

Department of Transport and Main Roads

August 2022

# Lowland Rainforest TEC Monitoring Report Kawana and Woondum Offset Areas 2022 Cooroy to Curra Stage D



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## Lowland Rainforest TEC Monitoring Report Kawana and Woondum Offset Areas 2022 Cooroy to Curra Stage D

Department of Transport and Main Roads

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# 1 Introduction and purpose

The Department of Transport and Main Roads (TMR) has completed the construction on a section of the existing Bruce Highway, including a bypass to the east of Gympie. This package of works is termed the Bruce Highway Cooroy to Curra Section D Project (the Project). The Project construction area extends for approximately 30 km and includes the acquisition of a project corridor to ultimately accommodate a six-lane divided carriageway.

TMR received conditions of approval (EPBC 2017/7941) for the Project from the Commonwealth Department of Agriculture, Water and Environment (DAWE) under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). The EPBC approval conditions require the delivery of specific environmental offsets for direct and indirect impacts to the Lowland Rainforest of Subtropical Australia Threatened Ecological Community (Lowland Rainforest TEC) resulting from the Project.

To maintain compliance with the EPBC Act approval conditions, TMR is required to establish, manage, and monitor two Project related environmental offset areas at Kawana and Woondum containing the Lowland Rainforest TEC. BioCondition plots were established in 2020 in order to determine a baseline condition for the Lowland Rainforest TEC offsets in accordance with this approval. The 2020 monitoring event also involved the monitoring of buffer zones adjacent to the mapped areas of Lowland Rainforest TEC which included mapping of vegetation communities, detecting weed presence, and identifying sites for targeted natural regeneration.

The purpose of this report is to assess the current ecological condition of each offset area located at Kawana and Woondum and compare this progression of the Lowland Rainforest TEC offsets against the 2020 baseline data.

This report communicates to TMR, the results of the 2022 monitoring and provides recommendations to improve the ecological condition at the Kawana and Woondum offset areas. Specifically, this report provides details regarding the field survey methods, results, and discussion on the following elements for each area in accordance with the requirements of the baseline and monitoring survey program, as prescribed by the Project Environmental Offsets Strategy (GHD 2019):

- details of the suitably qualified person (SQP)
- the results of monitoring at each monitoring site in accordance with the BioCondition methodology (Eyre et al 2019) and the ‘Modified Qld Habitat Quality Guide (DAWE)’
- species richness collected at each site including discussion on the number of species recorded across each offsets area in relation to Appendix A of the Threatened Species Scientific Committee (TSSC) (2011) Commonwealth Listing Advice on Lowland Rainforest of Subtropical Australia. Department of Sustainability, Environment, Water, Population and Communities (Listing Advice)
- qualitative observations and photo monitoring points of evidence of past and current land use and degradation (including cleared areas, evidence of disturbance erosion rubbish, access track etc.)
- buffer zone assessments (Including Quaternary level vegetation site assessments, weed mapping and potential areas for natural regeneration and/or revegetation)
- conclusions and recommendations.

## 2 Methods

In accordance with approval conditions the monitoring was led by a suitably qualified person (refer CV Appendix A) and undertaken over two trips on 23 – 27 May and 26 – 28 July 2022.

The 2022 Lowland Rainforest TEC BioCondition monitoring was undertaken in accordance with the following methods:

- *BioCondition: A Condition Assessment Framework for Terrestrial Biodiversity in Queensland method* (Eyre et al, 2015) (refer section Eyre et. al., 2015).
- *Guide to determining terrestrial habitat quality A toolkit for assessing land based offsets under the Queensland Environmental Offsets Policy* (the Guide) (DES 2020).
- Results of the field surveys were analysed using a combination of the BioCondition method and the *Modified QLD Habitat Quality spreadsheet – template* (DAWE 2019) (refer Section 2.2).

### 2.1 BioCondition monitoring and species richness

The BioCondition monitoring was conducted at four previously established monitoring transects including two transects in each offset area, as listed in Table 2.1 and depicted on Figure 2.2 for Kawana and Figure 2.3 for Woondum. Each BioCondition monitoring transect occupies a 100 m x 50 m (0.5 ha) area within which 13 site-based ecological condition indicators are measured.

Table 2.1 Lowland rainforest TEC BioCondition monitoring locations (MGA Zone 56)

| Offset site | Biocondition site no. | GPS start             | GPS centre            | GPS end               |
|-------------|-----------------------|-----------------------|-----------------------|-----------------------|
| Kawana      | KBC1                  | 510473 E<br>7041760 N | 510515 E<br>7041742 N | 510568 E<br>7041723 N |
| Kawana      | KBC2                  | 510339 E<br>7041471 N | 510390 E<br>7041488 N | 510428 E<br>7041503 N |
| Woondum     | WBC1                  | 471367 E<br>7096624 N | 471296 E<br>7096558 N | 471332 E<br>7096596 N |
| Woondum     | WBC2                  | 471223 E<br>7096498 N | 471262 E<br>7096498 N | 471308 E<br>7096509 N |

The method for collecting monitoring data for the 13 site-based ecological condition indicators is summarised as follows:

- 100 x 50 m area:
  - number of large trees
  - recruitment of canopy species
  - tree canopy height
  - native tree species richness
- along 100 m transect centreline:
  - native tree canopy cover
  - native shrub canopy cover
- 50 x 10 m sub-transect, centred from the 25 m point to the 75 m point along the centre transect, and encompassing 5 m either side of the transect:
  - non-native plant cover
  - plant species richness of shrubs
  - plant species richness of grass
  - plant species richness of forbs and others

- 50 x 20 m sub-transect, centred from the 25 m point to the 75 m point along the transect, and encompassing 10 m either side of the transect:
  - coarse woody debris
- five 1 x 1 m quadrats, starting at the 35 m point and located on alternate sides of the centreline, 10 m apart along the 100 m transect, with an average value derived the five 1 x 1 m quadrats:
  - native grass cover
  - organic litter.

In addition to the 13 site-based ecological condition indicators collected, directional photos (N, E, S and W) were taken from the 50 m transect centre of each monitoring transect, as well as single photographs from the start and end points of the transect.

Evidence of site degradation, such as accelerated soil erosion, pest animal presence or damage, pest plant infestations, and any other notable sign of degradation was also recorded.

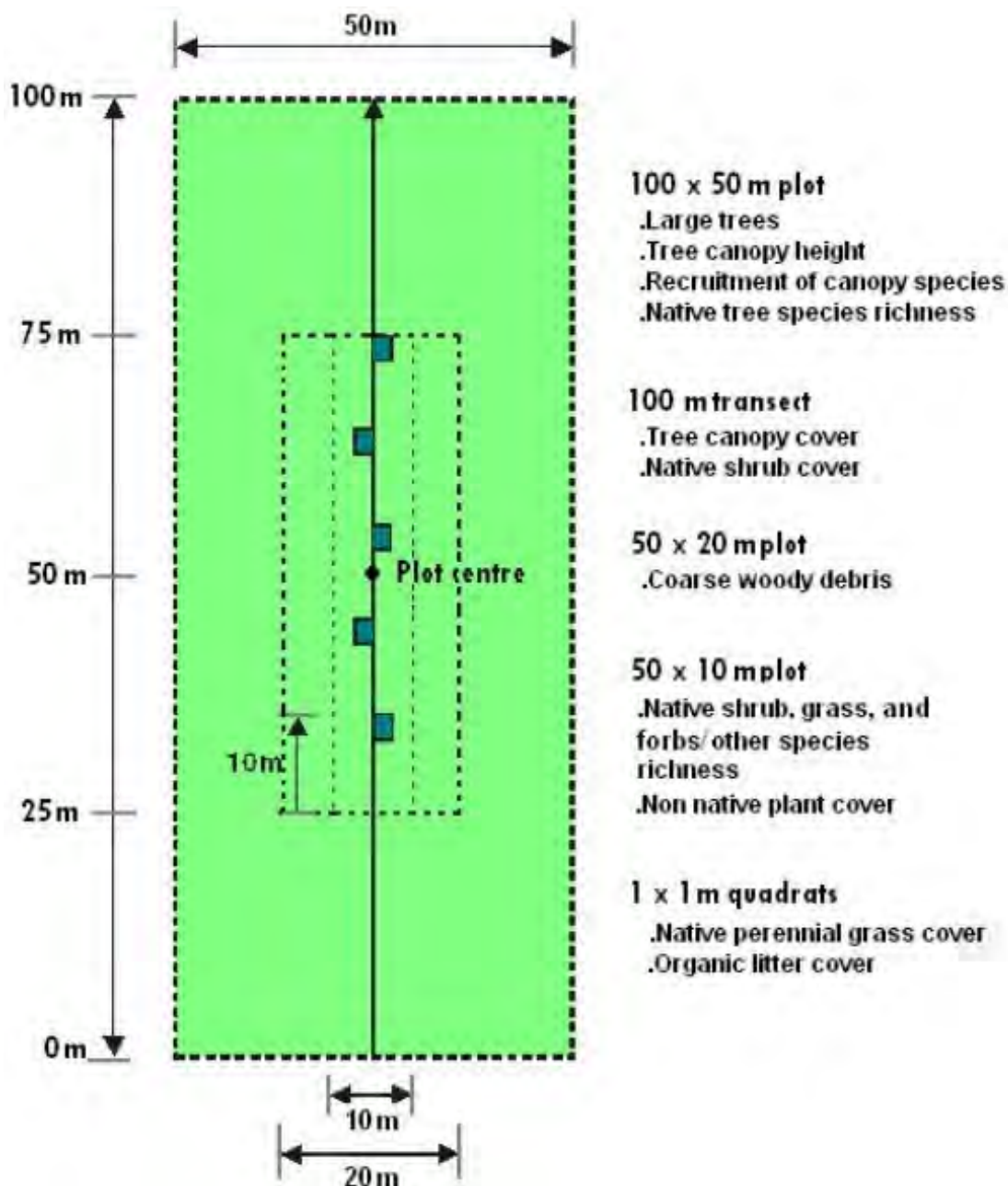


Figure 2.1 Standard layout of a BioCondition survey or monitoring transect



Within each monitoring transect, plants were either identified in the field by the suitably qualified person or samples were collected in a field herbarium for later identification using suitable reference keys and reference material including:

- *Rainforest Plants of Australia Rockhampton to Victoria. Interactive Key* (Harden et al 2014)
- *Rainforest Trees and Shrubs – Second Edition* (Harden, G. McDonald, B. & Williams 2018)
- *Rainforest Climbing Plants – Revised Edition* (Harden, G. McDonald, B. & Williams 2014).

Where plant samples were unable to be identified, or confirmed, they were forwarded to the Queensland Herbarium for verification. This provides quality assurance and an extra level of certainty for questionable identifications, as rainforest species can appear to be very similar, but in fact be a different species.

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## 2.2 Habitat quality data analysis

Benchmarks for scoring site ecological condition were sourced from *BioCondition Benchmarks for Regional Ecosystem Condition Assessment South East Queensland for Regional Ecosystem 12.11.10* (DES, 2019) for Woondum and were also provided as *Draft Benchmarks for Regional Ecosystem 12.3.1a by the Queensland Herbarium* for Kawana.

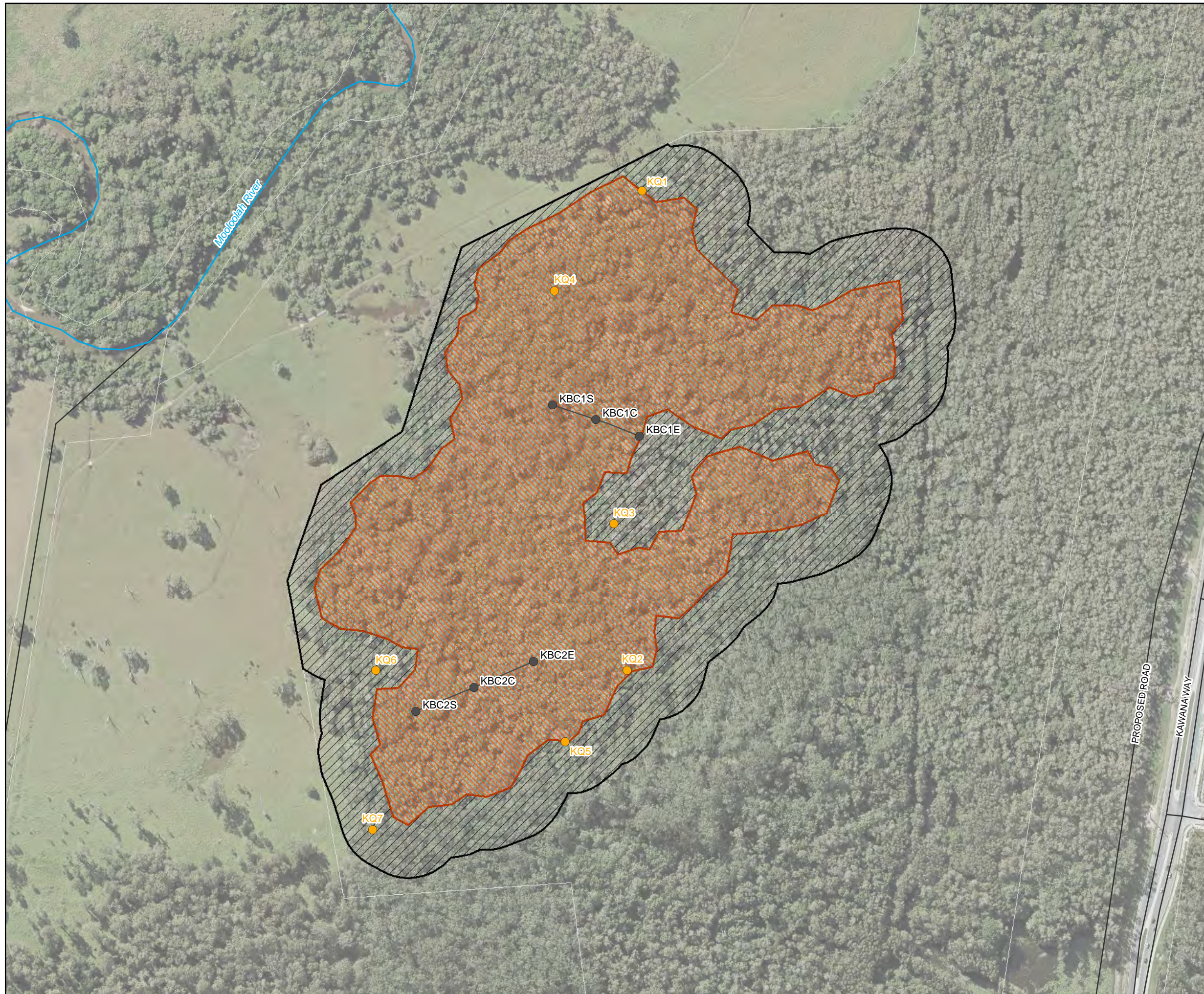
Site condition scores for each of the regional ecosystems are derived from ecological condition indicators collected from respective BioCondition monitoring transects. The data for each ecological condition indicator was scored against benchmark data for each regional ecosystem, to derive an overall quality score in accordance with ‘the Guide’ (DES 2020). Where multiple BioCondition transects were completed for the same regional ecosystem, the quality scores were averaged.

Site context including the GIS attributes of size of patch, connectedness, context, and ecological corridors from the Guide were also included in the analysis but were however taken from previous assessments prepared for the Project Environmental Offsets Strategy (GHD 2019) and Baseline Monitoring Report (WSP 2020).

Additional assessments for attributes of ‘threats to the species’ and ‘the role of each offset site location to the overall population in the state,’ were also analysed. Any changes to ‘threats to the species’ were assessed during field surveys, and ‘the role of each offset site location to the overall population in the state’ was taken from the Baseline Monitoring Report (WSP 2020).

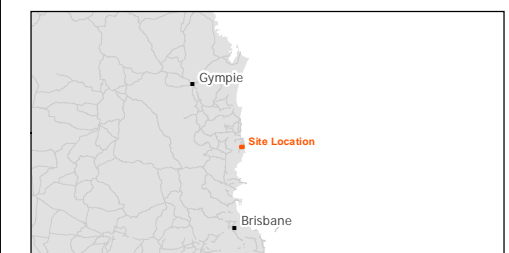
The results of the ecological condition, site context and additional assessments were analysed to provide an overall habitat quality baseline score for each area using the *Modified QLD Habitat Quality spreadsheet – template* (DAWE 2019).

**Figure 2.2  
Kawana Offset Area and  
Monitoring Sites**



**Legend**

- BioCondition (2)
- Quaternary (7)
- Transect
- Watercourse
- Cadastre
- ▨ Lowland Rainforest TEC
- ▨ Threatened Ecological Communities (offset buffer)



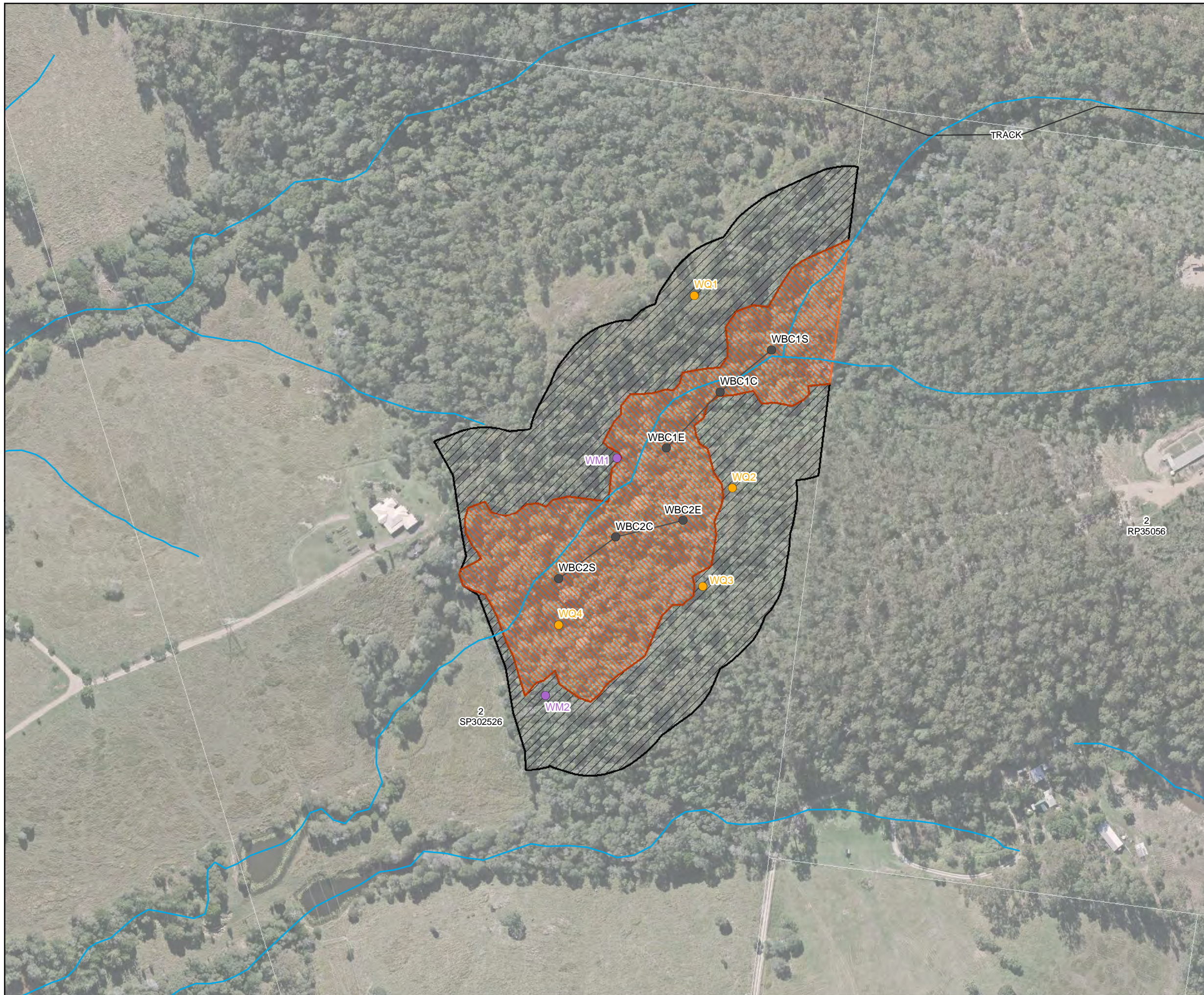
0 50 100  
Meters

Coordinate system: GDA 1994 MGA Zone 56  
 Scale ratio correct when printed at A3  
 1:3,500 Date: 23-Sep-20

Data sources: - DNRME, TMR, Translink, Geoscience Australia

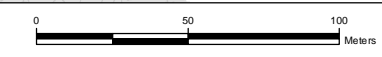
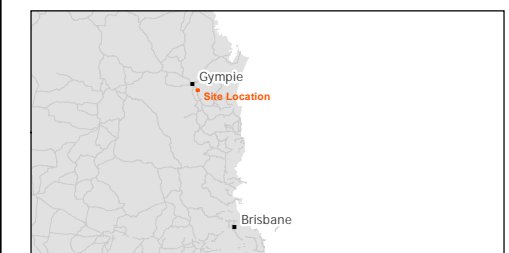
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**Figure 2.3**  
Woondum Offset Area and  
Monitoring Sites



**Legend**

- BioCondition (2)
- Quaternary (4)
- Photo Monitoring Site (2)
- Transect
- Watercourse
- Cadastre
- ▨ Lowland Rainforest TEC
- ▨ Threatened Ecological Communities (offset buffer)



Coordinate system: GDA 1994 MGA Zone 56  
 Scale ratio correct when printed at A3  
 1:2,500 Date: 23-Sep-20

Data sources: - DNRME, TMR, Translink, Geoscience Australia

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# 3 Site history and monitoring conditions

## 3.1 Monitoring history

The biannual monitoring for the Lowland Rainforest TEC was undertaken in 2022 at the Kawana and Woondum offset areas. This was the first biannual monitoring event in accordance with the EPBC 2017/7941 approval conditions, which was planned for completion during 2021 but was delayed due to an unacceptable risk of Covid-19 infection at the time.

The history of monitoring for the offset areas is shown in Table 3.1.

Table 3.1 Monitoring history for Kawana and Woondum offset areas

| Month and year | Monitoring event                              |
|----------------|-----------------------------------------------|
| April/May 2020 | Kawana and Woondum Baseline monitoring survey |
| May 2022       | Woondum biannual monitoring – year one        |
| July 2022      | Kawana biannual monitoring – year one         |

## 3.2 Climate and rainfall

The temperature during both the May and July survey periods was cool with maximum temperatures of 24.4°C and 19.9°, respectively. Both surveys were conducted following periods of heavy rainfall in the South East Queensland region.

### 3.2.1 Kawana offset area

Typical weather conditions at Kawana offset area are historically dry during winter with mean minimum temperatures of 9.7°C, and mean maximum temperatures of 21.3°C, with mean monthly rainfall of approximately 54.7 mm per month (refer Table 3.2). During summer temperatures range between a mean minimum of 20.7°C and mean maximum of 28.2°C, with mean monthly rainfall of approximately 382.4 mm per month (refer Table 3.2) (BOM 2022a – AWS040998 and AWS040861).

The total annual rainfall received for 12 months preceding the survey was 2248.4 mm and is significantly higher the historical average of 1553.9 mm. In addition, it is also significantly higher than the mean annual total rainfall for the region. This can be attributed to the significant La Nina event occurring from November 2021 through to June 2022 that caused heavy rainfall and flooding events throughout South East Queensland (BOM 2022b).

A summary of the weather conditions recorded within the region at Caloundra Airport BoM AWS: 040998 – approx. 8 km from Kawana offset area and Sunshine Coast Airport BoM AWS: 040861 – Approx. 16 km from Kawana offset area, over the 12 months prior to survey, are presented in Table 3.2 and historical annual rainfall since 2018 presented in Table 3.3.

### 3.2.2 *Woondum offset area*

Typical weather conditions at Woondum offset area are dryer and more variable than the Kawana offset area, with winter mean minimum temperatures of 8°C and a mean maximum temperatures of 22.1°C, with mean monthly rainfall of approximately 54.7 mm per month (refer Table 3.4). During summer temperatures range between a mean minimum of 19.4°C to a mean maximum of 29.7°C, with mean monthly rainfalls of approximately 334.9 mm per month (refer Table 3.4) (BOM, 2022a – AWS040093 and 040993).

Similar to the Kawana offset area, the total estimated annual rainfall received in Woondum offset area for 12 months preceding the survey (1899.4 mm) is significantly higher than the mean annual total rainfall for the region at 1117.6 mm.

A summary of the weather conditions recorded within the region (Gympie BoM AWS 040093, approx. 8 km from Woondum offset area and Gympie Alert BoM AWS: 040993 – approx. 8.5 km from Woondum offset area) over the 12 months prior to survey, are presented in Table 3.4 and historical annual rainfall since 2018 presented in Table 3.5.

### 3.2.3 Kawana offset area

Table 3.2 Weather conditions (rainfall data from Caloundra Airport BoM AWS: 040998 – approx. 8 km from Kawana Offset Site; temperature data from Sunshine Coast Airport BoM AWS: 040861 – Approx. 16 km from Kawana Offset Site) August 2021 to July 2022

|                                | Aug 2021 | Sept 2021 | Oct 2021 | Nov 2021 | Dec 2021 | Jan 2022 | Feb 2022 | Mar 2022 | April 2022 | May 2022 | Jun 2022 | Jul 2022 | Annual  |
|--------------------------------|----------|-----------|----------|----------|----------|----------|----------|----------|------------|----------|----------|----------|---------|
| Total Monthly Rainfall (mm)    | 16.1     | 33.3      | 121.9    | 272.3    | 215.1    | 185.7    | 746.3    | 245.9    | 140.3      | 123.6    | 24.3     | 123.6    | 2,248.4 |
| Mean Monthly Temperature (Min) | 10.6     | 12.3      | 16.3     | 18.7     | 19.9     | 21.8     | 20.4     | 20.2     | 18.5       | 17.8     | 8.7      | 9.9      | 16.3    |
| Mean Monthly Temperature (Max) | 22.6     | 24.1      | 27.4     | 26.9     | 27.8     | 28.7     | 28.2     | 28.0     | 26.4       | 23.8     | 21.3     | 19.9     | 25.4    |

Table 3.3 Historical annual rainfall (Caloundra Airport BoM AWS: 040998 – approx. 8 km from Kawana Offset Site)

|                            | 2018    | 2019    | 2020    | 2021    | 2022 YTD |
|----------------------------|---------|---------|---------|---------|----------|
| Total Annual Rainfall (mm) | 1,540.1 | 1,193.6 | 1,591.1 | 1,868.1 | 1,589.7  |

### 3.2.4 Woondum offset area

Table 3.4 Weather conditions (Gympie BoM AWS: 040093 – approx. 13 km from Woondum Offset Site and Gympie Alert BoM AWS: 040993 – approx. 8.5 km from Woondum Offset Site) August 2021 to July 2022

|                                | Aug 2021 | Sept 2021 | Oct 2021 | Nov 2021 | Dec 2021 | Jan 2022 | Feb 2022 | Mar 2022 | April 2022 | May 2022 | Jun 2022 | Jul 2022 | Annual  |
|--------------------------------|----------|-----------|----------|----------|----------|----------|----------|----------|------------|----------|----------|----------|---------|
| Total Monthly Rainfall (mm)    | 18.0     | 17.2      | 138.0    | 180.6    | 84.8     | 271.0    | 649.0    | 123.2    | 27.0       | 254.4    | 24.4     | 111.8    | 1,899.4 |
| Mean Monthly Temperature (Min) | 8.9      | 10.1      | 15.7     | 17.4     | 18.9     | 20.1     | 19.2     | 19.0     | 16.2       | 16.8     | 6.8      | 8.4      | 14.8    |
| Mean Monthly Temperature (Max) | 24.8     | 26.2      | 30.2     | 27.8     | 30.2     | 29.6     | 29.4     | 29.4     | 27.1       | 24.4     | 21.6     | 19.8     | 26.7    |

Table 3.5 Historical annual rainfall for Gympie, approx. 8 km from Woondum offset area (Gympie BoM AWS: 040093 – approx. 13 km from Woondum offset area and Gympie Alert BoM AWS: 040993 – approx. 8.5 km from Woondum offset area)

|                            | 2018  | 2019  | 2020 | 2021 | 2022 YTD |
|----------------------------|-------|-------|------|------|----------|
| Total Annual Rainfall (mm) | 981.2 | 548.4 | 834  | 905  | 1,460.8  |

# 4 Discussion and results

The following section provides the discussion and results of the 2022 monitoring for the Kawana offset area (refer Section 4.1) and Woondum offset area (refer Section 4.2).

The data collected for each offset area has been analysed and is discussed for each offset area respectively:

- site condition results of the 2022 monitoring has been presented graphically and scored against benchmark data for each regional ecosystem, deriving an overall quality score for each offset area against the Modified QLD Habitat Quality spreadsheet – template (DAWE 2019)
- species richness for Lowland Rainforest TEC offset areas combined
- weed and invasive plant presence
- buffer zone management
- comparison between the site condition data collected in 2022 and the baseline site condition data collected in 2020.

---

## 4.1 Kawana offset area

The Kawana offset area (Kawana) consists of a large patch (15.7 ha) of complex notophyll vine on coastal plains associated with Quaternary alluvium (Land Zone 3). Two permanent baseline BioCondition monitoring sites were established within Kawana during the 2020 surveys and re-assessed during the 2022 round of monitoring (refer Figure 2.2). In addition, several vegetation and weed surveys were undertaken to identify any changes in the dominant species, species richness and weed presence/abundance within the mapped buffer zone (approx. 10.4 ha) surrounding the Lowland Rainforest TEC at Kawana (refer Figure 2.2).

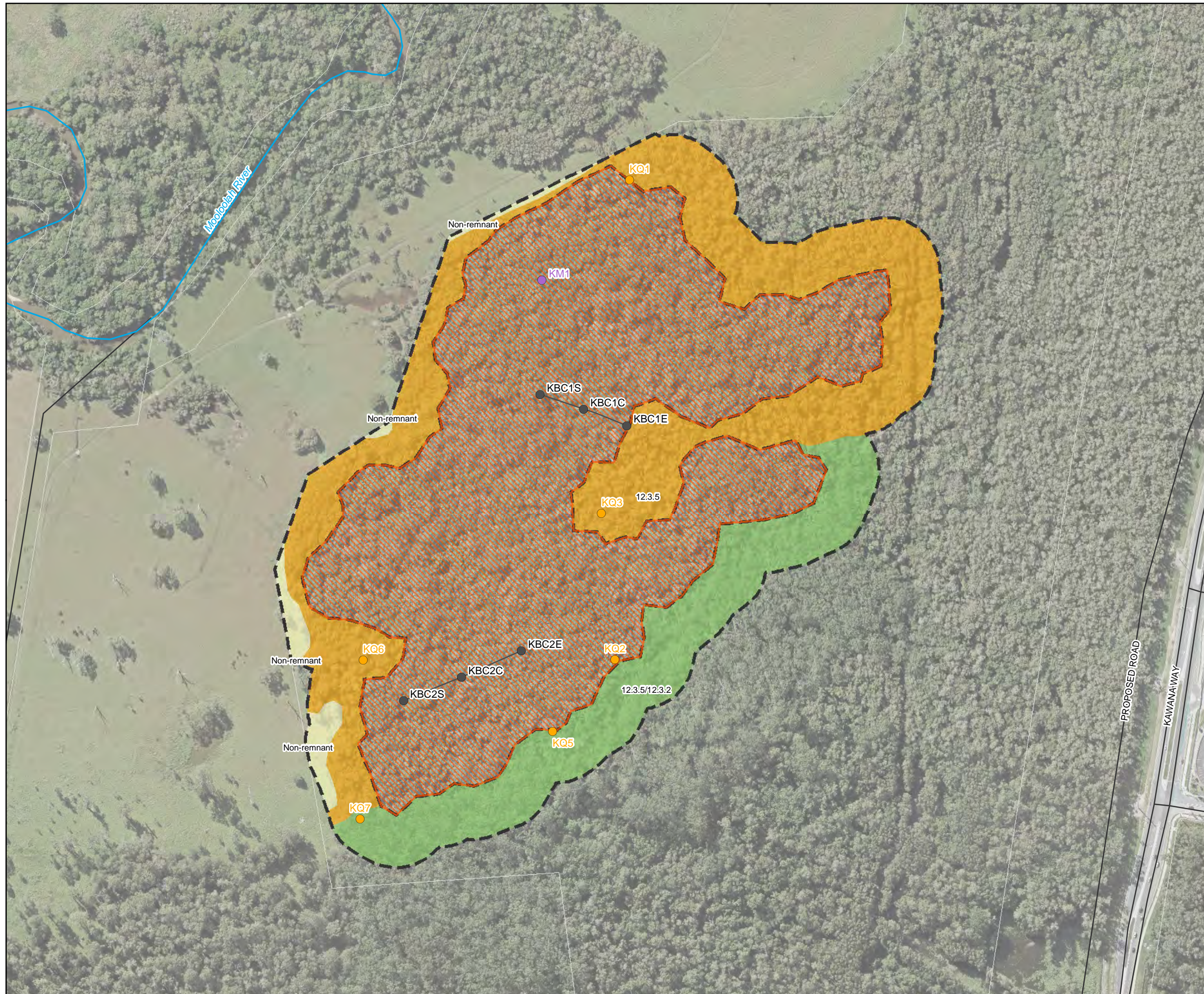
The vegetation communities and regional ecosystems verified within the Kawana offsets area were identical to those identified in the baseline data and remain unchanged from the 2020 report. The area was identified as RE 12.3.1a Complex notophyll vine forest on Quaternary alluvial plains and channels in areas of high rainfall (generally >1,300 mm), which is associated with the Lowland Rainforest TEC. This community is mapped in association with the Lowland Rainforest TEC in Figure 4.1. Several areas of palm forest dominated by Piccabeen Palm (*Archontophoenix cunninghamiana*) also occur within the mapped Lowland Rainforest TEC associated with RE 12.3.1a. These areas have lower species diversity than the more complex areas of the patch where permanent monitoring transects have been established, but do provide opportunities to be potentially improved as revegetation enhancement plantings grow.

The vegetated buffer zone surrounding the mapped Lowland Rainforest TEC at Kawana includes the following vegetation communities and regional ecosystems:

- RE 12.3.5 – *Melaleuca quinquenervia* open forest on coastal alluvium.
- RE 12.3.2 – *Eucalyptus grandis* tall open forest on alluvial plains with vine forest understorey ('wet sclerophyll').
- Small strips of 'non-remnant' previously cleared pastures.

This data was used to map each field verified vegetation community and regional ecosystem in association with the Lowland Rainforest TEC at Kawana in Figure 4.1. Only the area of RE 12.3.1a is associated with the Lowland Rainforest TEC. In accordance with the Listing Advice, in addition to a patch of Lowland Rainforest TEC, a minimum buffer zone that extends 50 m beyond the trunks of the outermost trees in the patch is required to assist in the preservation of the patch to help protect the ecological community from spray drift (fertiliser, pesticide or herbicide sprayed in adjacent land) and other threats (i.e. weed invasion). The purpose of the buffer zone is to protect and manage the patch and to help avoid potential indirect impacts to the ecological community. Its purpose is not specifically to extend the patch through regeneration and revegetation beyond its current extent.

**Figure 4.1**  
Kawana Offsets Area Vegetation  
Communities and Monitoring Sites

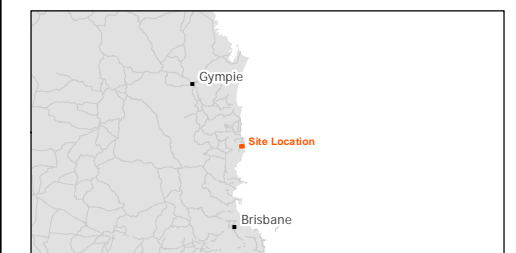


**Legend**

- BioCondition
- Weed Monitoring Site
- Photo Monitoring Site
- Transect
- Watercourse
- Cadastre
- ▬ Threatened Ecological Communities (offset buffer)
- ▨ Lowland Rainforest TEC (RE 12.3.1a)

**Field Verified Vegetation**

- Cleared pastures (non-remnant)
- ▨ Melaleuca forest with notophyll vine forest understory on alluvium (RE 12.3.5 - remnant)
- ▨ Mixed Melaleuca forest and Eucalyptus grandis forest with notophyll vine forest understory on alluvium (RE 12.3.5/12.3.2 - remnant)



Coordinate system: GDA 1994 MGA Zone 56  
 Scale ratio correct when printed at A3  
 1:3,500 Date: 4/11/2020

Data sources: - DNRME, TMR, Translink, Geoscience Australia

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#### 4.1.1 2022 (Year One) monitoring site condition results Kawana

The results from the two BioCondition transects for Kawana are presented in Figure 4.2 and Figure 4.3. The BioCondition parameters have been represented graphically against benchmark data to indicate where the transects data are performing well and/or where there is opportunity for improvement through intervention and management. Both monitoring transects performed well in most attributes compared to benchmarks data, with an overabundance of coarse woody debris and organic litter and an underabundance of large trees reducing the BioCondition scores.

The cover of coarse woody debris and organic litter exceeded 200% of the benchmark in each monitoring transect, which led to scores of two out of a possible five for coarse woody debris and three out of a possible five for organic litter. An overabundance of these factors can be indicative of disturbance.

Table 4.1 show the results of the data analysis for each site assessed against the site condition scores from the Modified QLD Habitat Quality spreadsheet (DAWE 2019). The results show site condition scores of 6.04 and 5.60 out of 7, with an average of 5.82 achieved overall.

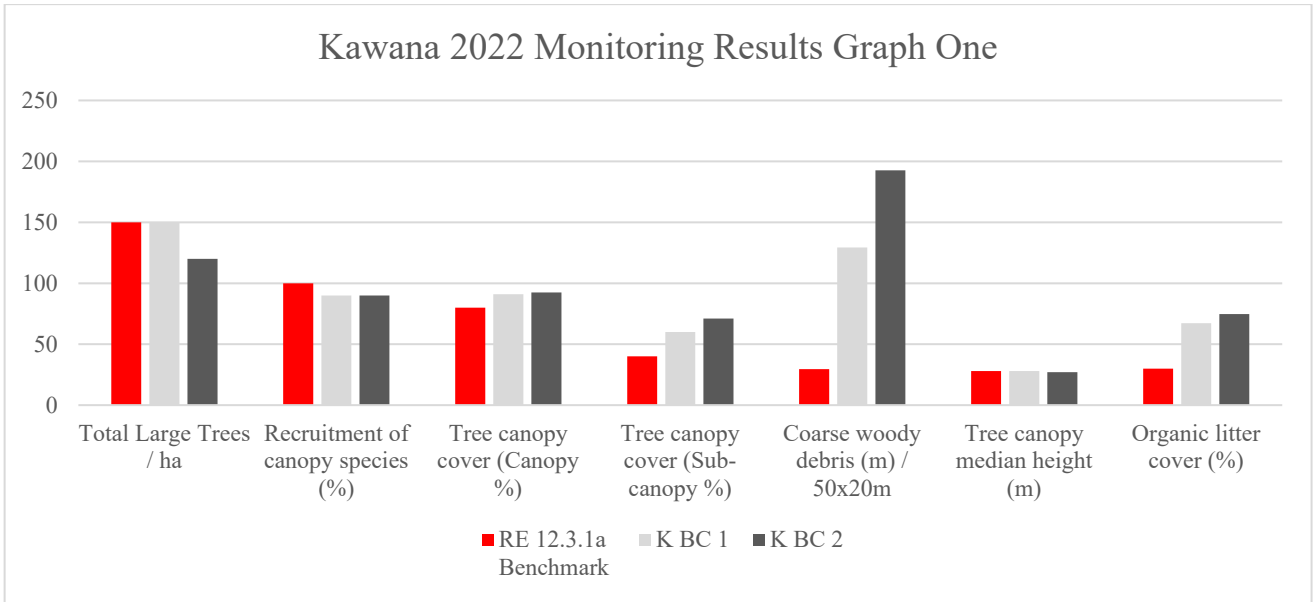


Figure 4.2 Kawana 2022 BioCondition monitoring results comparison against benchmarks (graph one)

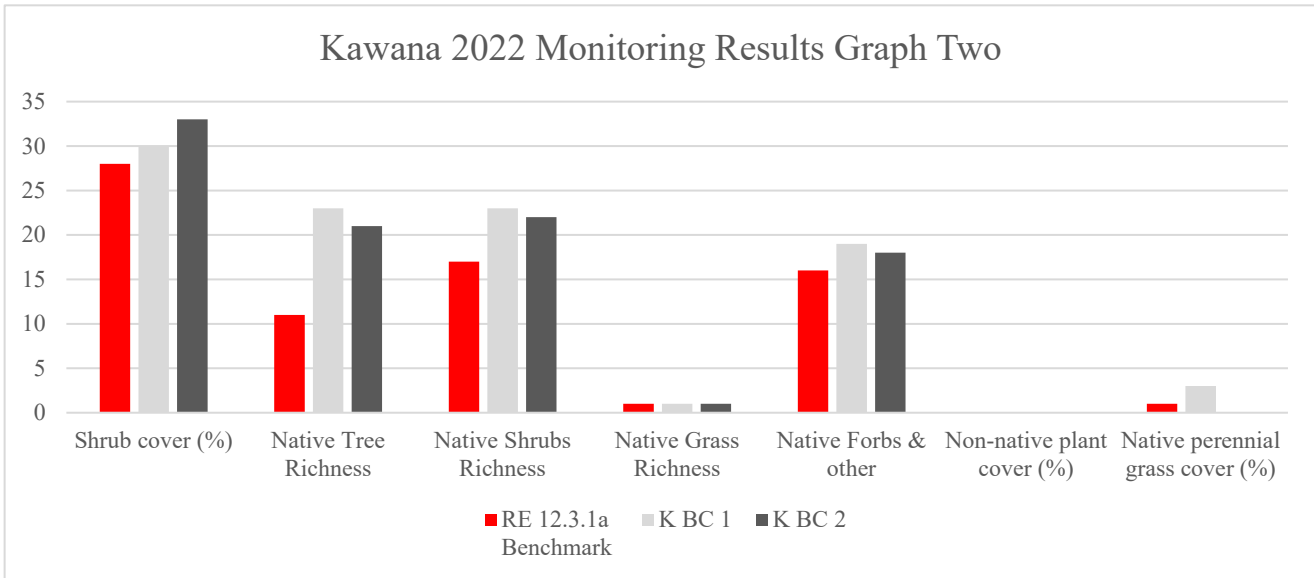


Figure 4.3 Kawana 2022 BioCondition monitoring results comparison against benchmarks (graph two)

Table 4.1 Kawana site condition results

| Assessment unit – regional ecosystem          | Kawana RE 12.3.1a |          |             |             |          |             |       |                    |       |             |
|-----------------------------------------------|-------------------|----------|-------------|-------------|----------|-------------|-------|--------------------|-------|-------------|
| Site reference                                | Benchmark         | KBC1     |             |             | KBC2     |             |       | Average% benchmark | Score |             |
| Kawana offset site condition                  | 12.3.1a           | Raw data | % Benchmark | Score       | Raw data | % Benchmark | Score |                    |       |             |
| Recruitment of woody perennial species in EDL | 100               | 90       | 90%         | 5           | 90       | 90%         | 5     | 90%                | 5     |             |
| Native plant species richness – trees         | 11                | 23       | 209%        | 5           | 21       | 191%        | 5     | 200%               | 5     |             |
| Native plant species richness – shrubs        | 17                | 23       | 135%        | 5           | 22       | 129%        | 5     | 132%               | 5     |             |
| Native plant species richness – grasses       | 1                 | 1        | 100%        | 5           | 1        | 100%        | 5     | 100%               | 5     |             |
| Native plant species richness – forbs         | 16                | 19       | 119%        | 5           | 18       | 113%        | 5     | 116%               | 5     |             |
| Tree Height Canopy                            | 28                | 28       | 100%        | 5           | 27       | 96%         | 5     | 98%                | 5     |             |
| Tree Height Sub-canopy                        | 8                 | 10       | 125%        |             | 10       | 125%        |       | 125%               |       |             |
| Tree Cover Canopy                             | 80                | 91       | 114%        | 4           | 92.4     | 116%        | 4     | 115%               | 4     |             |
| Tree Cover Sub-canopy                         | 28                | 60       | 214%        |             | 71       | 254%        |       | 234%               |       |             |
| Shrub canopy cover                            | 28                | 30       | 107%        | 5           | 33       | 118%        | 5     | 113%               | 5     |             |
| Native perennial grass cover                  | 1                 | 3        | 300%        | 5           | 0        | 0%          | 0     | 150%               | 2.5   |             |
| Organic litter                                | 30                | 67.2     | 224%        | 3           | 74.75    | 249%        | 3     | 237%               | 3     |             |
| Large trees (euc plus non-euc)                | 150               | 150      | 100%        | 10          | 120      | 80%         | 10    | 90%                | 10    |             |
| Coarse woody debris                           | 29.5              | 129.4    | 439%        | 2           | 192.7    | 653%        | 2     | 252%               | 2     |             |
| Non-native plant cover                        | 0                 | 0        | 0%          | 10          | 0.02     | 0%          | 10    | 0%                 | 10    |             |
| Site Condition Score                          |                   |          |             | 69          |          |             |       | 64                 |       | 68          |
| <i>Maximum Site Condition Score</i>           |                   |          |             | 80          |          |             |       | 80                 |       | 80          |
| <b>Site Condition Score – out of 7</b>        |                   |          |             | <b>6.04</b> |          |             |       | <b>5.60</b>        |       | <b>5.82</b> |

#### 4.1.2 2020 (Baseline) site condition results Kawana

The results for the two baseline BioCondition monitoring transects in 2020 for Kawana are presented in Figure 4.4 and Figure 4.5. The 2020 transects achieved the same score of 4.94 out of 7 for each transect, with an overabundance of leaf litter, and a lack of species richness for native shrubs, grasses and forbs limiting the scores.

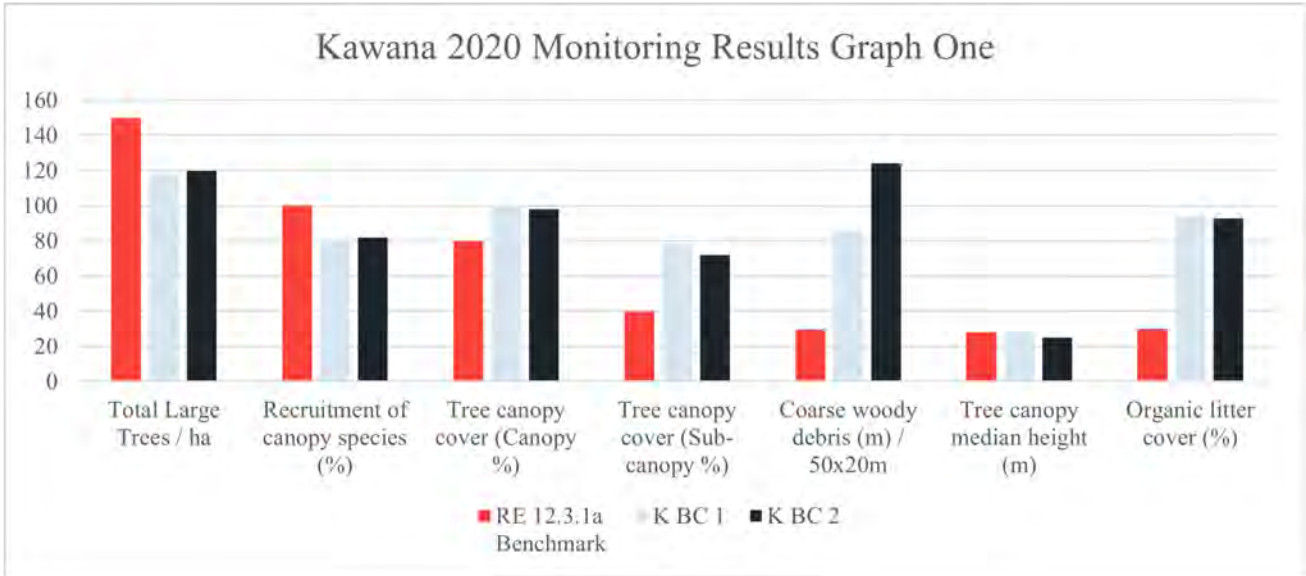


Figure 4.4 Kawana 2020 BioCondition monitoring results comparison against benchmarks (graph one)

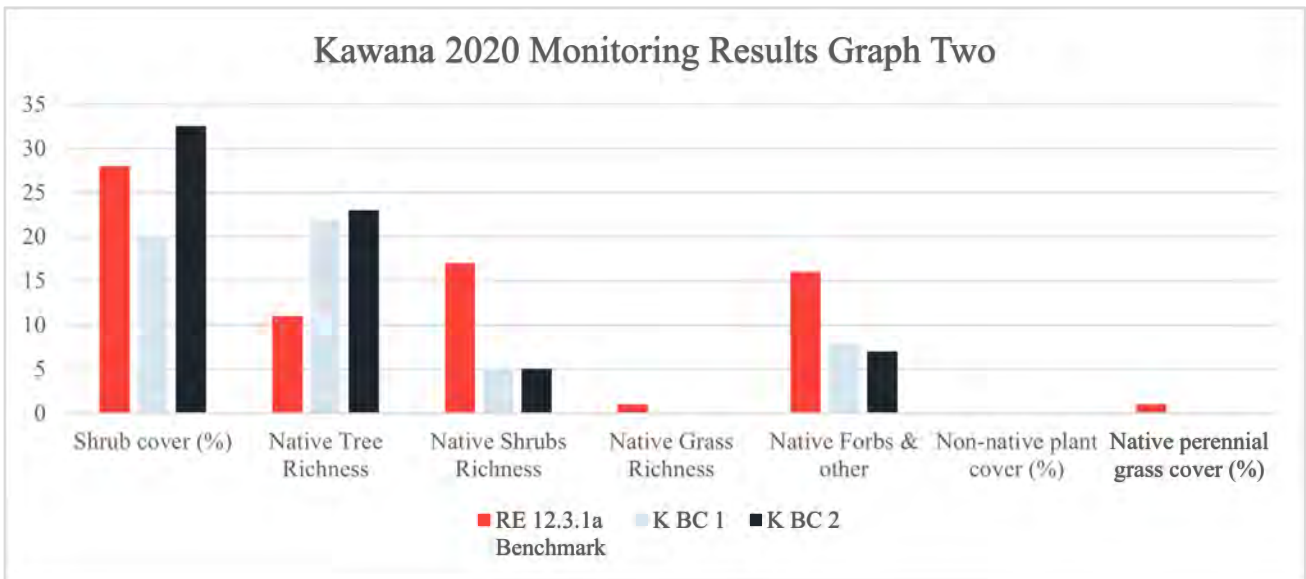


Figure 4.5 Kawana 2020 BioCondition monitoring results comparison against benchmarks (graph two)

### 4.1.3 Site context and habitat quality results Kawana

Table 4.2 highlights the scores for each site against the site context and habitat quality assessments including the ‘role of site location to the Lowland Rainforest TEC overall population in the state’ and the ‘threat to the species.’ These figures were unchanged from the baseline data collected during the 2020 monitoring.

Results of field surveys indicate there is still a very low threat to the community apart from some invasive plant species occurring within the vegetated buffer zone. Table 4.3 provides the overall habitat quality results for the Kawana offset area including site context data that was compiled during the 2020 baseline assessment.

Recommendations for improving the habitat score at Kawana have been provided in Section 5.

Table 4.2 Kawana site context results

| Site context                                                 | KBC1   | Score       | KBC2   | Score       | Average KBC1/KBC2 | Average score |
|--------------------------------------------------------------|--------|-------------|--------|-------------|-------------------|---------------|
| Size of patch (ha)                                           | 181    | 7           | 181    | 7           | 181               | 7             |
| Connectedness                                                | 90     | 5           | 90     | 5           | 90                | 5             |
| Context                                                      | 37     | 4           | 37     | 4           | 37                | 4             |
| Ecological Corridors                                         | Within | 6           | Within | 6           | –                 | 6             |
| Role of site location to TEC overall population in the state | Yes    | 5           | Yes    | 5           | –                 | 5             |
| Threats to the species                                       | Low    | 15          | Low    | 15          | –                 | 15            |
| Site Context Score                                           |        | 42          |        | 42          |                   | 42            |
| <i>MAX Site Context Score</i>                                |        | 46          |        | 46          |                   | 46            |
| <b>Site Context Score – out of 3</b>                         |        | <b>2.74</b> |        | <b>2.74</b> |                   | <b>2.74</b>   |

Table 4.3 Kawana habitat overall habitat quality baseline results

| Final habitat quality score (weighted)                     | KBC1        | KBC2        | Average/final |
|------------------------------------------------------------|-------------|-------------|---------------|
| Site Condition score (out of 7)                            | 6.04        | 5.60        | 5.82          |
| Site Context Score (out of 3)                              | 2.74        | 2.74        | 2.74          |
| Habitat Quality score (out of 10)                          | 8.78        | 8.16        | 8.47          |
| Assessment Unit area (ha)                                  | 181         | 181         | 181.00        |
| Total offset area (ha) for this MNES                       | 181         | 181         | 181.00        |
| Size Weighting                                             | 1.00        | 1.00        | 1.00          |
| <b>Weighted Habitat Quality Score out of maximum of 10</b> | <b>8.78</b> | <b>8.16</b> | <b>8.47</b>   |

#### 4.1.4 Weed and invasive plant presence at Kawana

Under the *Biosecurity Act 2014* (Bio. Act) everyone is obligated to take all reasonable and practical steps to minimise the risks associated with invasive plants under their control. This is called a general biosecurity obligation (GBO). *Ipomoea cairica*, an invasive plant that is not listed as prohibited or restricted under the Bio Act was recorded at the KBC2 BioCondition transect within the TEC. This is a new infestation that was not identified during the 2020 baseline surveys.

The vegetated buffer zone surrounding the community also supported populations of one restricted invasive plant and one naturalised pasture species (refer Appendix B). The invasive plants and their status under the Bio. Act have been listed in Table 4.4 below.

It is recommended annual weed control is continued in the vegetated buffer zone surrounding the mapped Lowland Rainforest TEC. Weed control should also be undertaken in the area surrounding the KBC2 BioCondition site to remove the minor infestation of *Ipomoea cairica*. This area should also be monitored to ensure that the infestation does not return (refer Section 5.1).

Table 4.4 Invasive plants and naturalised pastures Kawana Lowland Rainforest TEC vegetated buffer zone

| Species name                | Invasive plant status (DAF) |
|-----------------------------|-----------------------------|
| <i>Digitaria violascens</i> | Naturalised pasture         |
| <i>Ipomoea cairica</i>      | Other invasive              |
| <i>Lantana camara</i>       | Restricted invasive         |

#### 4.1.5 Vegetated buffer zone management Kawana

Results of field surveys confirmed the very low threat to the community except for some invasive plant species occurring within the TEC area and vegetated buffer zone. It is recommended the area is maintained and managed through ongoing weed control and stock exclusion to maintain a low risk level to the committed offset area (refer Section 5.1).

#### 4.1.6 Comparison between Baseline and Year One site condition data Kawana

The 2022 Year One monitoring data displays a general trend of increased quality when compared to the 2020 Baseline data.

As discussed in Section 2.2, site context and “role of site location to TEC overall population in the state” data was derived from the Environmental Offsets Strategy (GHD 2019) and Baseline Monitoring Report (WSP 2020) for the Project, as this data has not changed over time. Although a minor infestation of *Ipomoea cairica* was identified in the TEC area, this did not increase the “threats to species” at the site, which remain low.

The largest changes impacting the overall condition within the Kawana offset area are associated with the site condition results. Increases to species richness in the grass, shrub and forb layers throughout the two sites have been the largest drivers for the increases in overall condition scores for this TEC offset. Other factors increasing the site condition are native shrub cover, which is now above the benchmark for both plots, and native perennial grass cover which has increased above the benchmark in KBC1. Figure 4.6 and Figure 4.7 depict these changes to the average results for each site condition criterion.

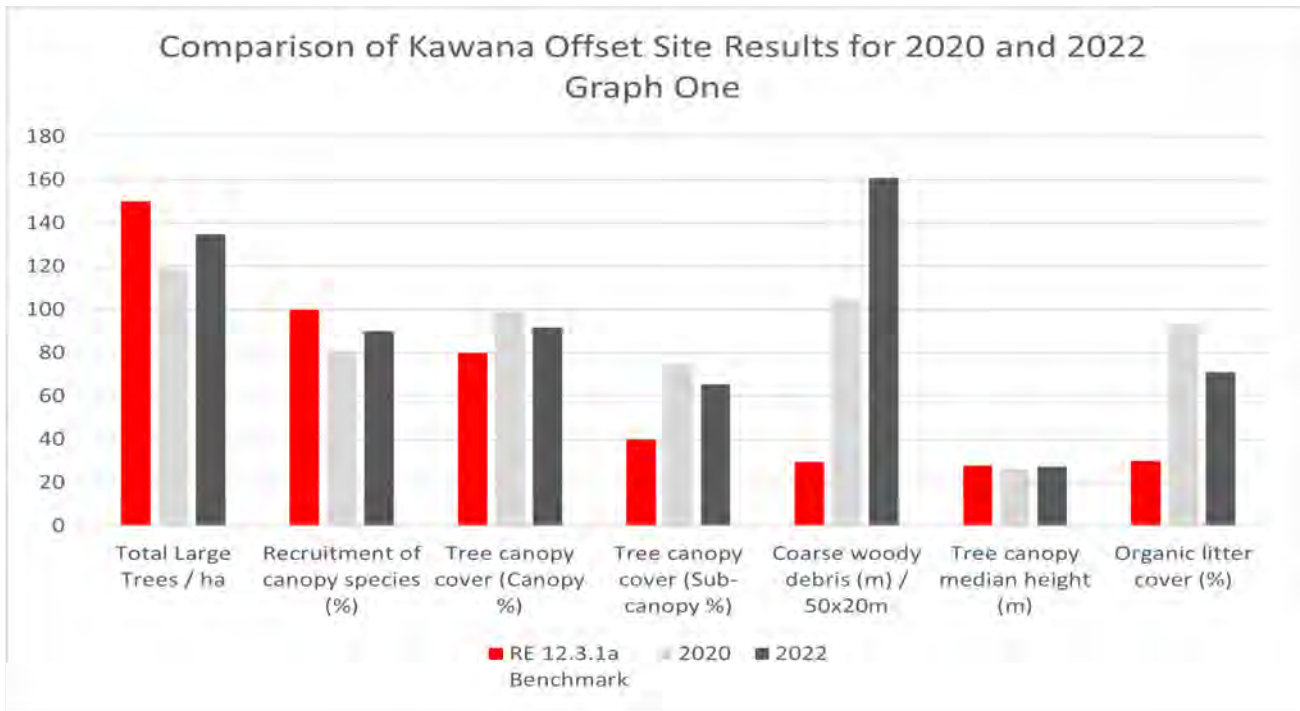


Figure 4.6 Comparison of Kawana offset monitoring results for 2020 and 2022 (graph one)

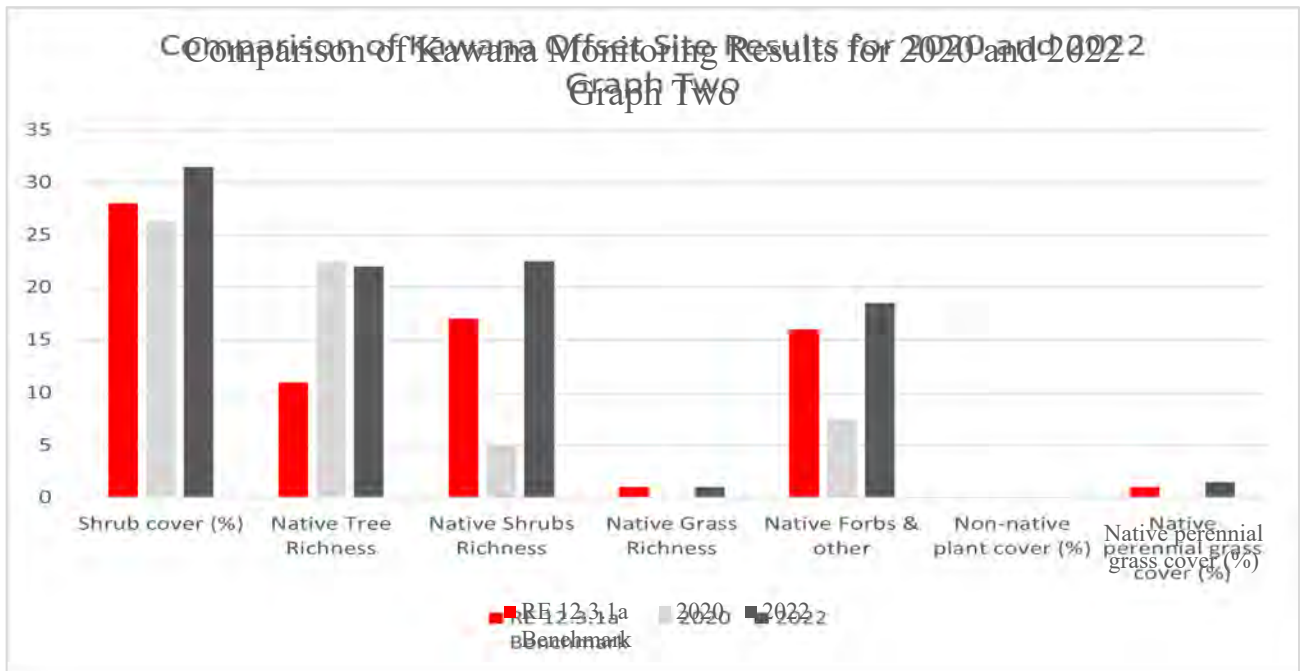


Figure 4.7 Comparison of Kawana offset monitoring results for 2020 and 2022 (graph two)

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## 4.2 Woondum offset area

The Woondum Offsets Area (Woondum) consists of a small patch (2.7 ha) of mixed notophyll vine forest on low hills of basaltically enriched colluvial slopes on metasediments of the Gympie province associated with Land Zone 11. The small corridor of mixed notophyll vine forest on colluvium occurs as a small valley between two steeper ridges dominated by Eucalypt communities on shallow soils.

Two permanent baseline BioCondition monitoring transects were established within Woondum during the 2020 surveys and re-assessed during the 2022 round of monitoring (refer Figure 2.3). In addition, several vegetation and weed surveys were undertaken to identify any changes in the dominant species, species richness and weed presence/abundance within the mapped buffer zone (approx. 10.4 ha) surrounding the Lowland Rainforest TEC at Woondum (refer Figure 2.3).

The regional ecosystem verified within the Woondum offset area recorded in association with the Lowland Rainforest TEC included RE 12.11.10 Notophyll vine forest +/- *Araucaria cunninghamii* on metamorphics +/- interbedded volcanics (see Figure 4.8).

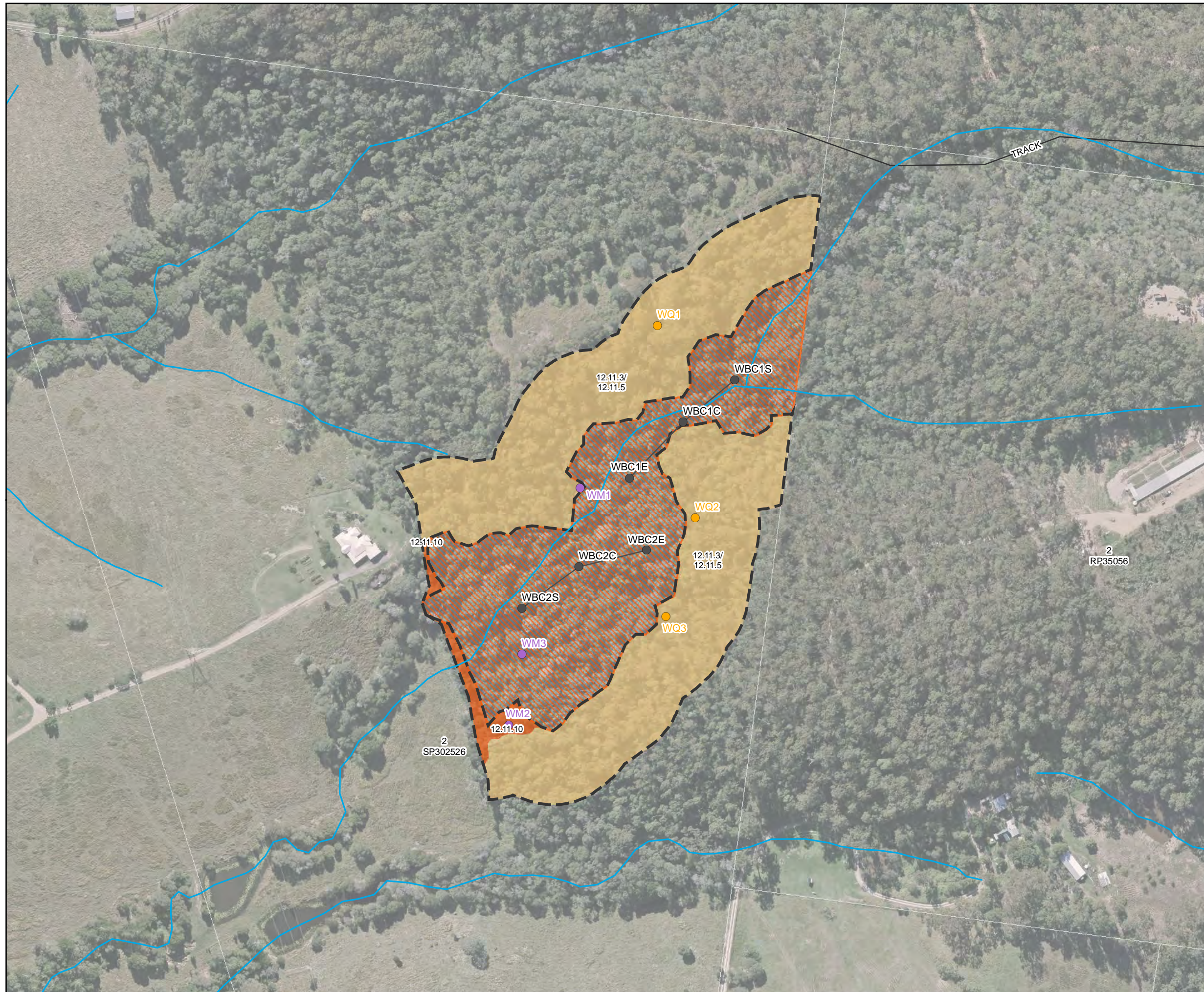
Field survey results for the vegetated buffer zone surrounding the Lowland Rainforest TEC at Woondum confirmed the presence of the following vegetation communities and regional ecosystems occurring on the steeper slopes with shallow soils adjacent to the mapped Lowland Rainforest TEC:

- RE 12.11.3 – *Eucalyptus siderophloia*, *E. propinqua* +/- *E. microcorys*, *Lophostemon confertus*, *Corymbia intermedia*, *E. acmenoides* open forest on metamorphics +/- interbedded volcanics.
- RE 12.11.5 – *Corymbia citriodora* subsp. *variegata* woodland to open forest +/- *Eucalyptus siderophloia*/*E. crebra*, *E. carnea*, *E. acmenoides*, *E. propinqua* on metamorphics +/- interbedded volcanics.
- High Value Regrowth RE 12.11.10 – Notophyll vine forest +/- *Araucaria cunninghamii* on metamorphics +/- interbedded volcanics.

The remnant area of RE 12.11.10 is the only area associated with the Lowland Rainforest TEC. However, in accordance with the Listing Advice, in addition to a patch of Lowland Rainforest TEC, a minimum buffer zone that extends 50 m beyond the trunks of the outermost trees in the patch is required to assist in the preservation of the patch to help protect the ecological community from spray drift (fertiliser, pesticide or herbicide sprayed in adjacent land) and other threats.



Figure 4.8  
Woondum Offsets Area Vegetation  
Communities and Monitoring Sites

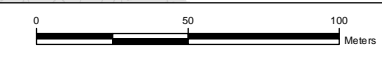
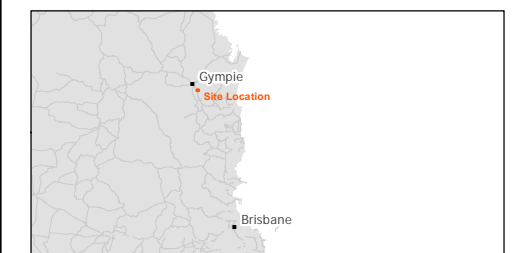


**Legend**

- BioCondition
- Weed Monitoring Site
- Photo Monitoring Site
- Transect
- Watercourse
- Cadastre
- ⬜ Threatened Ecological Communities (offset buffer)
- ▨ Lowland Rainforest TEC (RE 12.11.10)

**Field Verified Vegetation**

- High Value Regrowth Mixed
- Notophyll Vine Forest On Metasediments (RE 12.11.10 - HVR)
- Mixed open shrubby Eucalypt forest on metasediments with
- Lophostemon confertus, E. propinqua, E. siderophloia (RE 12.11.3/12.11.5 - remnant)



Coordinate system: GDA 1994 MGA Zone 56  
 Scale ratio correct when printed at A3  
 1:2,500 Date: 23-Sep-20

Data sources: - DNRME, TMR, Translink, Geoscience Australia

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#### 4.2.1 2022 (Year One) site condition results Woondum

The results of the two BioCondition monitoring for Woondum are presented in Figure 4.9 and Figure 4.10. The BioCondition parameters for each site have been represented graphically against benchmark data to indicate where the Woondum offsets sites are performing well and/or have the opportunity for improvement through intervention and management.

Both monitoring transects performed well in relation to tree canopy height and cover and approached the benchmarks for native tree richness and recruitment of canopy species. WBC2 performed fairly in number of large trees, however WBC1 was well below the benchmark score. There was an overabundance of shrub cover and coarse woody debris, with WBC2 additionally being overabundant in organic litter at each site. Both sites lack species richness for native forbs and shrubs when compared to benchmarks. Table 4.5 shows the results of the data analysis for each monitoring transect assessed against the site condition scores of the Modified QLD Habitat Quality spreadsheet (DAWE 2019). The results indicate that Woondum offset scored an average of 4.89 out of a possible 7 for site condition. BioCondition WBC1 was lacking an emergent layer which reduced its score, and the overabundance of shrub cover and lack of species richness of shrubs and forbs were consistent across both transects.

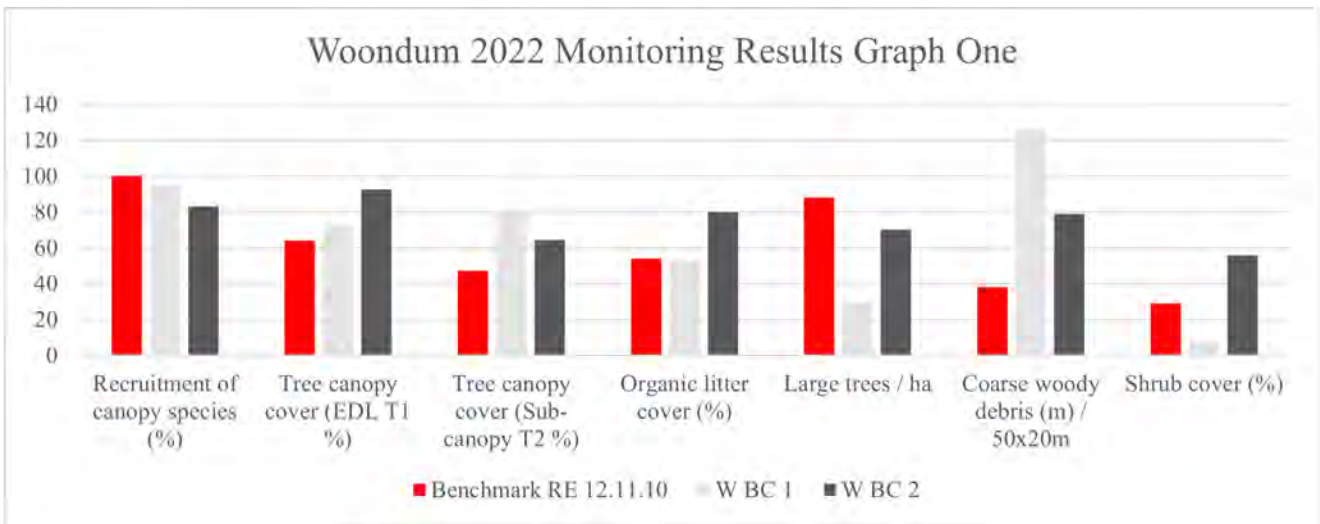


Figure 4.9 Woondum 2022 BioCondition monitoring results comparison against benchmarks (graph one)

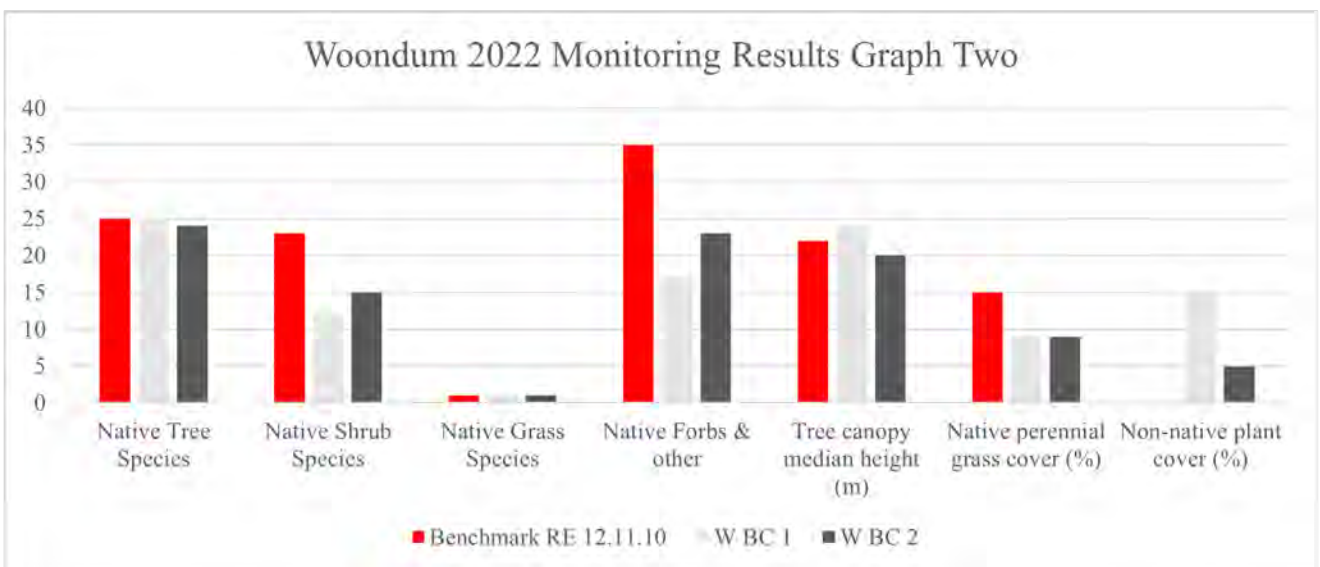


Figure 4.10 Woondum 2022 BioCondition monitoring results comparison against benchmarks (graph two)

Table 4.5 Woondum site condition results

| Assessment unit – regional ecosystem          | Woondum RE 12.11.10 |          |             |             |          |             |       |                    |             |
|-----------------------------------------------|---------------------|----------|-------------|-------------|----------|-------------|-------|--------------------|-------------|
| Site reference                                | Benchmark           | WBC1     |             |             | WBC2     |             |       | Average% Benchmark | Score       |
| Woondum offset site condition                 | 12.11.10            | Raw data | % Benchmark | Score       | Raw data | % Benchmark | Score |                    |             |
| Recruitment of woody perennial species in EDL | 100                 | 95       | 95%         | 5           | 83       | 83%         | 5     | 89%                | 5           |
| Native plant species richness – trees         | 25                  | 25       | 100%        | 5           | 24       | 96%         | 5     | 98%                | 5           |
| Native plant species richness – shrubs        | 23                  | 12       | 52%         | 2.5         | 15       | 65%         | 2.5   | 59%                | 2.5         |
| Native plant species richness – grasses       | 1                   | 1        | 100%        | 5           | 1        | 100%        | 5     | 100%               | 5           |
| Native plant species richness – forbs         | 35                  | 17       | 49%         | 2.5         | 23       | 66%         | 2.5   | 57%                | 2.5         |
| Tree Height Emergent                          | 33                  | 0        | 0%          | 3.3         | 25       | 76%         | 5     | 38%                | 4.2         |
| Tree Height Canopy                            | 22                  | 24       | 109%        |             | 20       | 91%         |       | 100%               |             |
| Tree Height Sub-canopy                        | 8                   | 10       | 125%        |             | 8        | 100%        |       | 113%               |             |
| Tree Cover Emergent                           | 5                   | 0        | 0%          | 3.3         | 6.5      | 130%        | 5     | 65%                | 4.2         |
| Tree Cover Canopy                             | 64                  | 73       | 114%        |             | 90       | 141%        |       | 127%               |             |
| Tree Cover Sub-canopy                         | 47                  | 81       | 172%        |             | 64       | 136%        |       | 154%               |             |
| Shrub canopy cover                            | 29                  | 8        | 28%         | 3           | 90       | 310%        | 3     | 169%               | 3           |
| Native grass cover                            | 15                  | 9        | 60%         | 3           | 9        | 60%         | 3     | 60%                | 3           |
| Organic litter                                | 54                  | 53       | 98%         | 5           | 27       | 50%         | 3     | 74%                | 4           |
| Large trees (euc plus non-euc)                | 88                  | 30       | 34%         | 5           | 70       | 80%         | 10    | 57%                | 7.5         |
| Coarse woody debris                           | 705                 | 1260     | 179%        | 5           | 1075     | 152%        | 5     | 166%               | 5           |
| Non-native plant cover                        | 0                   | 15       | 15%         | 5           | 5        | 5%          | 5     | 10%                | 5           |
| Site Condition Score                          |                     |          |             | 52.7        |          |             |       | 59                 | 55.8        |
| Maximum Site Condition Score                  |                     |          |             | 80          |          |             |       | 80                 | 80          |
| <b>Site Condition Score – out of 7</b>        |                     |          |             | <b>4.61</b> |          |             |       | <b>5.16</b>        | <b>4.89</b> |

#### 4.2.2 2020 (Baseline) site condition results Woondum

The results for the two baseline BioCondition monitoring transects completed in 2020 for Woondum offset area are presented in Figure 4.11 and Figure 4.12. The 2020 transects achieved a score of 4.48 and 5.25 averaging to a score of 4.86 out of 7, with an overabundance of leaf litter, and a lack of species richness for native shrubs, grasses and forbs limiting the scores.

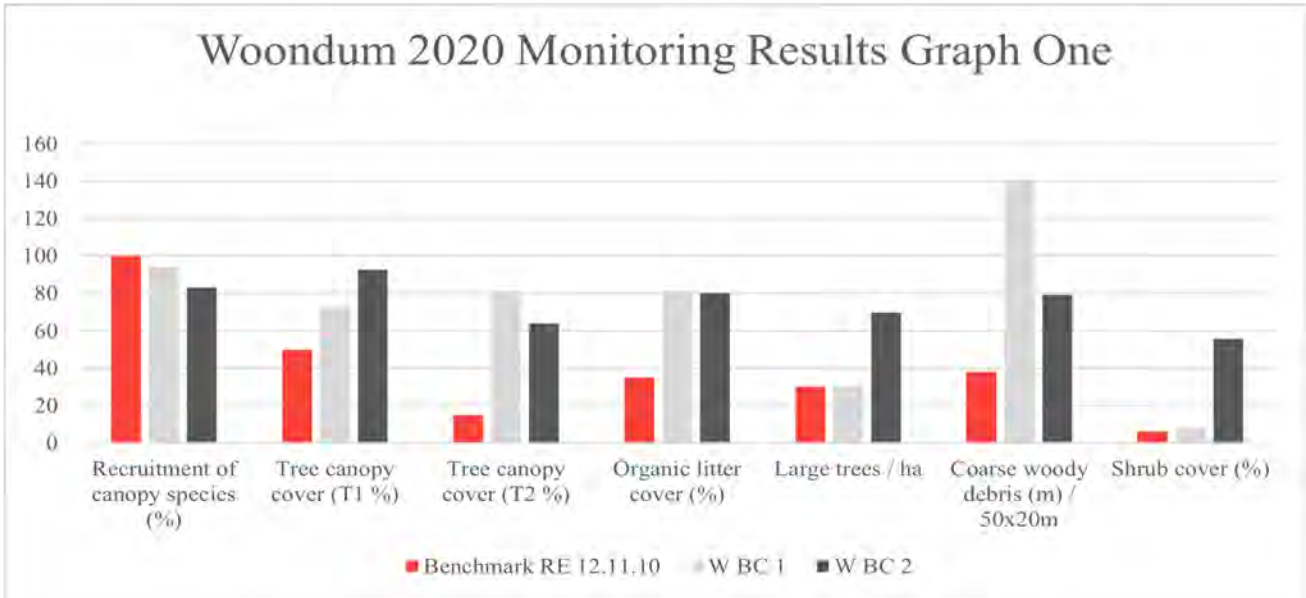


Figure 4.11 Woondum 2020 BioCondition transect comparison results against benchmarks (Graph One)

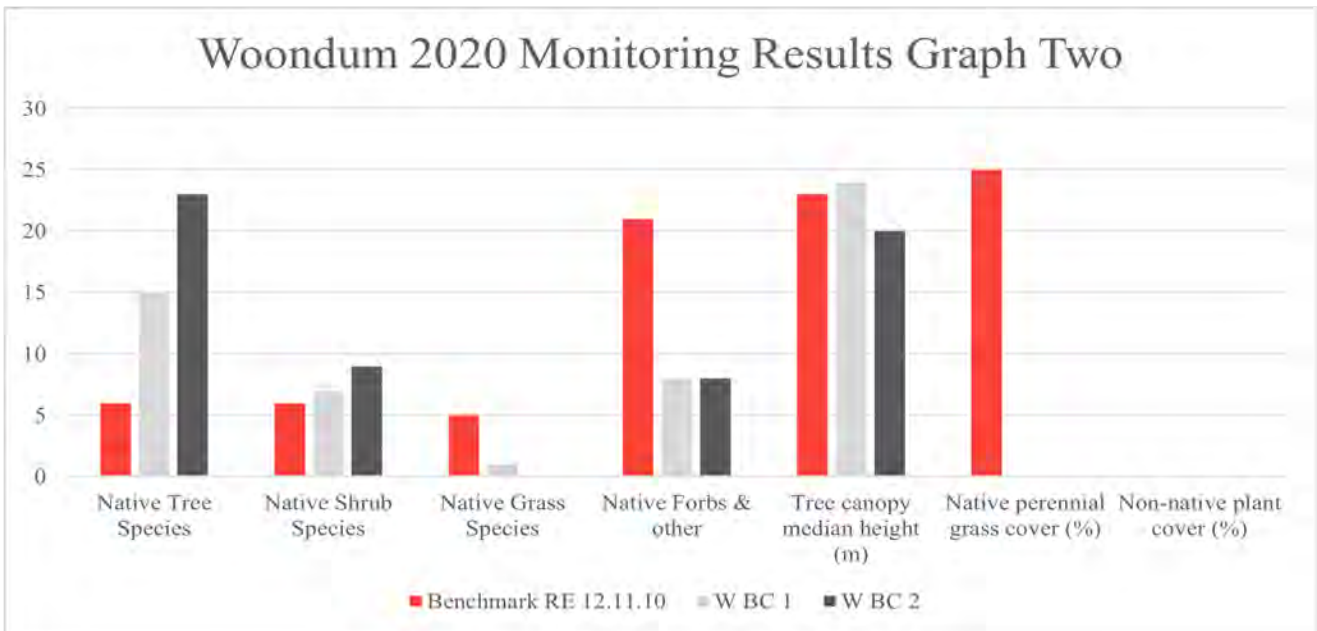


Figure 4.12 Woondum 2020 BioCondition transect comparison results against benchmarks (Graph Two)

### 4.2.3 Site context and habitat quality results Woondum

Table 4.6 highlights the scores for each monitoring transect against the site context and habitat quality assessments including the ‘role of site location to the Lowland Rainforest TEC overall population in the state’ and the ‘threat to the species.’ These figures were unchanged from the baseline data collected during the 2020 monitoring.

Results of the monitoring indicate there is still a threat to the community predominantly associated with the presence of invasive plant species in within the community and buffer zone, in particular the presence of Cats Claw Creeper (*Dolichandra unguis-cati*) was observed in the vicinity of both BioCondition sites and in the south-western portion of the offset area and buffer zone (refer Figure 4.8).

Table 4.7 provides the overall habitat quality results for the Woondum offset area. It is recommended the best opportunity for improving the habitat score at Woondum is to reduce the ‘threat to species’ associated with invasive plant species.

Recommendations for improving the habitat score at Woondum are provided in Section 5.

Table 4.6 Woondum site context results

| Site context                                                 | WBC1       | Score | WBC2       | Score | Average WBC1/WBC2 | Average score |
|--------------------------------------------------------------|------------|-------|------------|-------|-------------------|---------------|
| Size of patch                                                | 622        | 10    | 622        | 10    | 622               | 10            |
| Connectedness                                                | 97         | 5     | 97         | 5     | 97                | 5             |
| Context                                                      | 50         | 4     | 50         | 4     | 50                | 4             |
| Ecological Corridors                                         | Not within | 0     | Not within | 0     | –                 | 0             |
| Role of site location to TEC overall population in the state | No         | 1     | No         | 1     | –                 | 1             |
| Threats to the species                                       | Moderate   | 7     | Moderate   | 7     | –                 | 7             |
| Site Context Score                                           |            | 27    |            | 27    |                   | 27            |
| <i>MAX Site Context Score</i>                                |            | 46    |            | 46    |                   | 46            |
| Site Context Score – out of 3                                |            | 1.76  |            | 1.76  |                   | 1.76          |

Table 4.7 Woondum Habitat overall habitat quality baseline results

| Final habitat quality score (weighted) | WBC1        | WBC2        | Average/final |
|----------------------------------------|-------------|-------------|---------------|
| Site Condition score (out of 7)        | 4.61        | 5.16        | 4.89          |
| Site Context Score (out of 3)          | 1.76        | 1.76        | 1.76          |
| Habitat Quality score (out of 10)      | 6.37        | 6.92        | 6.65          |
| Assessment Unit area (ha)              | 622         | 622         | 622           |
| Total offset area (ha) for this MNES   | 622         | 622         | 622           |
| Size Weighting                         | 1.00        | 1.00        | 1             |
| <i>Weighted Habitat Quality Score</i>  | <b>6.37</b> | <b>6.92</b> | <b>6.65</b>   |

#### 4.2.4 Weed and invasive plant presence at Woondum

Three restricted invasive plants, two other invasive plants and three environmental weeds were recorded in the Woondum offsets area (refer Appendix B and Table 4.8).

The presence of Cats Claw Creeper (*Dolichandra unguis-cati*), Chinese Elm (*Celtis sinensis*) and Lantana (*Lantana camara*) pose a significant threat to the Lowland Rainforest TEC. Cats claw creeper was recorded within WBC1, WM2, WM3 and WQ3 and is still posing a major threat to the ecological condition of the Woondum offset area.

Although *Lantana camara* is still present throughout the survey area, the active management of this species is apparent throughout the Woondum offsets area and has led to increased recruitment of rainforest plants in WQ1.

It is recommended invasive plant weed management continues throughout the Lowland Rainforest TEC offset area and in the buffer zones (refer Section 5.1).

Table 4.8 Invasive plants and naturalised pastures Woondum Lowland Rainforest TEC vegetated buffer zone

| Species name                   | Invasive plant status (DAF) |
|--------------------------------|-----------------------------|
| <i>Ageratina riparia</i>       | Other invasive              |
| <i>Celtis sinensis</i>         | Restricted invasive         |
| <i>Dolichandra unguis-cati</i> | Restricted invasive         |
| <i>Lantana camara</i>          | Restricted invasive         |
| <i>Passiflora suberosa</i>     | Other invasive              |
| <i>Rivina humilis</i>          | Environmental weed          |
| <i>Solanum mauritianum</i>     | Other invasive              |
| <i>Solanum seaforthianum</i>   | Environmental weed          |

#### 4.2.5 Vegetated buffer zone management Woondum

The purpose of the buffer zone is to protect and manage the patch and to help avoid potential indirect impacts to the ecological community. Its purpose is not specifically to extend the patch through regeneration. The small strip of High Value Regrowth RE 12.11.10 has long term potential to be incorporated into the mapped area of Lowland Rainforest TEC. However, it requires continued weed control and assisted natural regeneration (refer Section 5).

#### 4.2.6 Comparison between Baseline and Year One site condition data Woondum

The 2022 biannual monitoring data displays a trend of increased quality in some criteria and reduced quality in others when compared to the 2020 baseline data.

As discussed in Section 2.2, site context and “role of site location to TEC overall population in the state” data was derived from the Environmental Offsets Strategy (GHD 2019) and Baseline Monitoring Report (WSP 2020) for the Project, as this data has not changed over time. “Threats to Species” remains moderate as invasive plant species are still prevalent within the offsets site and surrounding buffer areas in Woondum.

The 2022 BioCondition monitoring data shows an increase to species richness for all plant lifeforms. Native tree and grass species richness are at or near to the benchmark for RE 12.11.10 and although native shrub and forb richness is not yet approaching the benchmark, they are showing a significant improvement when compared to the baseline data. Ground cover has also shown a positive trend, with the percentage of ground litter reducing and native grass cover increasing, both towards their benchmarks. Course woody debris has also reduced slightly towards the benchmark for this criterion.

The average non-native plant cover has increased from 0% to 10% over the period between the 2020 and 2022 monitoring. Invasive species *Lantana camara*, *Passiflora suberosa*, *Rivina humilis*, *Solanum mauritianum* and *Solanum seaforthianum* have been identified within the BioCondition transects, at either WBC1, WBC2 or both (refer Appendix B). Weed management efforts will need to be continued at the Woondum site to increase this score for the next round of monitoring.

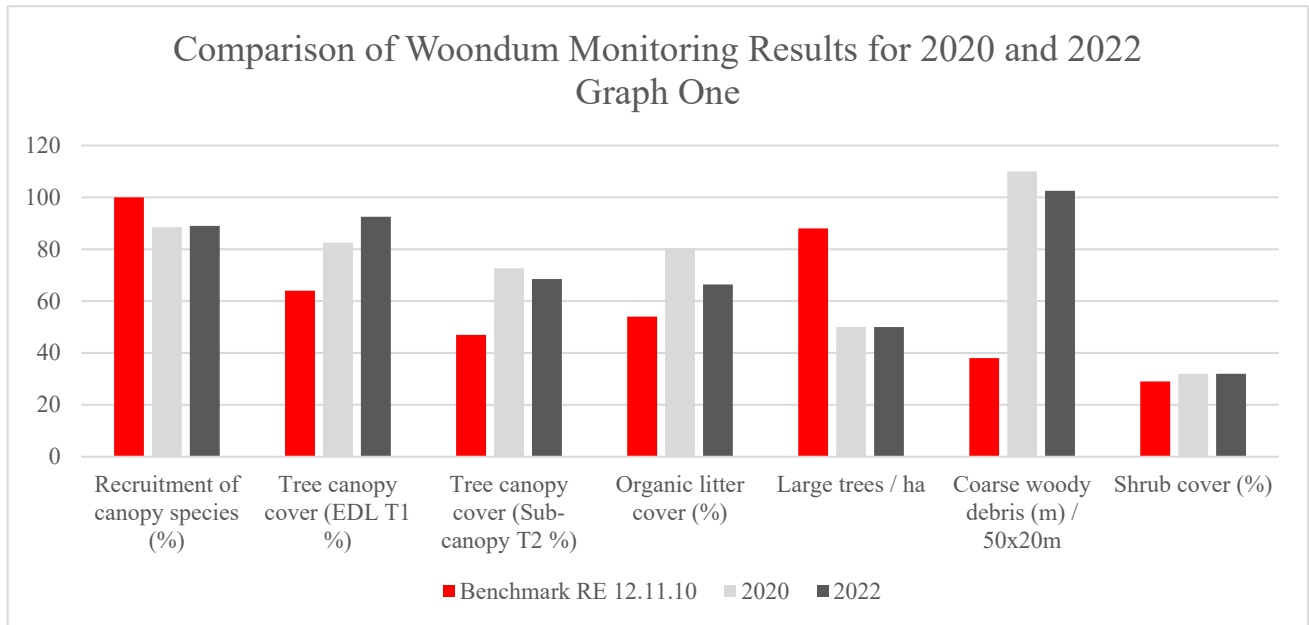


Figure 4.13 Comparison of Woondum monitoring results for 2020 and 2022 (graph one)

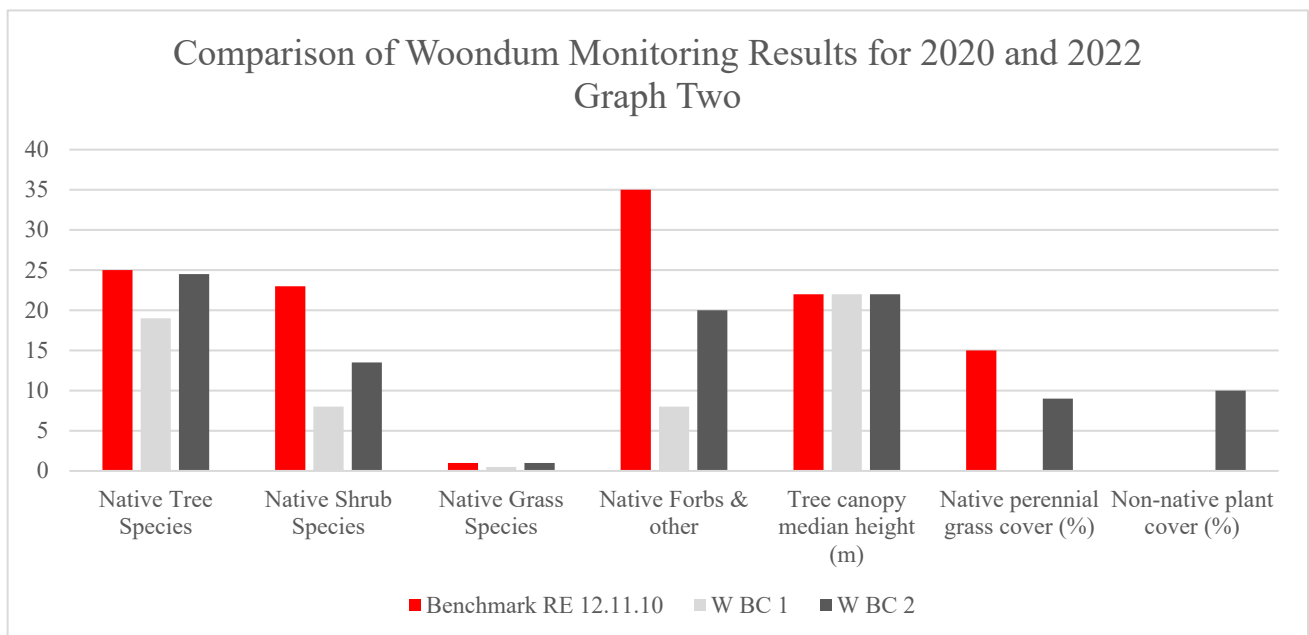


Figure 4.14 Comparison of Woondum monitoring results for 2020 and 2022 (graph two)

# 5 Recommendations

This section provides recommended management actions required to improve the site condition for each offset area based on the findings of the baseline monitoring. The purpose of the recommendations is to improve each offset area's overall habitat quality score over time. Recommendations have been split into the following categories:

- Weed Control and Buffer Zone Management
- Revegetation and Natural Regeneration.

## 5.1 Weed control and buffer zone management

### 5.1.1 Kawana offset area

Results of field surveys indicated there is a very low threat to the community at Kawana apart from several invasive plant species occurring within the vegetated buffer zone. Current weed management practices appear to be improving overall conditions within the offsets site, however the appearance of *Ipomoea cairica* within the TEC area at KBC2 highlights the need for ongoing management as new infestations may arise. It is recommended the maintenance of the buffer zone (refer Figure 5.1) is continued through an annual weed control program targeting the weed species recorded during the monitoring surveys listed in Table 5.1. The weed management area can be identified on Figure 5.1.

Table 5.1 Invasive plants and naturalised pastures Kawana Lowland Rainforest TEC vegetated buffer zone

| Species name                | Invasive plant status (DAF) |
|-----------------------------|-----------------------------|
| <i>Digitaria violascens</i> | Naturalised pasture         |
| <i>Ipomoea cairica</i>      | Other invasive              |
| <i>Lantana camara</i>       | Restricted invasive         |

In accordance with the requirements of the Project Draft Environmental Offsets Strategy (GHD 2019), it is also recommended ongoing weed monitoring is undertaken within the buffer zone and at all weed monitoring sites established during the baseline surveys points (Figure 4.1).

### 5.1.2 Woondum offset area

It is recommended the best opportunity for improving the habitat score at Woondum is still to reduce the 'threat to species' associated with restricted invasive plant species. Of importance is the control of weeds associated with the threat to the community including Cats Claw Creeper (*Dolichandra unguis-cati*), Chinese Elm (*Celtis sinensis*) and Lantana (*Lantana camara*).

The control of Lantana is showing signs of effectiveness throughout the monitoring area, with rainforest species showing increased signs of recruitment in areas where cover of Lantana has decreased. This indicates that the current management practices are beginning to have positive impacts on the overall condition throughout the offset area. It is recommended the weed management area identified in the buffer zone and across the entire offset areas (refer Figure 5.2) continues to be maintained and managed through an annual weed control program targeting the weed species recorded during the baseline surveys, as listed in Table 5.2.



Table 5.2 Invasive plants and naturalised pastures Woondum Lowland Rainforest TEC vegetated buffer zone

| Species name                   | Invasive plant status (DAF) |
|--------------------------------|-----------------------------|
| <i>Ageratina riparia</i>       | Other invasive              |
| <i>Celtis sinensis</i>         | Restricted invasive         |
| <i>Dolichandra unguis-cati</i> | Restricted invasive         |
| <i>Lantana camara</i>          | Restricted invasive         |
| <i>Passiflora suberosa</i>     | Other invasive              |
| <i>Rivina humilis</i>          | Environmental weed          |
| <i>Solanum mauritianum</i>     | Other invasive              |
| <i>Solanum seaforthianum</i>   | Environmental weed          |

## 5.2 Revegetation and natural regeneration

### 5.2.1 *Kawana offset area*

Revegetation plantings have been established throughout the Kawana TEC site since the 2020 baseline monitoring. It is evident from the increase in species richness of grass, forb and shrub species that these plantings are surviving, and this is having a positive effect on the overall condition of the offset site. No additional plantings are recommended following this round of monitoring.

### 5.2.2 *Woondum offset area*

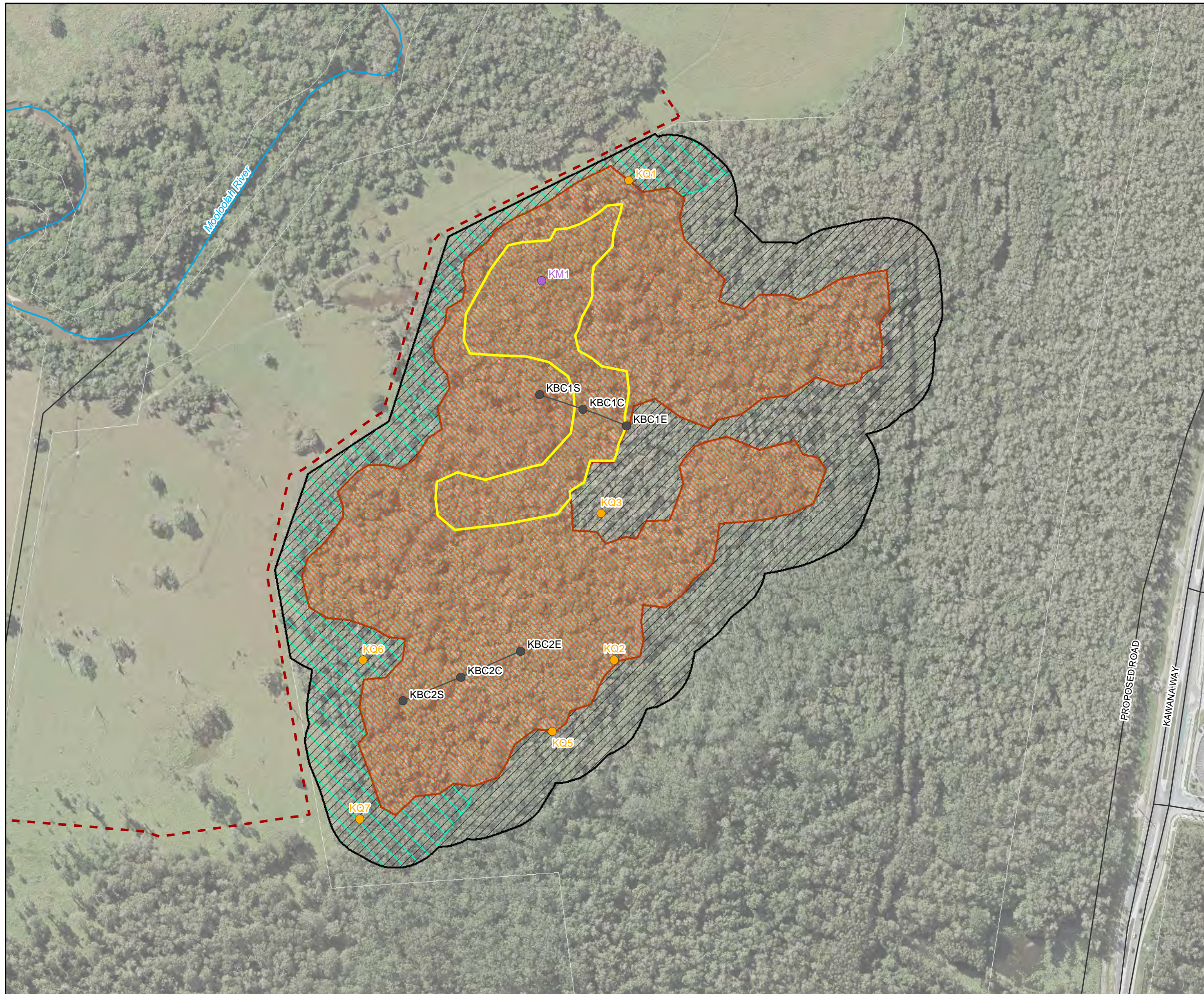
The results of the field survey indicated that species richness has increased in all layers of vegetation at Woondum within the two BioCondition transects. The current annual weed management and planting program is having a positive impact on the overall condition at the offset. There is still room for improvement however, as native shrub and forb richness are still well below the benchmarks, and non-native plant cover is still well above the benchmark.

It is recommended that weed management is continued throughout the weed management area identified in 2020 (refer Figure 5.2). This needs to be followed by revegetation of species in Table 5.3, taken from a combination of the draft BioCondition Benchmarks for RE 12.11.10 (Queensland Herbarium 2019) and Appendix A of the Listing Advice, to improve species richness for the offsets area.

Table 5.3 Woondum offsets recommended species for revegetation

| Revegetation strata     | Recommended species                                                                                                                                                                            |                                                                                                                                                                                                                           |
|-------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Native Trees and Shrubs | <i>Acacia disparrima</i><br><i>Acmena smithii</i><br><i>Backhousia kingii</i><br><i>Breynia oblongata</i><br><i>Cleistanthus cunninghamii</i><br><i>Ficus coronata</i><br><i>Ficus fraseri</i> | <i>Mallotus discolor</i><br><i>Melicope micrococca</i><br><i>Pittosporum revolutum</i><br><i>Pittosporum undulatum</i><br><i>Aphananthe philippinensis</i><br><i>Flindersia australis</i><br><i>Flindersia schottiana</i> |
| Native Grasses          | <i>Oplismenus aemulus</i><br><i>Ancistrachne uncinulata</i>                                                                                                                                    |                                                                                                                                                                                                                           |
| Native Forbs and other  | <i>Pararistolochia praevenosa</i><br><i>Lomandra hystrix</i><br><i>Dianella caerulea</i>                                                                                                       |                                                                                                                                                                                                                           |

Figure 5.1  
Kawana Offsets Area Management  
Areas



**Legend**

- BioCondition
- Weed Monitoring Site
- Photo Monitoring Site
- Proposed Access
- Transect
- Watercourse
- Cadastre
- ▨ Lowland Rainforest TEC
- ▨ Weed Management
- ▭ Recommended Revegetation Area
- ▨ Threatened Ecological Communities (offset buffer)



0 50 100  
Meters

Coordinate system: GDA 1994 MGA Zone 56

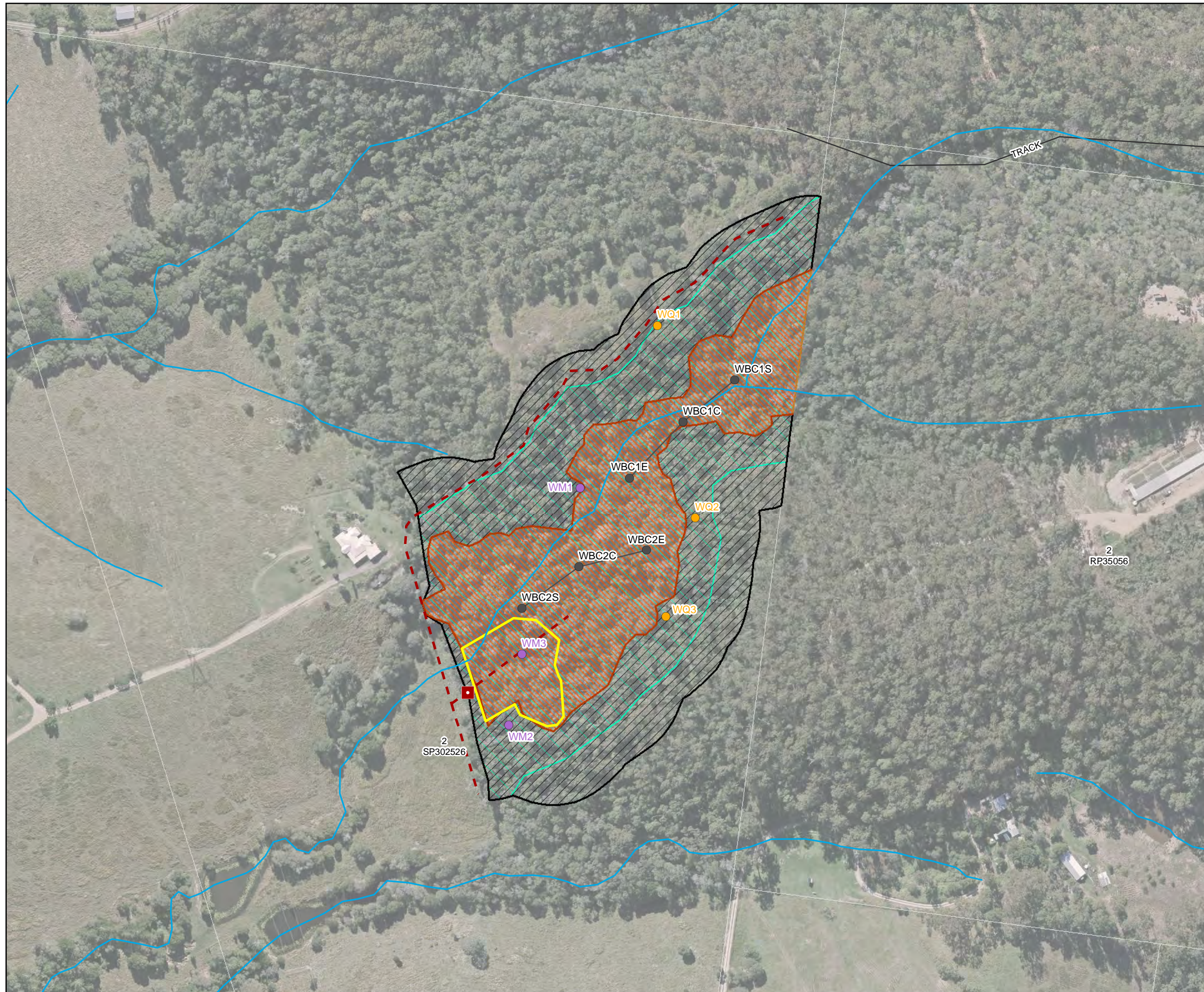
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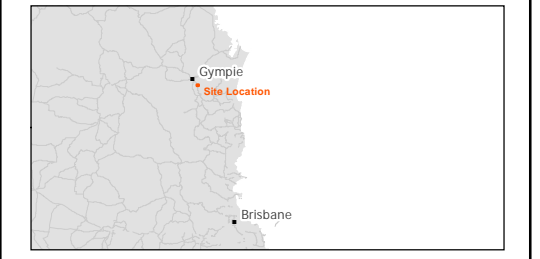
Data sources: - DNRME, TMR, Translink, Geoscience Australia

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**Figure 5.2  
Woondum Offsets Area Management  
Areas**



- Legend**
- BioCondition
  - Weed Monitoring Site
  - Photo Monitoring Site
  - Proposed Access Gate
  - Proposed Access Track
  - Transect
  - Watercourse
  - Cadastre
  - ▨ Lowland Rainforest TEC
  - ▨ Weed Management Area
  - ▨ Recommended Revegetation Area
  - ▨ Threatened Ecological Communities (offset buffer)



Coordinate system: GDA 1994 MGA Zone 56  
 Scale ratio correct when printed at A3  
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Data sources: - DNRME, TMR, Translink, Geoscience Australia  
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## 6 Limitations

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### 6.1 Scope of services

This report has been prepared in accordance with the scope of services set out in the contract, or as otherwise agreed, between the client and WSP (scope of services). In some circumstances the scope of services may have been limited by a range of factors such as time, budget, access and/or disturbance constraints.

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### 6.2 Reliance on data

In preparing the report, WSP has relied upon data, surveys, analyses, designs, plans and other information provided by the client and other individuals and organisations, most of which are referred to in the report (the data). Except as otherwise stated in the report, WSP has not verified the accuracy or completeness of the data. To the extent that the statements, opinions, facts, information, conclusions and/or recommendations in the report (conclusions) are based in whole or part on the data, those conclusions are contingent upon the accuracy and completeness of the data. WSP will not be liable in relation to incorrect conclusions should any data, information or condition be incorrect or have been concealed, withheld, misrepresented or otherwise not fully disclosed to WSP.

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### 6.3 Environmental conclusions

In accordance with the scope of services, WSP has relied upon the data and has conducted environmental field surveys in the preparation of the report. The nature and extent of survey conducted is described in the report.

Varying degrees of non-uniformity are encountered across all natural areas. Hence no sampling technique can eliminate the possibility that results are not totally representative of conditions encountered. The conclusions are based upon the data and the ecological surveys and are therefore merely indicative of the environmental condition of the study area at the time of preparing the report.

Also, it should be recognised that conditions, including the presence of threatened biodiversity, can change with time. No sampling technique can eliminate the possibility that a species is present within the proposal area. For example, some flora may be present in the soil seed bank and some fauna species use habitats on a sporadic or seasonal basis and may not be present within the study areas during surveys.

Within the limitations imposed by the scope of services, the surveys and preparation of this report have been undertaken and performed in a professional manner, in accordance with generally accepted practices and using a degree of skill and care ordinarily exercised by reputable environmental consultants under similar circumstances. No other warranty, expressed or implied, is made.

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### 6.4 Report for benefit of client

The report has been prepared for the benefit of the client (and no other party). WSP assumes no responsibility and will not be liable to any other person or organisation for or in relation to any matter dealt with or conclusions expressed in the report, or for any loss or damage suffered by any other person or organisation arising from matters dealt with or conclusions expressed in the report (including without limitation matters arising from any negligent act or omission of WSP or for any loss or damage suffered by any other party relying upon the matters dealt with or conclusions expressed in the report). Except as provided below parties other than the client should not rely upon the report or the accuracy or completeness of any conclusions and should make their own enquiries and obtain independent advice in relation to such matters.

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- Queensland Herbarium (2019) Draft RE 12.3.1a BioCondition Benchmarks. Queensland Herbarium, Queensland Department of Environment and Science, Brisbane, Qld.

# Appendix A

Suitably qualified person curriculum vitae





## MELANIE ASHMORE

Senior Ecologist



### Profile

Melanie has a Bachelor of Science over 5 years' experience as a terrestrial ecologist working throughout Queensland. She has worked in consulting and for the coal seam gas industry where she has gained an expertise in the flora of the brigalow belt bioregion.

During her time as an ecologist, Melanie has gained abundant experience in protected plants flora surveys and reporting, pre-clearance vegetation surveys including BioCondition, significant residual impacts reporting, rehabilitation monitoring and reporting, and regional ecosystem verification. She has also participated in fauna surveys which included habitat assessment, Spot Assessment Technique for koalas, and targeted spotlighting and trapping for marsupials, reptiles and bats.

### 5.5 years of experience

#### Areas of expertise

Terrestrial ecology

BioCondition surveys

Protected plants flora surveys and reporting

Ecological assessment and significant impact assessment

Regional ecosystem verification

### Education

University of Queensland  
Bachelor of Science majoring in Ecology

2016

### Professional Experience

#### Previous experience

##### Coal Seam Gas

- **Protected plant flora surveys, Surat Basin and Bowen Basin, Queensland, Australia (2018-2022): Arrow Energy, Ecologist.**

Planning and conducting supervised protected plant flora surveys throughout the Surat and Bowen Basins using the random meander technique. Preparing post-survey reporting and clearing permit/exemption notice applications.

- **Pre-clearance surveys, Surat Basin and Bowen Basin, Queensland, Australia (2018-2022): Arrow Energy, Ecologist.**

Conducting Quaternary, Tertiary and Secondary vegetation surveys, pest plant and protected plant surveys, Spot Assessment Technique surveys for koalas and general fauna habitat surveys.

- **Rehabilitation Monitoring, Surat Basin and Bowen Basin, Queensland, Australia (2018-2022): Arrow Energy, Ecologist.**

Rehabilitation field assessments and reporting in line with requirements set out in multiple Environmental Authorities.

- **Annual Return Reporting, Surat Basin and Bowen Basin, Queensland, Australia (2018-2022): Arrow Energy, Ecologist.**

Drafting and submitting annual returns assessing compliance with biodiversity conditions in multiple Environmental Authorities.

- **Targeted fauna surveys, Surat Basin, Queensland, Australia (2019-2020): Arrow Energy, Ecologist.**

Spotlighting, pitfall, funnel and harp trapping and handling reptiles, marsupials and bats.

### Mining

- **Curragh Mine, Backwater, QLD, Australia (2017): Wesfarmers Limited, Fauna Spotter Catcher.**

Tasks included Fauna Spotter during vegetation clearing.

- **New Acland Mine, Muldu, QLD, Australia (2017): New Hope Group, Ecologist.**





## MELANIE ASHMORE

*Senior Ecologist*

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Tasks included conducting multiple supervised protected plants flora surveys, koala habitat mapping and identifying fauna habitat.

– **Newlands Mine, Newlands, QLD, Australia (2017): Glencore, Ecologist.**

Tasks included conducting multiple supervised protected plants flora surveys, assessing biocondition and regional ecosystem identification.

– **Burton Mine, Moranbah, QLD, Australia (2017): Peabody Energy, Ecologist.**

Rehabilitation assessments across multiple borehole sites which included identifying plant species (threatened plants, native and introduced species), native groundcover and signs of erosion.

### *Professional Development*

|                                                                   |      |
|-------------------------------------------------------------------|------|
| Introduction to Regional Ecosystems, Oberonia                     | 2017 |
| BioCondition v2.2 – Application, Assessment and Scoring, Oberonia | 2017 |
| Queensland Construction Card                                      | 2017 |
| Venomous Snake Handling                                           | 2018 |
| Coal Seam Gas Industry Safety Induction                           | 2018 |
| Using Animals in Science                                          | 2018 |
| First Aid Certificate and CPR                                     | 2021 |
| Standard 11 Surface Mining Induction                              | 2022 |

### *Professional History*

|                                   |                |
|-----------------------------------|----------------|
| WSP - Ecologist                   | 2022 – Present |
| Arrow Energy - Ecologist          | 2018 – 2022    |
| QTREE Pty Ltd - Ecologist         | 2017 – 2018    |
| Green Army – Conservation Trainee | 2016 – 2016    |



5 years with WSP

18 years of experience

#### AREAS OF EXPERTISE

Biodiversity Offset Strategies

Vegetation Mapping

Environmental Assessments

Botanical Surveys

#### LANGUAGES

English

#### PROFILE

Mark is a highly experienced Principal Ecologist with over 18 years' experience within the industry. Mark has a breadth of experience in biodiversity impact assessment with particular emphasis in ecological surveys, ecological reporting, biodiversity offsetting, review and analysis. Mark has experience within both the public and private sectors and has developed effective communication and negotiating skills which have enabled him to achieve balanced solution based ecological outcomes, from initial constraint and option assessment, through project approval, and including biodiversity offsets and ecological management plans.

Mark has established an extensive knowledge of eastern Australian ecology with core strengths in vegetation and botanical analysis. Mark has also provided written and oral evidence in the NSW Land and Environment Court on many complex ecological matters.

#### EDUCATION

Bachelor of Science (Hons), University of Newcastle 2001

#### PROFESSIONAL ASSOCIATIONS

Australian Network for Plant Conservation ANPC

Australian Network for Ecology & Transportation ANET

#### PROFESSIONAL EXPERIENCE

##### Biodiversity Offsets

- **Parkes Special Activation Precinct - Biodiversity Certification Assessment Report Stage 1, Parkes, NSW (2019): NSW Department of Premier and Cabinet, Senior Botanist.**

This project involved undertaking native vegetation surveys in accordance with the BAM 2017 for an area of over 5000 hectares within the Parkes LGA. The project included targeted seasonal threatened species surveys and the preparation of a Stage 1 BCAR report.

- **Wagga Wagga Special Activation Precinct - Biodiversity Certification Assessment Report Stage 1, Wagga Wagga, NSW (2019): NSW Department of Premier and Cabinet, Senior Botanist.**

This project involved undertaking native vegetation surveys in accordance with the BAM 2017 on an area of over 4000 hectares within the Wagga Wagga LGA. The project included targeted seasonal threatened species surveys and the preparation of a Stage 1 BCAR report.

##### **Project Energy Connect, Preliminary Biodiversity Assessment - Buronga to Wagga Wagga (2019 - current): TransGrid, Senior Botanist.**

The project covers a linear distance of about 600 kilometres and was identified to contain 46 native plant community types (PCTs). Field validation identified seven threatened ecological communities listed under the BC Act and four under the EPBC Act.

- **Resurvey of vegetation at BioBanking sites, numerous BioBank sites within greater Sydney region, NSW, Australia (2018): Office of Environment and Heritage, Lead ecologist.**

Project involved resurveying 12 BioBank site monitoring locations using both the BBAM and BAM survey methodologies. Surveys were undertaken within numerous

vegetation types including Blue Gum High Forest, Sydney Turpentine Ironbark Forest, Cumberland Plain Woodland and River-flat Eucalypt Forest threatened ecological communities.

- **Sydney Metro Greater West EIS - Biodiversity Development Assessment Report, Western Sydney (2019): Sydney Metro, Senior Botanist.**

This project included native vegetation surveys undertaken in accordance with BAM 2017, targeted threatened flora surveys and BDAR reporting.

- **Sydney Gateway Project, Biodiversity Development Assessment Report, Mascot, Sydney (2018-2019): Roads and Maritime Services, Senior Botanist.**

This project involved undertaking native vegetation surveys in accordance with the BAM 2017 targeted threatened flora surveys and BDAR reporting. Biodiversity assessment of Swamp Oak Floodplain Forest was the primary issue.

- **Botany Rail Duplication: Biodiversity Development Assessment Report, Mascot to Botany, Sydney NSW (2018-2019): ARTC, Senior Botanist.**

The project included native vegetation surveys undertaken in accordance with BAM 2017, targeted threatened flora surveys and BDAR reporting. Biodiversity assessment of Swamp Oak Floodplain Forest and Freshwater Wetlands were the primary issues.

- **Qantas Flight Training Centre: Biodiversity Development Assessment Report, Mascot, Sydney NSW (2019): Qantas Airways Limited, Senior Botanist.**

A BDAR was prepared on a State Significant Development application for a proposed flight training centre on land known as Lots 2-5 DP 234489, Lot 1 DP 202747, Lot B DP 164829 and Lot 133 DP 659434, within the broader Qantas Mascot Campus. Swamp Oak Floodplain Forest was the primary issue.

- **Henry Lawson Drive – Biodiversity Development Assessment Report, Milperra and Lansdowne, Western Sydney, NSW, Australia (2018): Roads and Maritime Services, Project Manager / Senior Botanist.**

This project involved biodiversity surveys carried out over about 7 km of roadside vegetation between the M5 and the Hume Highway. The study area included parts of Shortland Brush Park, Lansdowne Reserve, Lansdowne Park, Mirabeena Regional Park, Henry Lawson Reserve, Lake Gillawarna, Amaroo Reserve, Airport Reserve and Ashford Reserve. All field survey and reporting was conducted in accordance with BAM 2017.

- **Harbourlink – Western Harbour Tunnel and Beaches Link, Sydney, NSW, Australia (2001 -ongoing): Roads and Maritime Services, Senior ecologist.**

The project involved the preparation of a Biodiversity Assessment Report (BAR) and Biodiversity Offset Strategy (BOS) in accordance with FBA.

- **Moorebank Intermodal Terminal Project – Biodiversity Offset Strategy and Impact Assessments, Moorebank, NSW, Australia (2014–present): Moorebank Intermodal Company, Project ecologist.**

The project involved the preparation of a Biodiversity Assessment Report (BAR) and Biodiversity Offset Strategy (BOS) in accordance with FBA. Currently preparing the delivery of the Biodiversity Offset Package for the project.

- **Linking Landscapes – Waitara Creek Catchment BioBanking Assessment, Waitara Creek, NSW, Australia (2014): NSW Office of Environment and Heritage, Senior ecologist.**

Undertaking a desktop and field assessment of the Waitara Creek study area to aid in preparing the application to establish a BioBank site owned by the Council. The project involved undertaking field surveys in accordance with BBAM 2014 and liaising with stakeholders on ecological issues such as Blue Gum High Forest CEEC.

### Rail

- **Inland Rail – Parkes to Narromine section: Biodiversity survey of proposed Borrow Pit sites, Parkes and Narrabri, NSW, Australia (2018): ARTC, Senior Botanist.**  
Project involved field surveys across seven properties to identify vegetation communities and threatened flora to inform a Biodiversity Development Assessment Report (BDAR) prepared in accordance with BAM 2017.
- **Inland Rail – Illabo to Stockinbingal section: Biodiversity survey of proposed geotechnical investigation sites, Illabo to Stockinbingal, NSW, Australia (2018): ARTC, Senior Botanist.**  
Project involved field surveys across numerous properties to identify vegetation communities and threatened flora to inform geotechnical investigation works.
- **Parramatta Light Rail, Sydney, NSW, Australia (2016-ongoing): Transport for NSW, Senior ecologist.**  
Preparation of a BAR and BOS for the project in accordance with the NSW Framework for Biodiversity Assessment 2014 (FBA). The BAR has been prepared with consideration of the Secretary’s Environmental Assessment Requirements (SEARs). The report also addressed the requirements under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).
- **New Intercity Fleet Project, Kangy Angy, NSW, Australia (2016–present): Transport for NSW, Project Manager / Senior Ecologist.**  
The project involved targeted threatened species searches and vegetation mapping of the development footprint and preparation of a species impact statement. I also project managed the delivery of the BOS and BOP.
- **ACT Capital Metro Light Rail Stage 1, Canberra, ACT, Australia (2014–2015): ACT Government, Project ecologist.**  
Undertook flora and fauna surveys to determine biodiversity impacts, including the identification of Natural Temperate Grassland, Box Gum Woodland and threatened flora and fauna species. The role included determining the ecological constraints and opportunities applicable to the Project.

### Roads

- **Shanes Park Biodiversity Assessment, Shanes Park, NSW, Australia (2018): Roads and Maritime Services, Botanist.**  
Project involved flora field surveys to identify threatened flora populations including the identification of threatened species (including *Dillwynia tenuifolia*, *Hibbertia puberula*, *Pultenaea parviflora* and *Grevillea juniperina subsp. juniperina*), habitat and mapping of threatened ecological communities (including the condition of each vegetation assemblage) within Shanes Park corridor reserve. This project identified the ecological constraints of the site and is being used to determine future planning designs in the future including the use of vegetation maps in consultation workshops.
- **Parkes Bypass – Biodiversity Assessment, Parkes, NSW, Australia (2017): Roads and Maritime Services, Principal ecologist.**  
The project involved the preparation of a Biodiversity Assessment to support an REF for project approval to construct a new heavy vehicle bypass as part of the Newell Highway Upgrade at Parkes.
- **Albion Park Rail Bypass Project, NSW, Australia (2017-ongoing): Roads and Maritime Services, Project manager.**  
The project involved the delivery of a Biodiversity Offset Package to address FBA offsetting requirements. Roads and Maritime Services.

- **Woolgoolga to Ballina Pacific Highway Upgrade, north-east NSW, Australia (2015–ongoing): Pacific Complete, Project ecologist.**  
Preparation of a Construction Flora and Fauna Management Plan for Stages 3-11 project works. Ongoing biodiversity technical support for Pacific Complete stages 1-11.
- **Foxground and Berry Bypass Project, south coast NSW, Australia (2016–present): Roads and Maritime Services, Project manager.**  
Project manager for the delivery of a Biodiversity Offset Package.
- **Heathcote Road Upgrade, Moorebank, NSW, Australia (2016–present): Roads and Maritime Services, Project ecologist.**  
Field surveys and technical review of biodiversity assessment.
- **Archbold Road Bridges, Sydney West, NSW, Australia (2015–present): Roads and Maritime Services, Project ecologist.**  
Field survey and technical review of biodiversity assessment.
- **Heavy Vehicle Enforcement Sites, Sydney, NSW, Australia (2015–present): Roads and Maritime Services, Project ecologist.**  
Managed ecology staff for field surveys, conducted field surveys and wrote flora reporting components for Picton Road. Technical review of three of the sites and ensured that all RMS guidelines were adhered to.
- **Campbelltown Road Upgrade, Sydney, NSW, Australia (2015–present): Roads and Maritime Services, Project ecologist.**  
Technical review of biodiversity assessment in the Addendum REF.
- **Rankin Park to Jesmond – Newcastle Inner City Bypass, Newcastle, NSW, Australia (2014): NSW Roads and Maritime Services, Project ecologist.**  
Desktop and field assessment including targeted threatened species and vegetation surveys, stag watching and hollow-bearing tree surveys. Targeted surveys included searches for *Tetratheca juncea*, *Diuris praecox* and *Grevillea parviflora subsp. parviflora*.
- **M2 Water Quality Basin Upgrade, Sydney, NSW, Australia (2015): Transurban, Senior ecologist.**  
Technical review of Ecological Impact Assessment to ensure all EPBC, TSC and RMS guidelines were adhered to.
- **Melbourne East West Link Project, Melbourne, VIC, Australia (2014–present): Lend Lease, Project ecologist.**  
Preparation of a draft construction Biodiversity Management Plan for Stage 1 project works.

#### Government

- **Prospect South Planning Proposal, Western Sydney, NSW, Australia (2017): Department of Planning & Environment, Lead ecologist.**  
Project involved a Biodiversity Constraints Assessment to accompany a planning proposal for a rezoning of rural land to industrial. The project involved applying Biodiversity Assessment Methodology 2017 and sampling the threatened ecological communities Cumberland Plain Woodland and River-flat Eucalypt Forest on Coastal Floodplain.
- **Somersby Business Park Expansion – Eastern Precinct, Somersby, NSW, Australia (2014): Gosford City Council, Environment assessment officer.**  
Ecological review of planning proposal, Ecological issues included the threatened flora species *Callistemon linearifolius*, threatened fauna species Eastern Pygmy Possum,



Squirrel Glider, Red-crowned Toadlet, Giant Burrowing Frog, Grey-headed Flying-fox, Greater Broad-nosed Bat, Eastern Bentwing-bat and Eastern Freetail-bat.

#### Water

- **South Muswellbrook Reservoir and Pipelines, Muswellbrook, NSW, Australia (2015): Muswellbrook Shire Council, Project ecologist.**

Ecological Assessment Report for the installation of six kilometres of water pipelines and a reservoir for Muswellbrook Shire Council.

#### Other

- **Former Gan Gan Military Camp, Nelson Bay, NSW, Australia (2015): Paradigm Planning, Project ecologist.**

Preliminary Ecological Assessment of the former military camp. Conducted field survey and reporting on ecological issues such as Koala habitat, SEPP 14 Coastal Wetland, Swamp Sclerophyll Forest EEC and Wallum Froglet.

#### Ecological Monitoring

- **Wingecarribee Swamp Threatened Plant Species Monitoring, Kangaloon, NSW, Australia (2014): Sydney Catchment Authority, Project ecologist.**

Undertook monitoring surveys and population census for a population of the critically endangered ground orchid *Prasophyllum fuscum* and the critically endangered herb *Gentiana wingecarribeensis* at Wingecarribee Swamp.

#### PROFESSIONAL DEVELOPMENT

|                                                                                        |      |
|----------------------------------------------------------------------------------------|------|
| Senior First Aid Certificate                                                           | 2013 |
| Associate Professional Certificate in Expert Evidence for the Land & Environment Court | 2008 |
| Managing Urban Stormwater – Morse McVey & Associates                                   | 2007 |

#### PROFESSIONAL HISTORY

|                                         |                |
|-----------------------------------------|----------------|
| WSP   Parsons Brinckerhoff              | 2014 – Present |
| Gosford City Council                    | 2009 – 2014    |
| Whelans Insites – Environmental Insites | 2008 – 2009    |
| Corymbia Consulting                     | 2007 – 2008    |
| Gosford City Council                    | 2004 – 2007    |
| Conacher Travers Pty Ltd                | 2002 – 2004    |
| Horticulturalist                        | 1991 – 2002    |

#### AWARDS

|                                                        |      |
|--------------------------------------------------------|------|
| Dean's Award for Academic Performance                  | 1999 |
| Geographical Society of NSW Annual Prize for Geography | 1999 |



#### Publications

Marco F Duretto, Andrew Orme, Jane Rodd, Mark Stables and Hellmut Toelken (2017) *Hibbertia fumana* (Dilleniaceae), a species presumed to be extinct rediscovered in the Sydney region, *Telopea*, Vol.20, pp. 143-146.

Stephen A.J. Bell and Mark Stables (2012) Floristic variability, distribution and an extension of range for the endangered Pittwater Spotted Gum Ironbark Forest, Central Coast, NSW. *Cunninghamia* (2012) 12 (2): pp 143-152.

Goodwin I.D., Stables M.A. & Olley J.M. (2006) Wave climate and sand budgets and shore alignment evolution of the Iluka-Woody Bay sand barrier, Northern NSW , Australia since 3000 yr BP, *Marine Geology*, Vol.226 Issue 1-2, pp 127-144.

# Appendix B

Baseline vegetation site survey results and  
species lists





# B1 Kawana baseline vegetation site survey results

| Survey sites                                           | KBC1                                                   | KBC2      | KQ1    | KQ2    | KQ3    | KQ4     | KQ5    | KQ6    | KQ7           |
|--------------------------------------------------------|--------------------------------------------------------|-----------|--------|--------|--------|---------|--------|--------|---------------|
| <b>Field verified regional ecosystems (RE)</b>         | RE12.3.1a                                              | RE12.3.1a | 12.3.5 | 12.3.2 | 12.3.5 | 12.3.1a | 12.3.5 | 12.3.5 | 12.3.5/12.3.2 |
| <b>Ecological dominant layer (EDL)</b>                 | T1                                                     | T1        | T1     | T1     | T1     | T1      | T1     | T1     | T1            |
| <b>EDL median height (m)</b>                           | 28                                                     | 25        | 22     | 35     | 25     | 25      | 30     | 23     | 28            |
| <b>EDL Canopy Cover % (estimated Quaternary sites)</b> | 100                                                    | 98        | 90     | 55     | 65     | 100     | 60     | 70     | 75            |
| <b>Species Name</b>                                    | <b>Lowland Rainforest TEC Appendix A Flora Species</b> |           |        |        |        |         |        |        |               |
| <i>Adiantum atroviride</i>                             | x                                                      |           |        |        |        |         |        |        |               |
| <i>Adiantum hispidulum</i>                             |                                                        | x         |        |        |        |         |        |        |               |
| <i>Alocasia brisbanensis</i>                           | x                                                      | x         |        |        |        |         |        |        |               |
| <i>Alphitonia excelsa</i>                              | x                                                      | x         | x      |        | x      |         |        | x      |               |
| <i>Alpinia caerulea</i>                                | x                                                      | x         |        |        |        |         | x      |        |               |
| <i>Archidendron grandiflorum</i>                       | x                                                      |           |        |        |        |         |        |        |               |
| <i>Archontophoenix cunninghamiana</i>                  | x                                                      | x         |        | x      |        | x       | x      |        |               |
| <i>Argyrodendron trifoliolatum</i>                     | x                                                      |           |        |        |        | x       |        |        |               |
| <i>Atractocarpus chartaceus</i>                        | x                                                      | x         |        |        |        |         |        |        |               |
| <i>Austrosteenisia blackii</i>                         | x                                                      | x         |        |        |        |         |        |        |               |
| <i>Beilschmiedia obtusifolia</i>                       | x                                                      | x         |        |        |        |         |        |        |               |
| <i>Blechnum indicum</i>                                | x                                                      |           |        |        |        |         |        |        |               |

| Survey sites                     |   | KBC1 | KBC2 | KQ1 | KQ2 | KQ3 | KQ4 | KQ5 | KQ6 | KQ7 |
|----------------------------------|---|------|------|-----|-----|-----|-----|-----|-----|-----|
| <i>Calamus muelleri</i>          | x | x    | x    |     |     |     |     | x   |     |     |
| <i>Castanospermum australe</i>   | x | x    | x    |     |     |     |     |     |     |     |
| <i>Christella dentata</i>        |   |      | x    |     | x   |     |     |     | x   |     |
| <i>Cissus antarctica</i>         | x | x    |      |     |     |     |     |     |     |     |
| <i>Commersonia bartramia</i>     | x | x    | x    |     |     | x   |     |     |     |     |
| <i>Cordyline rubra</i>           | x | x    | x    |     |     | x   |     |     | x   |     |
| <i>Crinum pedunculatum</i>       |   | x    | x    |     |     |     |     |     |     |     |
| <i>Croton verreauxii</i>         |   | x    | x    |     |     |     |     |     |     |     |
| <i>Cryptocarya obovata</i>       | x | x    | x    |     |     |     |     |     |     |     |
| <i>Cryptocarya triplinervis</i>  |   | x    | x    |     |     |     |     |     |     |     |
| <i>Cupaniopsis anacardioides</i> |   |      | x    |     |     |     |     |     |     |     |
| <i>Cyperus exaltus</i>           |   |      | x    |     | x   |     |     |     | x   |     |
| <i>Cyperus polystachyos</i>      |   | x    |      |     |     |     |     |     |     |     |
| <i>Digitaria violascens*</i>     |   |      |      |     |     |     |     |     |     | x   |
| <i>Diospyros pentamera</i>       | x | x    | x    |     |     |     |     |     |     |     |
| <i>Diploglottis australis</i>    | x | x    |      |     |     |     |     |     |     |     |
| <i>Endiandra discolor</i>        |   | x    | x    |     |     |     |     |     |     |     |
| <i>Eucalyptus grandis</i>        |   | x    |      |     | x   |     |     |     |     | x   |
| <i>Eucalyptus microcorys</i>     |   |      |      |     |     |     |     |     |     | x   |
| <i>Eustrephus latifolius</i>     | x | x    |      |     |     |     |     |     |     |     |
| <i>Ficus fraseri</i>             | x | x    | x    |     |     |     |     |     |     |     |

| Survey sites                   |   | KBC1 | KBC2 | KQ1 | KQ2 | KQ3 | KQ4 | KQ5 | KQ6 | KQ7 |
|--------------------------------|---|------|------|-----|-----|-----|-----|-----|-----|-----|
| <i>Ficus obliqua</i>           | x | x    |      |     |     |     | x   |     |     |     |
| <i>Ficus watkinsiana</i>       | x | x    | x    |     |     | x   | x   |     |     |     |
| <i>Flagellaria indica</i>      |   | x    |      |     |     |     |     |     |     |     |
| <i>Freycinetia scandens</i>    |   | x    |      |     | x   |     |     |     |     |     |
| <i>Geitonoplesium cymosum</i>  | x | x    | x    |     |     |     |     |     |     |     |
| <i>Glochidion sumatranum</i>   |   | x    | x    | x   | x   | x   |     | x   | x   | x   |
| <i>Goodenia rotundifolia</i>   |   | x    |      |     |     |     |     |     |     |     |
| <i>Gossia bidwillii</i>        | x |      | x    |     |     |     |     |     |     |     |
| <i>Guioa semiglauc</i>         | x | x    | x    |     |     |     |     |     |     |     |
| <i>Halfordia kendack</i>       |   |      |      |     |     |     |     |     |     |     |
| <i>Helicia glabriflora</i>     | x | x    | x    |     |     |     |     |     |     |     |
| <i>Ipomoea cairica</i> **      |   |      | x    |     |     |     |     |     |     |     |
| <i>Jagera pseudorhus</i>       | x | x    |      |     |     |     |     |     |     |     |
| <i>Lantana camara</i> **       |   |      |      |     |     |     |     |     |     | x   |
| <i>Livistona australis</i>     | x | x    | x    | x   | x   | x   |     |     | x   |     |
| <i>Lomandra hystrix</i>        |   | x    | x    |     |     |     |     |     |     |     |
| <i>Lophostemon suaveolens</i>  |   | x    |      | x   |     |     |     |     | x   |     |
| <i>Maclura cochinchinensis</i> | x |      | x    |     |     |     |     |     |     |     |
| <i>Melaleuca quinquenervia</i> |   | x    | x    | x   |     | x   |     |     | x   | x   |
| <i>Melicope elleryana</i>      |   | x    | x    |     |     |     |     |     |     |     |
| <i>Melodinus acutifolius</i>   |   | x    | x    |     |     | x   |     |     |     | x   |

| Survey sites                   |   | KBC1 | KBC2 | KQ1 | KQ2 | KQ3 | KQ4 | KQ5 | KQ6 | KQ7 |
|--------------------------------|---|------|------|-----|-----|-----|-----|-----|-----|-----|
| <i>Microsorium pustulatum</i>  |   |      | x    |     |     |     |     |     |     |     |
| <i>Mischocarpus pyriformis</i> |   | x    |      |     |     |     |     |     |     |     |
| <i>Mucuna gigantea</i>         |   | x    |      |     |     |     |     |     |     |     |
| <i>Oplismenus aemulus</i>      |   | x    | x    |     |     |     |     |     |     | x   |
| <i>Oxalis sp</i>               |   | x    |      |     |     |     |     |     |     |     |
| <i>Parsonsia straminea</i>     | x | x    | x    |     | x   |     |     |     |     |     |
| <i>Paspalum scrobiculatum*</i> |   |      |      |     |     |     |     |     |     |     |
| <i>Pittosporum multiflorum</i> | x | x    | x    |     |     |     |     |     |     |     |
| <i>Planchonella australis</i>  | x | x    | x    |     |     |     |     |     |     |     |
| <i>Pothos longipes</i>         |   | x    | x    |     |     |     |     |     |     |     |
| <i>Ripogonum album</i>         |   | x    | x    |     |     |     |     |     |     |     |
| <i>Sloanea australis</i>       | x | x    | x    |     |     |     |     |     |     |     |
| <i>Sloanea woollsii</i>        | x | x    | x    |     |     |     |     |     |     |     |
| <i>Smilax australis</i>        | x | x    |      |     |     |     |     | x   |     |     |
| <i>Stenocarpus sinuatus</i>    |   |      | x    |     |     |     |     |     |     |     |
| <i>Streblus brunonianus</i>    |   | x    | x    |     |     |     |     |     |     |     |
| <i>Symplocos thwaitesii</i>    |   | x    | x    |     |     |     |     |     |     |     |
| <i>Syzygium francisii</i>      | x | x    | x    |     | x   |     |     |     |     |     |
| <i>Syzygium luehmannii</i>     |   | x    | x    |     |     |     |     |     |     |     |
| <i>Syzygium oleosum</i>        |   | x    |      |     |     | x   |     |     |     |     |
| <i>Trophis scandens</i>        |   | x    | x    | x   | x   |     |     |     |     |     |
| <i>Wilkiea huegeliana</i>      | x | x    |      |     |     |     |     |     |     |     |

| Survey sites                                                      |           | KBC1      | KBC2      | KQ1      | KQ2       | KQ3      | KQ4      | KQ5      | KQ6      | KQ7      |
|-------------------------------------------------------------------|-----------|-----------|-----------|----------|-----------|----------|----------|----------|----------|----------|
| <b>Sub totals</b>                                                 | <b>33</b> | <b>60</b> | <b>50</b> | <b>6</b> | <b>10</b> | <b>9</b> | <b>4</b> | <b>5</b> | <b>8</b> | <b>8</b> |
| <b>Total native tree species</b>                                  |           | <b>23</b> | <b>21</b> | <b>5</b> | <b>5</b>  | <b>7</b> | <b>4</b> | <b>2</b> | <b>5</b> | <b>4</b> |
| <b>Total exotic species * and exotic invasive plant species**</b> | <b>4</b>  | <b>0</b>  | <b>1</b>  | <b>0</b> | <b>0</b>  | <b>0</b> | <b>0</b> | <b>0</b> | <b>0</b> | <b>2</b> |
| <b>Total shrub tree species</b>                                   |           | <b>23</b> | <b>22</b> |          |           |          |          |          |          |          |
| <b>Total forbs and other</b>                                      |           | <b>19</b> | <b>18</b> |          |           |          |          |          |          |          |
| <b>Total native grasses</b>                                       |           | <b>1</b>  | <b>1</b>  |          |           |          |          |          |          |          |
| <b>Proportion of canopy recruiting %</b>                          |           | <b>90</b> | <b>90</b> |          |           |          |          |          |          |          |
| <b>Total Species</b>                                              | <b>76</b> |           |           |          |           |          |          |          |          |          |

## B2 Woondum baseline vegetation site survey results

| Survey sites                                    |                                                 | WBC1     | WBC2     | WQ1              | WQ2     | WQ3     | WQ4               |
|-------------------------------------------------|-------------------------------------------------|----------|----------|------------------|---------|---------|-------------------|
| Field verified regional ecosystems (RE)         |                                                 | 12.11.10 | 12.11.10 | 12.11.5<br>(HVR) | 12.11.3 | 12.11.5 | 12.11.10<br>(HVR) |
| Ecological dominant layer (EDL)                 |                                                 | T1       | T1       | T1               | T1      | T1      | T1                |
| EDL median height (m)                           |                                                 | 24       | 20       | 8                | 20      | 20      | 18                |
| EDL Canopy Cover % (estimated Quaternary sites) |                                                 | 72.5     | 88.5     | 30               | 40      | 40      | 20                |
| Species Name                                    | Lowland Rainforest TEC Appendix A Flora Species |          |          |                  |         |         |                   |
| <i>Acacia disparrima</i>                        |                                                 |          | x        |                  |         |         | x                 |
| <i>Acacia glaucophylla</i>                      |                                                 |          |          |                  |         |         |                   |
| <i>Acacia irrorata subsp. velutinella</i>       |                                                 | x        |          |                  |         |         |                   |
| <i>Acacia maidenii</i>                          |                                                 | x        |          | x                |         | x       |                   |
| <i>Acronychia laevis</i>                        |                                                 | x        |          |                  | x       |         |                   |
| <i>Actephila lindleyi</i>                       | x                                               |          | x        |                  |         |         |                   |
| <i>Adiantum hispidulum</i>                      |                                                 | x        | x        |                  |         |         |                   |
| <i>Adiantum silvaticum</i>                      |                                                 |          | x        |                  |         |         |                   |
| <i>Ageratina riparia*</i>                       |                                                 |          |          |                  | x       |         |                   |
| <i>Alchornea ilicifolia</i>                     |                                                 |          | x        |                  |         |         |                   |
| <i>Alectryon tomentosus</i>                     |                                                 | x        | x        |                  |         |         |                   |
| <i>Alphitonia excelsa</i>                       | x                                               | x        |          | x                |         |         |                   |

| Survey sites                                           |   | WBC1 | WBC2 | WQ1 | WQ2 | WQ3 | WQ4 |
|--------------------------------------------------------|---|------|------|-----|-----|-----|-----|
| <i>Alyxia ruscifolia</i>                               |   | x    | x    |     |     |     |     |
| <i>Aphananthe philippinensis</i>                       | x | x    | x    |     |     |     |     |
| <i>Araucaria cunninghamiana</i>                        | x | x    | x    |     |     |     |     |
| <i>Argyrodendron trifoliolatum</i>                     | x |      | x    |     |     |     |     |
| <i>Argyrodendron sp. (Kin Kin W.D.Francis AQ81198)</i> |   |      | x    |     |     |     |     |
| <i>Arytera distylis</i>                                | x |      | x    |     |     |     |     |
| <i>Arytera divaricata</i>                              |   | x    |      |     |     |     |     |
| <i>Asplenium attenuatum</i>                            |   | x    | x    |     |     |     |     |
| <i>Atractocarpus chartaceus</i>                        | x |      | x    |     |     |     |     |
| <i>Austrosteenisia blackii</i>                         |   |      | x    |     |     |     |     |
| <i>Backhousia subargentea</i>                          |   |      | x    |     |     |     |     |
| <i>Bosistoa medicinalis</i>                            |   |      |      |     |     |     |     |
| <i>Callicarpa pedunculata</i>                          |   | x    |      |     |     |     |     |
| <i>Capparis arborea</i>                                | x | x    | x    |     |     |     |     |
| <i>Celtis sinensis**</i>                               |   |      |      |     |     |     | x   |
| <i>Cissus antarctica</i>                               | x |      | x    |     |     |     |     |
| <i>Cissus oblonga</i>                                  |   | x    | x    |     |     |     |     |
| <i>Clerodendrum tomentosum</i>                         |   |      |      |     |     |     |     |
| <i>Commersonia bartramia</i>                           | x | x    |      |     |     |     |     |
| <i>Cordyline rubra</i>                                 | x | x    | x    |     |     |     |     |

| Survey sites                                       |   | WBC1 | WBC2 | WQ1 | WQ2 | WQ3 | WQ4 |
|----------------------------------------------------|---|------|------|-----|-----|-----|-----|
| <i>Corymbia citriodora</i> var. <i>variegata</i>   |   | x    |      | x   |     | x   |     |
| <i>Corymbia intermedia</i>                         |   |      |      |     | x   |     |     |
| <i>Croton insularis</i>                            |   |      |      |     |     |     |     |
| <i>Croton stigmatosus</i>                          |   |      | x    |     |     |     |     |
| <i>Croton verreauxii</i>                           |   | x    |      |     |     |     |     |
| <i>Cryptocarya laevigata</i>                       |   |      |      |     |     |     |     |
| <i>Cryptocarya triplinervis</i> var. <i>pubens</i> |   |      | x    |     |     |     |     |
| <i>Cupaniopsis parvifolia</i>                      |   |      |      |     |     |     |     |
| <i>Cupaniopsis serrata</i>                         | x |      |      |     |     |     |     |
| <i>Cyperus haspan</i>                              |   |      | x    |     |     |     |     |
| <i>Dendrobium</i> spp.                             |   |      | x    |     |     |     |     |
| <i>Dianella caerulea</i> var. <i>caerulea</i>      |   | x    |      |     |     |     |     |
| <i>Dioscorea transversa</i>                        | x | x    | x    |     |     |     |     |
| <i>Diospyros fasciculosa</i>                       |   | x    |      |     |     |     |     |
| <i>Dissiliaria baloghioides</i>                    |   |      |      |     |     |     |     |
| <i>Dolichandra unguis-cati</i> **                  |   | x    |      |     |     | x   |     |
| <i>Doodia aspera</i>                               |   | x    |      |     |     |     |     |
| <i>Drypetes deplanchei</i>                         |   | x    | x    |     |     |     |     |
| <i>Erythroxylon australe</i>                       |   |      |      |     |     |     |     |
| <i>Eucalyptus acmenoides</i>                       |   |      |      |     | x   |     |     |
| <i>Eucalyptus propinqua</i> var. <i>propinqua</i>  |   |      |      | x   |     | x   |     |



| Survey sites                   |   | WBC1 | WBC2 | WQ1 | WQ2 | WQ3 | WQ4 |
|--------------------------------|---|------|------|-----|-----|-----|-----|
| <i>Eucalyptus siderophloia</i> |   |      |      | x   | x   |     |     |
| <i>Eustrephus latifolius</i>   | x |      | x    |     |     |     |     |
| <i>Everistia vacciniifolia</i> |   | x    | x    |     |     |     |     |
| <i>Flindersia australis</i>    | x |      | x    |     |     |     |     |
| <i>Flindersia schottiana</i>   | x |      | x    |     |     |     |     |
| <i>Gahnia melanocarpa</i>      |   | x    | x    |     |     |     |     |
| <i>Geitonoplesium cymosum</i>  | x | x    | x    |     |     |     |     |
| <i>Gossia acmenoides</i>       |   |      | x    |     |     |     |     |
| <i>Gossia bidwillii</i>        | x | x    | x    |     |     |     |     |
| <i>Guioa semiglauc</i>         | x | x    | x    |     |     |     |     |
| <i>Gymnostachys anceps</i>     |   | x    |      |     |     |     |     |
| <i>Hibiscus heterophyllus</i>  |   | x    | x    |     | x   |     |     |
| <i>Jagera pseudorhus</i>       | x | x    |      | x   |     |     |     |
| <i>Lantana camara**</i>        |   | x    | x    | x   | x   | x   | x   |
| <i>Lastreopsis decomposita</i> |   |      | x    |     |     |     |     |
| <i>Lastreopsis marginans</i>   |   |      | x    |     |     |     |     |
| <i>Lophostemon confertus</i>   | x | x    |      | x   | x   |     |     |
| <i>Mallotus philippinensis</i> | x | x    | x    | x   | x   | x   |     |
| <i>Medicosma cunninghamii</i>  |   |      | x    |     |     |     |     |
| <i>Melia azedarach</i>         | x |      |      |     |     |     | x   |
| <i>Mischocarpus pyriformis</i> |   |      | x    |     |     |     |     |

| Survey sites                                   |   | WBC1 | WBC2 | WQ1 | WQ2 | WQ3 | WQ4 |
|------------------------------------------------|---|------|------|-----|-----|-----|-----|
| <i>Myrsine variabilis</i>                      |   | X    |      |     |     |     |     |
| <i>Oplismenus aemulus</i>                      |   |      |      |     |     |     |     |
| <i>Oplismenus imbecilis</i>                    |   | X    | X    |     |     |     |     |
| <i>Pandorea baileyana</i>                      |   | X    |      |     |     |     |     |
| <i>Passiflora suberosa</i> **                  |   | X    | X    | X   | X   | X   |     |
| <i>Pellaea paradoxa</i>                        |   | X    | X    |     |     |     |     |
| <i>Pilidiostigma rhytispermum</i>              |   | X    |      |     |     |     |     |
| <i>Pittosporum ferrugineum</i>                 |   |      | X    |     |     |     |     |
| <i>Pittosporum multiflorum</i>                 | X |      | X    |     |     |     |     |
| <i>Pittosporum revolutum</i>                   | X | X    | X    |     |     |     |     |
| <i>Platycerium superbum</i>                    | X |      | X    |     |     |     |     |
| <i>Pollia crispata</i>                         | X | X    | X    |     |     |     |     |
| <i>Polyalthia nitidissima</i>                  |   | X    |      |     |     |     |     |
| <i>Polyscias elegans</i>                       | X | X    | X    | X   | X   |     |     |
| <i>Psychotria daphnoides</i> f. 'large-leaved' |   | X    | X    |     |     |     |     |
| <i>Psychotria loniceroides</i>                 |   | X    | X    |     |     |     |     |
| <i>Psydrax odorata</i>                         |   | X    | X    |     |     |     |     |
| <i>Pseuderanthemum variabile</i>               |   | X    | X    |     |     |     |     |
| <i>Rhodamnia dumicola</i>                      |   |      |      |     |     |     |     |
| <i>Rhodamnia rubescens</i> <sup>CR</sup>       | X | X    |      |     |     |     |     |
| <i>Ripogonum album</i>                         |   | X    | X    |     |     |     |     |

| Survey sites                       |   | WBC1 | WBC2 | WQ1 | WQ2 | WQ3 | WQ4 |
|------------------------------------|---|------|------|-----|-----|-----|-----|
| <i>Ripogonum discolor</i>          |   |      | x    |     |     |     |     |
| <i>Rivina humilis</i> **           |   | x    | x    |     |     |     |     |
| <i>Sarcopteryx stipata</i>         | x | x    |      |     |     |     |     |
| <i>Sloanea australis</i>           | x |      |      |     |     |     |     |
| <i>Smilax australis</i>            | x | x    | x    |     |     |     |     |
| <i>Solanum aviculare</i>           |   |      |      |     |     |     |     |
| <i>Solanum mauritianum</i> *       |   |      | x    |     |     |     |     |
| <i>Solanum seforthianum</i> **     |   | x    | x    |     |     | x   |     |
| <i>Stenocarpus sinuatus</i>        |   |      | x    |     |     |     |     |
| <i>Streblus brunonianus</i>        |   | x    | x    |     |     |     |     |
| <i>Syzygium luehmannii</i>         |   | x    | x    |     |     |     |     |
| <i>Tabernaemontana pandacaqui</i>  | x |      | x    |     |     |     |     |
| <i>Tapeinosperma repandulum</i>    |   |      | x    |     |     |     |     |
| <i>Tragia novae-hollandiae</i>     |   | x    |      |     |     |     |     |
| <i>Vitex lignum-vitae</i>          |   |      | x    |     |     |     |     |
| <i>Wilkiea austroqueenslandica</i> |   | x    | x    |     |     |     |     |
| <i>Wilkiea macrophylla</i>         |   | x    |      |     |     |     |     |

| Survey sites                                                      |            | WBC1      | WBC2      | WQ1       | WQ2       | WQ3      | WQ4      |
|-------------------------------------------------------------------|------------|-----------|-----------|-----------|-----------|----------|----------|
| <b>Sub totals</b>                                                 | <b>33</b>  | <b>34</b> | <b>46</b> | <b>11</b> | <b>11</b> | <b>8</b> | <b>4</b> |
| <b>Total native tree species</b>                                  |            | <b>15</b> | <b>24</b> | <b>9</b>  | <b>6</b>  | <b>4</b> | <b>2</b> |
| <b>Total exotic species * and exotic invasive plant species**</b> | <b>7</b>   | <b>3</b>  | <b>5</b>  | <b>2</b>  | <b>3</b>  | <b>4</b> | <b>2</b> |
| <b>Total shrub tree species</b>                                   |            | <b>7</b>  | <b>9</b>  |           |           |          |          |
| <b>Total forbs and other</b>                                      |            | <b>8</b>  | <b>8</b>  |           |           |          |          |
| <b>Total native grasses</b>                                       |            | <b>1</b>  | <b>0</b>  |           |           |          |          |
| <b>Proportion of canopy recruiting %</b>                          |            | <b>94</b> | <b>83</b> |           |           |          |          |
| <b>Total Species</b>                                              | <b>112</b> |           |           |           |           |          |          |

# Appendix C

Site photos and monitoring points



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# C1 Kawana site photos



Photo C.1 Kawana BC 1 North 2020



Photo C.2 Kawana BC 1 East 2020



Photo C.3 Kawana BC 1 South 2020



Photo C.4 Kawana BC 1 West 2020



Photo C.5 Kawana BC 2 North 2020



Photo C.6 Kawana BC 2 East 2020



Photo C.7 Kawana BC 2 South 2020



Photo C.8 Kawana BC 2 West 2020



Photo C.9 Kawana BC 2 North 2022



Photo C.10 Kawana BC 2 East 2022



Photo C.11 Kawana BC 2 South 2022



Photo C.12 Kawana BC 2 West 2022



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## C2 Woondum site photos



Photo C.13 Woondum BC 1 North 2020



Photo C.14 Woondum BC 1 East 2020



Photo C.15 Woondum BC 1 South 2020



Photo C.16 Woondum BC 1 West 2020



Photo C.17 Woondum Monitoring Site 1 (WM1) 2020



Photo C.18 Woondum Monitoring Site 2 (WM2) 2020



Photo C.19 Woondum BC 2 North 2020



Photo C.20 Woondum BC 2 East 2020



Photo C.21 Woondum BC 2 South 2020



Photo C.22 Woondum BC 2 West 2020



Photo C.23 Woondum BC 1 North 2022



Photo C.24 Woondum BC 1 East 2022



Photo C.25 Woondum BC 1 South 2022



Photo C.26 Woondum BC 1 West 2022



Photo C.27 Woondum Monitoring Site 1 (WM1) 2022



Photo C.28 Woondum Monitoring Site 2 (WM2) 2022



Photo C.29 Woondum BC 2 North 2022



Photo C.30 Woondum BC 2 East 2022



Photo C.31 Woondum BC 2 South 2022



Photo C.32 Woondum BC 2 West 2022

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