x26	45x15	10x10	none	
18Q	770	315	-	-	-	60x21	-	25x10	none	
18R	800	325	-	-	-	-	-	10x10	none	
18S	810	330	-	-	-	-	-	10x15	none	
18T	700	335	-	-	-	-	-	10x10	none	





### Monitoring point 18 - Asperula asthenes monitoring results



# APPENDIX D PHOTO MONITORING







## Appendix D.1 Biodiversity Offset Area Monitoiring Sites

Monitoring Point 1 (MP 1)

MP 1 2015



MP 1 2017





## MP 1 2019





Monitoring Point 2 (MP 2)

MP 2 2015





MP 2 2018







MP 2 2020



## Monitoring Point 3 (MP 3)



MP 3 2015



MP 3 2017





 $/\!\!/$ 

## MP 3 2019



2020 Annual Monitoring Report Kleinfelder



Monitoring Point 4 (MP 4)

MP 4 2015





MP 4 2018



MP 4 2019



MP 4 2020



## Monitoring Point 5 (MP 5)



MP 5 2015



MP 5 2017





## MP 5 2019







Monitoring Point 6 (MP 6)

MP 6 2015





## MP 6 2018



MP 6 2019



MP 6 2020



## Monitoring Point 7 (MP 7)



MP 7 2015



MP 7 2017





2019 MP 7







Monitoring Point 8 (MP 8)

MP 8 2015





MP 8 2018





MP 8 2020



## Monitoring Point 9 (MP 9)



MP 9 2015



MP 9 2017





### MP 9 2019







Monitoring Point 10 (MP 10)

MP 10 2015







MP 10 2018


MP 10 2019





MP 10



#### Monitoring Point 11 (MP 11)



MP 11 2016



MP 11 2017





MP 11 2019





# APPENDIX E EXOTIC SPECIES RECORDED WITHIN OFFSET AREA





Name	Qualification	Title/Experience
Ageratina riparia	Mistflower	-
Anagallis arvensis	Scarlet Pimpernel	-
Andropogon virginicus	Whisky Grass	
Asparagus aethiopicus	Ground Asparagus	Prohibition on dealings
Axonopus fissifolius	Narrow-leafed Carpet Grass	-
Bidens pilosa	Cobblers Pegs	•
Briza maxima	Quaking Grass	-
Chloris gayana	Rhodes Grass	•
Hypochaeris radicata	Catsear	-
Lantana camara	Lantana	Prohibition on dealings
Lolium perenne	Perennial Ryegrass	-
Melinis repens	Red Natal Grass	•
Paspalum dilatatum	Paspalum	-
Paspalum mandiocanum	Broadleaf Paspalum	•
Pennisetum clandestinum	Kikuyu	-
Plantago lanceolata	Lamb's Tongues	-
Senecio madagascariensis	Fireweed	Prohibition on dealings
Senna pendula var. glabrata	Cassia	-
Setaria sphacelata	South African Pigeon Grass	-
Solanum nigrum	Black-berry Nightshade	-
Stellaria media	Common Chickweed	-
Trifolium repens	White Clover	-
Tradescantia fluminensis	Wandering Jew	-
Verbena bonariensis	Purpletop	•
Vulpia myuros	Rat's Tail Fescue	-

## APPENDIX F STAFF CONTRIBUTIONS

The following staff were involved in the compilation of this report.

Name	Qualification	Title/Experience	Contribution
David Martin	MSc, BEnvSciMgnt	Ecologist (Botanist)	Field surveys, Report Writing
Daniel O'Brien	BEnvSciMgnt	Senor Ecologist	Report Review
Emily Fittell	BSc (Hons)	Ecologist	Field surveys
Nigel Fisher	PhD	Senor Ecologist	Field surveys
Gayle Joyce	BSc (Forestry) (Hons)	GIS Specialist	GIS and figure preparation



#### APPENDIX G

### LICENSING

Kleinfelder employees involved in the current study are licensed or approved under the *Biodiversity Conservation Act 2016* (License Number: SL100730, Expiry: 31 March 2021) and the *Animal Research Act 1985* to harm/trap/release protected native fauna and to pick for identification purposes native flora and to undertake fauna surveys.