Detailed and Targeted Flora and Vegetation Assessment

Lot 4395 Keirnan Street, Mundijong

Project No: EP21-057(02)

Prepared for Shire of Serpentine Jarrahdale
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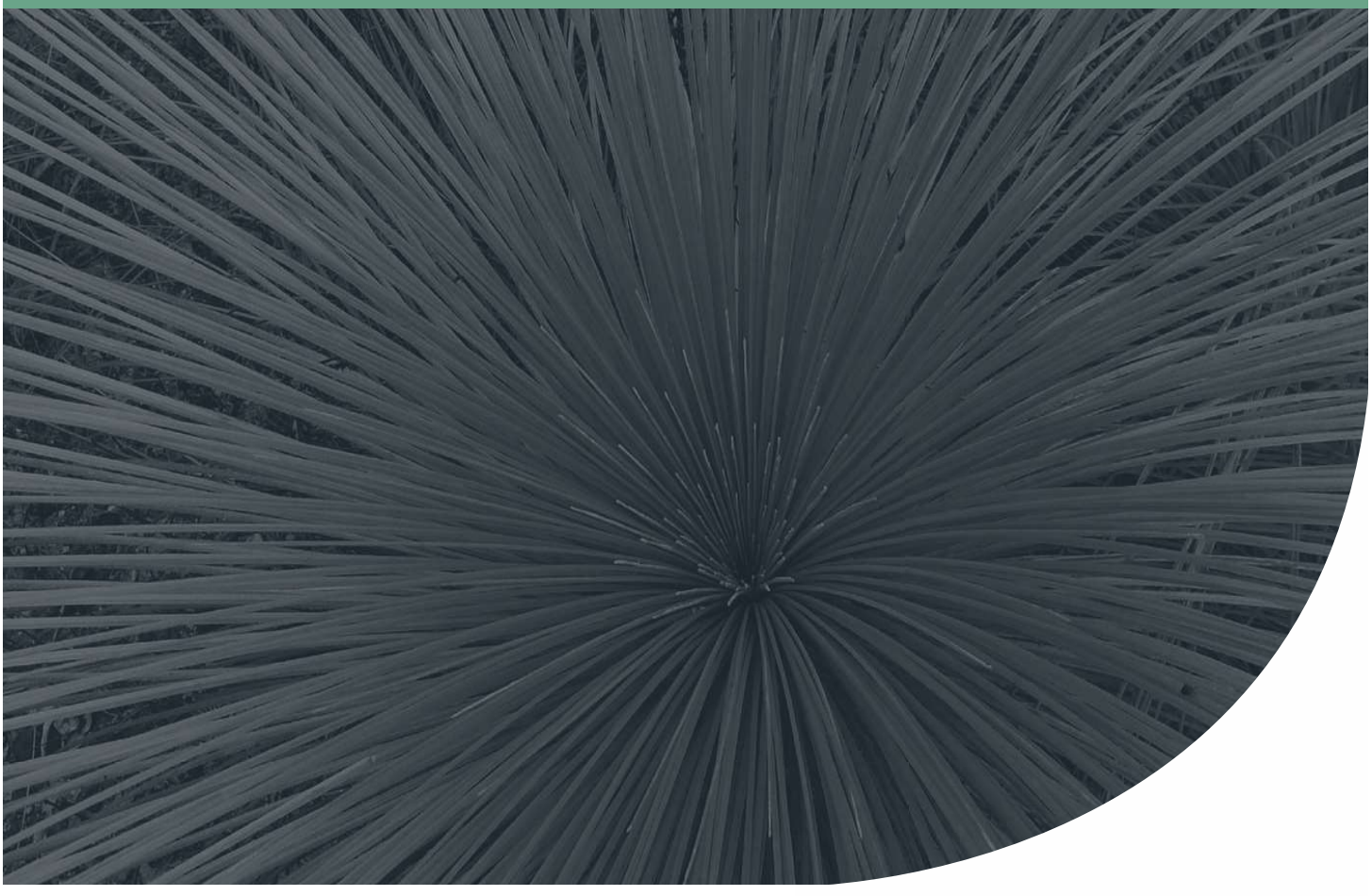

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Executive Summary

The Shire of Serpentine Jarrahdale engaged Emerge Associates to conduct a detailed and a targeted flora and vegetation assessment to provide information on the flora and vegetation values within Lot 4395 Keirnan Street in Mundijong (referred to herein as the 'site').

As part of the assessment a desktop review of relevant background information was completed and field surveys were undertaken during the months of September, October and November 2021. During the field surveys an assessment was made on the type, condition and values of vegetation across the site and targeted searches for conservation significant flora within areas of suitable habitat were completed.

Outcomes of the survey include the following:

- Non-native vegetation is present across 53.2 ha of the site.
- Remnant native vegetation is present across 9.8 ha of the site in varying levels of condition.
- A total of 50 native and 53 non-native (weed) species were recorded in the site.
- No threatened or priority flora species were recorded within the site or are considered likely to occur.
- Weed cover was generally high across the site. Five declared pests were recorded: **Asparagus asparagoides* (bridal creeper), **Echium plantagineum* (Paterson's curse), **Gomphocarpus fruticosus* (narrow leaf cotton bush), **Moraea flaccida* (one-leaf cape tulip) and **Zantedeschia aethiopica* (arum lily). These species are listed in the 'exempt' keeping category under the *Biosecurity and Agriculture Management Act 2007* for which no permit or conditions are required.
- The vegetation within the site was classified into the following four plant communities that are present in 'very good', 'good', 'degraded' and 'completely degraded' condition.
    - Plant community **CcEmX** includes the highest quality vegetation in the site and was considered most likely to represent FCT 3b '*Corymbia calophylla – Eucalyptus marginata* woodlands on sandy clay soils'.
    - Plant community **CcXp** consists of a canopy of large native trees over a more disturbed understorey with higher cover of introduced pasture grass. However, it also contains species indicative of FCT 3b.
    - Plant community **JaJkLs** consists of some native rushes associated with high cover of non-native species and was too degraded to assign to an FCT.
    - Pasture and non-native vegetation is present over the majority of the site and contains bare ground and non-native vegetation.
- Patches of **CcEmX** and **CcXp** vegetation in good or better condition are considered to represent the '*Corymbia calophylla – Eucalyptus marginata* woodlands on sandy clay soils of the southern Swan Coastal Plain' 'threatened ecological community' (TEC), which is listed as 'vulnerable' in Western Australia. Using 'good' condition as the threshold for identification, 7.56 ha of the TEC is present within the site.
- The vegetation may be considered locally significant as a remnant of the poorly reserved Forrestfield vegetation complex. Marri and jarrah trees within the site provide foraging habitat, and potentially breeding habitat for threatened species of black cockatoo.

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Abbreviation Tables

Table A1: Abbreviations – Organisations

Organisations	
EPA	Environmental Protection Authority
DBCA	Department of Biodiversity, Conservation and Attractions
DWER	Department of Water and Environmental Regulation
WALGA	Western Australian Local Government Association

Table A2: Abbreviations – General terms

General terms	
CCW	Conservation category wetland
ESA	Environmentally sensitive area
FCT	Floristic community type
FPC	Foliage projective cover
IBRA	Interim Biogeographic Regionalisation of Australia
MUW	Multiple use wetland
NVIS	National Vegetation Inventory System (ESCAVI 2003)
P1	Priority 1
P2	Priority 2
P3	Priority 3
P4	Priority 4
P5	Priority 5
PEC	Priority ecological community
REW	Resource enhancement wetland
T	Threatened
TEC	Threatened ecological community
UFI	Unique feature identifier
WoNS	Weeds of National Significance

Table A3: Abbreviations – Legislation

Legislation	
BAM Act	*Biosecurity and Agriculture Management Act 2007*
BC Act	*Biodiversity Conservation Act 2016*
CALM Act	*Conservation and Land Management Act 1984*
EP Act	*Environmental Protection Act 1986*
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
LA Act	*Land Administration Act 1997*
SCRM Act	*Swan and Canning Rivers Management Act 2006*

Table A4: Abbreviations – Units of measurement

Units of measurement	
cm	Centimetre
ha	Hectare
km	Kilometre
m	Metre
m^2	square metre
m AHD	m in relation to the Australian height datum
mm	Millimetre

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1 Introduction

1.1 Project background

Emerge Associates (Emerge) were engaged by the Shire of Serpentine Jarrahdale (the Shire) to characterise the flora and vegetation values within Lot 4395 Keirnan Street in Mundijong (referred to herein as the 'site'). Findings from the flora and vegetation assessment, together with other baseline environmental data gathered by the Shire, will be used to provide direction around the potential development within the site.

The site is located approximately 40 kilometres (km) south-east of the Perth Central Business District within the Shire of Serpentine Jarrahdale and is approximately 62.98 hectares (ha) in size. The site is bounded by Keirnan street to the north, South Western Highway to the east, Watkins Road Nature Reserve to the south and farmland to the west. The location and extent of the site is shown in **Figure 1**.

1.2 Purpose and scope of work

The scope of work was specifically to undertake a flora and vegetation assessment within the site to the standard required of a detailed and a targeted survey with reference to the Environmental Protection Authority's (EPA's) technical guidance (EPA 2016).

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

- Desktop review of relevant background information pertaining to the site and surrounds, including database searches for threatened flora species and ecological communities.
- A field survey to record a comprehensive list of flora species and assess vegetation type and condition.
- Identification of potential habitat for conservation significant flora and vegetation, and an assessment of likelihood of occurrence.
- Targeted searches for conservation significant flora within areas of suitable habitat.
- Mapping of plant communities, vegetation condition and conservation significant flora and vegetation.
- Documentation of the desktop assessment, survey methodology and results into a report.

2 Environmental Context

2.1 Climate

Climate influences the types of vegetation that grow in a region and the life cycles of the flora present. It is therefore critical for a flora and vegetation survey to respond appropriately to climatic conditions to ensure that surveys are conducted during times when flora species are easiest to detect and identify.

The south-west of Western Australia experiences a Mediterranean climate of hot dry summers and cool wet winters. In Mediterranean type climates some flora species will typically spend part of their lifecycle as either underground storage organs or as seed. This is an adaptation to unfavourable environmental conditions such as excessive heat and drought that occur over the summer period. These species, known as 'geophytes' or 'annuals', tend to re-emerge during winter when favourable conditions return and are most visible during spring, which is the flowering period for a majority of plant species. Therefore, spring is the optimal time to complete flora and vegetation surveys in the south-west of WA.

An average of 918.3 millimetres (mm) of rainfall is recorded annually from the Serpentine weather station (no. 9039), which is the closest weather station, located approximately 6 km from the site. The majority of this rainfall is received between the months of May and September. Mean maximum temperatures at the Karnet weather station, which is the nearest temperature recording station approximately 18 km south-east of the site, range from 15.5°C in July to 30.6°C in January, while mean minimum temperatures range from 6.3°C in July to 15.7°C in February (BoM 2021).

A total of 637.0 mm of rain was recorded from May to August 2021 prior to the survey, which is similar to the combined long-term average of 629.9 mm for the same period (BoM 2021). This amount of rainfall was considered to have been sufficient to promote the flowering and emergence of native flora.

2.2 Geomorphology and soils

Landform and soils influence vegetation types at regional and local scales. The site occurs on the Swan Coastal Plain, which is the geomorphic unit that characterises much of the Perth metropolitan area. The Swan Coastal Plain is approximately 500 km long and 20 to 30 km wide and is roughly bound by the Indian Ocean to the west and the Darling Scarp to the east. Broadly the Swan Coastal Plain consists of two sedimentary belts of different origin. Its eastern side comprises the Pinjarra Plain which formed from the deposition of alluvial material washed down from the Darling Scarp, while its western side comprises three dune systems that run roughly parallel to the Indian Ocean coastline (Seddon 2004).

Examination of broad scale soil mapping places the site within the Forrestfield association (Churchward and McArthur 1980) (**Figure 3**). The Forrestfield association comprises the lateritised foothills of the Darling Scarp which are dominated by gravelly and sandy soils (Churchward and McArthur 1980).

The site is not known to contain any restricted landforms or unique geological features.

2.3 Topography

The elevation of the site ranges from 45 m in relation to the Australian height datum (m AHD) on the western side of the site to 78 m AHD on the south-eastern side of the site (DoW 2008) (**Figure 3**).

2.4 Hydrology and wetlands

Wetlands are areas of seasonally, intermittently or permanently waterlogged land such as poorly drained soils, ponds, billabongs, lakes, swamps, tidal flats, estuaries, rivers and their tributaries (Wetlands Advisory Committee 1977). Wetlands can be recognised by the presence of vegetation associated with waterlogging or the presence of hydric soils such as peat, peaty sand or carbonate mud (Hill *et al.* 1996).

Wetlands of national or international significance may be afforded special protection under Commonwealth or international agreements. The following lists of important wetlands were checked as part of this assessment:

- *Ramsar List of Wetlands of International Importance* (DBCA 2017)
- *A Directory of Important Wetlands in Australia* (DBCA 2018)

No Ramsar or listed 'important wetlands' are located within or near the site.

Examination of the Department of Water and Environmental Regulation (DWER) hydrography dataset (DWER 2018) shows the following three wetland or water related features occur within the site:

- One minor, non-perennial watercourse in the western portion of the site which is associated with a palusplain.
- One linear un-named hydrological feature running across the central portion of the site and presented as four separate lines. This feature is associated with a palusplain.
- Three earth dams.

The locations of these water related features are shown in **Figure 3**.

The Department of Biodiversity, Conservation and Attractions (DBCA) has developed the *Geomorphic Wetlands, Swan Coastal Plain* dataset (DBCA 2020). This dataset maps geomorphic wetland features and classifies them based on their landform shape and water permanence. Each feature is assigned to one of three management categories which guides land use and conservation.

A review of the *Geomorphic Wetlands, Swan Coastal Plain* dataset indicated that one 'Multiple Use' category wetland feature (UFI 16021) occurs within the site (DBCA 2020). UFI 16021 is classified as a palusplain and occurs along the northern and western boundaries of the site. This wetland feature extends east in the central portion of the site. One 'Conservation' category wetland feature (UFI 7998) occurs in close proximity to the site. UFI 7998 is classified as a sumpland and is located approximately 70 m south of the site. The locations of the geomorphic wetland features within and adjacent to the site are shown in **Figure 3**.

2.5 Regional vegetation

Native vegetation is described and mapped at different scales in order to illustrate patterns in its distribution. At a continental scale the *Interim Biogeographic Regionalisation of Australia* (IBRA) divides Australia into floristic subregions (Environment Australia 2000).

The site is contained within the Swan Coastal Plain IBRA region and within the 'SWA02' or Perth subregion. The Perth subregion is characterised as mainly supporting *Banksia* low woodland on leached sands with *Melaleuca* swamps where ill-drained; and woodland of *Eucalyptus gomphocephala*, *E. marginata* and *Corymbia calophylla* on less leached soils (Beard 1990). This subregion is recognised as a biodiversity hotspot and contains a wide variety of endemic flora and vegetation types.

Variations in native vegetation can be further classified based on regional vegetation mapping.

Heddle *et al.* (1980) mapping shows the site as comprising the 'Forrestfield complex', which is described as vegetation ranging from open forest of *C. calophylla - Eucalyptus wandoo - E. marginata* to open forest of *E. marginata - C. calophylla - Allocasuarina fraseriana - Banksia* species with fringing woodland of *Eucalyptus rudis* in the gullies that dissect this landform (Government of Western Australia 2019). This complex was determined to have 12.29% of its pre-European extent remaining and 1.58% is protected for conservation purposes (Government of Western Australia 2019).

2.6 Historical land use

A review of historical images available from 1953 onwards shows that a large portion of the site had been cleared of native vegetation by 1953, with the exception of small pockets of native vegetation in the north-eastern and central portions of the site. Clearing of native vegetation at the site was likely associated with grazing and/or cropping uses (WALIA 2021).

2.7 Conservation significant flora and vegetation

2.7.1 Threatened and priority flora

Certain flora taxa that are considered to be rare or under threat warrant special protection under Commonwealth and/or State legislation. At a Commonwealth level, flora taxa may be listed as 'threatened' under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). Threatened flora species listed under the EPBC Act are assigned a conservation status according to attributes such as population size and geographic distribution. Any action likely to have a significant impact on a taxon listed under the EPBC Act requires Ministerial approval.

In Western Australia flora species may also be classed as 'threatened' under the *Biodiversity Conservation Act 2016* (BC Act). Similarly, it is an offence to 'take' or 'disturb' threatened flora listed under the BC Act without Ministerial approval.

Flora species that do not currently meet the criteria for listing as threatened but are potentially rare or threatened may be added to the DBCA's *Priority Flora List*. These species are classified into

'priority' levels based on threat. Whilst priority species are not under direct statutory protection, they are considered during State approval processes.

Further information on threatened and priority species and their categories is provided in **Appendix A**. An assessment of the likelihood of occurrence of threatened and priority flora within the site was undertaken (refer to **Sections 3.1** and **4.2.1**).

2.7.2 Threatened and priority ecological communities

An ecological community is a naturally occurring group of native plants, animals and other organisms that are interacting in a unique habitat. An ecological community's structure, composition and distribution are influenced by environmental factors such as soil type, position in the landscape, altitude, climate and water availability (DAWE 2021a). 'Threatened ecological communities' (TECs) are ecological communities that are recognised as rare or under threat and therefore warrant special protection.

Selected TECs are afforded statutory protection at a Commonwealth level under the EPBC Act. Similar to flora species, TECs listed under the EPBC Act are assigned a conservation status. Any action likely to have a significant impact on a community listed under the EPBC Act requires Ministerial approval.

TECs are also listed within Western Australia under the BC Act and the BC Regulations. Their significance is also acknowledged through other state environmental approval processes such as 'environmental impact assessments' pursuant to Part IV of *the Environmental Protection Act 1986* (EP Act) and the *Environmental Protection* (Clearing of Native Vegetation) *Regulations 2004*.

A plant community that is under consideration for listing as a TEC in Western Australia but does not yet meet survey criteria or has not been adequately defined may be listed as a 'priority ecological community' (PEC). Listing as a PEC is similarly considered during State approval processes.

Further information on categories of TECs and PECs is provided in **Appendix A**. An assessment of the likelihood of occurrence of threatened and priority ecological communities within the site was undertaken (refer to **Sections 3.1** and **4.3.1**).

2.7.3 Local and regional significance

Flora species and ecological communities may be significant irrespective of whether they have special protection under policy or legislation.

Five key reasons that vegetation within the site may be significant are listed below:

- The site is in close proximity to the Watkins Road Nature Reserve which is a significant bushland remnant in the Shire of Serpentine Jarrahdale.
- The vegetation is associated with wetlands/water courses.
- The vegetation provides or contributes to an ecological linkage.
- The vegetation has potential value as habitat for threatened or priority fauna species including, in particular, black cockatoos listed as threatened under the EPBC Act and BC Act.
- The vegetation includes species listed in *Bush Forever* 'significant flora of the Foothills and Pinjarra Plain in the Perth metropolitan region' (Government of WA 2000b).

2.8 Weeds and pests

The term 'weed' can refer to any plant that requires some form of action to reduce its effect on the economy, the environment, human health and amenity. Many non-native flora species and some native species are considered to be weeds. The likelihood of weeds occurring is higher in disturbed areas, especially areas that have been set aside for agricultural or urban land use.

A particularly invasive or detrimental weed species may be listed as a 'declared pest' pursuant to Western Australia's *Biosecurity and Agriculture Management Act 2007* (BAM Act), indicating that it warrants special management to limit its spread.

The Commonwealth government has further compiled a list of 32 *Weeds of National Significance* (WoNS) (DAWE 2021b). Whilst the WoNS list is non-statutory, many WoNS are also listed under the BAM Act. Further information on weeds and declared pests is provided in **Appendix A**.

Due to historical disturbance and current agricultural activities taking place on site, weed species are expected to be present at the site.

2.9 Bush Forever

The Government of Western Australia's *Bush Forever* policy is a strategic plan for conserving regionally significant bushland within the Swan Coastal Plain portion of the Perth Metropolitan Region. The objective of *Bush Forever* is to protect comprehensive representations of all original ecological communities by targeting a minimum of 10% of each vegetation complex for protection (Government of WA 2000a). *Bush Forever* sites are representative of regional ecosystems and habitat and have a key role in the conservation of Perth's biodiversity.

No *Bush Forever* sites occur within the site. Bush Forever Site 360 (Mundijong and Watkins Roads Bushland, Mundijong/Peel Estate) lies adjacent to the southern boundary of the site. Significant flora species are known to occur in this site. The location of Bush Forever Site 360 is shown in **Figure 2**.

2.10 DBCA managed or legislated lands

DBCA has tenure of or interests in numerous areas of land across the state for a range of purposes. Tenure categories include national parks, nature reserves, conservation parks, marine parks, marine nature reserves, marine management areas, section 5(1)(g) reserves, state forest and timber reserves. These areas are mapped within the *Legislated Lands and Waters* (DBCA 2021b) and *Lands of Interest* (DBCA 2021a) datasets. The *Legislated Lands and Waters* (DBCA 2021b) dataset includes lands subject to the following legislation; the *Conservation and Land Management Act 1984* (CALM Act 1984), *Swan and Canning Rivers Management Act 2006* (SCRM Act) and lands identified under the *Land Administration Act 1997* (LA Act). The *Lands of Interest* (DBCA 2021a) dataset includes all other lands of which DBCA is recognised as the manager but is not vested under any act. These lands are comprised of crown land and freehold land which DBCA has been acknowledged by the Department of Lands as the responsible agency.

No DBCA managed or legislated lands occur within the site. The Watkins Road Nature Reserve (R 23012) lies adjacent to the site along its southern boundary (DBCA 2021b), as shown in **Figure 2**. This nature reserve is listed under the CALM Act.

2.11 Ecological linkages

Ecological linkages are linear landscape elements that allow the movement of fauna, flora and genetic material between areas of remnant habitat. This exchange of genetic material between vegetation remnants improves the viability of those remnants by allowing greater access to breeding partners and food sources, refuge from disturbances such as fire and maintenance of genetic diversity of plant communities and populations. Ecological linkages are ideally continuous or near-continuous as the more fractured a linkage is, the less ease flora and fauna have in moving within the corridor (Alan Tingay and Associates 1998).

The Perth Biodiversity Project, supported by the Western Australian Local Government Association (WALGA), have identified and mapped regional ecological linkages within the Perth Metropolitan Region (WALGA and PBP 2004).

Ecological linkage no. 70 lies over the south-western corner of the site and extends outside of the site to the south running east to west. This linkage connects to additional ecological linkages located within the wider area. The locations of ecological linkages within the site and the wider area are shown in **Figure 2**.

Review of aerial imagery indicates that the vegetation within the site is separated from larger areas of native vegetation by roads and paddocks.

2.12 Previous surveys

No flora and vegetation surveys are known to have been previously undertaken within the site.

3 Methods

3.1 Desktop assessment

A search was conducted for threatened and priority flora that may occur or have been recorded within a 10 km radius of the site using the *Protected Matters Search Tool* (DAWE 2021c), *NatureMap* (DBCA 2021c) and DBCA's threatened and priority flora database (reference no. 66-0921FL).

A search was also conducted for TECs and PECs that may occur or have been recorded within a 10 km radius of the site using the *Protected Matters Search Tool* (DAWE 2021c), the *weed and native flora dataset* (Keighery *et al.* 2012) and DBCA's threatened and priority ecological communities' databases (reference no. 32-0921FL).

Prior to undertaking the field survey, information on the habitat preferences of threatened and priority flora species and communities identified from database searches was reviewed. This was compared to existing environmental information available for the site, such as geomorphology, soils, regional vegetation and historic land use, to identify species and communities for which habitat may occur in the site.

3.2 Field survey

Three ecologists from Emerge visited the site on 20 September, 25 October and 12 November 2021 to conduct the flora and vegetation field surveys.

3.2.1 Flora and vegetation

The site was traversed on foot and the composition and condition of vegetation was recorded.

Detailed sampling of the vegetation was undertaken using a combination of permanent 10 x 10 m quadrats and non-permanent relevés. The quadrats were established using fence droppers bound by measuring tape. Following monitoring of these quadrats, all fence droppers were removed with the exception of the north-western corner marker. The relevés were completed over an equivalent 10 x 10 m area without the use of physical markers and were included to provide a more rapid sample of patches of vegetation in poorer condition and/or of smaller size. The position of each sample was recorded with a hand-held GPS unit and is shown in **Figure 3**.

The data recorded within each sample included:

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

Additional plant taxa not observed within samples were recorded opportunistically as the ecologists traversed the site. Photographs were taken throughout the field visits to show particular site conditions.

The suitability of habitat within the site for conservation significant species identified in the desktop assessment was assessed (refer **Section 3.1**). Targeted searches were undertaken within areas of suitable habitat to search for conservation significant flora species.

All plant specimens collected during the field surveys were dried, pressed and then named in accordance with requirements of the Western Australian Herbarium. 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.

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 (**Table 1**).

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.

3.3 Mapping and data analysis

3.3.1 Conservation significant flora and vegetation

Based on the information recorded during the field surveys, an assessment of the likelihood of occurrence of threatened and priority flora species and communities within the site was undertaken using the categories outlined in **Table 2**.

Table 2: Likelihood of occurrence assessment categories and definitions

Likelihood	Definition
Recorded	The species was recorded during the current field survey.
Likely	The site contains suitable habitat for the species and it is likely the species may occur based on presence of a recent historical record within or close to the site.
Possible	The site contains suitable habitat for the species but there is no other information to suggest that the species may occur within or close to the site.
Unlikely	The site does not contain suitable habitat for the species or the site contains suitable habitat for the species within which thorough targeted searches were completed and conclusion has been made that the species is unlikely to be present.

3.3.2 Plant community identification and description

The plant communities within the site were identified from the sample data collected during the field survey. The vegetation was 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 identified plant communities were mapped on aerial photography from the sample locations and boundaries were interpreted from aerial photography and notes taken in the field. Vegetation condition was mapped on aerial photography based on the samples and notes recorded during the field survey to define areas with differing condition.

3.3.3 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* by Gibson *et al.* (1994). FCT analysis was not undertaken for samples located within degraded vegetation as lower native species diversity tends to result in inconclusive FCT assignment.

Presence/absence) data from samples in good or better condition was 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).

Each sample was compared to Gibson *et al.* (1994) separately to avoid the influence of spatial correlation. A resemblance matrix was generated 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.

Where a sample tended to cluster with a grouping of different FCTs, samples were assessed separately to differentiate between FCTs. The cluster analysis and contextual information relating to the soils, landforms and known locations of FCTs within the region were considered to determine an FCT for plant communities within the site.

3.3.4 Threatened and priority ecological communities

Areas of native vegetation potentially representing a TEC were assessed against key diagnostic characteristics and, if available, size and/or vegetation condition thresholds.

3.3.5 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 also offers a range of estimators to predict minimum species richness (Clarke and Gorley 2006). Both the Jacknife1 and Chao2 non-parametric estimators are reported, as these are 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.

3.4 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 3: 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 described in **Section 2** is adequate to place the site and vegetation in context.
	Limitation	Regarding assignment of FCTs, the authoritative Gibson *et al.* (1994) dataset was derived from a necessarily limited sample of vegetation from largely publicly owned land which is now more than 20 years out of date. Consequently, it is unknown to what degree official FCTs are appropriate reference to biodiverse vegetation across the Swan Coastal Plain. Furthermore, Gibson *et al.* (1994) collected data in the spring main flowering period and in many cases sampled plots multiple times to provide a complete species list.
Experience level of personnel	No limitation	This flora and vegetation assessment was undertaken by a qualified botanist with ten years of botanical experience in Western Australia. Technical review was undertaken by a principal environmental consultant with 20 years' experience in environmental science in Western Australia.

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

Constraint	Degree of limitation	Details
Suitability of timing	No limitation	The survey was conducted in September, October and November and thus multiple times within the main flowering season. High rainfall was recorded from May to September 2021 in the months preceding the site visits. Therefore, it is likely that many plant species would have been in flower and/or visible at the time of survey. The survey timing was considered adequate to allow the detection of species for which seasonal timing is critical.
Temporal coverage	No 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 in September, October and November 2021. The November site visits provided an insight into the vegetation condition and composition out of the main flowering period. Therefore, according to the EPA guidelines this survey is considered to meet the requirements of a 'detailed' survey.
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 103 species were recorded, of which 71 were recorded from six sample locations and 32 were recorded opportunistically. Minimum species richness within site is estimated at between 106 (Jacknife1) and 186 (Chao2) species (refer species accumulation curve and estimates shown in **Plate 7**). The number of species recorded in the site is close to that of the Jacknife1 estimate and, combined with the degraded nature of the majority of the site, demonstrates that survey effort was adequate to prepare a comprehensive species inventory for the site.
Influence of disturbance	Minor limitation	Time since fire is greater than 25 years as interpreted from aerial imagery and therefore short-lived species more common after fire may not have been visible.
	No limitation	Historical ground disturbance was evident through a large portion of the site. The disturbance history of the site was considered when undertaking field sampling.
Adequacy of resources	No limitation	All resources required to perform the survey were available.

4 Results

4.1 General site conditions

Much of the site is relatively low-lying and with clay soils and comprises cultivated crops of *Avena sativa* (common oats) (**Plate 1**). The north-western and central portions are higher in elevation and comprise sand and gravel soils. Portions of these higher areas comprise relatively intact native vegetation.

A seasonal waterway is present running from the north-western portion of the site through to the central portion of the site and extending east of the site (**Plate 2**). The central portion contains scattered native species whilst the eastern portion is entirely comprised of non-native species.

Plate 1: Cultivated crops of common oats present throughout much of the site and remnant native vegetation present in the centre of the site to right in background.

Plate 2: Waterway present in central portion of the site, with some remnant native vegetation cover.

4.2 Flora

4.2.1 Desktop assessment

The database search results identified a total of 17 threatened and 26 priority flora species occurring or potentially occurring within a 10 km radius of the site. Information on these species including their habitat preferences and flowering period is provided in **Appendix B**.

Based on background information available for the site, suitable habitat was considered to potentially occur within the site for 11 threatened flora species and 21 priority flora species as shown in **Table 4**.

Table 4: Conservation significant flora species considered to have potential to occur in the site based on known habitat preferences

Species	Level of significance		Life strategy	Habitat	Flowering period
	State	EPBC Act			
Caladenia huegelii	CR	EN	PG	Well-drained, deep sandy soils in lush undergrowth in a variety of moisture levels.	Sep-early Nov
Drakaea elastica	CR	EN	PG	Bare patches of sand within otherwise dense vegetation in low-lying areas alongside winter-wet swamps. Typically, in banksia woodland or thickets of *Kunzea glabrescens*.	late Sep-Oct/Nov, survey Jul-Aug
Lasiopetalum pterocarpum	CR	EN	P	Dark brown or red brown loam or clayey-sand over granite, near creek lines and on sloping banks. Associated with riparian vegetation including flooded gum, marri and swamp peppermint.	Aug-Nov
Synaphea sp. Serpentine (G.R. Brand 103)	CR	CR	P	Seasonally damp areas, loam - sand.	Sep-Oct
Verticordia plumosa var. *ananeotes*	CR	EN	P	Sand in open jarrah woodland or sandy/clay soils with marri.	Nov-Dec
Eucalyptus x balanites	CR	EN	P	Light coloured sandy soils over laterite. Habitat consists of gently sloping heathlands; open mallee woodland over shrubland (Population 2) or heathland with emergent mallees (population 1)	Oct - Feb
Diuris purdiei	EN	EN	PG	Sand to sandy clay soils in areas subject to winter inundation.	late September to mid-October, but only after a summer or early autumn fire (Brown et al., 1998)
Drakaea micrantha	EN	VU	PG	Open sandy patches often adjacent to winter-wet swamps.	Sept- early Oct
Tetraria australiensis	VU	VU	P	Sand over clay, winter wet depressions and drainage lines.	Nov-Dec
Diuris micrantha	VU	VU	PG	Dark grey-black sandy clay-loam in winter wet depressions or swamps. Often in shallow standing water.	Aug/Sep- early Oct

Table 4: Conservation significant flora species considered to have potential to occur in the site based on known habitat preferences (cont.)

Species	Level of significance		Life strategy	Habitat	Flowering period
	State	EPBC Act			
Eleocharis keigheryi	VU	VU	P	Clay or sandy loam in freshwater creeks and transient waterbodies such as seasonally wet clay pans.	Aug-Dec
Synaphea odocoileops	P1	-	P	Brown orange loam and sandy clay, granite, in swamps and winter wet areas.	Aug-Oct
Grevillea crowleyae	P2	-	P	Gravel, in gravel pit.	Aug-Nov
Johnsonia pubescens subsp. cygnorum	P2	-	P	Grey white yellow sands on flats and seasonally wet areas.	Sep
Millotia tenuifolia var. *laevis*	P2	-	A	Granite or lateritic soils.	Sep-Oct
Levenhookia pulcherrima	P3	-	A	Sand or loamy sand on floodplains, outwash hill-slopes or adjacent to granite outcropping	Oct - Nov
Acacia horridula	P3	-	P	Gravelly soils over granite, sand, rocky hillsides.	May-Aug
Angianthus drummondii	P3	-	A	Grey or brown clay soils, ironstone. On seasonally wet flats.	Oct-Dec
Babingtonia urbana	P3	-	P	Grey sand, lateritic gravel.	Jan-Mar
Dillwynia dillwynioides	P3	-	P	Winter wet depressions on sandy soils	Aug - Dec
Eryngium pinnatifidum subsp. Palustre (G.J. Keighery 13459)	P3	-	P	Grey brown sand or clay in winter wet flats.	Sep-Nov
Isopogon autumnalis	P3	-	P	Yellow-grey sand.	Feb-Jun
Jacksonia gracillima	P3	-	P	Sand, often adjacent to winter wet areas	Sep-Dec
Lasiopetalum glutinosum subsp. glutinosum	P3	-	P	Brown clay loam on slopes	Sep-Dec
Schoenus pennisetis	P3	-	A	Grey or peaty sand in swamps and winter-wet depressions.	Aug-Sep
Schoenus sp. Waroona (G.J. Keighery 12235)	P3	-	A	Clay or sandy clay. Winter-wet flats.	Oct-Nov
Drosera occidentalis	P4	-	P	Flat, brown/white/yellow moist sand/clay/peat, often near swamps.	Oct-Dec/Jan

Table 4: Conservation significant flora species considered to have potential to occur in the site based on known habitat preferences (cont.)

Species	Level of significance		Life strategy	Habitat	Flowering period
	State	EPBC Act			
Eucalyptus rudis subsp. *cratyantha*	P4	-	P	Loam on flats and hillsides.	Jul-Sep
Parsonsia diaphanophleba	P4	-	P	Alluvial soils along rivers.	Jan-Feb or Apr-Sep
Pimelea rara	P4	-	P	Lateritic soils.	Dec-Jan
Senecio leucoglossus	P4	-	A	Gravelly lateritic or granitic soils on outcrops or slopes.	Aug-Dec
Verticordia lindleyi subsp. *lindleyi*	P4	-	P	Sand and sandy clay in winter wet areas.	May or Nov-Jan

CR=critically endangered, EN=endangered, VU=vulnerable, P1-P4=Priority 1-Priority 4, P=perennial, PG=perennial geophyte.

4.2.2 Species inventory

A total of 50 native and 53 non-native (weed) species were recorded within the site during the field survey, representing 37 families and 78 genera. The dominant families containing native taxa were Fabaceae (ten native taxa and nine weed taxa) and Cyperaceae (seven native taxa). The most common genus was *Acacia* with six taxa. Of the species recorded 71 were recorded in sample locations and 32 were recorded opportunistically. A complete species list is provided in **Appendix C.**

4.2.3 Threatened and priority flora

No occurrences of threatened or priority flora species were recorded within the site. The threatened and priority flora species identified in the desktop assessment are not considered to occur in the site due to lack of suitable habitat and/or because they were not recorded during the field survey.

An assessment of the likelihood of occurrence of conservation significant species is provided in **Appendix B**.

4.2.4 Locally and regionally significant flora

One locally or regionally significant flora species was recorded within the site. *Kennedia coccinea* is listed within *Bush Forever* as a significant flora of the Foothills and Pinjarra Plain, due to 'significant populations' (Government of WA 2000b).

4.2.5 Declared pests

Five species listed as a declared pest (C3) pursuant to the BAM Act were recorded within the site. These were **Asparagus asparagoides* (bridal creeper), **Echium plantagineum* (Paterson's curse), **Gomphocarpus fruticosus* (narrowleaf cottonbush), **Moraea flaccida* (one leaf cape tulip) and **Zantedeschia aethiopica* (arum lily).

Bridal creeper is also listed as a weed of national significance (WoNS).

4.3 Vegetation

4.3.1 Desktop assessment

The database search results identified 11 TECs and four PECs occurring or potentially occurring within a 10 km radius of the site. Information on these communities is provided in **Appendix D**.

Based geomorphology, soils and regional vegetation patterns, two TECs were considered to have potential to occur in the site:

- '*Corymbia calophylla - Xanthorrhoea preissii* woodlands and shrublands, Swan Coastal Plain' TEC which is listed as 'endangered' under EPBC Act. This TEC has potential to also represent a State listed 'critically endangered' TEC.
- '*Corymbia calophylla - Eucalyptus marginata* woodlands on sandy clay soils of the southern Swan Coastal Plain' TEC which is listed as 'vulnerable' under the BC Act but is not listed under the EPBC Act.

4.3.2 Plant communities

A total of six locations were sampled, comprised of five quadrats and one relevé, as shown in **Figure 4**.

Four plant communities were identified within the site. Plant community **CcEmX** exists in the north-eastern portion of the site and extends over 7.69 ha. Plant community **CcXp** occurs in a smaller central portion of the site. This community extends over 2.34 ha of the site. Plant community **JaJkLs** exists on the western most boundary of the site and occupies 0.17 ha. Two man-made dams are present in the south-western portion of the site and comprise 0.04 ha. The remainder of the site (52.76 ha) contains pasture and non-native vegetation with bare soil, weeds or planted crops of **Avena sativa* (common oat).

A description and the area of each plant community is provided in **Table 5** and representative photographs of each are provided in **Plate 3** to **Plate 6**. The location of each plant community is shown in **Figure 4**. A matrix of species recorded within each plant community is provided in **Appendix E** and raw sample data in **Appendix F**.

Table 5: Description and extent of plant communities identified within the site

Plant community	Description	Area (ha)
CcEmX	Open forest of *Corymbia calophylla* with occasional *Eucalyptus marginata* over shrubland of *Xanthorrhoea* spp. and *Lechenaultia biloba* over sedgeland to closed sedgeland of *Morelotia octandra*, *Netrostylis capillaris, Mesomelaena tetragona* and *Lepidosperma* spp., forbland of *Dasypogon bromeliifolius*, *Microtis media*, *Conostylis* spp., *Burchardia congesta* and *Lomandra spp*. and sparse to closed grassland of **Ehrharta calycina* and **Briza maxima* (**Plate 3**)	7.25

Table 5: Description and extent of plant communities identified within the site (cont.)

Plant community	Description	Area (ha)
CcXp	Open forest of *Corymbia calophylla* over open shrubland to shrubland of *Xanthorrhoea preissii* and *Xanthorrhoea gracilis* over open sedgeland of *Morelotia octandra* and *Lepidosperma* spp. and grassland of weeds (**Plate 4**)	2.34
JaJkLs	Rushland of **Juncus articulatus* and *Juncus kraussii* over forbland of **Lotus* spp., **Lupinus luteus*, **Cotula coronopifolia, **Echium plantagineum* and other weed species (**Plate 5**)	0.17
Pasture and non-native	Heavily disturbed areas and croplands comprising cultivated and non-native species (**Plate 6**)	53.17
Open water	Man-made dams (**Plate 5**)	0.04

*Plate 3: Plant community **CcEmX** in 'very good' condition*

*Plate 4: Plant community **CcXp** in 'degraded' condition*

*Plate 5: Plant community **JaJkLs** in 'degraded' condition surrounding a man-made dam.*

*Plate 6: **Pasture and non-native vegetation** in 'completely degraded' condition.*

4.3.3 Vegetation condition

The most intact native vegetation was located in the north-eastern portion of the site (approximately 5.25 ha of the **CcEmX** plant community). Most of the **CcEmX** vegetation was mapped as being in 'very good' condition as it retains the structure expected of a jarrah forest community and has moderate native species diversity. Past disturbance of this area is evident from historical aerial photography and through the presence of weed species.

Portions of the **CcEmX** and **CcXp** plant communities were mapped as being in 'good' condition due to higher weed cover with lower native species diversity and cover, but retained basic vegetation structure.

Plant community **JaJkLs**, as well as some portions of the **CcEmX** and **CcXp** plant communities were mapped as being in 'degraded' condition and did not retain basic vegetation structure. The degraded portions of the **CcEmX** and **CcXp** vegetation tended to have limited or no remaining native understorey species remaining, as well as high weed cover. Plant community **JaJkLs** comprised some native rushes with predominantly non-native species and was present surrounding a man-made dam. This community is highly disturbed with minimal native species and cover.

Remaining areas in the site are in 'completely degraded' condition and consist of non-native species such as pasture weeds and planted crops. Sandy tracks within the site were also mapped as being in 'completely degraded' condition.

The extent of vegetation by condition category is detailed in **Table 6** and shown in **Figure 5**.

Table 6: Extent of vegetation condition categories within the site

Condition category (Gibson *et al.* 1994)	Size (ha)
Pristine	0
Excellent	0
Very good	5.25
Good	2.3
Degraded	2.21
Completely degraded	53.19
Not applicable	0.04

4.3.4 Floristic community types

Plant communities **CcEmX** and **CcXp** were considered to represent FCT 3b '*Corymbia calophylla* – *Eucalyptus marginata* woodlands on sandy clay soils'. This FCT is listed as 'well reserved' and 'vulnerable' by Gibson *et al.* (1994). All five quadrats grouped with FCT 6 'weed dominated wetlands on heavy soils' in the cluster analysis but tended to be most similar to Gibson *et al.* (1994) sites representing FCT 3b with 33-35% similarity (**Table 7**). High similarity was also noted to sites comprising FCT 11 (Q1), FCT 28 (Q2) and FCT 3c (Q5). The relevant portions of the cluster dendrograms showing Q1-Q5 are provided in **Appendix G**.

Plant community **JaJkLs** was considered too degraded to assign to an FCT.

Table 7: Plant community and likely FCT represented within the site for each sample

Plant community	Sample unit	Most similar Gibson *et al.* (1994) sites	Similarity (%)	Most likely floristic community type (FCT)	Reservation and conservation status (Gibson *et al.* 1994)
CcEmX	**Q1^**	ROWE01 (FCT 11)	35	FCT 3b: *Corymbia calophylla – Eucalyptus marginata* woodlands on sandy clay soils	Well reserved Vulnerable
		YARL03 (FCT 3b)	33		
		BURNRD02 (FCT 3b)	31		
	Q2^	KOOLJ-5 (FCT 3b)	35		
		SHENT-1 28	32		
		CARD11 (FCT 6)	31		
	Q3^	CARD4 (FCT 6)	35		
		BURNRD02 (FCT 3b)	34		
		CARD11 (FCT 6)	33		
		YARL03 (FCT 3b)	33		

Table 7: Plant community and likely FCT represented within the site for each sample (cont.)

Plant community	Sample unit	Most similar Gibson *et al.* (1994) sites	Similarity (%)	Most likely floristic community type (FCT)	Reservation and conservation status (Gibson *et al.* 1994)
CcXp	**Q4^**	CARD4 (FCT 6)	28	FCT 3b: *Corymbia calophylla – Eucalyptus marginata* woodlands on sandy clay soils	Well reserved Vulnerable
		CARD11 (FCT 6)	18		
		ELLEN-7 (FCT 6)	18		
	Q5^	CARD4 (FCT 6)	30		
		ELLEN-6 (FCT 3c)	29		
		DEPOT-1 (FCT 28)	28		
		CARD11 (FCT 6)	27		

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

4.3.5 Threatened and priority ecological communities

FCT 3b is associated with the '*Corymbia calophylla – Eucalyptus marginata* woodlands on sandy clay soils' TEC, which is listed as vulnerable at the State level but is not listed pursuant to the EPBC Act.

There is no conservation advice for the SCP3b TEC so it is unclear whether a condition threshold should be applied when identifying its presence. The DBCA has historically applied good condition as a threshold for the identification of TEC. Using good condition as a basis for identification, 7.56 ha of the **CcEmX** and **CcXp** vegetation is considered to represent the TEC. No other TECs or PECS occur in the site.

The location of the TEC within the site is shown in **Figure 5**.

An assessment of the likelihood of occurrence of other TECS and PECs is provided in **Appendix D**.

4.3.6 Locally and regionally significant vegetation

Large eucalypt trees (diameter at breast height larger than 500 mm) including *Corymbia calophylla* (marri) and *Eucalyptus marginata* (jarrah) are present in the site. These trees provide foraging habitat and have the potential to be used as roosting or breeding habitat by threatened species of black cockatoo, along with other ecological services.

4.4 Species richness

A total of 71 species were recorded from six samples. A species accumulation curve derived from sample data is presented in **Plate 7**. After six samples the curve is still increasing and has not reached its asymptote. This indicates that a proportion of species likely remain undetected by sampling.

Species richness was estimated in PRIMER v6 to be between 106 (Jacknife1) and 186 (Chao2). Based on the trend of the species accumulation curve approximately 25 to 60 samples would be required to capture that many species. Including the 32 additional species recorded opportunistically, a total of

103 species was recorded in the site. This indicates that between 55 and 97% of the estimated 106-186 species in the site were recorded. Considering the degraded nature of the majority of the site and the time spent sampling and searching the wetland vegetation, the survey effort was considered to be adequate to prepare a comprehensive species inventory.

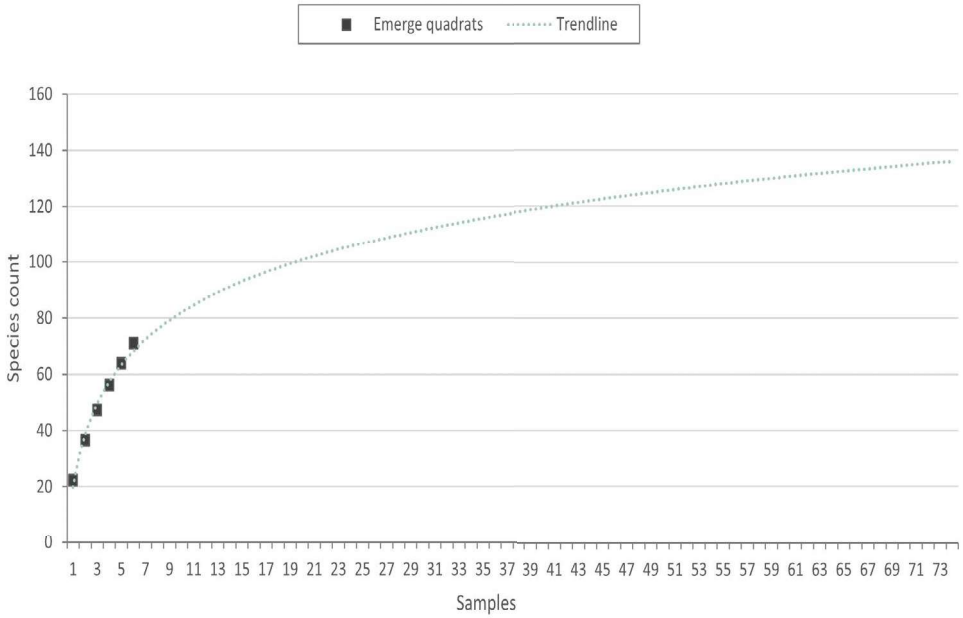

Plate 7: Species accumulation curve derived from sample data (y = 26.969ln(x) + 19.969 R^2 = 0.9852)

5 Discussion

The vegetation within the site has been subject to significant past disturbance. Approximately 84% of the site is in completely degraded condition and currently used for the production of crops.

The most intact native vegetation occurs in the eastern portion of the site where the **CcEmX** plant community is present. This vegetation was considered to represent FCT 3b, which is a State TEC.

5.1 Threatened and priority flora

No threatened or priority flora species were recorded within the site.

Prior to the survey, based on background information, 11 threatened and 21 priority flora species were considered to potentially occur within the site. The field surveys in September, October and November were considered sufficient to determine that these species are unlikely to occur. This is because either suitable habitat does not occur or the species were not recorded during traverses within potentially suitable habitat. The absence of the larger perennial species such as *Eucalyptus x balanites, Verticordia plumosa var. ananeotes, Jacksonia gracillima* and *Lasiopetalum pterocarpum* was relatively easy to confirm. However, due to their size and seasonal lifeform, smaller annual, cryptic or geophytic species such as *Caladenia huegelii*, *Diuris purdiei*, *Drakaea elastica* and *Morelotia australiensis* can be more difficult to detect.

The timing of the surveys coincided with the main flowering period of the majority of the conservation significant flora identified in the desktop assessment and therefore they should have been visible, if present. The species with flowering periods outside of September to November are perennials and would be visible throughout the year. Since no unidentified specimens which had potential to comprise conservation significant species were collected, the survey effort is also considered sufficient to confirm the absence of these species.

The threatened species *Morelotia australiensis* (previously *Tetraria australiensis*) is known to occur within the Watkins Road Nature Reserve located directly south of the site. This species superficially resembles *Morelotia octandra* (previously *Tetraria octandra*) which was a common species within the understorey or plant communities **CcEmX** and **CcXp** within the site. Moreover, M. *australiensis* only tends to flower after fire (DEWHA 2008). As such, flowering features could not be used to distinguish the species. Significant time was spent undertaking targeted searches for the species and checking specimens of *M. octandra* within the site for defining characteristics of *M. australiensis*. The botanists also visited the Watkins Road Nature Reserve to ensure that the two species could be viewed and distinguished. On this basis it was ascertained that none of the *Morelotia* sp. plants detected within with the site were *M. australiensis,* and that furthermore the species is unlikely to occur within the site.

5.2 Vegetation condition

Assigning condition using a categorical scale is always most difficult when vegetation qualities are close to the boundary between two categories. Categorical schemes may also invariably yield

different results when applied by different assessors, because of differences in skill levels or personal bias.

A vegetation condition score has the greatest implications when the condition of vegetation is close the boundary between 'good' and 'degraded'. This is because good condition is typically accepted as the threshold for conservation significance, while 'degraded' condition implies a low conservation requirement. Separating these two condition categories is further complicated by the fact that good condition is more correctly understood to mean 'average' condition. Applying the Keighery (1994) condition scale good condition vegetation can be expected to be significantly altered, with very obvious disturbance and the presence of aggressive weeds at high density. Therefore, good does not literally mean "good" as the label implies.

A relatively small area of **CcEmX** vegetation in very good condition remains (8.3% of the sites area). An additional 3.7% of the site contains **CcEmX** and **CcXp** vegetation in good condition. Despite being mapped as good and very good condition, the **CcEmX** and especially the **CcXp** vegetation present within the site includes notable weed cover, has been subject to recent physical disturbance and was considered to have a reduced level of native species diversity in comparison to other areas of marri and jarrah vegetation. Nonetheless it also retains an open forest structure and a moderate level of native species diversity.

The 'degraded' portions of the **CcEmX** and **CcXp** vegetation had significantly lower native species diversity and higher weed density than the areas mapped as being in 'good' condition.

5.3 Floristic community type assignment

The results of the FCT cluster analysis were not entirely conclusive as the samples from plant communities **CcEmX** and **CcXp** clustered with FCT 6 in the dendogram and showed similarity to multiple FCTs. FCT 6 (weed dominated wetlands on heavy soils) is the most disturbed community described in Gibson *et al.* (1994), is largely defined by weed species and likely to have arisen from major disturbance events, such as extensive clearing and grazing (Gibson *et al.* 1994). Despite clustering with FCT 6, samples Q1-Q3, which represented the best condition vegetation present within the site, showed the highest similarity to sites comprising FCT 3b. As such, FCT 3b was considered the most appropriate classification for plant communities **CcEmX** and **CcXp** which are best described as jarrah and marri woodland than weed dominated wetland.

However, it is noted that sampled diversity of 10 to 33 is significantly lower than expected for FCT 3b (61.2 mean species richness) (Gibson *et al.* 1994). The lower diversity likely accounts for the inconclusive results and indicates historical disturbance has modified the composition and condition of 3b vegetation in the site.

FCT 3b is associated with FCT 3a and FCT 3c that also occur on the eastern side of the swan coastal plain (Gibson *et al.* 1994) and are associated with Commonwealth and State TECs (DoEE 2017a, b). The **CcEmX** and **CcXp** vegetation was assigned to 3b as they included species like *Conostylis juncea* and *Acacia saligna* that are generally not recorded within FCT 3a and FCT 3c. However, sample Q5 within plant community **CcXp** had moderate similarity (29%) to FCT 3c. Due to the similarity of vegetation at the Q5 sample to better condition **CcEmX** vegetation that showed high similarity to FCT 3b, it was considered the **CcXp** vegetation better represented a more disturbed area of FCT 3b than

FCT 3c. This conclusion is further supported by the fact that the native understorey species present within the **CcXp** vegetation were present within the **CcEmX** vegetation, but with higher weed and lower native species cover.

5.4 Threatened and priority ecological communities

There is no conservation advice for the '*Corymbia calophylla – Eucalyptus marginata* woodlands on sandy clay soils of the southern Swan Coastal Plain' TEC. Good condition was applied as threshold for its identification within the site. It is unknown whether other areas should also be considered as part of a patch of the TEC.

5.5 Local and regional significance

Broadly, the remnant native vegetation within the site (plant communities **CcEmX** and **CcXp**) may be considered to be locally or regionally significant as they are a remnant of the Forrestfield complex, which has been extensively cleared and the remaining extent is poorly reserved (refer **Section 2.5**).

Plant communities **CcEmX** and **CcXp** contain plants known to provide foraging habitat for threatened species of black cockatoo. In addition, mature *Corymbia calophylla* and *Eucalyptus marginata* trees with a diameter at breast height larger than 50 cm are present within the site and have the potential to provide breeding habitat for black cockatoos, along with other ecological services.

6 Conclusions

The site is highly disturbed and modified, with approximately 53.2 ha of the site containing 'completely degraded', non-native vegetation. The remaining 9.77 ha of the site includes native vegetation that is present in 'degraded' to 'very good' condition.

No threatened or priority flora species were recorded within the site or are considered likely to occur.

Weed cover is generally high across the site. Five declared pests were recorded: **Asparagus asparagoides* (bridal creeper), **Echium plantagineum* (Paterson's curse), **Gomphocarpus fruticosus* (narrow leaf cotton bush), **Moraea flaccida* (one-leaf cape tulip) and **Zantedeschia aethiopica* (arum lily). These species are listed in the 'exempt' keeping category under the *Biosecurity and Agriculture Management Act 2007* for which no permit or conditions are required.

Patches of plant communities **CcEmX** and **CcXp** in good or better condition are considered to represent *Corymbia calophylla – Eucalyptus marginata* woodlands on sandy clay soils of the southern Swan Coastal Plain' which is listed as vulnerable in Western Australia. Applying a minimum threshold of good condition, 7.56 ha of this TEC occurs within the site.

The vegetation may be considered locally significant as a remnant of the poorly reserved Forrestfield vegetation complex. Marri and jarrah trees within the site provide foraging habitat, and potentially breeding habitat, for threatened species of black cockatoo.

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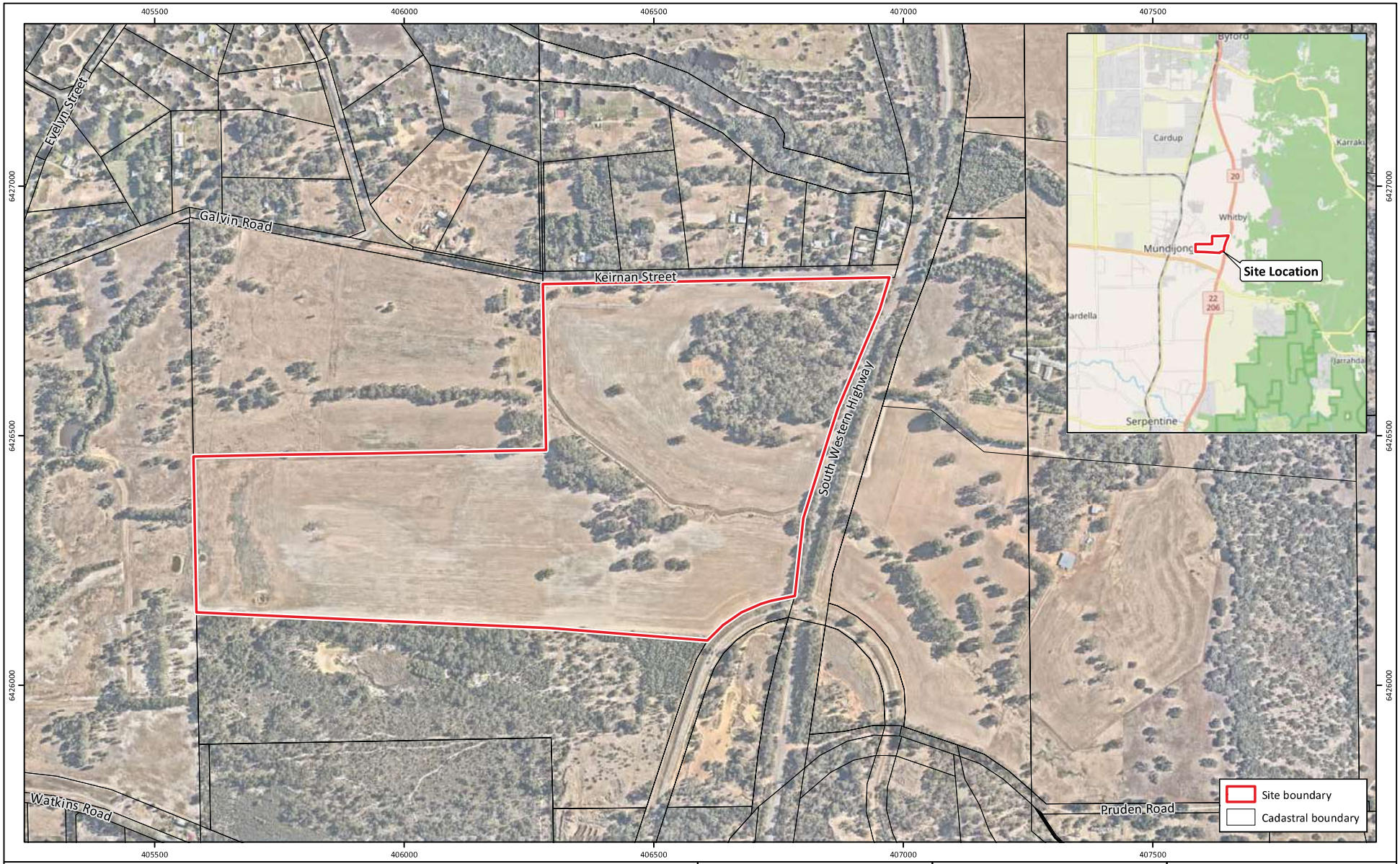

Figure 1: Site Location

Project: Detailed Flora and Vegetation Assessment
Lot 4395 Keirnan Street, Mundijong
Client: Shire of Serpentine - Jarrahdale

Plan Number:
EP21-057(02)--F01
Drawn: GAR
Date: 02/12/2021
Checked: SKP
Approved: RAW
Date: 09/12/2021

N

0 100 200 300
Metres
Scale: 1:10,000@A4
GDA 1994 MGA Zone 50

emerge ASSOCIATES

While Emerge Associates makes every attempt to ensure the accuracy and completeness of data, Emerge accepts no responsibility for externally sourced data used
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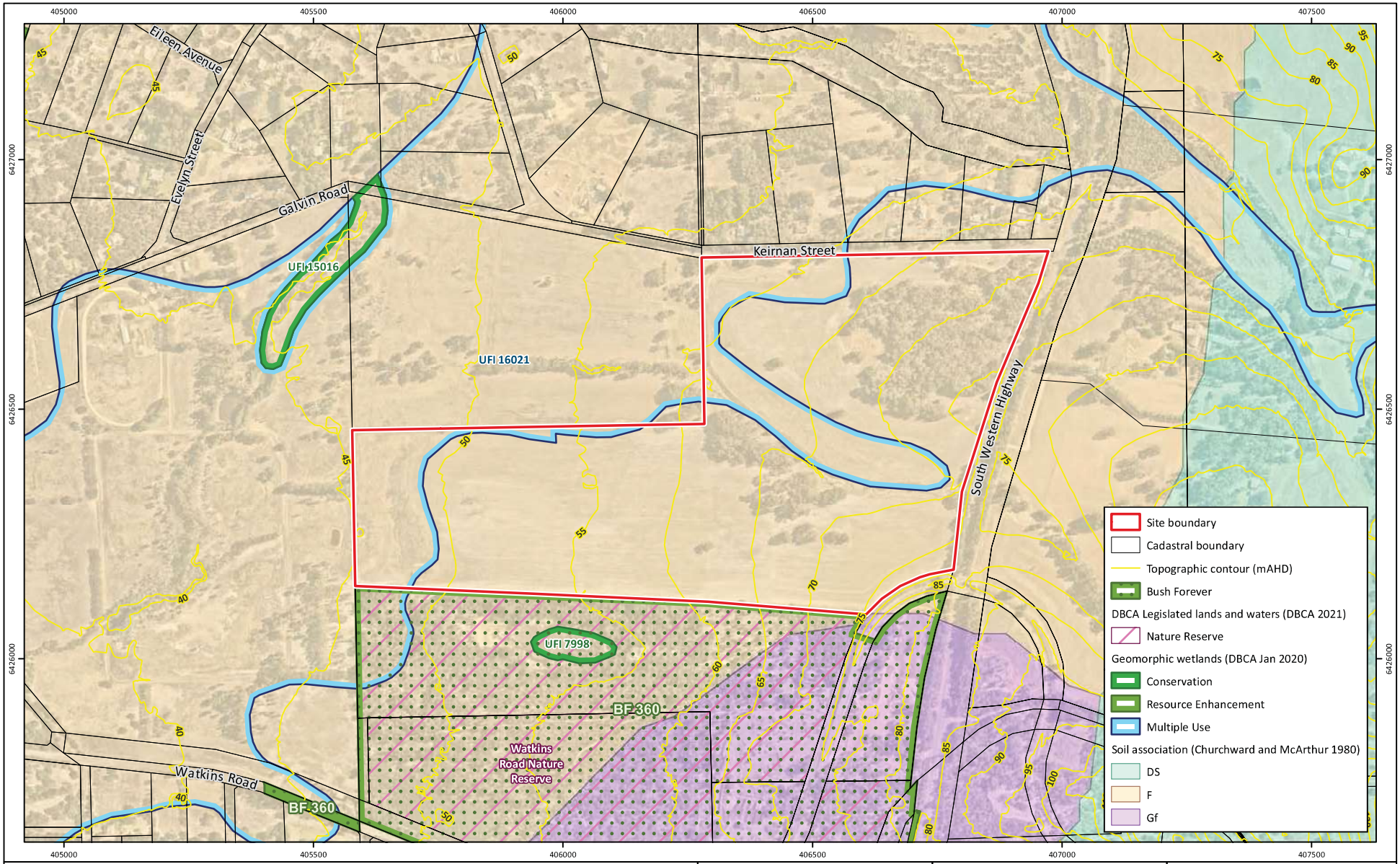

Figure 2: Environmental Features

Project: Detailed Flora and Vegetation Assessment
Lot 4395 Keirnan Street, Mundijong
Client: Shire of Serpentine - Jarrahdale

Plan Number:
EP21-057(02)--F02
Drawn: GAR
Date: 02/12/2021
Checked: SKP
Approved: RAW
Date: 09/12/2021

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Scale: 1:10,000@A4
GDA 1994 MGA Zone 50

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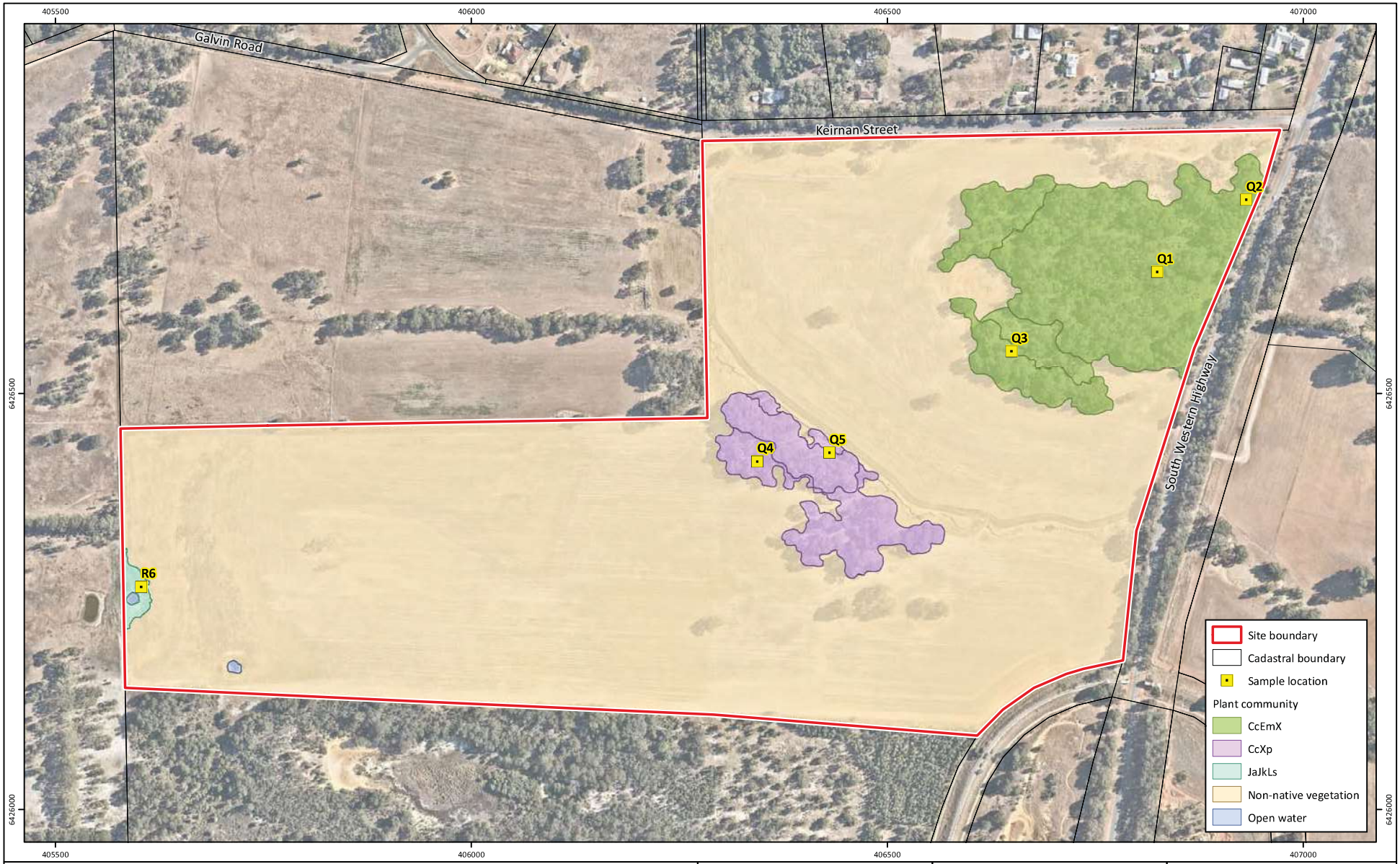

Figure 3: Plant Communities

Project: Detailed Flora and Vegetation Assessment
Lot 4395 Keirnan Street, Mundijong
Client: Shire of Serpentine - Jarrahdale

Plan Number:
EP21-057(02)--F03
Drawn: GAR
Date: 02/12/2021
Checked: SKP
Approved: RAW
Date: 09/12/2021

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Scale: 1:6,000@A4
GDA 1994 MGA Zone 50

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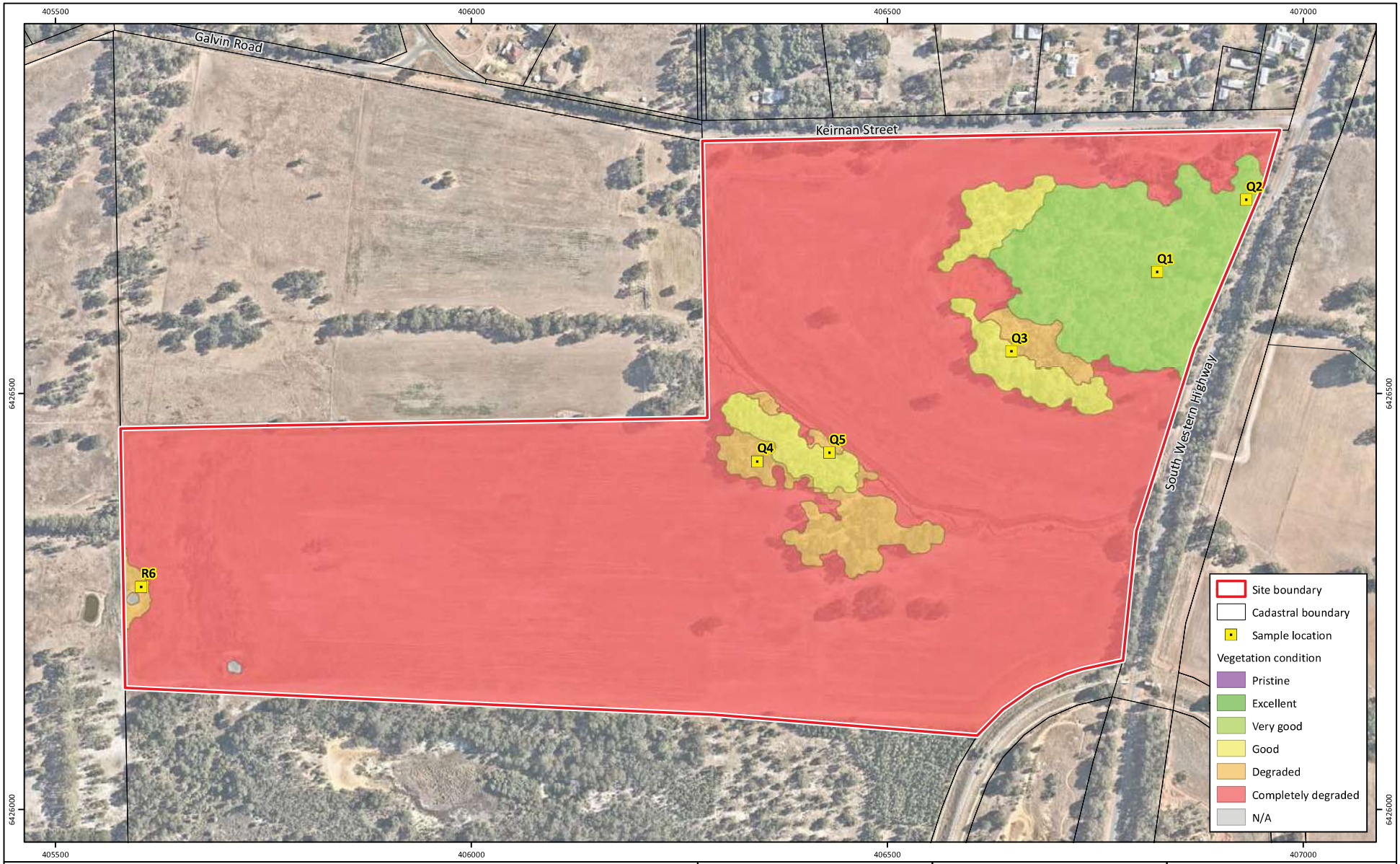

Figure 4: Vegetation Condition

Project: Detailed Flora and Vegetation Assessment
Lot 4395 Keirnan Street, Mundijong
Client: Shire of Serpentine - Jarrahdale

Plan Number:
EP21-057(02)--F04
Drawn: GAR
Date: 02/12/2021
Checked: SKP
Approved: RAW
Date: 09/12/2021

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Scale: 1:6,000@A4
GDA 1994 MGA Zone 50

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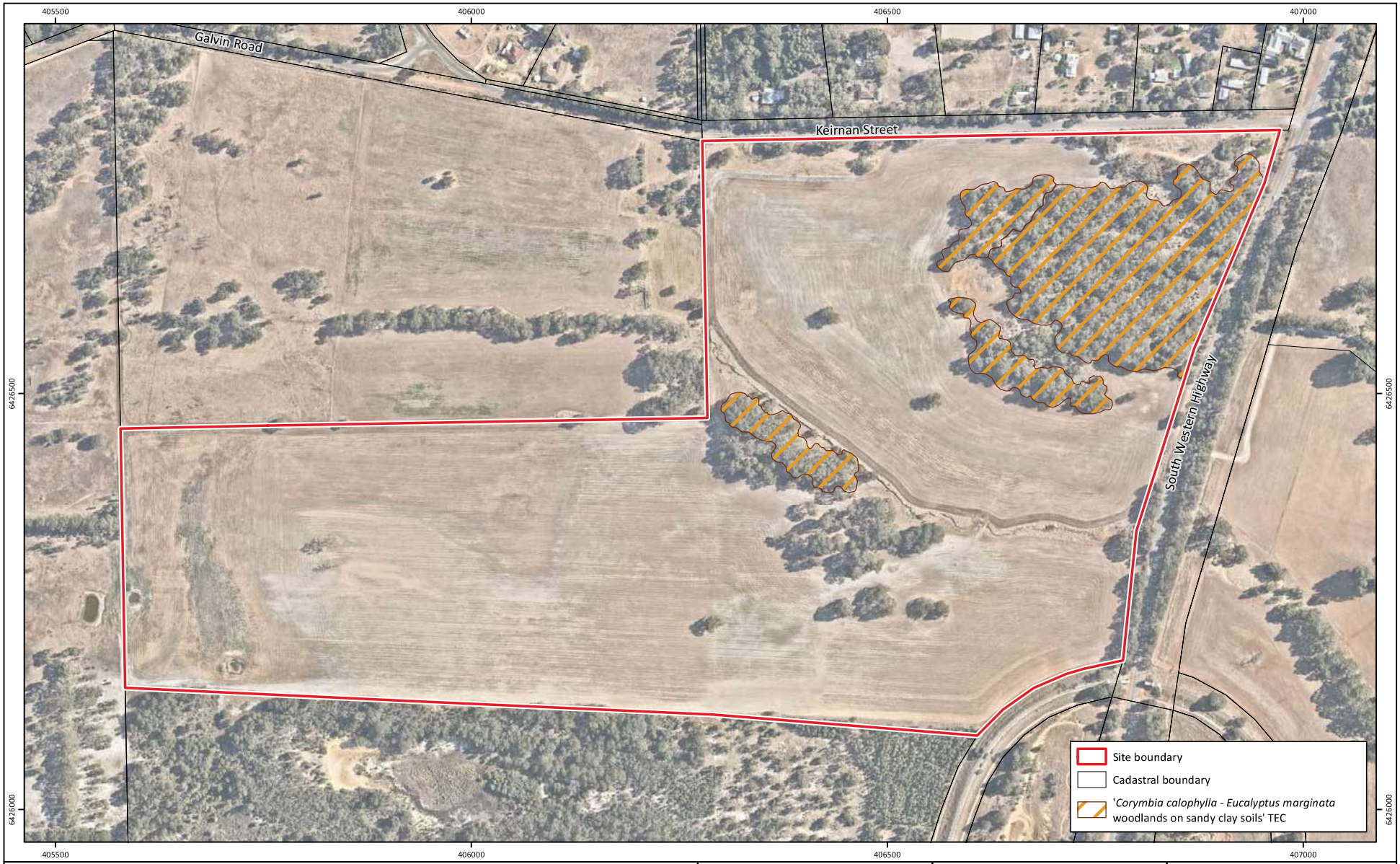

Figure 5: Threatened Ecological Communities

Project: Detailed Flora and Vegetation Assessment
Lot 4395 Keirnan Street, Mundijong
Client: Shire of Serpentine - Jarrahdale

Plan Number:
EP21-057(02)--F05
Drawn: GAR
Date: 02/12/2021
Checked: SKP
Approved: RAW
Date: 09/12/2021

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Metres
Scale: 1:6,000@A4
GDA 1994 MGA Zone 50

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Appendix A

Additional Information

Conservation Significant Flora and Vegetation

Threatened and priority flora

Flora species considered rare or under threat warrant special protection under Commonwealth and/or State legislation. At the Commonwealth level, flora species can be listed under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). Flora species considered 'threatened' pursuant to Schedule 1 of the EPBC Act are assigned categories according to their conservation status, as outlined in **Table 1**.

In Western Australia, plant taxa may be classed as 'threatened' under the *Biodiversity Conservation Act 2016* (BC Act) which is enforced by Department of Biodiversity Conservation and Attractions (DBCA). Threatened flora species are listed under sections 19(1) and 26(2) of the BC Act. It is an offence to 'take' or disturb threatened flora without Ministerial approval. Section 5(1)1 of the Act defines to take as including "… to gather, pluck, cut, pull up, destroy, dig up, remove, harvest or damage flora by any means" or to cause or permit the same to be done. The definition of threatened flora under the BC Act is provided in **Table 1**.

Section 43 of the BC Act requires that an occurrence of a threatened species or threatened ecological community is reported to DBCA where the occurrence has been identified as part of field work completed:

- as part of an assessment under Part IV of the *Environmental Protection Act 1986*; or
- in relation to an application for a clearing permit under the *Environmental Protection Act 1986* section 51E(1)(d).

Penalties apply to individuals and organisations that fail to provide accurate reports of threatened species or communities.

The *Biodiversity Conservation Regulations 2018* (BC Regulations 2018) came into effect on January 1 2019. The BC Regulations include provisions for licencing, charges, penalties and other provisions associated with the BC Act.

Flora species that may be threatened or near threatened but lack sufficient information to be listed under the BC Act may be added to the DBCA's *Priority Flora List* (DBCA 2018b). Priority flora species are considered during State approval processes. Priority flora categories and definitions are listed in **Table 1**.

Table 1: Definitions of conservation significant flora species pursuant to the EPBC Act and BC Act and on DBCA's Priority Flora List (DBCA 2018b)

Conservation code	Description
EX†	Threatened Flora – Presumed Extinct Taxa which have not been collected, or otherwise verified, over the past 50 years despite thorough searching, or of which all known wild populations have been destroyed more recently, and have been gazetted as such.
T^†	Threatened Flora – Extant Taxa which are declared to be likely to become extinct or is rare, or otherwise in need of special protection.
CR^	Threatened Flora – Critically Endangered Taxa which are considered to be facing an extremely high risk of extinction in the wild.
EN^	Threatened Flora – Endangered Taxa which are considered to be facing a very high risk of extinction in the wild.
VU^	Threatened Flora – Vulnerable Taxa which are considered to be facing a high risk of extinction in the wild.
P1	Priority One – Poorly Known Taxa which are known from one or a few (generally <5) populations which are under threat, either due to small population size, or being on lands under immediate threat e.g. road verges, urban areas, farmland, active mineral leases etc., or the plants are under threat, e.g. from disease, grazing by feral animals etc. May include taxa with threatened populations on protected lands. Such taxa are under consideration for declaration as 'rare flora', but are in urgent need of further survey.
P2	Priority Two – Poorly Known Taxa which are known from one or a few (generally <5) populations, at least some of which are not believed to be under immediate threat (i.e. not currently endangered). Such taxa are under consideration for declaration as 'rare flora', but urgently need further survey.
P3	Priority Three – Poorly Known Taxa which are known from several populations, and the taxa are not believed to be under immediate threat (i.e. not currently endangered), either due to the number of known populations (generally >5), or known populations being large, and either widespread or protected. Such taxa are under consideration for declaration as 'rare flora' but needs further survey.
P4	Priority Four – Rare Taxa which are considered to have been adequately surveyed and which, whilst being rare (in Australia), are not currently threatened by any identifiable factors. These taxa require monitoring every 5-10 years.

^pursuant to the EPBC Act, †pursuant to the BC Act, on DBCA's *Priority Flora List*

Threatened and priority ecological communities

'Threatened ecological communities' (TECs) are recognised as ecological communities that are rare or under threat and therefore warrant special protection. Selected TECs are afforded statutory protection at a Commonwealth level under section 181 of the EPBC Act. TECs nominated for listing under the EPBC Act are considered by the Threatened Species Scientific Committee and a final decision is made by the Commonwealth Minister for the Environment. Once listed under the EPBC Act, communities are categorised as either 'critically endangered', 'endangered' or 'vulnerable' as defined in **Table 2**. Any action likely to have a significant impact on a community listed under the EPBC Act requires approval from the Minister for the Environment.

Within Western Australia TECs are determined by the Western Australian Threatened Ecological Communities Scientific Advisory Committee (WATECSAC) and endorsed by the State Minister for the Environment. The WATECSAC is an independent group comprised of representatives from organisations including tertiary institutions, the Western Australian Museum and DBCA. The TECs endorsed by the State Minister are published by DBCA (DBCA 2018a).

TECs are assigned to one of the categories outlined in **Table 2** according to their status (in relation to the level of threat). TECs are afforded direct statutory protection at a State level under the BC Act and BC Regulations. Ecological communities are listed under Section 27(1) and 33 of the BC Act. Their significance is also acknowledged through other state environmental approval processes such as 'environmental impact assessment' pursuant to Part IV of the *Environmental Protection Act 1986* (EP Act) and the *Environmental Protection (Clearing of Native Vegetation) Regulations 2004*.

Table 2: Categories of threatened ecological communities (English and Blyth 1997; DEC 2009)

Conservation code	Description
PD	Presumably Totally Destroyed An ecological community that has been adequately searched for but for which no representative occurrences have been located.
CE	Critically Endangered An ecological community that has been adequately surveyed and is found to be facing an extremely high risk of total destruction in the immediate future.
E	Endangered An ecological community that has been adequately surveyed and is not critically endangered but is facing a very high risk of total destruction in the near future.
V	Vulnerable An ecological community that has been adequately surveyed and is not critically endangered or endangered but is facing a high risk of total destruction or significant modification in the medium to long-term future.

An ecological community that is under consideration for listing as a TEC, but does not yet meet survey criteria or has not been adequately defined may be listed as a 'priority ecological community' (PEC). PECs are categorised as priority category 1, 2 or 3 as described in **Table 3**. Ecological communities that are adequately known and are rare but not threatened, or meet criteria for 'near threatened', or that have been recently removed from the threatened list, are placed in 'priority 4'. These ecological communities require regular monitoring. Conservation dependent ecological communities are placed in 'priority 5' (DEC 2013). Listed PECs are published by DBCA (DBCA 2017).

Table 3: Categories of priority ecological communities (DEC 2013)

Priority code	Description
P1	Priority One: Poorly known ecological communities Ecological communities that are known from very few occurrences with a very restricted distribution (generally ≤5 occurrences or a total area of ≤ 100ha). Occurrences are believed to be under threat either due to limited extent, or being on lands under immediate threat (e.g. within agricultural or pastoral lands, urban areas, active mineral leases) or for which current threats exist. May include communities with occurrences on protected lands. Communities may be included if they are comparatively well-known from one or more localities but do not meet adequacy of survey requirements, and/or are not well defined, and appear to be under immediate threat from known threatening processes across their range.
P2	Priority Two: Poorly known ecological communities Communities that are known from few occurrences with a restricted distribution (generally ≤10 occurrences or a total area of ≤200ha). At least some occurrences are not believed to be under immediate threat (within approximately 10 years) of destruction or degradation. Communities may be included if they are comparatively well known from one or more localities but do not meet adequacy of survey requirements, and/or are not well defined, and appear to be under threat from known threatening processes.
P3	Priority Three: Poorly known ecological communities (i) Communities that are known from several to many occurrences, a significant number or area of which are not under threat of habitat destruction or degradation or: (ii) communities known from a few widespread occurrences, which are either large or with significant remaining areas of habitat in which other occurrences may occur, much of it not under imminent threat (within approximately 10 years), or; (iii) communities made up of large, and/or widespread occurrences, that may or may not be represented in the reserve system, but are under threat of modification across much of their range from processes such as grazing by domestic and/or feral stock, inappropriate fire regimes, clearing, hydrological change etc. Communities may be included if they are comparatively well known from several localities but do not meet adequacy of survey requirements and/or are not well defined, and known threatening processes exist that could affect them.
P4	Priority Four: Ecological communities that are adequately known, rare but not threatened or meet criteria for Near Threatened, or that have been recently removed from the threatened list. These communities require regular monitoring. (i) Rare. Ecological communities known from few occurrences that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection, but could be if present circumstances change. These communities are usually represented on conservation lands. (ii) Near Threatened. Ecological communities that are considered to have been adequately surveyed and that do not qualify for Conservation Dependent, but that are close to qualifying for a higher threat category. (iii) Ecological communities that have been removed from the list of threatened communities during the past five years.
P5	Priority Five: Conservation Dependent ecological communities Ecological communities that are not threatened but are subject to a specific conservation program, the cessation of which would result in the community becoming threatened within five years.

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Appendix B

Conservation Significant Flora Species and likelihood of Occurrence Assessment

Species name	Level of significance		Life strategy	Habitat	Flowering period	Likelihood of occurrence
	WA	EPBC Act				
Caladenia huegelii	CR	EN	PG	Well-drained, deep sandy soils in lush undergrowth in a variety of moisture levels.	Sep-early Nov	Unlikely
Drakaea elastica	CR	EN	PG	Bare patches of sand within otherwise dense vegetation in low-lying areas alongside winter-wet swamps. Typically in banksia woodland or thickets of Kunzea glabrescens.	late Sep-Oct/Nov, survey Jul-Aug	Unlikely
Lasiopetalum pterocarpum	CR	EN	P	Dark brown or red brown loam or clayey-sand over granite, near creek lines and on sloping banks. Associated with riparian vegetation including flooded gum, marri and swamp peppermint.	Aug-Nov	Unlikely
Synaphea sp. Serpentine (G.R. Brand 103)	CR	CR	P	Seasonally damp areas, loam - sand.	Sep-Oct	Unlikely
Verticordia plumosa var. ananeotes	CR	EN	P	Sand in open jarrah woodland or sandy/clay soils with marri.	Nov-Dec	Unlikely
Eucalyptus x balanites	CR	EN	P	Light coloured sandy soils over laterite. Habitat consists of gently sloping heathlands; open mallee woodland over shrubland (Population 2) or heathland with emergent mallees (population 1)	Oct - Feb	Unlikely
Calectasia cyanea	CR	CR	P	Heathland on white sand or laterite gravel over laterite. Known only from one population near Albany.	Jun-Oct	Unlikely
Synaphea sp. Fairbridge Farm (D. Papenfus 696)	CR	CR	P	Low woodland on grey, clayey sand with lateritic pebbles (Pinjarra Plain) near winter wet flats.	Sep-Nov	Unlikely

Species name	Level of significance		Life strategy	Habitat	Flowering period	Likelihood of occurrence
	WA	EPBC Act				
Diuris purdiei	EN	EN	PG	Sand to sandy clay soils in areas subject to winter inundation.	late September to mid-October, but only after a summer or early autumn fire (Brown et al., 1998)	Unlikely
Drakaea micrantha	EN	VU	PG	Open sandy patches often adjacent to winter-wet swamps.	Sept- early Oct	Unlikely
Lepidosperma rostratum	EN	EN	P	Peaty sand and clay amongst low heath, in winter-wet swamps.	May-Jun (survey late Jun-Aug)	Unlikely
Synaphea sp. Pinjarra Plain (A.S. George 17182)	EN	CR	P	White grey clayey sand on edges of seasonally inundated low lying areas.	Sep-Oct	Unlikely
Morelotia australiensis	VU	VU	P	Sand over clay, winter wet depressions and drainage lines.	Nov-Dec	Unlikely
Diuris micrantha	VU	VU	PG	Dark grey-black sandy clay-loam in winter wet depressions or swamps. Often in shallow standing water.	Aug/Sep-early Oct	Unlikely
Eleocharis keigheryi	VU	VU	P	Clay or sandy loam in freshwater creeks and transient waterbodies such as seasonally wet clay pans.	Aug-Dec	Unlikely
Andersonia gracilis	VU	EN	P	Seasonally damp, black sandy clay flats near or on the margins of swamps.	Sep-Nov	Unlikely
Anthocercis gracilis	VU	VU	P	Steep granite slopes along the Darling Scarp in shallow, humis-rich sandy or loamy soils.	Sep-Oct, Apr	Unlikely
Synaphea odocoileops	P1	-	P	Brown orange loam and sandy clay, granite, in swamps and winter wet areas.	Aug-Oct	Unlikely

Species name	Level of significance		Life strategy	Habitat	Flowering period	Likelihood of occurrence
	WA	EPBC Act				
Acacia lasiocarpa var. bracteolata long peduncle variant (G.J. Keighery 5026)	P1	-	P	Grey or black sand over clay. Swampy areas, winter wet lowlands.	May or Aug	Unlikely
Grevillea crowleyae	P2	-	P	Gravel, in gravel pit.	Aug-Nov	Unlikely
Johnsonia pubescens subsp. cygnorum	P2	-	P	Grey white yellow sands on flats and seasonally wet areas.	Sep	Unlikely
Millotia tenuifolia var. laevis	P2	-	A	Granite or lateritic soils.	Sep-Oct	Unlikely
Levenhookia pulcherrima	P3	-	A	Sand or loamy sand on floodplains, outwash hill-slopes or adjacent to granite outcropping	Oct - Nov	Unlikely
Acacia horridula	P3	-	P	Gravelly soils over granite, sand, rocky hillsides.	May-Aug	Unlikely
Angianthus drummondii	P3	-	A	Grey or brown clay soils, ironstone. On seasonally wet flats.	Oct-Dec	Unlikely
Babingtonia urbana	P3	-	P	Grey sand, lateritic gravel.	Jan-Mar	Unlikely
Dillwynia dillwynioides	P3	-	P	Winter wet depressions on sandy soils	Aug - Dec	Unlikely
Eryngium pinnatifidum subsp. Palustre (G.J. Keighery 13459)	P3	-	P	Grey brown sand or clay in winter wet flats.	Sep-Nov	Unlikely
Isopogon autumnalis	P3	-	P	Yellow-grey sand.	Feb,Mar,Apr,May or June	Unlikely
Jacksonia gracillima	P3	-	P	Sand, often adjacent to winter wet areas	Sep-Dec	Unlikely
Lasiopetalum glutinosum subsp. glutinosum	P3	-	P	Brown clay loam on slopes	Sep-Dec	Unlikely
Schoenus pennisetis	P3	-	A	Grey or peaty sand in swamps and winter-wet depressions.	Aug-Sep	Unlikely
Schoenus sp. Waroona (G.J. Keighery 12235)	P3	-	A	Clay or sandy clay. Winter-wet flats.	Oct-Nov	Unlikely
Acacia oncinophylla subsp. oncinophylla	P3	-	P	Granitic soils	Aug-Oct	Unlikely
Pithocarpa corymbulosa	P3	-	P	Gravelly or sandy loam, amongst granite outcrops.	Jan-Apr	Unlikely
Schoenus capillifolius	P3	-	A	Brown mud in claypans.	Oct-Nov	Unlikely

Species name	Level of significance		Life strategy	Habitat	Flowering period	Likelihood of occurrence
	WA	EPBC Act				
Stylidium aceratum	P3	-	A	Sandy soils in swamp heathland.	Oct-Nov	Unlikely
Drosera occidentalis	P4	-	P	Flat, brown/white/yellow moist sand/clay/peat, often near swamps.	Oct-Dec/Jan	Unlikely
Eucalyptus rudis subsp. cratyantha	P4	-	P	Loam on flats and hillsides.	Jul-Sep	Unlikely
Parsonsia diaphanophleba	P4	-	P	Alluvial soils along rivers.	Jan-Feb or Apr-Sep	Unlikely
Pimelea rara	P4	-	P	Lateritic soils.	Dec-Jan	Unlikely
Senecio leucoglossus	P4	-	A	Gravelly lateritic or granitic soils	Aug-Dec	Unlikely
Verticordia lindleyi subsp. lindleyi	P4	-	P	Sand and sandy clay in winter wet areas.	May or Nov-Jan	Unlikely

Note: T=threatened, CE=critically endangered, E=endangered, V=vulnerable, P1=Priority 1, P2=Priority 2, P3=Priority 3, P4=Priority 4, P=perennial, PG=perennial geophyte, A=annual. Species considered to potentially occur within the site are shaded green

Appendix C

Species List

Family	Status	Species
Anacardiaceae		
	*	*Schinus terebinthifolia*
Apocynaceae		
	*, DP	*Gomphocarpus fruticosus*
Araceae		
	*, DP	*Zantedeschia aethiopica*
Asparagaceae		
	*, DP, WoNS	*Asparagus asparagoides*
		Lomandra caespitosa
		Lomandra purpurea
		Lomandra sonderi
Asteraceae		
	*	*Arctotheca calendula*
	*	*Cotula coronopifolia*
	*	*Hypochaeris glabra*
	*	*Tolpis barbata*
	*	*Vellereophyton dealbatum*
Bignoniaceae		
	*	*Jacaranda mimosifolia*
Boraginaceae		
	*, DP	*Echium plantagineum*
Brassicaceae		
	*	*Rapistrum rugosum*
	*	*Raphanus raphanistrum*
Colchicaceae		
		Burchardia congesta
Chenopodiaceae		
	*	*Chenopodium* sp.
Cyperaceae		
		Isolepis cernua
		Isolepis marginata
		Lepidosperma leptostachyum
		Lepidosperma pubisquameum
		Mesomelaena tetragona
		Morelotia octandra
		Netrostylis capillaris
Dasypogonaceae		
		Dasypogon bromeliifolius
Dilleniaceae		
		Hibbertia hypericoides
		Hibbertia pilosa
Droseraceae		
		Drosera stolonifera
Fabaceae		
		Acacia barbinervis
	*	*Acacia iteaphylla*
	*	*Acacia longifolia*
	*	*Acacia podalyriifolia*

Family	Status	Species
Fabaceae (cont.)		*Acacia pulchella*
		Acacia saligna
		Bossiaea ornata
		Daviesia physodes
	*, Pl	*Erythrina ×sykesii*
		Hovea elliptica
		Jacksonia sternbergiana
		Kennedia coccinea
		Kennedia prostrata
		Labichea punctata
	*	*Lotus angustissimus*
	*	*Lotus subbiflorus*
	*	*Lupinus angustifolius*
	*	*Lupinus luteus*
	*	*Trifolium campestre*
Fagaceae		
	*, Pl	*Quercus* sp.
Goodeniaceae		
		Lechenaultia biloba
Haemodoraceae		
		Conostylis aculeata
		Conostylis juncea
		Conostylis setosa
		Haemodorum laxum
Hemerocallidaceae		
		Dianella revoluta
Iridaceae		
	*	Iridaceae sp.
	*, DP	*Moraea flaccida*
	*	*Moraea ochroleuca*
		Patersonia occidentalis var. *latifolia*
	*	*Romulea rosea*
	*	*Watsonia borbonica*
Juncaceae		
	*	*Juncus articulatus*
		Juncus kraussii
Lamiaceae		
	*	*Stachys arvensis*
Loranthaceae		
		Nuytsia floribunda
Moraceae		
	*, Pl	*Ficus sp.*
Myrtaceae		
		Babingtonia camphorosmae
		Corymbia calophylla
	*, Pl	*Eucalyptus* sp.
		Eucalyptus marginata
	*	*Leptospermum laevigatum*

Family	Status	Species
Oleaceae		
	*	*Olea europaea*
Orchidaceae		
	*	*Disa bracteata*
		Microtis media
		Thelymitra benthamiana
		Thelymitra crinita
Oxalidaceae		
	*	*Oxalis pes-caprae*
	*	*Oxalis purpurea*
Phyllanthaceae		
		Phyllanthus calycinus
Pittosporaceae		
		Marianthus sp.
Poaceae		
	*	*Arundo donax*
	*	*Avena barbata*
	*	*Avena sativa*
	*	*Briza maxima*
	*	*Ehrharta calycina*
	*	*Ehrharta longiflora*
	*	*Eragrostis curvula*
	*	*Holcus lanatus*
	*	*Lolium perenne*
		Microlaena stipoides
	*	*Poa annua*
		Rytidosperma ?occidentale
Polygonaceae		
	*	*Rumex acetosella*
	*	*Rumex crispus*
	*	*Rumex hypogaeus*
Portulacaceae		
	*	*Portulaca oleracea*
Proteaceae		
		Banksia nivea
		Hakea stenocarpa
Restionaceae		
		Desmocladus fasciculatus
		Hypolaena exsulca
Rutaceae		
	*, Pl	*Citrus sp.*
Xanthorrhoeaceae		
		Xanthorrhoea gracilis
		Xanthorrhoea preissii

*=non-native, Pl=planted, WoNS=weed of national significance

Appendix D

Conservation Significant Communities and Likelihood of Occurrence Assessment

Code	Community name	TEC/ PEC	Level of significance		Likelihood of occurrence
			State	EPBC Act	
SCP3a	*Corymbia calophylla - Kingia australis* woodlands on heavy soils, Swan Coastal Plain	TEC	CR	EN	Does not occur
SCP3c	*Corymbia calophylla - Xanthorrhoea preissii* woodlands and shrublands, Swan Coastal Plain	TEC	CR	EN	Does not occur
Mound Springs SCP	Communities of Tumulus Springs (Organic Mound Springs, Swan Coastal Plain)	TEC	CR	EN	Does not occur
SCP20b	*Banksia attenuata* and/or *Eucalyptus marginata* woodlands of the eastern side of the Swan Coastal Plain	TEC	EN	EN	Does not occur
SCP10a	Shrublands on dry clay flats	TEC	EN	CR	Does not occur
SCP3b	*Corymbia calophylla - Eucalyptus marginata* woodlands on sandy clay soils of the southern Swan Coastal Plain	TEC	VU	-	Present within the site
SCP09	Dense shrublands on clay flats	TEC	VU	CR	Does not occur
SCP08	Herb rich shrublands in clay pans	TEC	VU	CR	Does not occur
	Clay Pans of the Swan Coastal Plain	TEC	Various	CR	Does not occur
Banksia WL SCP	Banksia Woodlands of the Swan Coastal Plain	TEC/ PEC	P3	EN	Does not occur
Casuarina obesa association	*Casuarina* obesa association	PEC	P1	-	Does not occur
SCP1a	*Eucalyptus haematoxylon - E. marginata* woodlands on Whicher foothills	PEC	P3	-	Does not occur
Tuart woodlands	Tuart (*Eucalyptus gomphocephala*) woodlands and forests of the Swan Coastal Plain	TEC/ PEC	P3	CR	Does not occur

Note: TEC=threatened ecological community, PEC=priority ecological community, CR=critically endangered, EN=endangered, VU=vulnerable, P3=priority 3

Appendix E

Species x Plant Community Matrix

Flora Species x Plant Community Matrix - Lot 4395 Keirnan Street Mundijong

Species	Plant community			
	CcEmXp	CcXp	JaJkLs	Pasture and non-native vegetation
Acacia barbinervis	X			
Acacia iteaphylla	X			
Acacia longifolia	X			
Acacia podalyriifolia	X			
Acacia pulchella	X	X		
Acacia saligna	X	X		
Arctotheca calendula	X		X	
Arundo donax				X
Asparagus asparagoides	X			
Avena barbata		X		
Avena sativa				X
Babingtonia camphorosmae	X	X		
Banksia nivea	X			
Bossiaea ornata	X			
Briza maxima	X	X		
Burchardia congesta	X			
Chenopodium sp.	X			
Citrus sp.				X
Conostylis aculeata	X			
Conostylis juncea	X			
Conostylis setosa	X			
Corymbia calophylla	X	X		
Cotula coronopifolia			X	
Dasypogon bromeliifolius	X			
Daviesia physodes	X			
Desmocladus fasciculatus	X			
Dianella revoluta	X			
Disa bracteata	X			
Drosera stolonifera	X			
Echium plantagineum			X	
Ehrharta calycina	X	X	X	
Ehrharta longiflora	X	X		
Eragrostis curvula	X	X		
Erythrina ×sykesii				X
Eucalyptus marginata	X			
Eucalyptus sp.				X
Ficus sp.				X
Gomphocarpus fruticosus			X	
Haemodorum laxum	X			
Hakea stenocarpa	X			
Hibbertia hypericoides	X			
Hibbertia pilosa	X			
Holcus lanatus			X	
Hovea elliptica	X			
Hypochaeris glabra	X		X	
Hypolaena exsulca	X			

Flora Species x Plant Community Matrix - Lot 4395 Keirnan Street Mundijong

Species	Plant community			
	CcEmXp	CcXp	JaJkLs	Pasture and non-native vegetation
Iridaceae sp.			X	
Isolepis cernua			X	X
Isolepis marginata			X	X
Jacaranda mimosifolia	X			
Jacksonia sternbergiana		X		
Juncus articulatus			X	
Juncus kraussii		X	X	
Kennedia coccinea	X			
Kennedia prostrata	X			
Labichea punctata	X			
Lechenaultia biloba	X			
Lepidosperma leptostachyum		X		
Lepidosperma pubisquameum	X			
Leptospermum laevigatum	X			
Lolium perenne				X
Lomandra caespitosa		X		
Lomandra purpurea	X			
Lomandra sonderi	X			
lotus angustissimus			X	
Lotus subbiflorus			X	
Lupinus angustifolius	X			
Lupinus luteus			X	
Marianthus sp.	X			
Mesomelaena tetragona	X			
Microlaena stipoides		X		
Microtis media	X			
Moraea flaccida	X	X	X	
Moraea ochroleuca	X			
Morelotia octandra	X	X		
Netrostylis capillaris	X			
Nuytsia floribunda	X			
Olea europaea	X	X		
Oxalis pes-caprae	X			
Oxalis purpurea	X			
Patersonia occidentalis var. latifolia	X			
Phyllanthus calycinus		X		
Poa annua				X
Portulaca oleracea			X	
Quercus sp.				X
Raphanus raphanistrum			X	X
Rapistrum rugosum				X
Romulea rosea	X	X	X	
Rumex acetosella			X	
Rumex crispus		X		
Rumex hypogaeus		X		
Rytidosperma ?occidentale	X			

Flora Species x Plant Community Matrix - Lot 4395 Keirnan Street Mundijong

Species	Plant community			
	CcEmXp	CcXp	JaJkLs	Pasture and non-native vegetation
Schinus terebinthifolia			X	
Stachys arvensis			X	
Thelymitra crinita	X			
Thelymitra benthamiana	X			
Tolpis barbata	X			
Trifolium campestre	X	X		
Vellereophyton dealbatum			X	
Watsonia borbonica	X			
Xanthorrhoea gracilis	X	X		
Xanthorrhoea preissii	X	X		
Zantedeschia aethiopica	X			

Appendix F

Sample Data

Vegetation Sample Data

Sample Name: Q1

Project no.: EP21-057
Date: 20/09/2021, 25/10/21 **Status** Permanent
Author: SKP,other Q1: Page 1 of 2

Quadrat and landform details

Sample type:	quadrat	Size:	10 m x 10 m
NW corner easting:	406824	NW corner northing:	6426646
Altitude (m):	75	Geographic datum/zone:	GDA94/Zone 50
Soil water content:	slightly damp	Landform:	mid-slope
Time since fire:	> 5 yrs	Disturbance:	moderate - grazing, weeds
Soil type/texture	sand/loam with organic layer	Bare ground (%):	1
Rocks (%) and type:	1%, laterite	Soil colour:	brown/
Litter:	40% (leaves,twigs,)	Vegetation condition:	very good

Vegetation Sample Data

Sample Name: Q1

Project no.: EP21-057
Date: 20/09/2021, 25/10/21 **Status** Permanent
Author: SKP,other Q1: Page 2 of 2

Species Data

* denotes non-native species

Status	Confirmed name	Cover (%)
	Acacia barbinervis	opp
*	*Briza maxima*	0.1
	Burchardia congesta	0.1
	Conostylis juncea	0.1
	Conostylis setosa	0.1
	Corymbia calophylla	20
	Dasypogon bromeliifolius	2
	Desmocladus fasciculatus	0.1
*	*Disa bracteata*	0.1
*	*Ehrharta calycina*	0.1
	Haemodorum laxum	0.1
*	*Hypochaeris glabra*	0.1
	Labichea punctata	opp
	Lechenaultia biloba	opp
	Lepidosperma pubisquameum	0.5
	Lomandra purpurea	0.1
	Lomandra sonderi	0.5
	Mesomelaena tetragona	2
	Microtis media	opp
*	*Moraea flaccida*	0.1
	Morelotia octandra	20
	Netrostylis capillaris	10
*	*Olea europaea*	opp
*	*Romulea rosea*	0.1
*	*Trifolium campestre*	0.1
	Xanthorrhoea gracilis	2
	Xanthorrhoea preissii	50
*, DP	*Zantedeschia aethiopica*	0.1
*	*Acacia iteaphylla*	opp
	Drosera stolonifera	opp
*	*Eragrostis curvula*	opp
*	*Arctotheca calendula*	opp
	Acacia saligna	opp
	Thelymitra crinita	opp
	Daviesia physodes	opp
	Acacia pulchella	opp

Vegetation Sample Data

Sample Name: Q2

Project no.: EP21-057
Date: 20/09/2021, 25/10/21
Author: SKP,other
Status Permanent
Q2: Page 1 of 2

Quadrat and landform details

Sample type:	quadrat	Size:	10 m x 10 m
NW corner easting:	406932	NW corner northing:	6426733
Altitude (m):	79	Geographic datum/zone:	GDA94/Zone 50
Soil water content:	slightly damp	Landform:	mid-slope
Time since fire:	> 5 yrs	Disturbance:	moderate - edge effects, weeds
Soil type/texture	sand/loam with organic layer	Bare ground (%):	1
Rocks (%) and type:	1%, laterite	Soil colour:	brown/
Litter:	60% (leaves,twigs,)	Vegetation condition:	very good

Vegetation Sample Data

Sample Name: Q2

Project no.: EP21-057
Date: 20/09/2021, 25/10/21 **Status** Permanent
Author: SKP,other Q2: Page 2 of 2

Species Data

* denotes non-native species

Status	Confirmed name	Cover (%)
	Acacia barbinervis	0.1
	Bossiaea ornata	opp
*	*Briza maxima*	0.1
	Burchardia congesta	0.1
	Conostylis aculeata	0.1
	Conostylis setosa	0.1
	Corymbia calophylla	50
	Dasypogon bromeliifolius	0.1
	Dianella revoluta	opp
*	*Disa bracteata*	0.1
	Drosera stolonifera	0.1
*	*Ehrharta calycina*	opp
*	*Ehrharta calycina*	0.1
*	*Ehrharta longiflora*	0.1
	Eucalyptus marginata	5
	Haemodorum laxum	0.1
	Hakea stenocarpa	opp
	Hibbertia hypericoides	0.1
*	*Jacaranda mimosifolia*	1
	Kennedia prostrata	0.1
	Lepidosperma pubisquameum	10
	Lomandra purpurea	0.1
	Lomandra sonderi	0.1
	Mesomelaena tetragona	0.1
	Morelotia octandra	5
	Netrostylis capillaris	1
*	*Olea europaea*	1
*	*Oxalis purpurea*	1
	Patersonia occidentalis var. latifolia	0.1
*	*Romulea rosea*	0.1
	Xanthorrhoea gracilis	2
	Xanthorrhoea preissii	15
*, DP	*Zantedeschia aethiopica*	0.1
	Thelymitra benthamiana	opp
	Babingtonia camphorosmae	opp
	Hibbertia pilosa	opp

Vegetation Sample Data

Sample Name: Q3

Project no.:	EP21-057		
Date:	20/09/2021, 25/10/21	**Status**	Permanent
Author:	SKP,other	Q3: Page 1 of	2

Quadrat and landform details

Sample type:	quadrat	Size:	10 m x 10 m
NW corner easting:	406643	NW corner northing:	6426551
Altitude (m):	78	Geographic datum/zone:	GDA94/Zone 50
Soil water content:	slightly damp	Landform:	mid-slope
Time since fire:	> 5 yrs	Disturbance:	moderate - edge effects, weeds
Soil type/texture	sand/loam with organic layer	Bare ground (%):	2
Rocks (%) and type:	1%, laterite	Soil colour:	brown/
Litter:	25% (leaves,twigs,)	Vegetation condition:	very good

Vegetation Sample Data

Sample Name: Q3

Project no.: EP21-057
Date: 20/09/2021, 25/10/21 **Status** Permanent
Author: SKP,other Q3: Page 2 of 2

Species Data

* denotes non-native species

Status		Confirmed name	Cover (%)
	*	*Acacia iteaphylla*	0.1
		Acacia saligna	opp
	*	*Briza maxima*	5
		Burchardia congesta	0.1
	*	*Chenopodium sp.*	0.1
		Conostylis juncea	0.1
		Conostylis setosa	0.1
		Corymbia calophylla	20
		Dasypogon bromeliifolius	15
		Desmocladus fasciculatus	1
	*	*Disa bracteata*	0.1
		Drosera stolonifera	0.1
	*	*Ehrharta calycina*	2
	*	*Ehrharta longiflora*	2
		Eucalyptus marginata	15
		Haemodorum laxum	0.1
	*	*Hypochaeris glabra*	0.1
		Lepidosperma pubisquameum	5
		Lepidosperma pubisquameum	1
		Lomandra sonderi	0.1
		Marianthus sp.	0.1
		Mesomelaena tetragona	0.1
		Morelotia octandra	5
		Netrostylis capillaris	1
	*	*Romulea rosea*	0.1
	*	*Trifolium campestre*	0.1
		Xanthorrhoea gracilis	1
		Xanthorrhoea preissii	10
		Eucalyptus marginata	opp
		Kennedia coccinea	opp
		Banksia nivea	opp
		Hovea elliptica	opp
	*	*Acacia longifolia*	opp
	*	*Oxalis pes-caprae*	opp
	*	*Leptospermum laevigatum*	opp
	*	*Acacia podalyriifolia*	opp

Vegetation Sample Data

Sample Name: Q4

Project no.: EP21-057
Date: 20/09/2021 **Status** Permanent
Author: SKP,other Q4: Page 1 of 2

Quadrat and landform details

Sample type:	quadrat	Size:	10 m x 10 m
NW corner easting:	406343	NW corner northing:	6426419
Altitude (m):	70	Geographic datum/zone:	GDA94/Zone 50
Soil water content:	slightly damp	Landform:	flat
Time since fire:	> 5 yrs	Disturbance:	high - weeds, grazing
Soil type/texture	sand/loam with organic layer	Bare ground (%):	0
Rocks (%) and type:	No rocks	Soil colour:	brown/grey
Litter:	20% (leaves,twigs,)	Vegetation condition:	very good

Vegetation Sample Data

Sample Name: Q4

Project no.: EP21-057
Date: 20/09/2021 **Status** Permanent
Author: SKP,other Q4: Page 2 of 2

Species Data

* denotes non-native species

Status	Confirmed name	Cover (%)
	Babingtonia camphorosmae	1
	Corymbia calophylla	50
*	*Ehrharta calycina*	10
*	*Ehrharta longiflora*	10
*	*Eragrostis curvula*	5
*, DP	*Moraea flaccida*	5
*	*Romulea rosea*	10
*	*Trifolium campestre*	0.1
	Xanthorrhoea gracilis	1
	Xanthorrhoea preissii	10
*	*Rumex crispus*	opp
	Acacia saligna	opp
	Juncus kraussii	opp
*	*Rumex hypogaeus*	opp
*	*Rapistrum rugosum*	opp
*	*Moraea ochroleuca*	opp
*	*Watsonia borbonica*	opp
*	*Lolium perenne*	opp
*	*Arundo donax*	opp
*, Pl	*Eucalyptus sp.*	opp
*	*Poa annua*	opp

Vegetation Sample Data

Sample Name: Q5

Project no.: EP21-057
Date: 20/09/2021, 12/11/2021 **Status** Permanent
Author: SKP,other Q5: Page 1 of 2

Quadrat and landform details

Sample type:	quadrat	Size:	10 m x 10 m
NW corner easting:	406430	NW corner northing:	6426429
Altitude (m):	70	Geographic datum/zone:	GDA94/Zone 50
Soil water content:	damp	Landform:	flat
Time since fire:	> 5 yrs	Disturbance:	high - weeds, grazimg
Soil type/texture	clay/loam with organic layer	Bare ground (%):	10
Rocks (%) and type:	No rocks	Soil colour:	brown/
Litter:	20% (leaves,twigs,)	Vegetation condition:	very good

Vegetation Sample Data

Sample Name: Q5

Project no.: EP21-057
Date: 20/09/2021, 12/11/2021 **Status** Permanent
Author: SKP,other Q5: Page 2 of 2

Species Data

* denotes non-native species

Status	Confirmed name	Cover (%)
	Acacia pulchella	opp
*	*Avena barbata*	0.5
*	*Briza maxima*	10
	Corymbia calophylla	50
*	*Ehrharta calycina*	15
*	*Ehrharta longiflora*	15
	Jacksonia sternbergiana	opp
	Lepidosperma leptostachyum	1
	Lomandra caespitosa	0.1
	Microlaena stipoides	0.1
*, DP	*Moraea flaccida*	1
	Morelotia octandra	1
*	*Olea europaea*	0.1
	Phyllanthus calycinus	opp
*	*Romulea rosea*	2
	Xanthorrhoea preissii	25

Vegetation Sample Data

Sample Name: R6

Project no.: EP21-057
Date: 20/09/2021
Author: SKP,other
Status Non-permanent
R6: Page 1 of 2

Quadrat and landform details

Sample type:	releve	Size:	other
NW corner easting:	0	NW corner northing:	0
Altitude (m):	46	Geographic datum/zone:	GDA94/Zone 50
Soil water content:	saturated	Landform:	depression
Time since fire:	no evidence	Disturbance:	high - clearing, sump, grazing
Soil type/texture	clay/sand	Bare ground (%):	0
Rocks (%) and type:	No rocks	Soil colour:	brown/
Litter:	0% (,,)	Vegetation condition:	very good

Vegetation Sample Data

Sample Name: R6

Project no.: EP21-057
Date: 20/09/2021 **Status** Non-permanent
Author: SKP,other R6: Page 2 of 2

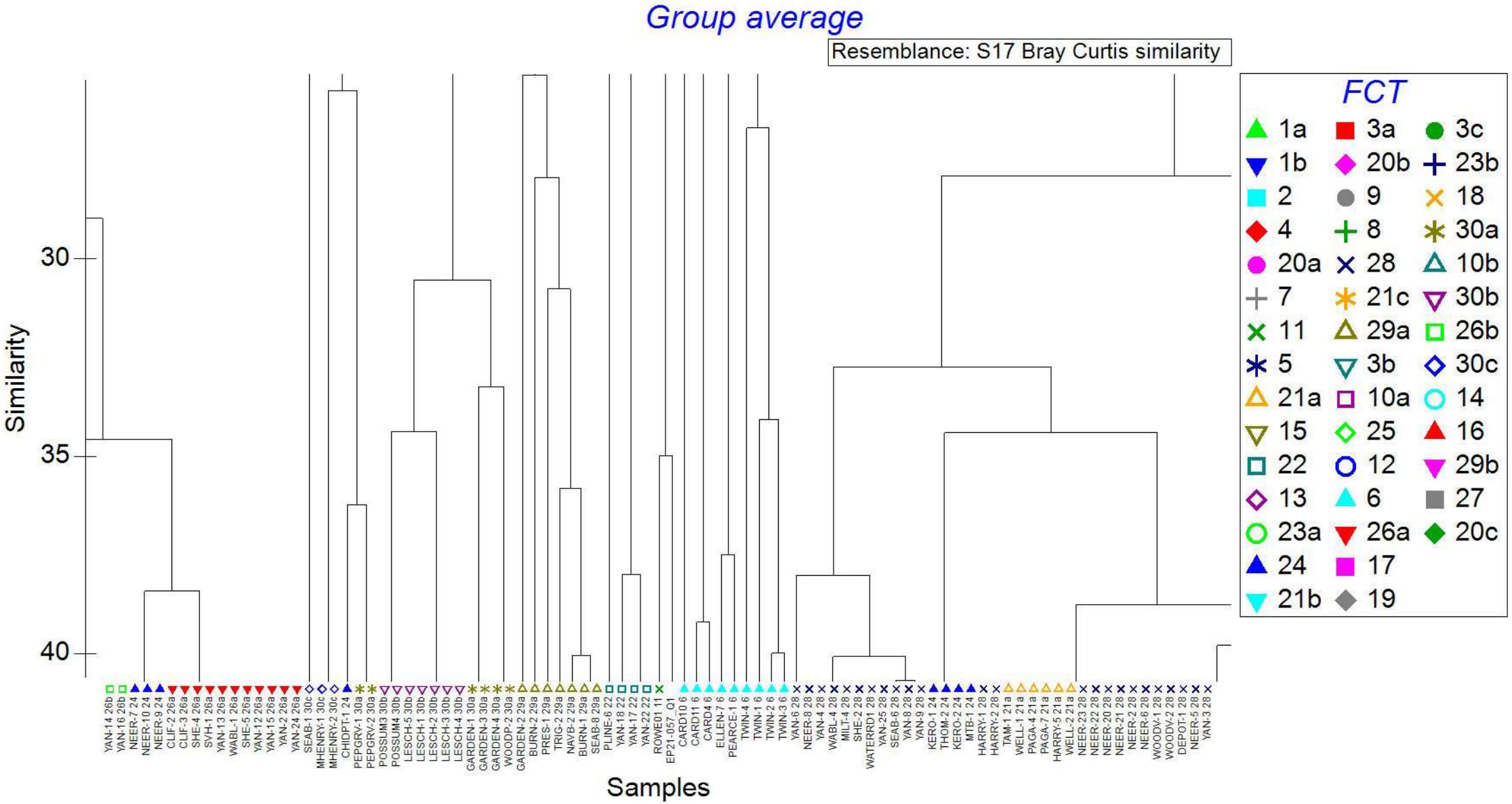
Species Data

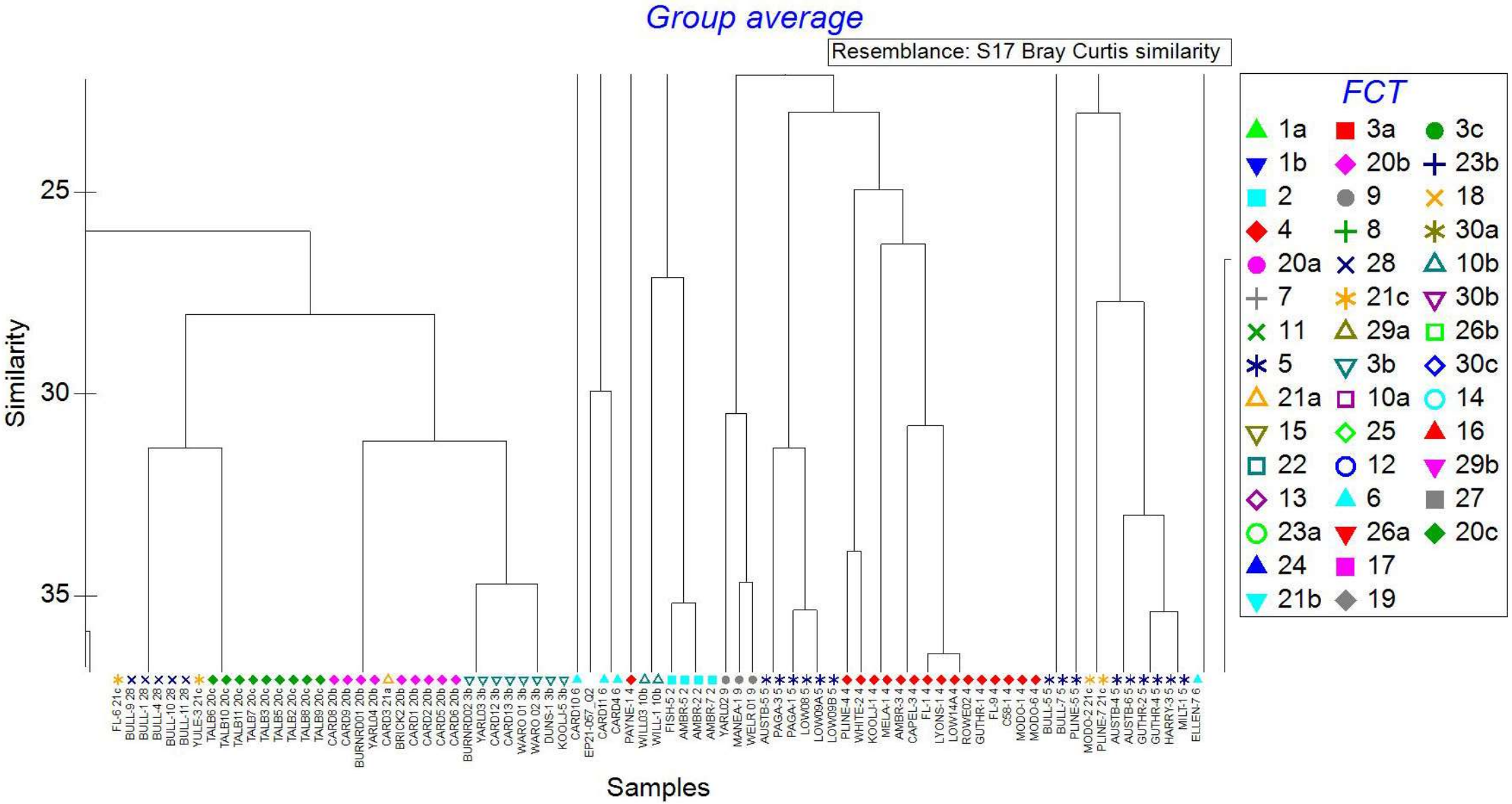
* denotes non-native species

Status	Confirmed name
*	*Arctotheca calendula*
*	*Cotula coronopifolia*
*	*Cotula coronopifolia*
*, DP	*Echium plantagineum*
*	*Ehrharta calycina*
*, DP	*Gomphocarpus fruticosus*
*	*Holcus lanatus*
*	*Hypochaeris glabra*
*	*Iridaceae sp.*
	Isolepis cernua
	Isolepis marginata
*	*Juncus articulatus*
*	*Juncus articulatus*
	Juncus kraussii
*	*lotus angustissimus*
*	*Lotus subbiflorus*
*	*Lupinus luteus*
*	*Moraea flaccida*
*	*Portulaca oleracea*
*	*Raphanus raphanistrum*
*	*Romulea rosea*
*	*Rumex acetosella*
*	*Schinus terebinthifolia*
*	*Stachys arvensis*
*	*Vellereophyton dealbatum*

Appendix G

Cluster Dendrograms


Group average
Resemblance: S17 Bray Curtis similarity
Similarity
30
35
40
Samples
FCT
1a
3a
3c
1b
20b
23b
2
9
18
4
8
30a
20a
28
10b
7
21c
30b
11
29a
26b
5
3b
30c
21a
10a
14
15
25
16
22
12
29b
13
6
27
23a
26a
20c
24
17
21b
19
YAN-14 26b
YAN-16 26b
NEER-7 24
NEER-10 24
NEER-9 24
CLIF-2 26a
CLIF-3 26a
SHE-4 26a
SYH-1 26a
YAN-13 26a
WABL-1 26a
SHE-5 26a
YAN-12 26a
YAN-15 26a
YAN-2 26a
YAN-24 26a
SEAB-1 30c
MHENRY-1 30c
MHENRY-2 30c
CHIDPT-1 24
PEPGRV-1 30a
PEPGRV-2 30a
POSSUM3 30b
POSSUM4 30b
LESCH-5 30b
LESCH-1 30b
LESCH-2 30b
LESCH-3 30b
LESCH-4 30b
GARDEN-1 30a
GARDEN-3 30a
GARDEN-4 30a
WOODP-2 30a
GARDEN-2 29a
BURN-2 29a
PRES-1 29a
TRIG-2 29a
NAVB-2 29a
BURN-1 29a
SEAB-8 29a
PLINE-6 22
YAN-18 22
YAN-17 22
YAN-22 22
ROWE01 11
EP21-057_Q1
CARD10 6
CARD11 6
CARD4 6
ELLEN-7 6
PEARCE-1 6
TWIN-4 6
TWIN-1 6
TWIN-2 6
TWIN-3 6
YAN-6 28
NEER-8 28
YAN-4 28
WABL-4 28
MILT-4 28
SHE-2 28
WATERRD1 28
YAN-25 28
SEAB-6 28
YAN-8 28
YAN-9 28
KERO-1 24
THOM-2 24
KERO-2 24
MTB-1 24
HARRY-1 28
HARRY-2 28
TAM-1 21a
WELL-1 21a
PAGA-4 21a
PAGA-7 21a
HARRY-5 21a
WELL-2 21a
NEER-23 28
NEER-22 28
NEER-20 28
NEER-21 28
NEER-2 28
NEER-6 28
WOODV-1 28
WOODV-2 28
DEPOT-1 28
NEER-5 28
YAN-3 28


Group average
Resemblance: S17 Bray Curtis similarity
Similarity
25
30
35
Samples
FCT
1a
1b
2
4
20a
7
11
5
21a
15
22
13
23a
24
21b
3a
20b
9
8
28
21c
29a
3b
10a
25
12
6
26a
17
19
3c
23b
18
30a
10b
30b
26b
30c
14
16
29b
27
20c
FL-6 21c
BULL-9 28
BULL-1 28
BULL-4 28
BULL-10 28
BULL-11 28
YULE-3 21c
TALB6 20c
TALB10 20c
TALB11 20c
TALB7 20c
TALB3 20c
TALB5 20c
TALB2 20c
TALB8 20c
TALB9 20c
CARD8 20b
CARD9 20b
BURNRD01 20b
YARL04 20b
CARD3 21a
BRICK2 20b
CARD1 20b
CARD2 20b
CARD5 20b
CARD6 20b
BURNRD02 3b
YARL03 3b
CARD12 3b
CARD13 3b
WARO 01 3b
WARO 02 3b
DUNS-1 3b
KOOLI-5 3b
CARD10 6
EP21-057_Q2
CARD11 6
CARD4 6
PAYNE-1 4
WILL03 10b
WILL-1 10b
FISH-5 2
AMBR-5 2
AMBR-2 2
AMBR-7 2
YARL02 9
MANEA-1 9
WELR 01 9
AUSTB-5 5
PAGA-3 5
PAGA-1 5
LOW08 5
LOW09A 5
LOW09B 5
PLINE-4 4
WHITE-2 4
KOOLI-1 4
MELA-1 4
AMBR-3 4
CAPEL-3 4
FL-1 4
LYONS-1 4
LOW14A 4
ROWE02 4
GUTHR-1 4
FL-9 4
C58-1 4
MODO-1 4
MODO-6 4
BULL-5 5
BULL-7 5
PLINE-5 5
MODO-2 21c
PLINE-7 21c
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GUTHR-2 5
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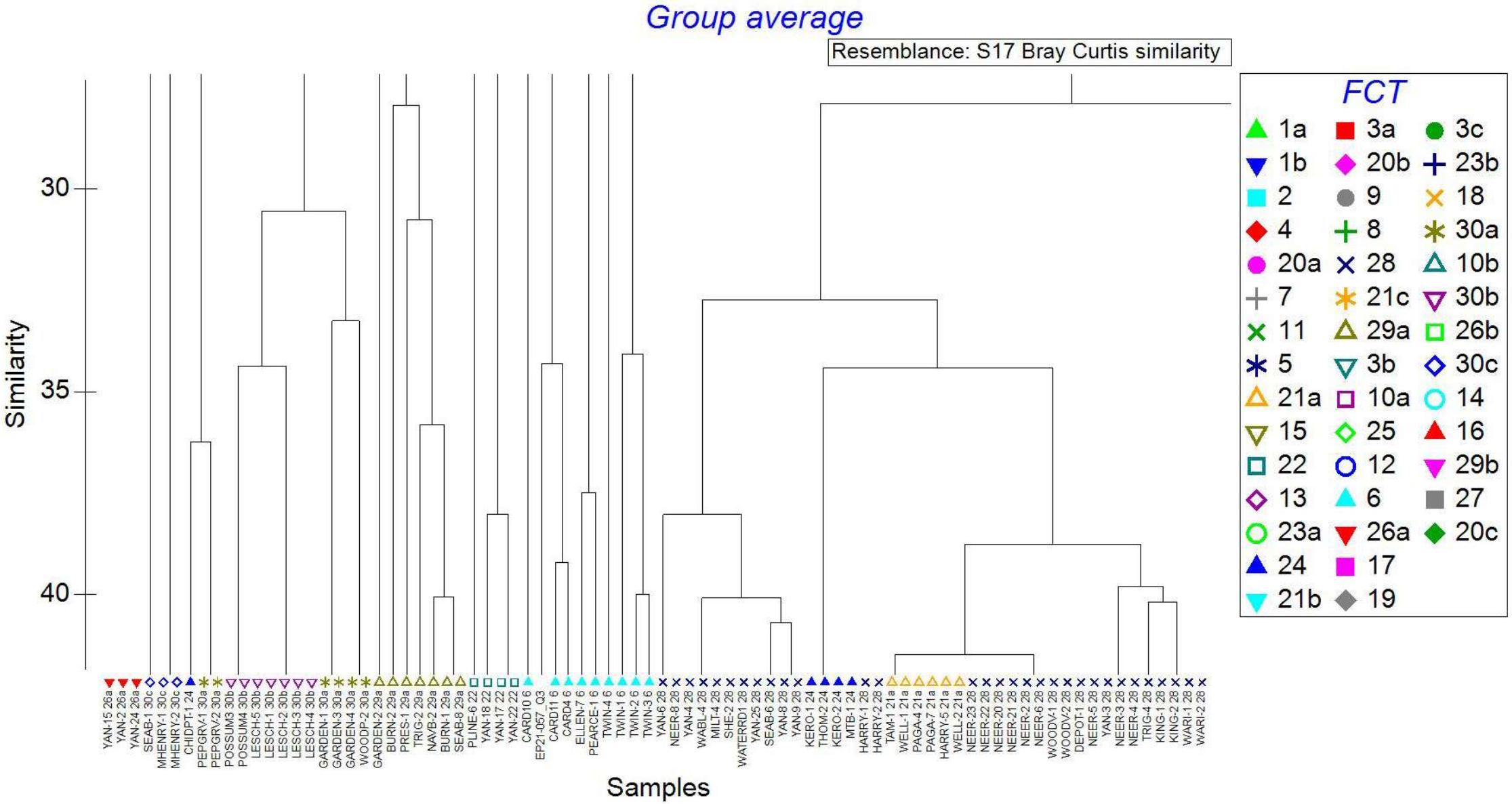
MILT-1 5
ELLEN-7 6


Group average
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Similarity
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Samples
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3c
1b
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2
9
18
4
8
30a
20a
28
10b
7
21c
30b
11
29a
26b
5
3b
30c
21a
10a
14
15
25
16
22
12
29b
13
6
27
23a
26a
20c
24
17
21b
19
YAN-15 26a
YAN-2 26a
YAN-24 26a
SEAB-1 30c
MHENRY-1 30c
MHENRY-2 30c
CHIDPT-1 24
PEPGRV-1 30a
PEPGRV-2 30a
POSSUM3 30b
POSSUM4 30b
LESCH-5 30b
LESCH-1 30b
LESCH-2 30b
LESCH-3 30b
LESCH-4 30b
GARDEN-1 30a
GARDEN-3 30a
GARDEN-4 30a
WOODP-2 30a
GARDEN-2 29a
BURN-2 29a
PRES-1 29a
TRIG-2 29a
NAVB-2 29a
BURN-1 29a
SEAB-8 29a
PLINE-6 22
YAN-18 22
YAN-17 22
YAN-22 22
CARD10 6
EP21-057_Q3
CARD11 6
CARD4 6
ELLEN-7 6
PEARCE-1 6
TWIN-4 6
TWIN-1 6
TWIN-2 6
TWIN-3 6
YAN-6 28
NEER-8 28
YAN-4 28
WABL-4 28
MILT-4 28
SHE-2 28
WATERRD1 28
YAN-25 28
SEAB-6 28
YAN-8 28
YAN-9 28
KERO-1 24
THOM-2 24
KERO-2 24
MTB-1 24
HARRY-1 28
HARRY-2 28
TAM-1 21a
WELL-1 21a
PAGA-4 21a
PAGA-7 21a
HARRY-5 21a
WELL-2 21a
NEER-23 28
NEER-22 28
NEER-20 28
NEER-21 28
NEER-2 28
NEER-6 28
WOODV-1 28
WOODV-2 28
DEPOT-1 28
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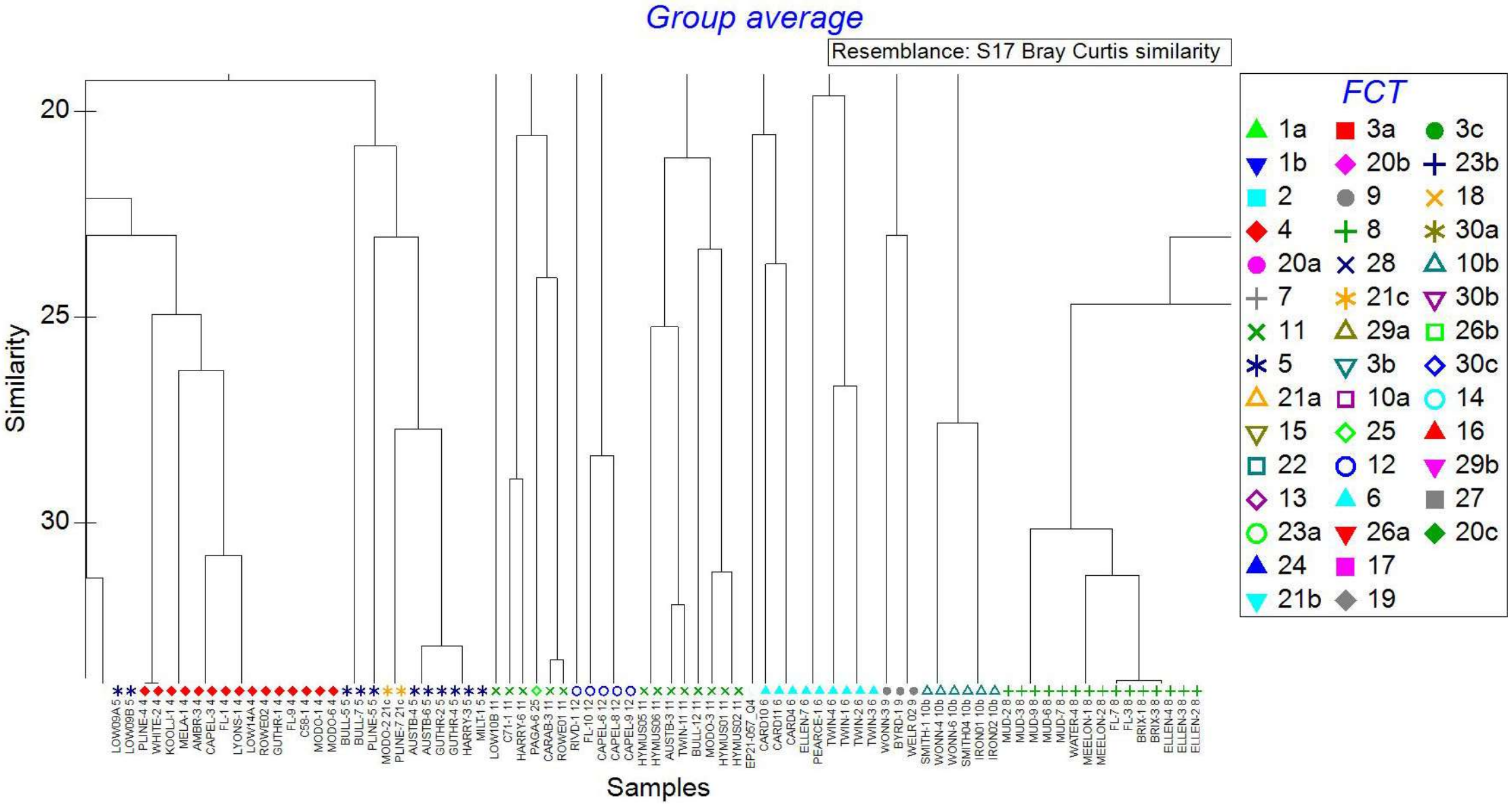
Group average
Resemblance: S17 Bray Curtis similarity
Similarity
20
25
30
Samples
FCT
1a
1b
2
4
20a
7
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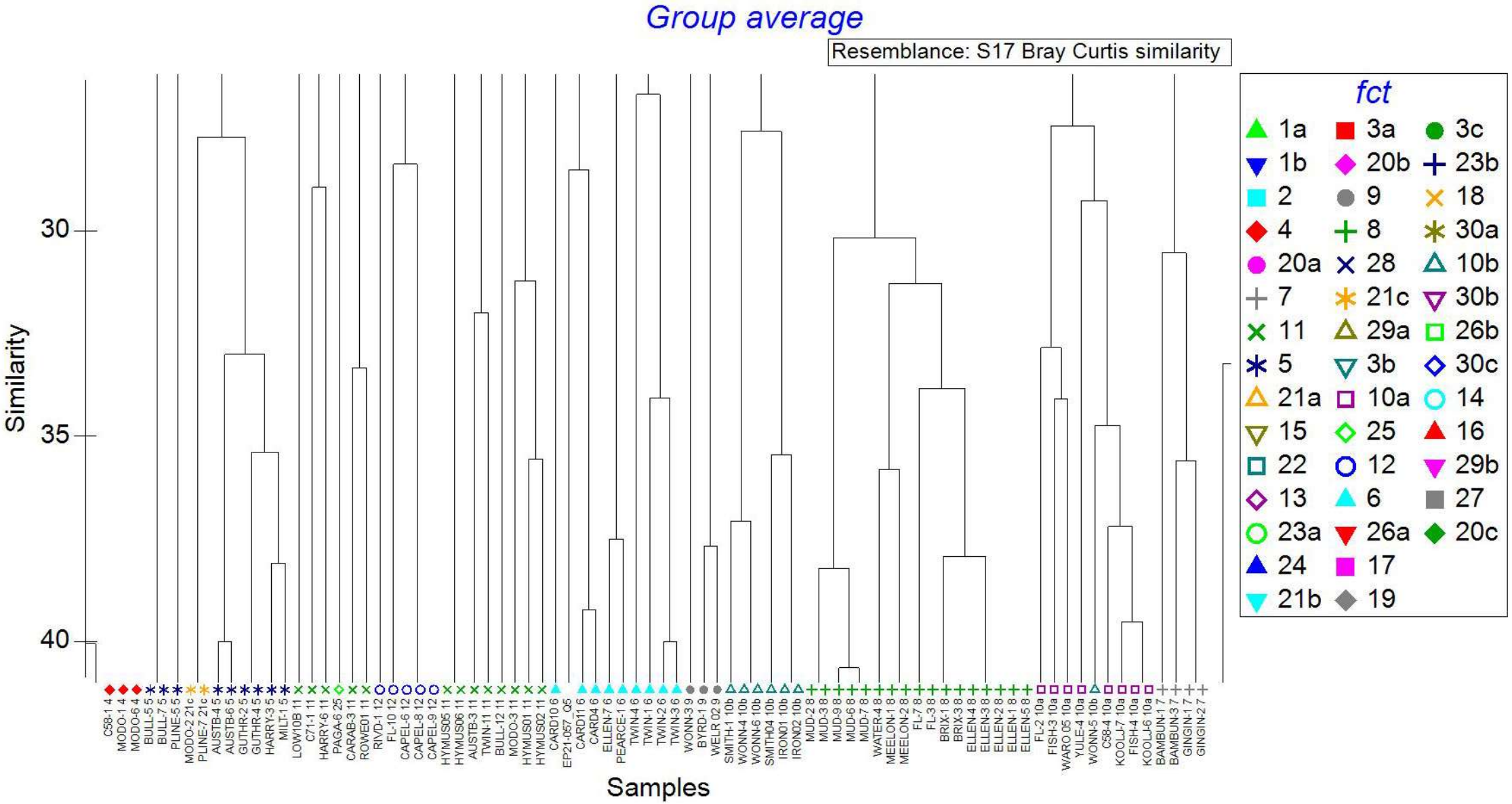
21a
15
22
13
23a
24
21b
3a
20b
9
8
28
21c
29a
3b
10a
25
12
6
26a
17
19
3c
23b
18
30a
10b
30b
26b
30c
14
16
29b
27
20c
LOW09A 5
LOW09B 5
PLINE-4 4
WHITE-2 4
KOOLJ-1 4
MELA-1 4
AMBR-3 4
CAPEL-3 4
FL-1 4
LYONS-1 4
LOW14A 4
ROWE02 4
GUTHR-1 4
FL-9 4
C58-1 4
MODO-1 4
MODO-6 4
BULL-5 5
BULL-7 5
PLINE-5 5
MODO-2 21c
PLINE-7 21c
AUSTB-4 5
AUSTB-6 5
GUTHR-2 5
GUTHR-4 5
HARRY-3 5
MILT-1 5
LOW10B 11
C71-1 11
HARRY-6 11
PAGA-6 25
CARAB-3 11
ROWE01 11
RIVD-1 12
FL-10 12
CAPEL-6 12
CAPEL-8 12
CAPEL-9 12
HYMUS05 11
HYMUS06 11
AUSTB-3 11
TWIN-11 11
BULL-12 11
MODO-3 11
HYMUS01 11
HYMUS02 11
EP21-057_Q4
CARD10 6
CARD11 6
CARD4 6
ELLEN-7 6
PEARCE-1 6
TWIN-4 6
TWIN-1 6
TWIN-2 6
TWIN-3 6
WONN-3 9
BYRD-1 9
WELR 02 9
SMITH-1 10b
WONN-4 10b
WONN-6 10b
SMITH04 10b
IRON01 10b
IRON02 10b
MUD-2 8
MUD-3 8
MUD-9 8
MUD-6 8
MUD-7 8
WATER-4 8
MEELON-1 8
MEELON-2 8
FL-7 8
FL-3 8
BRIX-1 8
BRIX-3 8
ELLEN-4 8
ELLEN-3 8
ELLEN-2 8


Group average
Resemblance: S17 Bray Curtis similarity
Similarity
30
35
40
Samples
fct
1a
1b
2
4
20a
7
11
5
21a
15
22
13
23a
24
21b
3a
20b
9
8
28
21c
29a
3b
10a
25
12
6
26a
17
19
3c
23b
18
30a
10b
30b
26b
30c
14
16
29b
27
20c