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Emerge contact: Tom Atkinson

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PERTH OFFICE  
Suite 4, 26 Railway Road  
Subiaco  
Western Australia 6008

P +61 8 9380 4988  
F +61 8 9380 9636  
emergeassociates.com.au

Emerge Environmental Services Pty Ltd ABN  
57144772510 trading as EmERGE Associates

Attention: Martin Harrop

Shire of Murray

PO Box 21

Pinjarra 6208 WA

Delivered by email to: [meng@murray.wa.gov.au](mailto:meng@murray.wa.gov.au); [tso@murray.wa.gov.au](mailto:tso@murray.wa.gov.au)

Dear Martin

## TARGETED THREATENED ECOLOGICAL COMMUNITY ASSESSMENT – RESERVE NUMBER 1456, COOLUP

This letter report communicates the outcomes of a targeted ‘threatened ecological community’ assessment completed by EmERGE Associates across reserve number 1456, Coolup.

### 1 INTRODUCTION

#### 1.1 Project background

EmERGE Associates (EmERGE) were engaged by the Shire of Murray to conduct a threatened ecological community (TEC) assessment within reserve number 1456 in Coolup.

This reserve (referred to herein as the ‘site’) has been proposed by the Shire of Murray as a potential offset for impacts to the ‘*Corymbia calophylla* - *Xanthorrhoea preissii* woodlands and shrublands, Swan Coastal Plain’ (SCP3c) TEC proposed under clearing permit application CPS 8687.

The site is located approximately 100 kilometres (km) south of the Perth Central Business District within the Shire of Murray. It is bounded by South Western Highway to the east, Blake Road to the south and rural land to the north and west, and is approximately 2.02 hectares (ha) in size. The location and extent of the site is shown in **Figure 1**.

#### 1.2 Purpose and scope of works

The scope of work was specifically to undertake a targeted (detailed) flora and vegetation assessment with reference to the Environmental Protection Authority’s (EPA’s) technical guidance (EPA 2016) to enable confirmation that the SCP3c TEC occurs in the site.

As part of this scope of work, the following tasks were undertaken:

- Desktop review of relevant background information pertaining to the site and surrounds.
- A field survey to record a comprehensive list of flora species and assess vegetation type and condition.
- Mapping of plant communities, vegetation condition and conservation significant flora and vegetation.

- Identification of potential habitat for conservation significant flora and vegetation and an assessment of likelihood of occurrence.
- Documentation of the desktop assessment, methodology, field survey and results into a report.

## 2 METHODS

### 2.1 Desktop review

Department of Biodiversity, Conservation and Attractions (DBCA) flora and ecological communities database searches (no. 24-0920FL and no. 07-10\_1020EC) and likelihood of occurrence assessments previously conducted as part of technical studies informing CPS 8687 were reviewed (Emerge Associates 2020, 2021). Attention was specifically paid to TECs that have previously been recorded or that may occur within the locality of Coolup.

Prior to undertaking the field survey, the habitat preferences of relevant TECs were reviewed and compared to environmental information available for the site, such as geomorphology, soils, regional vegetation and historic land use. Following the survey, the likelihood of occurrence of TECs was further refined and considered as part of the classification of vegetation within the site.

### 2.2 Field survey

A botanist from Emerge visited the site on 28 October 2022 to conduct the flora and vegetation field survey<sup>1</sup>. During the survey the site was traversed on foot and the composition and condition of vegetation was recorded. Photographs were taken to record flora and site conditions.

Plant specimens collected during the field survey were dried, pressed and named in accordance with requirements of the Western Australian Herbarium (2022). Identification of specimens occurred through comparison with named material and through the use of taxonomic keys. Flora species not native to Western Australia are denoted by an asterisk (\*) in text and raw data.

#### 2.2.1 Sampling

Detailed sampling of the vegetation was undertaken at three locations using permanent 10 x 10 metre (m) quadrats established using fence droppers bound by measuring tape (Q1, Q2 and Q3). The position of each quadrat was recorded with a hand-held GPS unit. Sample locations are shown in **Figure 2**.

The data recorded within each quadrat included:

- site details (site name, site number, observers, date and location)
- environmental information (slope, aspect, bare-ground, rock outcropping, soil type and colour class, litter layer, topographical position and time since last fire event)
- biological information (vegetation structure and condition, 'foliage projective cover' (FPC), degree of disturbance and species present).

Plant taxa additional to those noted in quadrats were recorded opportunistically as the botanist traversed the site.

#### 2.2.2 Vegetation condition

Vegetation condition was assigned at each sample and changes in vegetation condition were also noted and mapped across the site. The condition of the vegetation was assessed using the Keighery (1994) scale outlined in **Table 1**.

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<sup>1</sup> The botanist holds a tertiary qualification in environmental science and has 20 plus years' work experience in identification and surveys of flora and vegetation native to the bioregion.

**Table 1: Vegetation condition scale applied during the field assessment**

Condition category	Definition (Keighery 1994)
Pristine	Pristine or nearly so, no obvious signs of disturbance.
Excellent	Vegetation structure intact, disturbance affecting individual species and weeds are non-aggressive species.
Very good	Vegetation structure altered obvious signs of disturbance. For example, disturbance to vegetation structure caused by repeated fires, the presence of some more aggressive weeds, dieback, logging and grazing.
Good	Vegetation structure significantly altered by very obvious signs of multiple disturbances. Retains basic vegetation structure or ability to regenerate it. For example, disturbance to vegetation structure caused by very frequent fires, the presence of some very aggressive weeds at high density, partial clearing, dieback and grazing.
Degraded	Basic vegetation structure severely impacted by disturbance. Scope for regeneration but not to a state approaching good condition without intensive management. For example, disturbance to vegetation structure caused by very frequent fires, the presence of very aggressive weeds, partial clearing, dieback and grazing.
Completely degraded	The structure of the vegetation is no longer intact and the area is completely or almost completely without native species. These areas are often described as 'parkland cleared' with the flora comprising weed or crop species with isolated native trees or shrubs.

## 2.3 Mapping and analysis

### 2.3.1 Plant community description and mapping

Plant communities were described according to the dominant species present using the structural formation descriptions of the *National Vegetation Inventory System* (NVIS) (NVIS Technical Working Group 2017). The boundaries of each plant community were interpreted from aerial photography using sample data and notes taken during the field survey.

### 2.3.2 Vegetation condition mapping

Vegetation condition was mapped on aerial photography using sample data and notes recorded during the field survey.

### 2.3.3 Floristic community type assignment

The identified plant communities were compared to the regional 'floristic community type' (FCT) dataset *A floristic survey of the southern Swan Coastal Plain* (Gibson *et al.* 1994). Each sample was compared to Gibson *et al.* (1994) separately to limit the influence of spatial correlation when assigning an FCT.

Sample data (presence/absence) was first reconciled with Gibson *et al.* (1994) by standardising the names of taxa with those used in the earlier study. This was necessary due to changes in nomenclature in the intervening period. Taxa that were only identified to genus level were excluded, while some infra-species that have been identified since 1994 were reduced to species level. The combined dataset was then imported into the statistical analysis package PRIMER v6 (Clarke and Gorley 2006).

PRIMER v6 was used to generate a resemblance matrix using the Bray-Curtis distance measure which provided the percentage similarity between all pairs of samples. Subsequently, a cluster analysis was undertaken using the resemblance matrix and hierarchical agglomerative clustering, to produce a dendrogram.

The results of the cluster analysis, resemblance matrix and contextual information relating to the soils, landforms and known FCTs within the region were then considered and, where possible, an FCT was determined for plant communities in the site.

#### 2.3.4 Threatened and priority ecological communities

Vegetation potentially representing a TEC was assessed against diagnostic characteristics and size and/or vegetation condition thresholds (Gibson *et al.* 1994; English and Blyth 2000; ESSS 2000; Keighery *et al.* 2012; DoEE 2017b, a).

#### 2.3.5 Species accumulation curve

A species accumulation curve was plotted from sample data by generating a trendline (log) in Microsoft Excel. The trendline was forecast to locate the asymptote of the curve (the point at which the curve flattens), which provides an indication of amount of sampling that would be required before it can be assumed few species remain undetected.

PRIMER v6 estimators were then calculated to predict minimum species richness (Clarke and Gorley 2006). The Jackknife1 and Chao2 non-parametric estimators are reported, as these are both known to perform well in comparison to simulated and real data sets and are also recommended for small sample sizes (Gotelli and Colwell 2011). Comparison between actual and estimated species accumulation assists in evaluating the adequacy of sampling effort.

## 2.4 Survey limitations

It is important to note the specific constraints imposed on surveys and the degree to which these may have limited survey outcomes. An evaluation of the survey methodology against standard constraints outlined in the EPA document *Technical Guidance – Flora and Vegetation Surveys for Environmental Impact Assessment* (EPA 2016) is provided in **Table 3**.

**Table 2: Evaluation of survey methodology against standard constraints outlined in EPA (2016)**

Constraint	Degree of limitation	Details
Availability of contextual information	No limitation	The broad scale contextual information including that prepared as inputs to support CPS 8687 were adequate to place the site and vegetation in context.
Experience level of personnel	No limitation	This flora and vegetation assessment was undertaken by an experienced ecological consultant with over 20 years' of botanical experience in Western Australia.
Suitability of timing	Minor limitation	The survey was conducted in October and thus within the main flowering season. Sufficient, seasonally typical, rainfall was recorded in the months preceding the site visit and a majority of plant species were in flower and/or visible at the time of survey. The survey timing was therefore considered adequate to allow the detection of most species for which seasonal timing is critical. However, the site was visited once and some flora that were sterile at the time of survey were not identified to species level. Further site visits in early spring and other seasons would likely result in additional species being recorded.
Temporal coverage	Limitation	Detailed flora and vegetation assessments can require multiple visits, at different times of year, and over a period of a number of years, to enable observation of all species present. The site was visited and sampled only once and, while the data collected was sufficient in the context of TEC assessment, further survey may have afforded greater ability to distinguish FCTs and record a comprehensive list of flora present.

**Table 3: Evaluation of survey methodology against standard constraints outlined in EPA (2016)(cont.)**

Constraint	Degree of limitation	Details
Spatial coverage and access	No limitation	Site coverage was comprehensive (track logged).
	No limitation	All parts of the site could be accessed as required.
Sampling intensity	Minor limitation	A total of 56 native and 26 non-native species were recorded, of which 57 were recorded within quadrats and 25 were recorded opportunistically. Minimum species richness within site is estimated at between 74 (Jackknife1) and 78 (Chao2) species (refer species accumulation curve and estimates shown in <b>Plate 4</b> ). The number of species recorded in the site is equal to the estimates and, combined with the degraded nature of parts of the site, demonstrates that survey effort was adequate to prepare a near-comprehensive species inventory. A number of planted, non-endemic native species within revegetation area in the site were not identified as this area was not prioritised during the field survey.
Influence of disturbance	Minor limitation	Time since fire was determined to be greater than five years as interpreted from site conditions and therefore short-lived species more common after fire may not have been visible during the field survey.
	No limitation	Vegetation within the core of the site is still relatively intact, while historical ground disturbance and weed encroachment was evident around the margins. The disturbance history was considered when undertaking field sampling.
Adequacy of resources	No limitation	All resources required to perform the survey were available.

### 3 RESULTS

#### 3.1 General site conditions

The site contains a flat landform, with grey sandy soils that regularly had prominent organic accumulation at the surface.

The majority of vegetation within the site is remnant native. However, the vegetation is generally only intact in the interior of the site and non-native species dominate the understory at the margins. A small area of historical revegetation occurs on the eastern side comprising a variety of planted, non-endemic<sup>2</sup> native species.

A mineral earth parking area has been constructed at the eastern boundary of the site adjacent to south west highway and a firebreak / access track has been cleared around the perimeter of the site.

#### 3.2 Flora

##### 3.2.1 Species inventory

A total of 56 native and 26 non-native (weed or planted) species were recorded within the site during the field survey, representing 28 families and 70 genera. Of the species recorded, 56 occurred within or adjacent to sample quadrats and 26 were recorded opportunistically.

A list of flora species recorded is provided in **Attachment A**.

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<sup>2</sup> That is not endemic to the site

### 3.3 Vegetation

#### 3.3.1 Plant communities

One native plant community, **EmCcXp**, was identified within the site extending over 1.82 ha as shown in **Figure 2**. The remainder of the site supports native trees over planted **revegetation** (0.07 ha), or cleared areas dominated by non-native weed species or bare ground. A description of each plant community is provided in **Table 4** and representative photographs of each are provided in **Plate 1**, **Plate 2** and **Plate 3**. A species by plant community matrix is provided in **Attachment B**. Raw sample data is provided in **Attachment C**.

**Table 3: Description and extent of plant communities identified within the site**

Plant community	Description	Area (ha)
EmCcXp	Open to closed forest of <i>Eucalyptus marginata</i> and <i>Corymbia calophylla</i> over open shrubland of <i>Xanthorrhoea preissii</i> and <i>Kingia australis</i> over: <ul style="list-style-type: none"> <li>• low open shrubland of <i>Babingtonia camphorosmae</i>, <i>Acacia stenoptera</i>, <i>Banksia dallanneyi</i>, <i>Kunzea micrantha</i> subsp. <i>micrantha</i> over low closed sedgeland, forbland and grassland of <i>Conostylis aculeata</i>, <i>Cyathochaeta avenacea</i>, <i>Dampiera linearis</i>, <i>Dasyopogon bromeliifolius</i>, <i>Mesomelaena tetragona</i>, <i>Phlebocarya ciliata</i>, <i>Scaevola calliptera</i>, <i>Haemodorum laxum</i>, <i>Lepidosperma squamatum</i>, <i>Neurachne alopecuroidea</i>, <i>Rhytidosperma ?caespitosum</i> and <i>Pyrorchis nigricans</i>; or</li> <li>• low closed grassland and forbland of <i>Microlaena stipoides</i> and <i>Dichopogon capillipes</i>; or</li> <li>• (where degraded) low closed forbland and grassland of predominantly non-native species (<b>Plate 1</b>).</li> </ul>	1.82
Revegetation	Open forest of <i>Corymbia calophylla</i> over tall shrubland of planted <i>Casuarina obesa</i> , <i>Melaleuca</i> spp. over low closed forbland and grassland of predominantly non-native species ( <b>Plate 2</b> ).	0.07
Cleared	Low closed forbland and grassland of predominantly non-native species or bare ground ( <b>Plate 3</b> ).	0.13



**Plate 1: Plant community EmCcXp in 'excellent' condition**





Plate 2: Plant community *revegetation* in 'degraded to completely degraded' condition.



Plate 3: Plant community *cleared* in 'degraded to completely degraded' condition

### 3.3.2 Vegetation condition

The most intact native vegetation occurs in the core of the site where an approximately 0.43 ha portion of the **EmCcXp** plant community was mapped as being in 'excellent' or 'very good' condition. This vegetation has relatively high native species diversity and cover, and low weed encroachment. Towards the margins of the site the **EmCcXp** vegetation is disturbed and was

mapped as being in 'good' or 'degraded' condition due to lower native species cover and higher weed cover.

The area of **revegetation** towards the central eastern side of the site is both disturbed and planted with non-endemic, native tree and/or shrub species as shown in **Plate 2**. The understory in the **revegetation** is dominated by non-native weed species and was mapped as being in 'degraded to completely degraded' condition. Remaining areas of vegetation in the site are 'completely degraded' and consist of a variety of non-native pasture grasses and weeds as shown in **Plate 3**. Bare ground within the site was also mapped as being in 'completely degraded' condition.

The extent of vegetation by condition category is detailed in **Table 7** and shown in **Figure 3**.

**Table 4: Extent of vegetation condition categories within the site**

Condition category (Keighery 1994)	Size (ha)
Pristine	0
Excellent	0.11
Very good	0.32
Good	0.56
Degraded	0.81
Degraded – completely degraded	0.09
Completely degraded	0.13

### 3.3.3 Floristic community types

Plant community **EmCcXp** was determined to represent FCT 3c '*Corymbia calophylla* - *Xanthorrhoea preissii* woodlands and shrublands', as shown in **Table 6**. The relevant portions of the cluster dendrograms showing samples Q1, Q2 and Q3 in **EmCcXp** are provided in **Attachment D**.

**Table 5: Plant community sample FCT assignment**

Plant community	Sample	FCT cluster group	Most similar Gibson <i>et al.</i> (1994) sites	Similarity (%) <sup>^</sup>	Most likely floristic community type (FCT)
<b>EmCcXp</b>	All samples	3c (in larger dendrogram branch of 3a and 3c)	N/A	N/A	FCT 3c ' <i>Corymbia calophylla</i> - <i>Xanthorrhoea preissii</i> woodlands and shrublands'
	Q1	3c	CARD12 (FCT 3b)	44.2	
			TALB4 (FCT 3c)	37.5	
			BRICK6 (FCT 3a)	37.2	
			BRIX-2 (FCT 3a)	36.4	
			KOOLJ-5 (FCT 3b)	36.1	
	Q2	3c	CARD12 (FCT 3b)	45.2	
			KOOLJ-5 (FCT 3b)	42.0	
			WARO 01 (FCT 3b)	40.4	
			TALB4 (FCT 3c)	38.5	
			BRICK6 (FCT 3a)	38.1	
	Q3	3a (in larger dendrogram branch of 3a and 3c)	BRICK6 (FCT 3a)	47.1	
			BRIX-2 (FCT 3a)	46.0	
			TALB4 (FCT 3c)	43.0	
			CARD12 (FCT 3b)	42.6	
BRICK8 (FCT 3a)			41.2		

Note: <sup>^</sup> shows highest percent similarity to individual Gibson *et al.* (1994) samples rather than similarity to a cluster of samples.



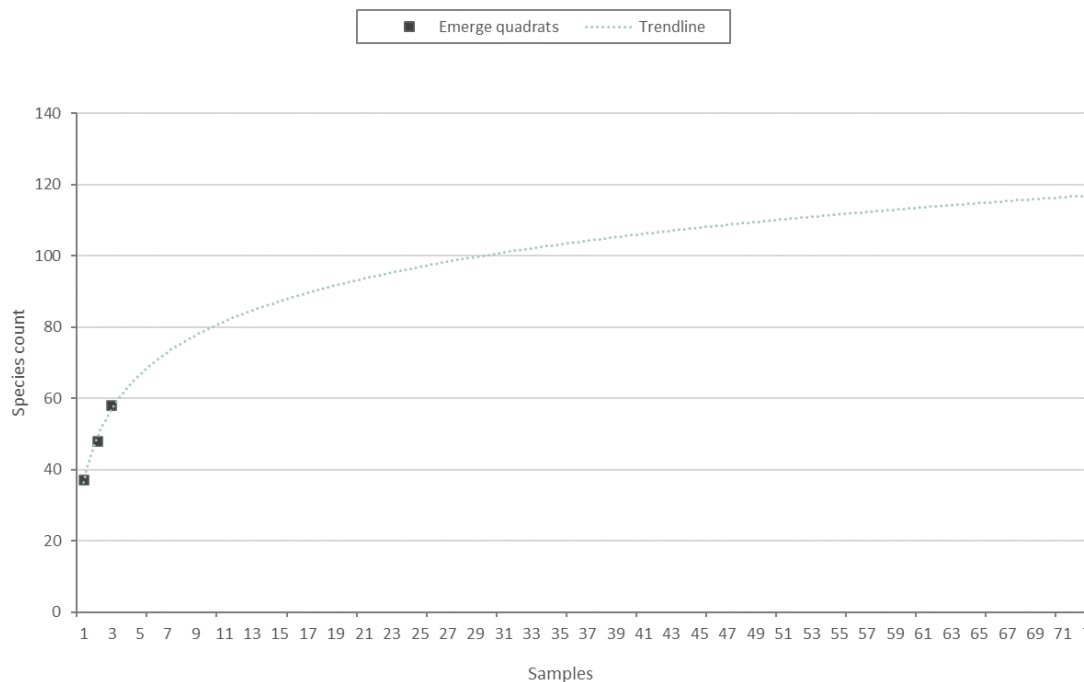
### 3.3.4 Threatened ecological communities

A total of 1.89 ha of the SCP3c TEC is identified within the site as shown in **Figure 4**.

Refer discussion **Section 4.2**, the vegetation mapped as SCP3c TEC is further considered to include or to some extent also be representative of the SCP3a TEC.

### 3.3.5 Species richness

A total of 58 species were recorded from three samples. A species accumulation curve derived from sample data is presented in **Plate 4**. After three samples the curve is still increasing and has not reached its asymptote. This indicates that a proportion of species remained undetected by sampling.



**Plate 4: Species accumulation curve derived from sample data ( $y = 18.766\ln(x) + 36.459$ ,  $R^2 = 0.9851$ )**

The species richness of plant community **EmCcXp** was estimated in PRIMER v6 to be between 74 (Jackknife1) and 78 (Chao2). Based on the trend of the species accumulation curve approximately 10 samples would be required to capture that many species. Including the 26 additional species recorded opportunistically, a total of 82 species was recorded in the site. This indicates that a majority of the species within **EmCcXp** were likely recorded.

Considering the degraded nature of the majority of the site, and noting the temporal coverage limitation and unidentified taxa acknowledged in **Table 3**, the survey effort was considered to be adequate to prepare a near-comprehensive species inventory and sufficient to confirm the presence of TECs in the site.

## 4 DISCUSSION

Of the TECs that occur within the locality of Coolup, the following three were most likely to occur in the site based on the geomorphology, soils, hydrology and vegetation present:

- SCP3a – *Corymbia calophylla* - *Kingia australis* woodlands on heavy soils, Swan Coastal Plain TEC which is listed as 'endangered' under EPBC Act and 'critically endangered' in Western Australia.
- SCP3b - *Corymbia calophylla* - *Eucalyptus marginata* woodlands on sandy clay soils of the southern Swan Coastal Plain TEC which is listed as 'vulnerable' in Western Australia.

- SCP3c - *Corymbia calophylla* - *Xanthorrhoea preissii* woodlands and shrublands, Swan Coastal Plain TEC which is listed as 'endangered' under EPBC Act and 'critically endangered' in Western Australia.

SCP3a, SCP3b and SCP3c are *Corymbia calophylla* (marri) dominated plant communities that occur on heavy soils on the eastern side of the Swan Coastal Plain (DoEE 2017b, a). Originally identified by Gibson et al (1994) as FCT 3a, 3b and 3c, these TECs are similar and commonly co-occur at relatively fine scales. DoEE (2017b, 2017a) conservation advice indicates the floristic composition of these TECs is influenced by water regime, with SCP3a, preferring wetter conditions, SCP3c, preferring drier conditions and SCP3b, preferring conditions that are intermediate.

The Shire of Murray was undoubtedly conscious of the potential that a marri dominated community occurred when recommending the site as a potential offset site for SCP3c.

#### 4.1 TEC classification

When samples Q1, Q2 and Q3 were appended to the Gibson *et al.* (1994) dataset together<sup>3</sup>, the cluster analysis grouped them with FCT 3c sites. However, when inserted singularly, only Q1 and Q2 clustered with FCT 3c sites, while Q3 clustered with FCT 3a. While none of the samples grouped with sites for FCT 3b in the cluster analysis, they showed strong similarity to FCT 3b sites in the resemblance matrix. The FCT 3a and FCT 3c results, which are respectively associated with wetter and drier regimes, suggests conditions in the site may in fact be 'intermediate' and therefore the **EmCcXp** might equally be considered representative of FCT 3b. Review of the resemblance data revealed that all samples showed strongest similarity to Gibson *et al.* (1994) sites for FCTs 3a, 3b and 3c. The **EmCcXp** vegetation is therefore considered, to some extent, to be representative of all three of these FCTs.

The dominant species in **EmCcXp** vegetation included *Corymbia calophylla*, *Xanthorrhoea preissii*, *Banksia dallanneyi*, *Cyathochaeta avenacea*, *Moreletia octandra*, along with *Burchardia congesta* and *Neurachne alopecuroidea* in localised patches. These species are referenced in the description of the SCP3c TEC (DoEE 2017b). However, despite this they are not particularly strong indicators for the FCT 3c alone, as they also occur with relative frequency in FCT 3a and FCT 3b. Furthermore, *Hypocalymma angustifolium* and *Gompholobium marginatum*, which are also referred to in the description of FCT 3c, were not recorded (noting these species have also been recorded in FCTs 3a and 3b (Gibson *et al.* 1994; Keighery *et al.* 2012).

Based on review of regional floristic datasets (Gibson *et al.* 1994; Keighery *et al.* 2012), specific plants recorded in the **EmCcXp** vegetation that may indicate FCT 3c over FCT 3a include *Dichopogon capillipes* (which occurs in dense localised swards) and *Desmocladius flexuosus* (which was infrequently noted), and to a lesser extent *Acacia pulchella* (also infrequently noted) and *Caesia micrantha* (which was abundant in the site).

The **EmCcXp** vegetation also includes a variety of plants that are more indicative of FCT 3a and/or FCT 3b than FCT3c, such *Eucalyptus marginata*, *Kingia australis*, *Acacia stenoptera*, *Desmocladius fasciculatus*, *Kunzea micrantha* subsp. *micrantha* and (infrequently noted), *Babingtonia camphorosmae*, *Macrozamia riedlei*, *Xanthosia huegelii*, *Bossiaea eriocarpa* and *Philothea spicata* (DoEE 2017a). However, with the exception of localised areas of *Eucalyptus marginata* and to a lesser extent *Kingia australis*, these plants were generally observed infrequently and do not make up a significant proportion of the understorey of **EmCcXp**.

Ultimately, based on the cluster analysis result being mostly FCT 3c, a holistic assessment of the sites landform and the structure and composition of the **EmCcXp** vegetation, FCT 3c was determined to be the most appropriate classification.

The **EmCcXp** vegetation was then classified to SCP3c TEC over SCP3a as:

<sup>3</sup> DBCA advises single sample insertion

- the site generally had a dry / drier hydrology
- the holistic structure and composition of the **EmCcXp** vegetation best agreed with the description provided for FCT 3c and the SCP3c TEC (DoEE 2017b, a)
- with the exception of *Eucalyptus marginata* and to a lesser extent *Kingia australis*, species that might be more indicative of FCT 3a occurred infrequently and did not make up a large proportion of the lower stratum of the **EmCcXp** vegetation.

With further field survey it may be possible to map plant communities in the site at a finer scale such that the vegetation mapped as **EmCcXp** might be separated into units that more specifically reflect a single FCT (such as FCT 3c, 3a or even 3b). However, from the information obtained from the single October 2022 field visit the finer scale identification and mapping of plant communities is not practicable. Furthermore, as the extent of the site is relatively small (~2 ha), the fine scale separation of plant communities may not significantly alter the characterisation of the site's conservation significance, as the **EmCcXp** vegetation will be representative of one or more similar TECs.

In the context of offsets, the classification of the vegetation to SCP3c TEC over SCP 3a TEC has some consequence in relation to specificity. However, both the SCP3c and SCP3a TECs are listed as 'endangered' under the EPBC Act and 'critically endangered' in Western Australia, and so they share equivalency with respect to conservation significance. The distinction between FCT 3c / FCT 3a and SCP3c / SCP 3a TECs may therefore not be crucial to the characterisation of the conservation value of the site and its appropriateness as an offset.

#### 4.2 Plant identification

No threatened or priority flora were recorded in the site during the field survey. The SCP3c TEC is generally not associated with such species (DoEE 2017b, a). Therefore, while the site was visited only once, the likelihood that threatened or priority flora occur is considered to be low.

Three taxa recorded in quadrats, *Drosera* sp., *Lomandra* sp. and *Thysanotus* sp., were not identified to species level as they were sterile at the time of the field survey. Additional field visits would have provided greater opportunity to confirm the identity of these plants and would likely have resulted in records for additional species. If the identity of these plants is as speculated (*Drosera ?porrecta*, *Lomandra ?purpurea* or *L. ?preissii*, *Thysanotus ?thyrsoides* and/or *T. ?spartus*) they would regardless likely be associated with FCT 3c and FCT 3a as defined by Gibson *et al.* (1994).

#### 4.3 Extent of TEC

The conservation advice for the SCP3c TEC indicates that no condition threshold should be applied when identifying the TEC (DoEE 2017b, a)<sup>4</sup>. A lack of condition thresholds is generally problematic in application, if not non-sensical. However, it greatly simplified locating the TEC in the site as all the **EmCcXp** vegetation could automatically be deemed representative.

The areas of **EmCcXp** in excellent, very good or good condition are exemplar marri dominated woodland (whether FCT 3c or FCT 3a / 3b). Whereas, the degraded areas might be better characterised as remnants of a marri woodland, which have fitting structure and broad composition, but that lack the native understorey diversity and cover that might be expected of an intact ecological community.

The area of **revegetation** mapped in degraded to completely degraded condition was also mapped as TEC. While the **revegetation** included planted non-endemic species, it still broadly comprises a marri woodland and, being contiguous with **EmCcXp**, it was included in the mapped extent of TEC.

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<sup>4</sup> Same for the SCP 3a TEC.

## Summary and closing

The **EmCcXp** vegetation in excellent, very good, good and degraded condition in the site is considered to represent an approximately 1.89 ha occurrence of the SCP3c TEC. The mapped occurrence of TEC is also, to some extent, representative of the SCP3a TEC.

Given the occurrence of intact and degraded remnant vegetation, the site provides an opportunity for both the conservation and restoration of the SCP 3c TEC, and may therefore be considered expressly suitable as an offset.

I trust this letter has provided sufficient clarification on this matter. But should you have any queries or concerns regarding any of the above, please do not hesitate to contact the undersigned.

Yours sincerely  
Emerge Associates



### **Tom Atkinson**

PRINCIPAL ENVIRONMENTAL CONSULTANT

cc: [tso@murray.wa.gov.au](mailto:tso@murray.wa.gov.au)

Encl: Figure 1: Site Location  
Figure 2: Plant Communities  
Figure 3: Vegetation Condition  
Figure 4: Threatened Ecological Community  
Attachment A: Species List  
Attachment B: Species x Plant Community Matrix  
Attachment C: Sample Data  
Attachment D: Cluster Dendograms

## General References

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# Figures



*Figure 1: Site Location*

*Figure 2: Plant Communities*

*Figure 3: Vegetation Condition*

*Figure 4: Threatened Ecological Community*



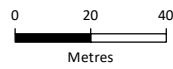


**Figure 1: Site Location**

**Project:** Detailed Flora and Vegetation Assessment  
Reserve Number 1453, Coolup

**Client:** Shire of Murray

**Plan Number:** EP20-102(06)--F40  
**Drawn:** GAR  
**Date:** 29/11/2022  
**Checked:** TAA  
**Approved:** TAA  
**Date:** 14/12/2022



**Scale:** 1:2,000@A4  
GDA 1994 MGA Zone 50



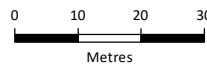




**Figure 2: Plant Communities**

**Project:** Detailed Flora and Vegetation Assessment  
Reserve Number 1453, Coolup  
**Client:** Shire of Murray

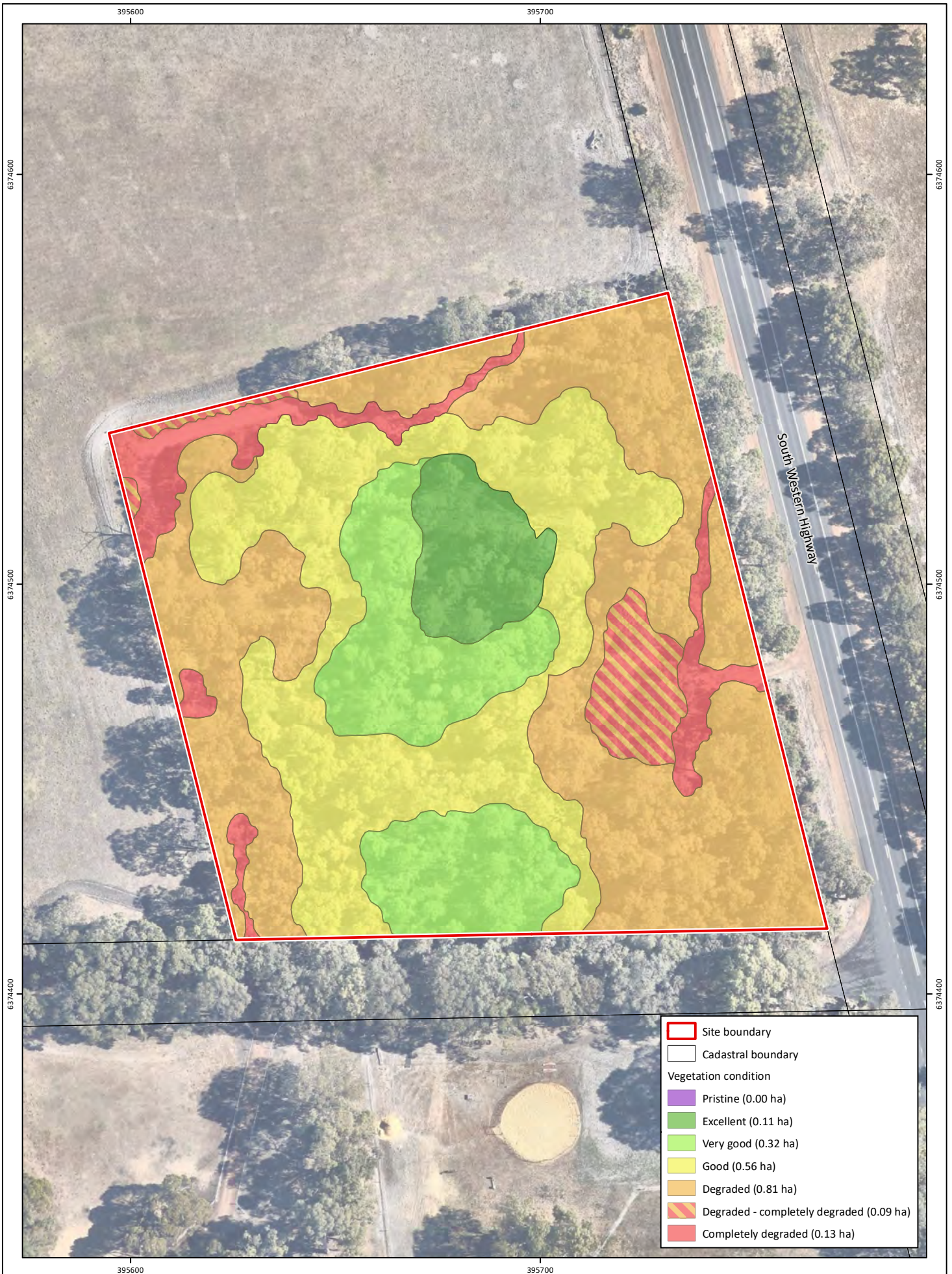
**Plan Number:** EP20-102(06)-F41a  
**Drawn:** GAR  
**Date:** 04/01/2023  
**Checked:** TAA  
**Approved:** TAA  
**Date:** 04/01/2023



**Scale:** 1:1,200@A4  
GDA 1994 MGA Zone 50







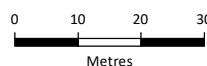
	Site boundary
	Cadastral boundary
<b>Vegetation condition</b>	
	Pristine (0.00 ha)
	Excellent (0.11 ha)
	Very good (0.32 ha)
	Good (0.56 ha)
	Degraded (0.81 ha)
	Degraded - completely degraded (0.09 ha)
	Completely degraded (0.13 ha)

**Figure 3: Vegetation Condition**

**Project:** Detailed Flora and Vegetation Assessment  
Reserve Number 1453, Coolup

**Client:** Shire of Murray

**Plan Number:** EP20-102(06)-F42a  
**Drawn:** GAR  
**Date:** 04/01/2023  
**Checked:** TAA  
**Approved:** TAA  
**Date:** 04/01/2023



**Scale:** 1:1,200@A4  
GDA 1994 MGA Zone 50





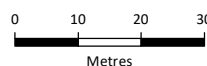


**Figure 4: Threatened Ecological Community**

**Project:** Detailed Flora and Vegetation Assessment  
Reserve Number 1453, Coolup

**Client:** Shire of Murray

**Plan Number:** EP20-102(06)--F43  
**Drawn:** GAR  
**Date:** 29/11/2022  
**Checked:** TAA  
**Approved:** TAA  
**Date:** 14/12/2022



**Scale:** 1:1,200@A4  
GDA 1994 MGA Zone 50





# Attachment A

Species List





Family	Status	Species
Apiaceae		<i>Xanthosia huegllii</i>
Asparagaceae		<i>Dichopogon capillipes</i> <i>Sowerbaea laxiflora</i> <i>Thysanotus</i> sp. ( <i>T. ?thyrsoideus</i> ) <i>Lomandra</i> sp. ( <i>L. ?purpurea</i> )
Asteraceae	*	<i>Hypochaeris glabra</i>
	*	? <i>Monoculus monstrosus</i>
	*	<i>Osteospermum ecklonis</i>
Casuarinaceae	PI	<i>Casuarina obesa</i>
Centrolepidaceae		<i>Aphelia cyperoides</i>
Colchicaceae		<i>Burchardia congesta</i> <i>Burchardia multiflora</i>
Cyperaceae		<i>Cyathochaeta avenacea</i> <i>Lepidosperma squamatum</i> <i>Mesomelaena tetragona</i> <i>Morelotia octandra</i>
Dasypogonaceae		<i>Dasypogon bromeliifolius</i> <i>Kingia australis</i>
Dilleniaceae		<i>Hibbertia hypericoides</i>
Droseraceae		<i>Drosera</i> sp. ( <i>D. ?porrecta</i> ) <i>Drosera drummondii</i>
Ericaceae		<i>Styphelia pallida</i>
Fabaceae	*	<i>Acacia podalyriifolia</i> <i>Acacia pulchella</i> <i>Acacia stenoptera</i> <i>Bossiaea eriocarpa</i>
	*	<i>Chamaecytisus palmensis</i> <i>Gastrolobium capitatum</i> <i>Jacksonia sternbergiana</i> <i>Kennedia prostrata</i>
Goodeniaceae		<i>Dampiera linearis</i> <i>Scaevola calliptera</i>
Haemodoraceae		<i>Conostylis aculeata</i>



		<i>Haemodorum laxum</i>
		<i>Phlebocarya ciliata</i>
		<i>Haemodorum</i> sp. ( <i>H. ?spicatum</i> )
Hemerocallidaceae		
		<i>Agrostocrinum hirsutum</i>
		<i>Caesia micrantha</i>
		<i>Dianella revoluta</i>
		<i>Tricoryne elatior</i>
Iridaceae		
	*	<i>Babiana angustifolia</i>
		<i>Patersonia occidentalis</i>
	*	<i>Watsonia meriana</i>
Myrtaceae		
	PI	<i>Agonis flexuosa</i>
		<i>Babingtonia camphorosmae</i>
		<i>Corymbia calophylla</i>
	PI	<i>Eucalyptus camaldulensis</i>
		<i>Eucalyptus marginata</i>
		<i>Kunzea micrantha</i> subsp. <i>micrantha</i>
	PI	<i>Melaleuca</i> sp. (1)
	PI	<i>Melaleuca</i> sp. (2)
Oleaceae		
	*	<i>Olea europaea</i>
Orchidaceae		
	*	<i>Disa bracteata</i>
		<i>Microtis media</i> subsp. <i>media</i>
		<i>Pyrorchis nigricans</i>
		<i>Thelymitra macrophylla</i>
Oxalidaceae		
	*	<i>Oxalis glabra</i>
	*	<i>Oxalis pes-caprae</i>
Papaveraceae		
	*	<i>Fumaria capreolata</i>
Pittosporaceae		
		<i>Billardiera variifolia</i>
Poaceae		
	*	<i>Anthoxanthum odoratum</i>
	*	<i>Arundo donax</i>
	*	<i>Avena ? barbata</i>
	*	<i>Briza maxima</i>
	*	<i>Briza minor</i>
	*	<i>Bromus diandrus</i>
	*	<i>Ehrharta calycina</i>
	*	<i>Ehrharta longiflora</i>
	*	<i>Eragrostis curvula</i>
		<i>Microlaena stipoides</i>
		<i>Neurachne alopecuroidea</i>
		<i>Rhytidosperra ?caespitosa</i>
Proteaceae		

*Banksia dallyaniana*  
*Banksia grandis*  
*Petrophile brevifolia*

Restionaceae

*Chaetanthus aristatus*  
*Desmocladus fasciculatus*  
*Desmocladus flexuosa*  
*Hypolaena exsulca*

Rutaceae

*Philothea spicata*

Xanthorrhoeaceae

*Xanthorrhoea preissii*

Zamiaceae

*Macrozamia riedlei*

---

\*=non-native, Pl=planted



# Attachment B

Species x Plant Community Matrix





Species	Plant community		
	EmCcXp	Revegetation	Cleared
<i>Acacia podalyriifolia</i>	X		
<i>Acacia pulchella</i>	X		
<i>Acacia stenoptera</i>	X		
<i>Agonis flexuosa</i>	X		
<i>Agrostocrinum hirsutum</i>	X		
<i>Anthoxanthum odoratum</i>	X	X	X
<i>Aphelia cyperoides</i>	X		
<i>Arundo donax</i>	X		
<i>Avena ?barbata</i>	X	X	X
<i>Babiana angustifolia</i>	X	X	X
<i>Babingtonia camphorosmae</i>	X		
<i>Banksia dallyaniana</i>	X		
<i>Banksia grandis</i>	X		
<i>Billardiera variifolia</i>	X		
<i>Bossiaea eriocarpa</i>	X		
<i>Briza maxima</i>	X	X	X
<i>Briza minor</i>	X	X	X
<i>Bromus diandrus</i>	X	X	X
<i>Burchardia congesta</i>	X		
<i>Burchardia multiflora</i>	X		
<i>Caesia micrantha</i>	X		
<i>Casuarina obesa</i>	X	X	
<i>Chaetanthus aristatus</i>	X		
<i>Chamaecytisus palmensis</i>	X		
<i>Conostylis aculeata</i>	X		
<i>Corymbia calophylla</i>	X	X	X
<i>Cyathochaeta avenacea</i>	X		
<i>Dampiera linearis</i>	X		
<i>Dasypogon bromeliifolius</i>	X		
<i>Desmocladius fasciculatus</i>	X		
<i>Desmocladius flexuosa</i>	X		
<i>Dianella revoluta</i>	X		
<i>Dichopogon capillipes</i>	X		
<i>Disa bracteata</i>	X		
<i>Drosera drummondii</i>	X		
<i>Drosera sp. (D. ?porrecta)</i>	X		
<i>Ehrharta calycina</i>	X	X	X
<i>Ehrharta longiflora</i>	X	X	X
<i>Eragrostis curvula</i>	X	X	X
<i>Eucalyptus camaldulensis</i>	X		
<i>Eucalyptus marginata</i>	X		
<i>Fumaria capreolata</i>	X	X	X
<i>Gastrolobium capitatum</i>	X		
<i>Haemodorum laxum</i>	X		
<i>Haemodorum sp. (H. ?spicatum)</i>	X		
<i>Hibbertia hypericoides</i>	X		
<i>Hypochaeris glabra</i>	X	X	X



<i>Hypolaena exsulca</i>	X		
<i>Jacksonia sternbergiana</i>	X		
<i>Kennedia prostrata</i>	X		
<i>Kingia australis</i>	X		
<i>Kunzea micrantha subsp. micrantha</i>	X		
<i>Lepidosperma squamatum</i>	X		
<i>Lomandra</i> sp. ( <i>L. ?purpurea</i> )	X		
<i>Macrozamia riedlei</i>	X		
<i>Melaleuca</i> sp. (1)		X	
<i>Melaleuca</i> sp. (2)		X	
<i>Mesomelaena tetragona</i>	X		
<i>Microlaena stipoides</i>	X		
<i>Microtis media</i> subsp. <i>media</i>	X		
? <i>Monoculus monstrosus</i>	X		
<i>Morelotia octandra</i>	X		
<i>Neurachne alopecuroidea</i>	X		
<i>Olea europa</i>	X		
<i>Osteospermum ecklonis</i>	X		
<i>Oxalis glabra</i>	X	X	X
<i>Oxalis pes-caprae</i>	X	X	X
<i>Patersonia occidentalis</i>	X		
<i>Petrophile brevifolia</i>	X		
<i>Philothea spicata</i>	X		

# Attachment C

Sample Data





**Sample Name: Q1**

**Project no.:** EP20-102(06)

**Date:** 28/10/2022

**Author:** TAA,

**Status** Permanent

Q1: Page 1 of 2

### Quadrat and landform details

Sample type: quadrat

Size: 10 m x 10 m

NW corner easting: 0

NW corner northing: 0

Altitude (m): 0

Geographic datum/zone: GDA94/Zone 50

Soil water content: damp

Landform: flat

Time since fire: > 5 yrs

Disturbance: moderate - weeds

Soil type/texture sand/other with organic layer

Bare ground (%): 0

Rocks (%) and type: No rocks

Soil colour: grey/brown

Litter: 20% (leaves,twigs,logs)

Vegetation condition: very good



Species Data		Q1
Status	Confirmed name	Cover (%)
	<i>Corymbia calophylla</i>	70
	<i>Morelotia octandra</i>	33
	<i>Cyathochaeta avenacea</i>	20
	<i>Sowerbaea laxiflora</i>	20
	<i>Desmocladius fasciculatus</i>	10
	<i>Lepidosperma squamatum</i>	10
	<i>Xanthorrhoea preissii</i>	10
	<i>Bossiaea eriocarpa</i>	2
*	<i>Babiana angustifolia</i>	1
	<i>Caesia micrantha</i>	1
	<i>Conostylis aculeata</i>	1
	<i>Jacksonia sternbergiana</i>	1
	<i>Mesomelaena tetragona</i>	1
	<i>Banksia dallyaniana</i>	<1
*	<i>Briza maxima</i>	<1
	<i>Dampiera linearis</i>	<1
	<i>Drosera sp. (D. ?porrecta)</i>	<1
*	<i>Eragrostis curvula</i>	<1
	<i>Gastrolobium capitatum</i>	<1
	<i>Lomandra sp. (L. ?purpurea)</i>	<1
	<i>Microtis media subsp. media</i>	<1
	<i>Patersonia occidentalis (wetland form)</i>	<1
	<i>Phlebocarya ciliata</i>	<1
	<i>Scaevola calliptera</i>	opp
	<i>Acacia pulchella</i>	opp
*	<i>Anthoxanthum odoratum</i>	opp
*	<i>Avena ?barbata</i>	opp
	<i>Babingtonia camphorosmae</i>	opp
	<i>Burchardia congesta</i>	opp
	<i>Eucalyptus marginata</i>	opp
	<i>Haemodorum laxum</i>	opp
	<i>Hypolaena exsulca</i>	opp
	<i>Kennedia prostrata</i>	opp
	<i>Kingia australis</i>	opp
	<i>Macrozamia riedlei</i>	opp
	<i>Microlaena stipoides</i>	opp
	<i>Petrophile brevifolia</i>	opp
	<i>Pyrorchis nigricans</i>	opp
	<i>Tricoryne elatior</i>	opp

\* denotes non-native species



**Sample Name:**

**Q2**

**Project no.:** EP20-102(06)

**Date:** 29/10/2022

**Author:** TAA,

**Status** Permanent

Q2: Page 1 of 2

**Quadrat and landform details**

Sample type: quadrat

Size: 10 m x 10 m

NW corner easting: 0

NW corner northing: 0

Altitude (m): 0

Geographic datum/zone: GDA94/Zone 50

Soil water content: slightly damp

Landform: flat

Time since fire: > 5 yrs

Disturbance: low - weeds

Soil type/texture sand/other with organic layer

Bare ground (%): 0

Rocks (%) and type: No rocks

Soil colour: grey/brown

Litter: 15% (leaves,twigs,branches)

Vegetation condition: excellent





Species Data		Q2
Status	Confirmed name	Cover (%)
	<i>Eucalyptus marginata</i>	80
	<i>Xanthorrhoea preissii</i>	33
	<i>Cyathochaeta avenacea</i>	20
	<i>Banksia dallyaniana</i>	10
	<i>Lepidosperma squamatum</i>	10
	<i>Pyrorchis nigricans</i>	10
	<i>Sowerbaea laxiflora</i>	10
	<i>Corymbia calophylla</i>	5
	<i>Acacia stenoptera</i>	1
	<i>Bossiaea eriocarpa</i>	1
	<i>Caesia micrantha</i>	1
	<i>Conostylis aculeata</i>	1
	<i>Dasypogon bromeliifolius</i>	1
	<i>Desmocladius fasciculatus</i>	1
	<i>Drosera sp. (D. ?porrecta)</i>	1
	<i>Mesomelaena tetragona</i>	1
	<i>Morelotia octandra</i>	1
	<i>Patersonia occidentalis (wetland form)</i>	1
	<i>Babiana angustifolia</i>	<1
*	<i>Briza maxima</i>	<1
*	<i>Briza minor</i>	<1
	<i>Dampiera linearis</i>	<1
	<i>Haemodorum laxum</i>	<1
	<i>Kennedia prostrata</i>	<1
	<i>Petrophile brevifolia</i>	<1
	<i>Styphelia pallida</i>	<1
	<i>Thelymitra macrophylla</i>	<1
	<i>Tricoryne elatior</i>	<1
	<i>Anthoxanthum odoratum</i>	opp
	<i>Banksia grandis</i>	opp
	<i>Burchardia congesta</i>	opp
	<i>Burchardia multiflora</i>	opp
	<i>Dianella revoluta</i>	opp
	<i>Gastrolobium capitatum</i>	opp
	<i>Kingia australis</i>	opp
	<i>Neurachne alopecuroidea</i>	opp
	<i>Thysanotus sp. (T. ?thyrsoides)</i>	opp

\* denotes non-native species

**Sample Name:**

**Q3**

**Project no.:** EP20-102(06)

**Date:** 30/10/2022

**Author:** TAA,

**Status** Permanent

Q3: Page 1 of 2

**Quadrat and landform details**

Sample type: quadrat

Size: 10 m x 10 m

NW corner easting: 0

NW corner northing: 0

Altitude (m): 0

Geographic datum/zone: GDA94/Zone 50

Soil water content: damp

Landform: flat

Time since fire: > 5 yrs

Disturbance: low - weeds

Soil type/texture sand/other with organic layer

Bare ground (%): 0

Rocks (%) and type: No rocks

Soil colour: grey/brown

Litter: 15% (leaves,twigs,)

Vegetation condition: excellent



Species Data		Q3
Status	Confirmed name	Cover (%)
	<i>Corymbia calophylla</i>	40
	<i>Cyathochaeta avenacea</i>	30
	<i>Banksia dallyaniana</i>	10
	<i>Morelotia octandra</i>	10
	<i>Sowerbaea laxiflora</i>	10
	<i>Xanthorrhoea preissii</i>	10
	<i>Gastrolobium capitatum</i>	5
	<i>Lepidosperma squamatum</i>	5
	<i>Mesomelaena tetragona</i>	5
*	<i>Babiana angustifolia</i>	2
	<i>Babingtonia camphorosmae</i>	2
	<i>Caesia micrantha</i>	1
	<i>Conostylis aculeata</i>	1
	<i>Dampiera linearis</i>	1
	<i>Desmocladius fasciculatus</i>	1
	<i>Kingia australis</i>	1
	<i>Kunzea micrantha subsp. micrantha</i>	1
	<i>Xanthosia huegllii</i>	1
	<i>Aphelia cyperoides</i>	<1
	<i>Disa bracteata</i>	<1
	<i>Haemodorum laxum</i>	<1
*	<i>Hypochaeris glabra</i>	<1
	<i>Hypolaena exsulca</i>	<1
	<i>Neurachne alopecuroidea</i>	<1
	<i>Patersonia occidentalis (wetland form)</i>	<1
	<i>Agrostocrinum hirsutum</i>	opp
*	<i>Briza maxima</i>	opp
	<i>Burchardia congesta</i>	opp
	<i>Chaetanthus aristatus</i>	opp
	<i>Drosera drummondii</i>	opp
	<i>Eucalyptus marginata</i>	opp
	<i>Microlaena stipoides</i>	opp
	<i>Philothea spicata</i>	opp
	<i>Phlebocarya ciliata</i>	opp
	<i>Thelymitra macrophylla</i>	opp
	<i>Thysanotus sp. (T. ?thyrsoideus)</i>	opp
	<i>Tricoryne elatior</i>	opp

\* denotes non-native species

# Attachment D

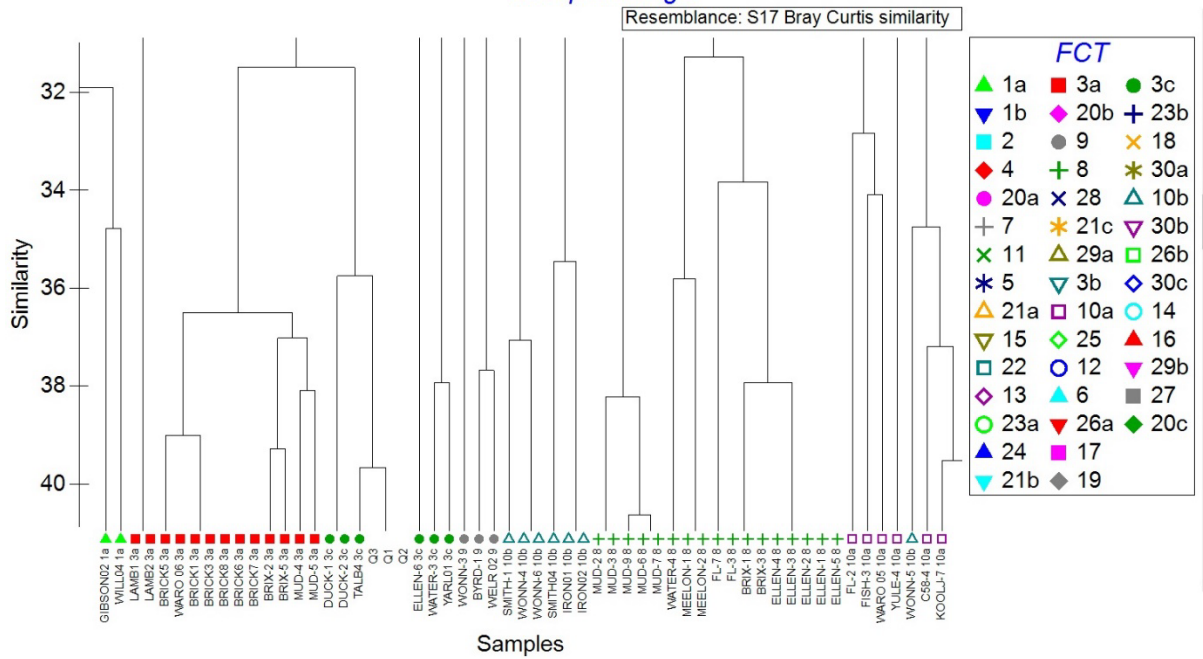
Cluster Dendrograms



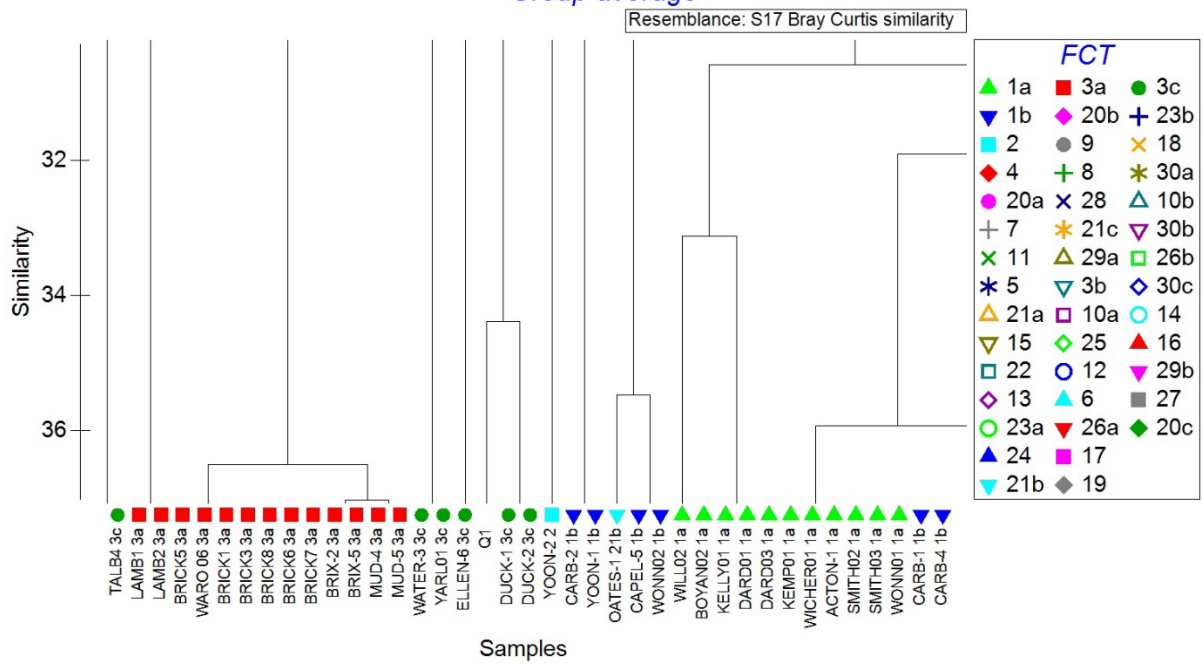




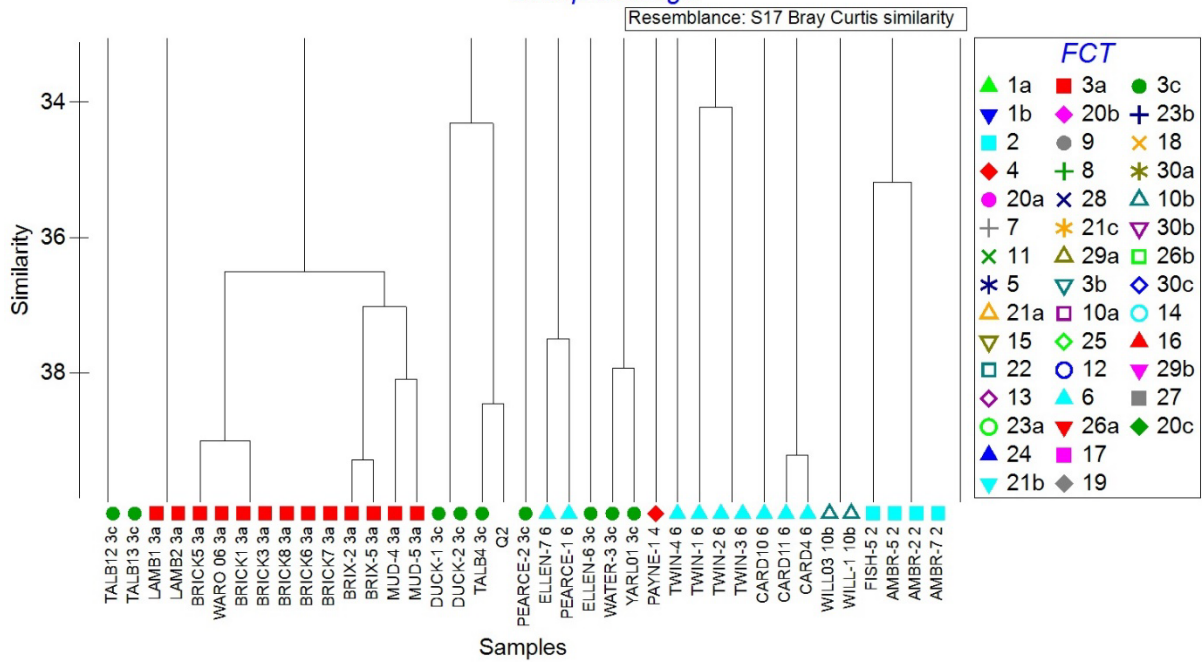
Q1, Q2 and Q3  
Group average



Q1  
Group average



Q2  
Group average



Q3  
Group average

