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Reconnaissance Flora and Vegetation Assessment

Part Lot 3000 on Deposited Plan 44066

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Executive Summary

Peet Limited engaged Emerge Associates to conduct a reconnaissance flora and vegetation assessment within part of Lot 3000 on deposited plan 44066 in Burns Beach (hereafter referred to as the 'site').

As part of the assessment a desktop review of relevant background information was completed and a field survey was undertaken on 13 December 2021. During the field survey an assessment was made on the type, condition and values of vegetation across the site.

Outcomes of the survey include the following:

- A total of 51 native and 17 non-native (weed) species were recorded in the site.
- No threatened or priority flora species were recorded within the site.
- Three priority flora species may occur in the site:
  - *Conostylis bracteata* (P3)
  - *Conostylis pauciflora* subsp. *euryrhipis* (P4)
  - *Conostylis pauciflora* subsp. *pauciflora* (P4).
- Further survey during August to September/October would be required to confirm the presence or absence of the above priority flora species.
- 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 **ArSgXp** comprises intact native vegetation in the site and extends over 4.05 ha (79% of the site). This vegetation represents 'floristic community type' (FCT) 24 'northern Spearwood shrublands and woodlands'.
  - Plant community **EgMsLm** comprises intact native vegetation and extends over 0.33 ha (6% of the site). This vegetation represents FCT 29b 'acacia shrublands on taller dunes, southern Swan Coastal Plain'.
  - Plant community **Ar** comprises established revegetation and extends over 0.12 ha (2% of the site).
  - The remainder of the site supports recent revegetation (0.28 ha/5%) and bare ground (0.35 ha/7%).
- The following threatened and priority ecological communities (TEC and PEC) occur within the site:
  - The tuart (*Eucalyptus gomphocephala*) woodlands and forests of the Swan Coastal Plain TEC/PEC extends over 1.11 ha.
  - The SCP24 northern Spearwood shrublands and woodlands PEC (P3) extends over 4.04 ha.
  - The SCP29b acacia shrublands on taller dunes, southern Swan Coastal Plain PEC (P3) extends over 0.33 ha.

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Abbreviation Tables

Table A1: Abbreviations – Organisations

Organisations	
EPA	Environmental Protection Authority
DBCA	Department of Biodiversity, Conservation and Attractions
WALGA	Western Australia Local Government Association

Table A2: Abbreviations – General terms

General terms	
FCT	Floristic community type
P1	Priority 1
P2	Priority 2
P3	Priority 3
P4	Priority 4
P5	Priority 5
PEC	Priority ecological community
T	Threatened
TEC	Threatened ecological communities

Table A3: Abbreviations – Legislation

Legislation	
BAM Act	*Biosecurity and Agriculture Management Act 2007*
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*

Table A4: Abbreviations – Units of measurement

Units of measurement	
cm	Centimetre
ha	Hectare
m	Metre
m AHD	m in relation to the Australian height datum
mm	Millimetre

1 Introduction

1.1 Project background

Peet Limited (Peet) are seeking to commence development of stages 16 and 17 of Burns Beach Estate, which will require the construction of batters into part of Lot 3000 on deposited plan 44066 in Burns Beach (hereafter referred to as the 'site').

Emerge Associates (Emerge) were engaged by Peet to characterise the flora and vegetation values within the site. The site is located approximately 29 kilometres (km) north-west of the Perth Central Business District within the City of Joondalup.

The site is approximately 5.13 hectares (ha) in size and is bounded by native vegetation to all sides and Burleigh Drive to the south-east. 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 reconnaissance 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 representative list of flora species and assess vegetation type and condition.
- Mapping of plant communities, vegetation condition and conservation significant flora and vegetation.
- Identification of potential habitat for conservation significant flora and vegetation and an assessment of likelihood of occurrence.
- Documentation of the desktop assessment, methodology, field survey and results into a report.

2 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 612.8 millimetres (mm) of rainfall is recorded annually from the Tamala Park weather station (no. 9264), which is the closest weather station, located approximately 1 km from the site. The majority of this rainfall is received between the months of May and September. Mean maximum temperatures at the Perth Metro weather station (no. 9225), which is the nearest temperature recording station, range from 18.5°C in July to 31.5°C in February, while mean minimum temperatures range from 8.0°C in July and August to 18.3°C in February (BoM 2022).

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 western side of the Swan Coastal Plain comprises three dune systems that run roughly parallel to the Indian Ocean coastline (Seddon 2004). These dune systems, referred to as Quindalup, Spearwood and Bassendean associations, represent a succession of coastal deposition that has occurred since the late Quaternary period (approximately two million years ago) (Kendrick *et al.* 1991) and, as a result, they contain soils at different stages of leaching and formation. The site lies within the Quindalup dunes, which comprise calcareous sands and occur as beach ridges and parabolic dunes (Churchward and McArthur 1980). The spearwood dunes are mapped as occurring approximately 120 m east of the eastern boundary of the site (Gozzard 2011).

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

2.3 Topography

The elevation of the site ranges from 30 m in relation to the Australian height datum (mAHD) on the eastern side of the site to 35 mAHD in the central portion and to 10 mAHD on the western side of the site (DoW 2008).

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.

No other mapped hydrological features occur within the site (DWER 2018; DBCA 2021a).

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.

Vegetation mapping by Heddle *et al.* (1980) indicates the site lies within the 'Quindalup complex' which is described as supporting two alliances: 'the strand and fore dune alliance and the mobile and stable dune alliance. Local variations include the low closed forest of *Melaleuca lanceolata - Callitris preissii* and the closed scrub of *Acacia rostellifera*' (Heddle *et al.* 1980).

The Quindalup complex was determined to have 60.49% of its pre-European extent remaining, of which 9.84% is protected for conservation purposes (Government of Western Australia 2019).

2.6 Historical land use

Review of historical images available from 1965 onwards shows that the majority of the site was largely undisturbed excepting some minor tracks. Imagery from August 2019 shows vegetation clearing in the western portion for construction of the footpath.

2.7 Conservation significant values

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 2021b). '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 assessment' pursuant to Part IV of *the Environmental Protection Act 1986* (EP Act) and the *Environmental Protection* (Clearing of Native Vegetation) *Regulations 2004*.

An ecological 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 flora within the site was undertaken (refer to **Sections 3.1** and **4.3.1**).

2.7.3 Locally and regionally significant flora and vegetation

Flora and vegetation may be significant irrespective of protections under policy or legislation.

Three key reasons that flora or vegetation within the site may be significant are listed below:

- 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.
- Flora species listed in *Bush Forever* 'significant flora of the Quindalup dunes 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 areas disturbed areas, especially areas that have been agricultural or urban landuse.

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 2021c). 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**.

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.

The site lies within Bush Forever Site 322 (Burns Beach Bushland), which extends beyond the site to the north, east, west and south.

2.10 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 Australia Local Government Association (WALGA), have identified and mapped regional ecological linkages within the Perth Metropolitan Region (WALGA and PBP 2004). This study was extended beyond the Perth Metropolitan Region through the South West Biodiversity Project, resulting in the identification and mapping of the South West regional ecological linkages (Molloy *et al.* 2009).

The eastern portion of the site lies within ecological linkage number 1, which extends to the north and south.

Review of aerial imagery indicates that the vegetation within the site is connected to extensive areas of native vegetation within the local area.

2.11 Previous surveys

A flora and vegetation survey of the full extent of the Burns Beach Estate, including Lot 3000, was undertaken in 1999 (Alan Tingay & Associates 1999). No subsequent surveys are known to have been undertaken within the site.

3 Methods

3.1 Database searches

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 2021a) and *NatureMap* (DBCA 2021b). A search was also conducted of DBCA's threatened and priority flora database using a 30 km radius, as recommended by DBCA (reference no. 12-1221FL).

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 2022), the *weed and native flora dataset* (Keighery *et al.* 2012) and DBCA's threatened and priority ecological communities' databases (reference no. 07_1221EC).

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

Two botanists from Emerge visited the site on 13 December 2021 to conduct the field survey.

3.2.1 Flora and vegetation

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

The site was traversed on foot and the composition and condition of vegetation was recorded. Detailed sampling of the vegetation was undertaken using a non-permanent relevés. The relevés were completed over an approximate 10 x 10 m area without the use of physical markers. The position of each relevé was recorded with a hand-held GPS unit.

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, degree of disturbance and species present).

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

All plant specimens collected during the field survey were dried, pressed and then named in accordance with requirements of the Western Australian Herbarium (2022). Identification of specimens occurred through comparison with named material and through the use of taxonomic

keys. Flora species not native to Western Australia are denoted by an asterisk ('*') in text and raw data.

3.2.2 Targeted searches

The suitability of habitat within the site for conservation significant flora and communities identified in the database searches was assessed (refer **Section 3.1**). Areas of suitable habitat were traversed to searched for conservation significant species, as required.

3.2.3 Vegetation condition

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

3.3.1 Conservation significant flora and communities

Based on the information recorded during the field survey, 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 then compared to the regional 'floristic community type' (FCT) dataset *A floristic survey of the southern Swan Coastal Plain* by Gibson *et al.* (1994). The sample data (presence/absence) 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).

As data from a localised survey is often spatially correlated, data for each sample was compared to Gibson *et al.* (1994) separately. This removed the influence of spatial correlation when assigning an FCT. The analysis included the compilation of a resemblance matrix using the Bray-Curtis distance measure which provided the percentage similarity between all pairs of samples. Subsequently, a cluster analysis was undertaken using the resemblance matrix and hierarchical agglomerative clustering, to produce a dendrogram.

Where the sample tended to cluster with a grouping of different FCTs, samples were assessed separately to differentiate between FCTs. Ultimately the cluster analysis, as well as contextual information relating to the soils, landforms and known locations of FCTs within the region, was considered in the final determination of an FCT for vegetation within the site.FCT analysis was not undertaken for samples located within disturbed vegetation with low native species diversity as the vegetation was considered unlikely to currently represent an FCT.

3.3.4 Threatened and 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.

3.4 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.
	No 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. This reconnaissance survey only sampled the site once and outside of the main flowering period. However, FCT analysis was conclusive, with samples showing high (≥35%) similarity to Gibson *et al.* (1994) sites and so the data was considered to be sufficient to assign FCTs.
Experience level of personnel	No limitation	This flora and vegetation assessment was undertaken by qualified botanists with over ten and 20 years of botanical experience in Western Australia. Technical review was undertaken by a senior environmental consultant with 20 years' experience in environmental science in Western Australia.
Suitability of timing	Limitation	The survey was conducted in December and thus outside of the main flowering season. Therefore, there is a possibility that some priority flora species that require reproductive features for identification were not flowering at the time of the survey. The survey timing was acceptable for a reconnaissance level survey but additional surveys would be required to determine whether some priority flora species occur (as listed in **Section 4.2.3**). No other surveys are considered to be required.
Temporal coverage	Limitation	Detailed flora and vegetation assessments can require multiple visits, at different times of year, and over a period of a number of years, to enable observation of all species present. The site was sampled once and outside of the main flowering period. However, due to the small size of the site a sufficient inventory of species was collected for the reconnaissance level of the 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.
Influence of disturbance	No limitation	Historical ground disturbance was evident in parts of the site and 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

The site comprises undulating dunes on deep white to grey/brown sands. Native vegetation occurs across most of the site, with some cleared sand tracks in the central and western portions. Mature shrubland revegetation occurs in a small area in the south-eastern portion of the site and more recent revegetation adjacent to a footpath occurs in the western portion. The native vegetation in the site is contiguous with extensive areas of native vegetation of a similar type and quality to the north, east and west.

4.2 Flora

4.2.1 Desktop assessment

The database search results identified a total of 13 threatened and 37 priority flora species occurring or potentially occurring within a 10-30 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 two threatened flora species and 18 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			
Eucalyptus argutifolia	VU	VU	P	Shallow soils over limestone. Slopes or gullies of limestone ridges, outcrops	Mar-Apr
Melaleuca sp. Wanneroo (G.J. Keighery 16705)	EN	EN	P	Over sand on limestone slopes	Nov-Apr
Acacia benthamii	P2	-	P	Sand, typically on limestone breakaways	Aug-Sept
Austrostipa mundula	P3	-	P	Grey sand over limestone.	Sept-Nov
Baeckea sp. Limestone (N. Gibson & M.N. Lyons 1425)	P1	-	P	Grey yellow sand over limestone.	Sep-Dec
Conostylis bracteata	P3	-	P	Sand, limestone. Consolidated sand dunes	Aug-Sep
Conostylis pauciflora subsp. euryrhipis	P4	-	P	White, grey, yellow sand on coastal consolidated dunes.	Aug-Oct
Conostylis pauciflora subsp. pauciflora	P4	-	P	Grey sand, limestone. Hillslopes, consolidated dunes.	Aug-Oct

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

Species	Level of significance		Life strategy	Habitat	Flowering period
	State	EPBC Act			
Grevillea sp. Ocean Reef (D. Pike Joon 4)	P1	-	P	Dry, bare, light yellow-brown/grey sand. Sand dunes.	Nov
Hibbertia leptotheca	P3	-	P	Brown to white sand with limestone.	Aug-Oct
Jacksonia sericea	P4	-	P	Calcareous and sandy soils on Swan Coastal Plain	Dec-Feb
Lasiopetalum membranaceum	P3	-	P	Sand over limestone	Sep-Dec
Lepidium pseudotasmanicum	P4	-	P	Loam, sand	Feb or Dec
Leucopogon maritimus	P1	-	P	Sand dunes and lower heath. White, grey and yellow sand.	Mar
Leucopogon sp. Yanchep (M. Hislop 1986)	P3	-	P	Light grey-yellow sand, brown loam, limestone, laterite, granite. Coastal plain, breakaways, valley slopes, low hills	Apr-Jun or Sep
Pimelea calcicola	P3	-	P	Sand, limestone on coastal ridges.	Sep-Nov
Poranthera moorokatta	P2	-	A	Sandy or clay soils. Dampland or low sandy dunes in banksia woodland.	Oct or Feb
Sarcozona bicarinata	P3	-	P	White sand.	Aug
Schoenus griffinianus	P4	-	P	White sand.	Sep-Oct
Stylidium maritimum	P3	-	P	Dune slopes and flats. Coastal heath and shrubland, open Banksia woodland.	Sep-Nov

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 51 native and 17 non-native (weed) species were recorded within the site during the field survey, representing 33 families. The dominant families containing native taxa were Fabaceae (seven native taxa and one weed taxa) and Poaceae (five native taxa and seven weed taxa). A complete species list is provided in **Appendix C.**

4.2.3 Threatened and priority flora

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

The majority of the threatened and priority flora species identified in the database searches 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. The survey was unable to confirm the presence or absence of the following three priority flora species:

- *Conostylis bracteata* (P3)
- *Conostylis pauciflora* subsp. *euryrhipis* (P4)
- *Conostylis pauciflora* subsp. *pauciflora* (P4).

The likelihood of occurrence assessment is provided in **Appendix B**.

4.2.4 Locally and regionally significant flora

No locally or regionally significant flora species were recorded within the site.

4.2.5 Declared pests

No flora species listed as a declared pest (C3) pursuant to the BAM Act or as a weed of national significance (WoNS) were recorded.

4.3 Vegetation

4.3.1 Desktop assessment

The database search results identified six TECs and seven 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 and five PECs were considered to have potential to occur in the site:

- 'tuart (*Eucalyptus gomphocephala*) woodlands and forests of the Swan Coastal Plain' TEC/PEC.
- 'banksia woodlands of the Swan Coastal Plain' TEC/PEC
- SCP29a 'coastal shrublands on shallow sands' PEC
- SCP24 'northern Spearwood shrublands and woodlands' PEC
- SCP29b 'acacia shrublands on taller dunes' PEC.

4.3.2 Plant communities

Two locations were sampled in the site using relevés, as shown in **Figure 2**.

Four plant communities were identified within the site, including two areas of revegetation. The remainder of the site comprises bare ground associated with tracks.

A description and the area of each plant community is provided in **Table 5** and representative photographs of each are provided in **Plate 1** to **Plate 5**. The location of each plant community is shown in **Figure 3**. Raw sample data is provided in **Appendix E**.

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

Plant community	Description	Area (ha)
ArSgXp	Occasional *Eucalyptus gomphocephala* over closed shrubland *Acacia rostellifera, Spyridium globulosum, Xanthorrhoea preissii* and *Alyogyne huegelii* over low open shrubland *Phyllanthus* calycinus over herbland **Trachyandra divaricata*, **Crassula glomerata* and *Clematis linearifolia* over open grassland *Austrostipa* spp. and **Lagurus ovatus*	4.05

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

Plant community	Description	Area (ha)
EgMsLm	Open woodland *Eucalyptus gomphocephala* over shrubland *Melaleuca systena, Olearia axillaris, Acacia lasiocarpa* and *Hibbertia* spp. over herbland *Lomandra maritima*, *Desmocladus flexuosus* and *Opercularia vaginata* over scattered grasses *Poa ?porphyroclados*.	0.33
Ar	Established revegetation comprising a tall shrubland with *Acacia rostellifera, Acacia saligna, Spyridium globulosum* and *Banksia sessilis*	0.12
Revegetation	Recent revegetation over jute matting comprising a low open shrubland/sedgeland with *Acacia rostellifera, Olearia axillaris*, *Scaevola crassifolia* and *Lepidosperma gladiatum*	0.28
Bare ground	Areas of bare ground such as tracks	0.35

*Plate 1: Plant community **ArSgXp** in 'very good' condition*

*Plate 2: Plant community **EgMsLm** in 'very good' condition*

*Plate 3: Plant community **Ar** in 'good' condition*

*Plate 4: Plant community **revegetation** (no condition category applied)*

Plate 5: Bare ground in 'completely degraded' condition (right)

4.3.3 Vegetation condition

The majority of the **ArSgXp** vegetation and all of the **EgMsLm** vegetation were mapped as being in 'very good' condition as they support an intact structure and relatively low weed cover and diversity.

One small patch of **ArSgXp** vegetation was mapped as being in 'degraded' condition as it showed signs of disturbance with areas of open ground and higher weed cover.

Plant community **Ar** was mapped as being in 'good' condition because it is has the basic shrubland structure expected of coastal vegetation but with lower native species diversity.

The **revegetation** plant community was not assigned a condition category.

The bare ground was mapped as being in 'completely degraded' condition as it is mostly devoid of vegetation.

The extent of vegetation by condition category is detailed in **Table 6** and shown in **Figure 3**.

Table 6: Extent of vegetation condition categories within the site

Condition category (Gibson *et al.* 1994)	Size (ha)
Pristine	0
Excellent	0
Very good	4.37
Good	0.12
Degraded	0.01
Completely degraded	0.35
N/A (revegetation)	0.28

4.3.4 Floristic community types

Plant community **ArSgXp** was determined to represent FCT 24 'northern Spearwood shrublands and woodlands'. R1 grouped with FCT 24 in the cluster analysis, being most similar to one Gibson *et al.* (1994) site representing FCT 24 with 50% similarity (**Table 7**).

Plant community **EgMsLm** was determined to represent FCT 29b 'acacia shrublands on taller dunes, southern Swan Coastal Plain'. R2 grouped with FCT 29b in the cluster analysis, being most similar to one Gibson *et al.* (1994) site representing FCT 29b with 35% similarity (**Table 7**).

The relevant portions of the cluster dendrograms showing R1 and R2 are provided in **Appendix F.**

Other plant communities in the site were 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)
ArSgXp	R1	COOL08 (FCT 24)	50%	FCT 24: northern Spearwood shrublands and woodlands	Well reserved Susceptible
EgMsLm	R2	TRIG-1 (FCT 29b)	35%	FCT 29b: acacia shrublands on taller dunes, southern Swan Coastal Plain	Poorly reserved Susceptible

4.3.5 Threatened and priority ecological communities

The following TECs and PECs were identified within the site:

- tuart (*Eucalyptus gomphocephala*) woodlands and forests of the Swan Coastal Plain TEC (1.11 ha)
- tuart (*Eucalyptus gomphocephala*) woodlands and forests of the Swan Coastal Plain PEC (P3) (1.11 ha)
- SCP24 northern Spearwood shrublands and woodlands PEC (P3) (4.04 ha)
- SCP29b acacia shrublands on taller dunes, southern Swan Coastal Plain PEC (P3) (0.33 ha).

The locations of the TEC and PECs within the site are shown in **Figure 4**.

Three patches of the Commonwealth listed 'tuart (*Eucalyptus gomphocephala*) woodlands and forests of the Swan Coastal Plain' TEC, occur within the site, outlined in **Table 8**.

Table 8: Assessment of site conditions against the tuart (Eucalyptus gomphocephala) woodlands and forests of the Swan Coastal Plain TEC criteria (adopted from (DoEE 2019))

Criteria	Requirements for meeting criteria	Site implications
1. Must meet key diagnostic characteristics	• Located in appropriate bioregion and landform. • At least 2 living established *E. gomphocephala* trees with DBH≥ 15cm present in canopy layer and with <60 m between the outer edges of canopies^ • Vegetation structure is a woodland, forest, open forest, open woodland, or mallee (various forms).	• Site is located in appropriate bioregion and landform. • The western portion of the site contains three patches which each have at least two living established *E. gomphocephala* trees with DBH≥ 15cm present in canopy layer and with <60 m between the outer edges of canopies. • Vegetation within the patches comprise a woodland to open woodland structure.
2. Must meet size threshold	• A patch must be larger than 0.5 ha#	• Each patch is >0.5 ha.
3. Must meet condition thresholds	• Patches >5 ha: no condition threshold • Patches ≥0.5 – <2 ha: 'very high' or 'high' condition† • Patches ≥2 – ≤5 ha: 'very high', 'high' or 'moderate' condition†	• Each patch is ≥0.5 – <2 ha. • Each patch meets the 'high' condition threshold as ≥60% of all understorey vegetation cover is native, at least eight native understorey species per 0.01 ha and they have an 'important landscape role' (≤100 m to native vegetation).
4. Must incorporate surrounding context	• Breaks (e.g. tracks, cleared areas) < 30 m do not separate vegetation into separate patches • The site should be thoroughly sampled in the appropriate season. • Survey timing should be appropriate. • Surrounding environment should be considered (e.g. connectivity, conservation values, fauna habitat)	• Breaks such as paths and tracks occur within patches but do not separate the patch. • The survey timing was sufficient to determine that the patch represents the TEC. • A large portion of each patch lies outside of the site.
Result	The site supports three patches of the tuart (*Eucalyptus gomphocephala*) woodlands and forests of the Swan Coastal Plain TEC, which collectively extend over 1.11 ha.	

^Includes dead trees. Where species of dead tree is unclear it is assumed to be *E. gomphocephala* if its canopy is within 60 m of an identified *E. gomphocephala tree*. #Note that a patch comprises a 30 m buffer around the canopy of each *E.*

gomphocephala canopy tree, may extend beyond a lot boundary and may include areas of bare ground, waterbodies and hardscape. †Using the condition scale provided in (DoEE 2019).

DBCA's *Priority Ecological Community* list indicates that the description, area and condition thresholds that apply to the Commonwealth-listed TEC of the same name also apply to the 'tuart (*Eucalyptus gomphocephala*) woodlands and forests of the Swan Coastal Plain PEC (DBCA 2020). Therefore, a total of 1.11 ha of this PEC occurs within the site.

FCT 24 is synonymous with the state-listed PEC 'SCP24 'northern Spearwood shrublands and woodlands' (P3). FCT 29b is synonymous with the state-listed PEC 'SCP29b acacia shrublands on taller dunes, southern Swan Coastal Plain'(P3).

At the State level, there is limited advice for the SCP24 and SCP29b PECs so it is unclear whether a condition threshold should be applied when identifying their presence. DBCA has historically applied 'good' condition as a threshold for the identification of conservation significant vegetation. Using good condition as a basis for identification, the **ArSgXp** vegetation in 'very good' and 'good' condition is considered to represent SCP24 (total of 4.04 ha) and the **EgMsLm** vegetation in 'very good' condition is considered to represent SCP29b (total of 0.33 ha).

No other TECs or PECs occur within the site.

5 Discussion

No threatened or priority flora species were recorded within the site. The absence of most of the species identified in the database searches was relatively easy to confirm as they were not recorded during the field survey. However, the field survey was undertaken outside of the flowering period of three species of *Conostylis* which are listed as priority: *C. bracteata* (P3), *C. pauciflora* subsp. *euryrhipis* (P4) and *C. pauciflora* subsp. *pauciflora* (P4). Flowers assist in observing these species during a survey and are also required for taxonomic identification. Further survey within the main flowering period of these species (August to September/October) would be required to determine whether they occur in the site.

Assignment of the **EgMsLm** vegetation to FCT 29b was not unexpected, as this community is confined to the Quindalup dunes and has been recorded within the local area (Gibson *et al.* 1994). The high similarity of plant community **ArSgXp** to FCT 24 was unexpected as the site is mapped as being within the Quindalup dunes and this FCT is confined to the Spearwood dunes (Gibson *et al.* 1994). However, soil mapping indicates that the Spearwood dune system is very close to the eastern boundary of the site and so it is likely that the site lies within a geomorphic interzone, with characteristics of both the Quindalup and Spearwood dunes. The species recorded within the **ArSgXp** vegetation are appropriate and so the community was assigned to FCT 24.

Confirming the presence of the tuart (*Eucalyptus gomphocephala*) woodlands and forests of the Swan Coastal Plain TEC was relatively straightforward as the areas of TEC clearly met the diagnostic features and thresholds identified in DoEE (2019). A patch of the TEC may include small areas without understorey vegetation, such as hardscape, that do not significantly alter the overall function of the ecological community (DoEE 2019). Therefore, portions of the footpath were included where they lie within the TEC boundary.

The two PECs, SCP24 and SCP29b, were defined by their associated FCTs and ‘good’ condition as a threshold. The ‘good’ condition category indicates native vegetation with a recognisable structure and was considered an appropriate threshold to define the PECs.

6 Conclusions

No threatened or priority flora species were recorded within the site. The current reconnaissance survey was not undertaken in the main flowering season (spring) and further survey would be required to confirm the presence or absence of the following three priority flora species:

- *Conostylis bracteata* (P3)
- *Conostylis pauciflora* subsp. *euryrhipis* (P4)
- *Conostylis pauciflora* subsp. *pauciflora* (P4).

Four plant communities were mapped within the site. The majority (85%) of the vegetation was mapped as being in 'very good' condition. The remainder was mapped as being in 'good' condition (2%), 'completely degraded' condition (7%) or were not assigned a condition category (revegetation, 5%).

The following TECs and PECs were identified within the site:

- tuart (*Eucalyptus gomphocephala*) woodlands and forests of the Swan Coastal Plain TEC/PEC (1.11 ha)
- SCP24 northern Spearwood shrublands and woodlands PEC (P3) (4.04 ha)
- SCP29b acacia shrublands on taller dunes, southern Swan Coastal Plain PEC (P3) (0.33 ha).

7 References

7.1 General references

The references listed below have been considered as part of preparing this document.

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7.2 Online references

The online resources that have been utilised in the preparation of this report are referenced in **Section 7.1**, with access date information provided in **Table R 1**.

Table R 1 Access dates for online references

Reference	Date accessed	Website or dataset name
BoM (2022)	4 February 2022	Climate Data Online
DAWE (2021a)	16 December 2021	Threatened Ecological Communities
DAWE (2021b)	16 December 2021	Protected Matters Search Tool
DAWE (2021c)	16 December 2021	Weeds of National Significance (WoNS)
DBCA (2021b)	16 December 2021	NatureMap
WALIA (2022)	14 January 2022	Landgate Map Viewer
Western Australian Herbarium (2022)	14 January 2022	Florabase

Figures

Figure 1: Site Location

Figure 2: Plant Communities

Figure 3: Vegetation Condition

Figure 4: Threatened and Priority Ecological Communities

Figure 1: Site Location

Project: Flora and Vegetation Assessment
Part Lot 3000 on Deposited Plan 44066, Burns Beach
Client: Peet Limited

Plan Number:
EP15-020(17)--F50
Drawn: GAR
Date: 13/01/2022
Checked: RAW
Approved: TAA
Date: 04/02/2022

N

0 50 100 150
Metres
Scale: 1:5,000@A4
GDA 1994 MGA Zone 50

emerge ASSOCIATES

Figure 2: Plant Communities

Project: Flora and Vegetation Assessment
Part Lot 3000 on Deposited Plan 44066, Burns Beach
Client: Peet Limited

Plan Number:
EP15-020(17)--F51
Drawn: GAR
Date: 13/01/2022
Checked: RAW
Approved: TAA
Date: 04/02/2022

N

0 50 100
Metres
Scale: 1:3,500@A4
GDA 1994 MGA Zone 50

emerge ASSOCIATES

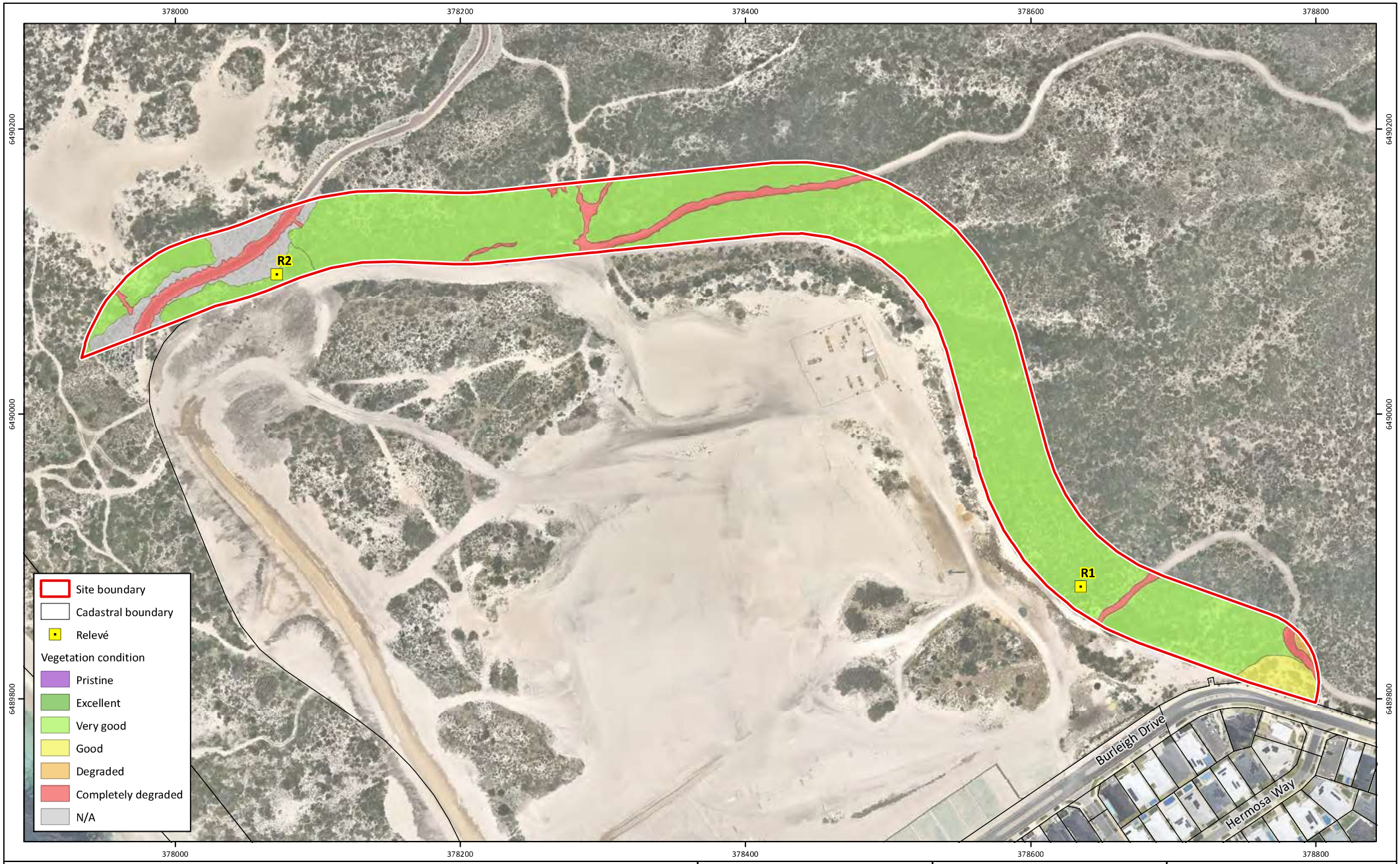

Figure 3: Vegetation Condition

Project: Flora and Vegetation Assessment
Part Lot 3000 on Deposited Plan 44066, Burns Beach
Client: Peet Limited

Plan Number:
EP15-020(17)--F52
Drawn: GAR
Date: 13/01/2022
Checked: RAW
Approved: TAA
Date: 04/02/2022

N

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Metres
Scale: 1:3,500@A4
GDA 1994 MGA Zone 50

emerge ASSOCIATES

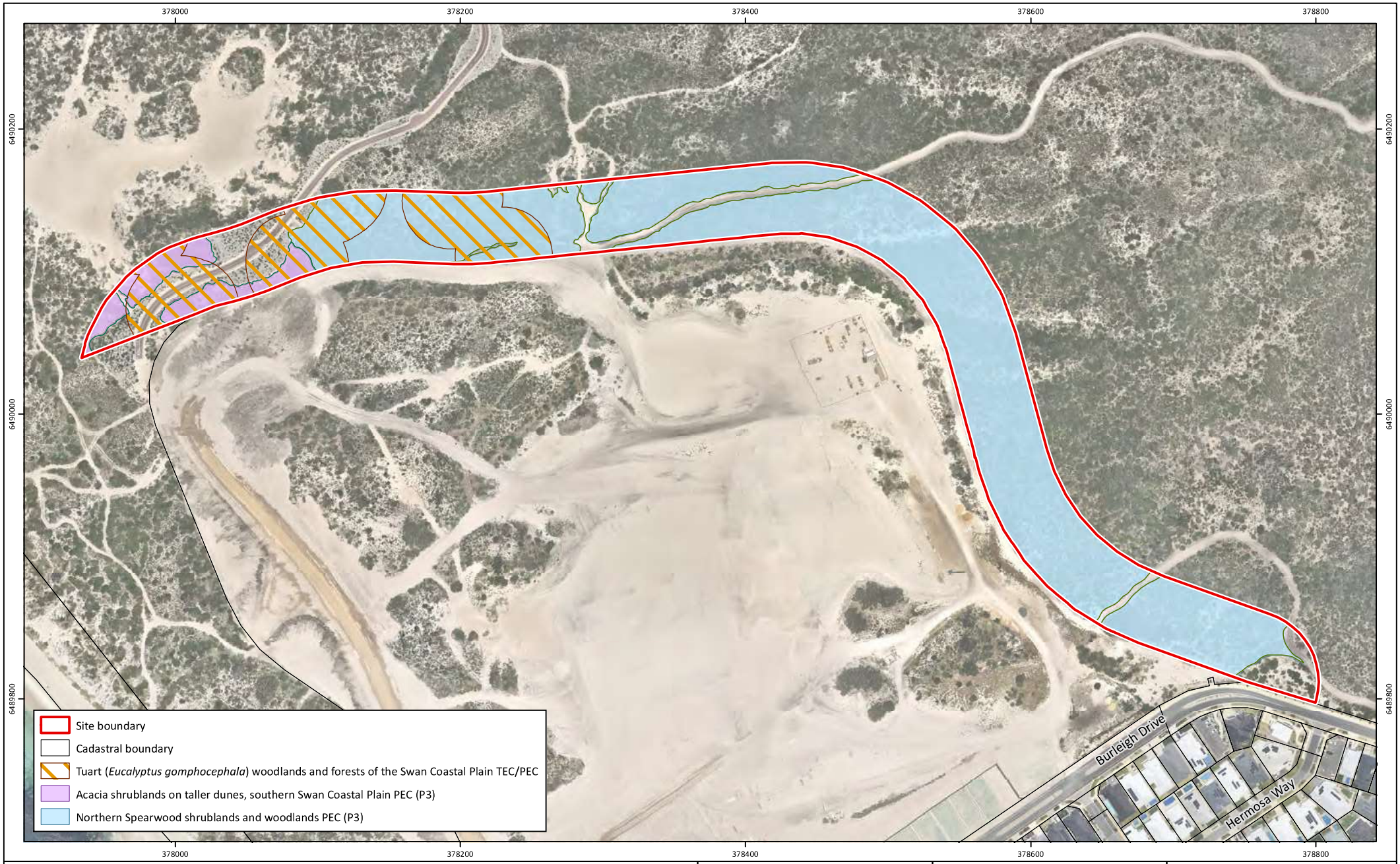

Figure 4: Threatened and Priority Ecological Communities

Project: Flora and Vegetation Assessment
Part Lot 3000 on Deposited Plan 44066, Burns Beach
Client: Peet Limited

Plan Number:
EP15-020(17)--F53
Drawn: GAR
Date: 13/01/2022
Checked: RAW
Approved: TAA
Date: 04/02/2022

N

0 50 100
Metres
Scale: 1:3,500@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.

Weeds

A number of legislative and policy documents exist in relation to weed management at state and national levels. The *Biosecurity and Agriculture Management Act 2007* (BAM Act) is the principle legislation guiding weed management in Western Australia and lists declared pest species. At a national level, the Australian government has compiled a list of 32 Weeds of National Significance (WoNS) (DoEE 2018), of which many are also listed under the BAM Act.

Declared Pests

Part 2.3.23 of the BAM Act requires a person must not; "*a) keep, breed or cultivate the declared pest; b) keep, breed or cultivate an animal, plant or other thing that is infected or infested with the declared pest; c) release into the environment the declared pest, or an animal, plant or other thing that is infected or infested with the declared pest; or d) intentionally infect or infest, or expose to infection or infestation, a plant, animal or other thing with a declared pest*".

Under the BAM Act, all declared pests are assigned a legal status, as described in **Table 7**. Species assigned to the 'declared pest, prohibited - s12' category are placed in one of three control categories, as described in **Table 8**.

The *Biosecurity and Agriculture Management Regulations 2013* specify keeping categories for species assigned to the 'declared pest - s22(2)' category, which relate to the purposes of which species can be kept, as well as the entities that can keep them. The categories are described in **Table 9**.

The Western Australian Organism List (WAOL) provides the status of organisms which have been categorised under the BAM Act (DPIRD 2020).

Table 4: Legal status of declared pest species listed under the BAM Act (DPIRD 2020)

Category	Description
Declared Pest Prohibited - s12	May only be imported and kept subject to permits. Permit conditions applicable to some species may only be appropriate or available to research organisations or similarly secure institutions.
Declared Pest s22(2)	Must satisfy any applicable import requirements when imported, and may be subject to an import permit if they are potential carriers of high-risk organisms. They may also be subject to control and keeping requirements once within Western Australia

Table 5: Control categories of declared pest species listed under the BAM Act (DPIRD 2020)

Category	Description
C1	Exclusion Not established in Western Australia and control measures are to be taken, including border checks, in order to prevent them entering and establishing in the State.
C2	Eradication Present in Western Australia in low enough numbers or in sufficiently limited areas that their eradication is still a possibility.
C3	Management Established in Western Australia but it is feasible, or desirable, to manage them in order to limit their damage. Control measures can prevent a C3 pest from increasing in population size or density or moving from an area in which it is established into an area which currently is free of that pest.

Table 6: Keeping categories of declared pest species listed under the BAM Act (DPIRD 2020)

Category	Description
Prohibited	Can only be kept under a permit for public display and education purposes, and/or genuine scientific research, by entities approved by the state authority.
Exempt	No permit or conditions are required for keeping.
Restricted	Organisms which, relative to other species, have a low risk of becoming a problem for the environment, primary industry or public safety and can be kept under a permit by private individuals.

References

General references

Department of Biodiversity Conservation and Attractions (DBCA) 2017, *Priority Ecological Communities for Western Australia Version 27*, Species and Communities Branch, Department of Biodiversity, Conservation and Attractions.

Department of Biodiversity, Conservation and Attractions (DBCA) 2018a, *List of Threatened Ecological Communities endorsed by the Western Australian Minister for Environment*, Perth.

Department of Biodiversity, Conservation and Attractions (DBCA) 2018b, *Threatened and Priority Flora List 16 January 2018*, Perth.

Department of Environment and Conservation (DEC) 2009, *Definitions, Categories and Criteria for Threatened and Priority Ecological Communities*, Perth.

Department of Conservation (DEC) 2013, *Definitions, Categories and Criteria for Threatened and Priority Ecological Communities*, Perth.

English, V. and Blyth, J. 1997, *Identifying and Conserving Threatened Ecological Communities in the South West Botanical Province*, ANCA National Reserves System Cooperative Program, Project Number N702, Perth.

Online references

Department of Environment and Energy (DoEE) 2018, Weeds of National Significance, <http://www.environment.gov.au/biodiversity/invasive/weeds/weeds/lists/wons.html>.

Department of Primary Industries and Regional Development (DPIRD) 2020, The Western Australian Organism List (WAOL), < https://www.agric.wa.gov.au/bam/western-australian-organism-list-waol>.

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				
Calectasia cyanea	CR	CR	P	Heathland on white sand or laterite gravel over laterite. Known only from one population near Albany.	Jun-Oct	Unlikely
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
Diuris purdiei	EN	EN	PG	Sand to sandy clay soils in areas subject to winter inundation.	late Sep to mid-Oct, but only after summer/autumn fire	Unlikely
Macarthuria keigheryi	EN	EN	P	Low-lying winter-wet damp grey/white sands in open patches.	Sep-Dec or Feb-Mar	Unlikely
Marianthus paralius	EN	EN	P	White sand over limestone. Low coastal cliffs	Sep-Nov	Unlikely
Melaleuca sp. Wanneroo (G.J. Keighery 16705)	EN	EN	P	Over sand on limestone slopes	Nov-Apr	Unlikely
Drakaea micrantha	EN	VU	PG	Open sandy patches often adjacent to winter-wet swamps.	Sept- early Oct	Unlikely
Andersonia gracilis	VU	EN	P	Seasonally damp, black sandy	Sep-Nov	Unlikely
Anigozanthos viridis subsp. Terraspectans	VU	VU	P	Grey sand, clay loam. Winter-wet depressions.	Aug-Sep	Unlikely
Diuris micrantha	VU	VU	PG	Dark grey-black sandy clay-loam	Aug/Sep-	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
Eucalyptus argutifolia	VU	VU	P	Shallow soils over limestone. Slopes or gullies of limestone ridges, outcrops	Mar-Apr	Unlikely

Species name	Level of significance		Life strategy	Habitat	Flowering period	Likelihood of occurrence
	WA	EPBC Act				
Baeckea sp. Limestone (N. Gibson & M.N. Lyons 1425)	P1	-	P	Grey yellow sand over limestone.	Sep-Dec	Unlikely
Drosera patens	P1	-	P	Sandy soils on margins of winter-wet depressions, swamps and lakes.	Aug-Dec	Unlikely
Drosera x sidjamesii	P1	-	P	Along lake margins, close to winter high-water line	Nov-Dec or Jan-Mar	Unlikely
Grevillea sp. Ocean Reef (D. Pike Joon 4)	P1	-	P	Dry, bare, light yellow-brown/grey sand. Sand dunes.	Nov	Unlikely
Leucopogon maritimus	P1	-	P	Sand dunes and lower heath. White, grey and yellow sand.	Mar	Unlikely
Acacia benthamii	P2	-	P	Sand, typically on limestone breakaways	Aug-Sept	Unlikely
Calectasia elegans	P2	-	P	Grey yellow sand on plains.	Sep-Oct	Unlikely
Millotia tenuifolia var. laevis	P2	-	A	Granite or lateritic soils.	Sep-Oct	Unlikely
Netrostylis sp. Chandala (G.J. Keighery 17055)	P2	-	P	Peaty soils on edges of swamps.	Feb, July	Unlikely
Poranthera moorokatta	P2	-	A	Sandy or clay soils. Dampland or low sandy dunes in banksia woodland.	Oct or Feb	Unlikely
Stenanthemum sublineare	P2	-	P	White sand on coastal plains.	Oct-Dec	Unlikely
Tetraria sp. Chandala (G.J. Keighery 17055)	P2	-	P	Black peat in swamps.	Sep-Feb	Unlikely
Thelymitra variegata	P2	-	P	Sandy clay, sand, laterite.	Jun-Sep	Unlikely
Adenanthos cygnorum subsp. chamaephyton	P3	-	P	Grey sand, lateritic gravel.	Jul or Sep to Dec or Jan	Unlikely
Austrostipa mundula	P3	-	P	Grey sand over limestone.	Sept-Nov	Unlikely
Conostylis bracteata	P3	-	P	Sand, limestone. Consolidated sand dunes	Aug-Sep	Possible
Cyathochaeta teretifolia	P3	-	P	Grey sand, sandy clay in swamps and creek edges.	Oct-Jan	Unlikely
Dampiera triloba	P3	-	P	Damp peat/loam soil.	Aug-Dec	Unlikely
Hibbertia leptotheca	P3	-	P	Brown to white sand with limestone.	Aug-Oct	Unlikely
Jacksonia gracillima	P3	-	P	Sand, often adjacent to winter wet areas	Sep-Dec	Unlikely

Species name	Level of significance		Life strategy	Habitat	Flowering period	Likelihood of occurrence
	WA	EPBC Act				
Lasiopetalum membranaceum	P3	-	P	Sand over limestone	Sep-Dec	Unlikely
Leucopogon sp. Yanchep (M. Hislop 1986)	P3	-	P	Light grey-yellow sand, brown loam, limestone, laterite, granite. Coastal plain, breakaways, valley slopes, low hills	Apr-Jun or Sep	Unlikely
Pimelea calcicola	P3	-	P	Sand, limestone on coastal ridges.	Sep-Nov	Unlikely
Pithocarpa corymbulosa	P3	-	P	Gravelly or sandy loam, amongst granite outcrops.	Jan-Apr	Unlikely
Sarcozona bicarinata	P3	-	P	White sand.	Aug	Unlikely
Sphaerolobium calcicola	P3	-	P	White-grey-brown sand, sandy clay over limestone, black peaty sandy clay. Tall dunes, winter-wet flats, interdunal swamps, low-lying areas.	Jun or Sep-Nov	Unlikely
Stylidium maritimum	P3	-	P	Dune slopes and flats. Coastal heath and shrubland, open Banksia woodland.	Sep-Nov	Unlikely
Stylidium paludicola	P3	-	P	Peaty sand over clay. Winter wet habitats. Marri and Melaleuca woodland, Melaleuca shrubland	Oct-Dec	Unlikely
Styphelia filifolia	P3	-	P	Brown over pale yellow sand.	Feb-Apr	Unlikely
Anigozanthos humilis subsp. chrysanthus	P4	-	P	Grey or yellow sand	Jul-Oct	Unlikely
Conostylis pauciflora subsp. euryrhipis	P4	-	P	White, grey, yellow sand on coastal consolidated dunes.	Aug-Oct	Possible
Conostylis pauciflora	P4	-	P	Grey sand, limestone. Hillslopes,	Aug-Oct	Possible
Jacksonia sericea	P4	-	P	Calcareous and sandy soils on	Dec-Feb	Unlikely
Lepidium	P4	-	P	Loam, sand	Feb or Dec	Unlikely
Schoenus griffinianus	P4	-	P	White sand.	Sep-Oct	Unlikely
Stylidium longitubum	P4	-	A	Sandy clay, clay. Seasonal	Oct-Dec	Unlikely
Tripterococcus sp. Brachylobus (A.S. George 14234)	P4	-	P	Winter-wet areas on grey sand.	Oct-Feb	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
Aizoaceae		
		Carpobrotus virescens
Asparagaceae		
		Acanthocarpos preissii
		Lomandra maritima
Asphodelaceae		
	*	*Trachyandra divaricata*
Asteraceae		
		Olearia axillaris
		Podotheca gnaphalioides
	*	*Sonchus oleraceus*
Brassicaceae		
	*	*Brassica sp.*
	*	*Cakile maritima*
	*	*Heliophila pusilla*
Campanulaceae		
		Lobelia tenuior
Chenopodiaceae		
		Rhagodia baccata
		Threlkeldia diffusa
Crassulaceae		
		Crassula colorata
	*	*Crassula glomerata*
Cyperaceae		
		Lepidosperma calcicola
		Lepidosperma gladiatum
Dilleniaceae		
		Hibbertia racemosa
		Hibbertia subvaginata
Ericaceae		
		Leucopogon parviflorus
		Styphelia insularis
Euphorbiaceae		
	*	*Euphorbia terracina*
Fabaceae		
		Acacia cyclops
		Acacia lasiocarpa
		Acacia rostellifera
		Acacia saligna
		Gastrolobium nervosum
		Hardenbergia comptoniana
		Templetonia retusa
	*	*Trifolium sp.*
Geraniaceae		
	*	*Pelargonium capitatum*
Goodeniaceae		
		Scaevola crassifolia
Haemodoraceae		

Family	Status	Species
		Conostylis aculeata subsp. aculeata
		Conostylis candicans
Hemerocallidaceae		
		Dianella revoluta
		Tricoryne elatior
Iridaceae		
	*	*Gladiolus caryophyllaceus*
	*	*Romulea rosea*
Lamiaceae		
		Hemiandra glabra
		Hemiandra pungens
Lauraceae		
		Cassytha glabella
Malvaceae		
		Alyogyne huegelii
Myrtaceae		
		Eucalyptus gomphocephala
		Melelauca systena
Phyllanthaceae		
		Phyllanthus calycinus
Poaceae		
		Austrostipa ?flavescens
		Austrostipa elegantissima
	*	*Avena barbata*
	*	*Briza maxima*
	*	*Bromus diandrus*
	*	*Ehrharta calycina*
	*	*Lagurus ovatus*
	*	*Lolium rigidum*
		Poa ?porphyroclados
		Rytidosperma sp.
		Rytidosperma occidentale
	*	*Vulpia sp.*
Polygalaceae		
		Comesperma integerrimum
Ranunculaceae		
		Clematis linearifolia
Restionaceae		
		Desmocladus flexuosus
Rhamnaceae		
		Spyridium globulosum
		Trymalium ledifolium var. ledifolium
Rubiaceae		
		Opercularia vaginata
Santalaceae		
		Exocarpos sparteus
		Santalum acuminatum
Scrophulariaceae		

Family	Status	Species
	*	*Dischisma arenarium*
		Myoporum insulare
Solanaceae		
		Anthocercercis ilicifolia
		Solanum symonii
Xanthorrhoeaceae		
		Xanthorrhoea preissii

*=non-native, Pl=planted

Appendix D

Conservation Significant Communities and Likelihood of Occurrence Assessment

Code	Community name	TEC/ PEC	Level of significar		Likelihood of occurrence
			State	EPBC Act	
Tuart woodlands	Tuart (*Eucalyptus gomphocephala*) woodlands and forests of the Swan Coastal Plain	TEC/ PEC	CR	P3	Recorded
SCP20a	*Banksia attenuata* woodlands over species rich dense shrublands	TEC	EN	EN	Does not occur
Banksia WL SCP	Banksia woodlands of the Swan Coastal Plain	TEC/ PEC	EN	P3	Does not occur
SCP22	*Banksia ilicifolia* woodlands	TEC/ PEC	EN	P3	Does not occur
SCP26a	*Melaleuca huegelii - Melaleuca systena* shrublands on limestone ridges	TEC		EN	Does not occur
SCP30a	*Callitris preissii* (or *Melaleuca lanceolata*) forests and woodlands, Swan Coastal Plain	TEC		VU	Does not occur
SCP29a	Coastal shrublands on shallow sands	PEC		P3	Does not occur
SCP24	Northern Spearwood shrublands and woodlands	PEC		P3	Recorded
SCP25	Southern *Eucalyptus gomphocephala-Agonis flexuosa* woodlands	PEC		P3	Does not occur
SCP29b	Acacia shrublands on taller dunes	PEC		P3	Recorded

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

Appendix E

Sample Data

Vegetation Sample Data

Part Lot 300 on DP 44066

Sample Name: R1

Project no.: EP15-020
Date: 13/12/2021 **Status** Non-permanent
Author: RAW,TAA R1: Page 2 of 2

Quadrat and landform details

Sample type:	releve	Size:	other
NW corner easting:	378635.2487	NW corner northing:	6489879.044
Altitude (m):	26	Geographic datum/zone:	GDA94/Zone 50
Soil water content:	dry	Landform:	mid-slope
Time since fire:	no evidence	Disturbance:	low - weeds, fauna
Soil type/texture	sand/	Bare ground (%):	5
Rocks (%) and type:	No rocks	Soil colour:	grey/brown
Litter:	30% (leaves,twigs,branches)	Vegetation condition:	very good

Vegetation Sample Data

Part Lot 300 on DP 44066

Sample Name: R1

Project no.: EP15-020
Date: 13/12/2021 **Status** Non-permanent
Author: RAW,TAA R1: Page 2 of 2

Species Data

* denotes non-native species

Status	Confirmed name
	Acacia rostellifera
	Acacia saligna
	Acanthocarpos preissii
	Alyogyne huegelii
	Austrostipa ?flavescens
	Austrostipa elegantissima
*	*Avena barbata*
	Clematis linearifolia
	Comesperma integerrimum
	Conostylis aculeata subsp. aculeata
	Crassula colorata
*	*Crassula glomerata*
	Desmocladus flexuosus
*	*Ehrharta calycina*
*	*Euphorbia terracina*
	Exocarpos sparteus
	Hemiandra pungens
*	*Lagurus ovatus*
	Lepidosperma calcicola
	Lobelia tenuior
	Melelauca systena
	Olearia axillaris
	Phyllanthus calycinus
	Rhagodia baccata
	Spyridium globulosum
*	*Trachyandra divaricata*
	Xanthorrhoea preissii

Vegetation Sample Data

Part Lot 300 on DP 44066

Sample Name: R2

Project no.: EP15-020
Date: 13/12/2021 **Status** Non-permanent
Author: RAW,TAA R2: Page 2 of 2

Quadrat and landform details

Sample type:	releve	Size:	other
NW corner easting:	378071.2505	NW corner northing:	6490098.199
Altitude (m):	17	Geographic datum/zone:	GDA94/Zone 50
Soil water content:	dry	Landform:	upper slope
Time since fire:	no evidence	Disturbance:	low - weeds, fauna
Soil type/texture	sand/	Bare ground (%):	15
Rocks (%) and type:	No rocks	Soil colour:	grey/white
Litter:	10% (leaves,twigs,)	Vegetation condition:	very good

Vegetation Sample Data

Part Lot 300 on DP 44066

Sample Name: R2

Project no.: EP15-020
Date: 13/12/2021 **Status** Non-permanent
Author: RAW,TAA R2: Page 2 of 2

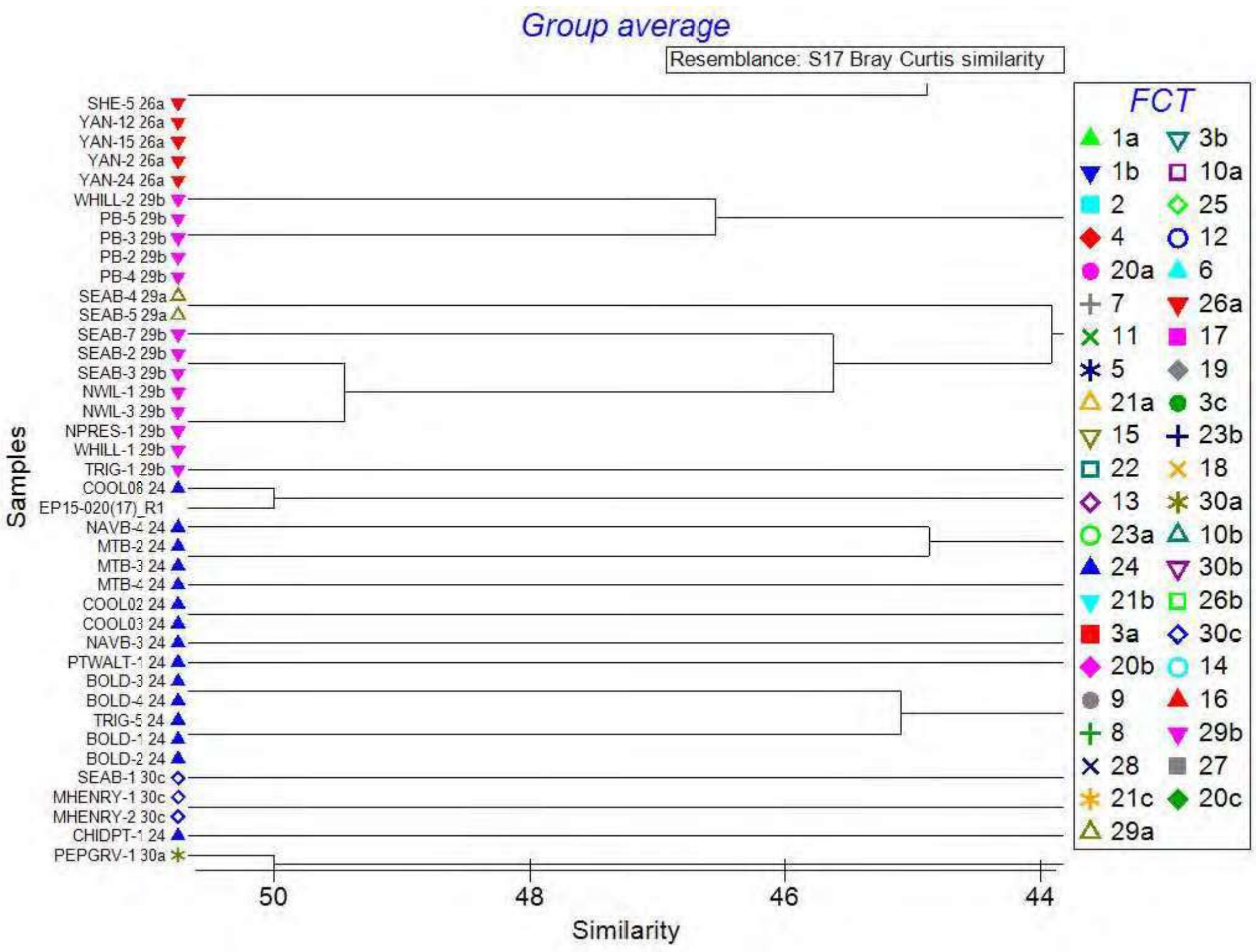
Species Data

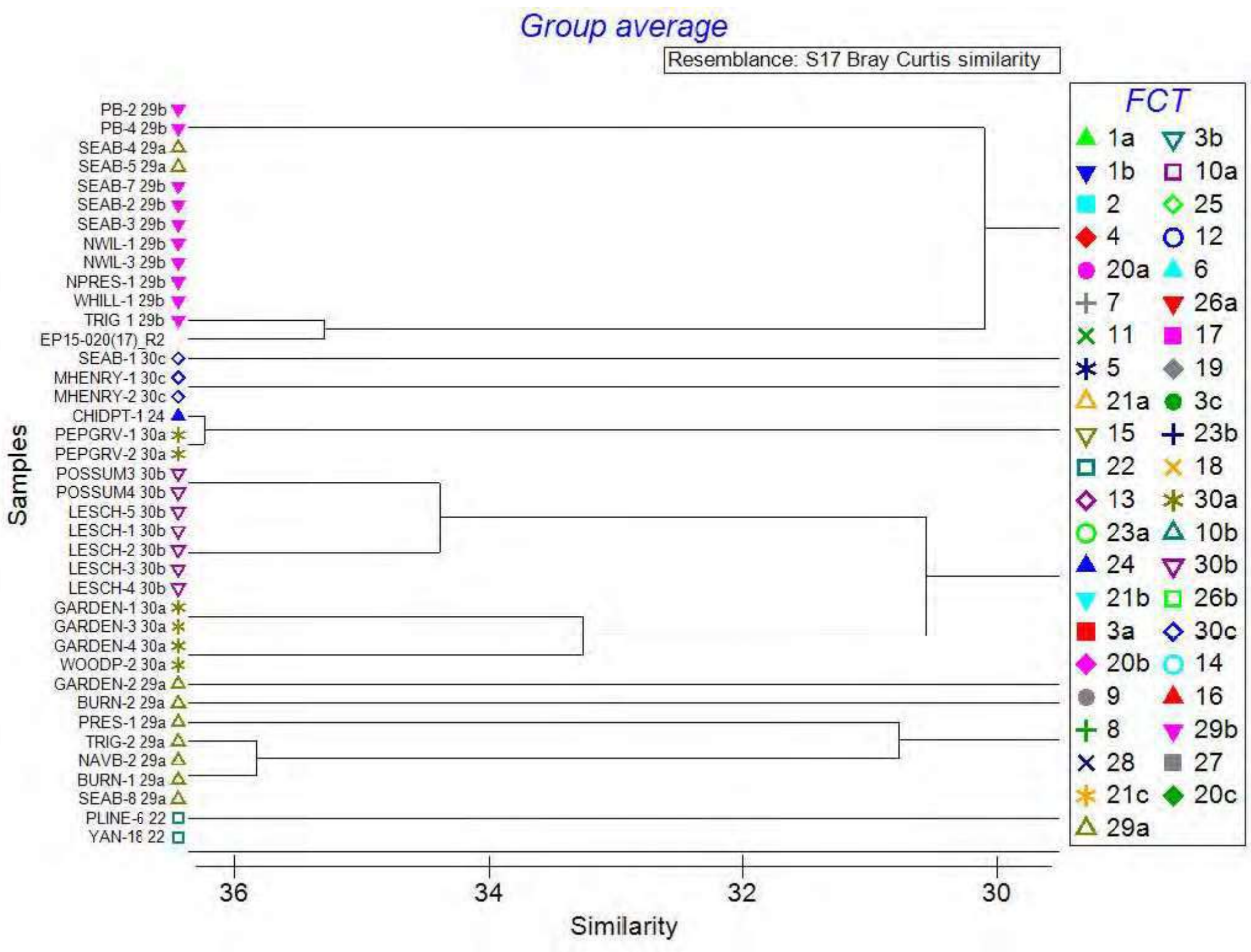
* denotes non-native species

Status	Confirmed name
	Acacia cyclops
	Acacia lasiocarpa
	Carpobrotus virescens
	Conostylis candicans
	Desmocladus flexuosus
	Eucalyptus gomphocephala
	Gastrolobium nervosum
*	*Gladiolus caryophyllaceus*
	Gompholobium tomentosum
	Hardenbergia comptoniana
*	*Heliophila pusilla*
	Hemiandra glabra
	Hibbertia racemosa
	Hibbertia subvaginata
	Hybanthus calycinus
*	*Lagurus ovatus*
	Lepidosperma gladiatum
	Lomandra maritima
	Melelauca systena
	Myoporum insulare
	Opercularia vaginata
*	*Pelargonium capitatum*
	Pithocarpa cordata
	Poa ?porphyroclados
	Rytidosperma occidentale
	Styphelia insularis
	Templetonia retusa
	Trymalium ledifolium var. ledifolium

Appendix F

Cluster Dendrograms


Group average
Resemblance: S17 Bray Curtis similarity
Samples
SHE-5 26a
YAN-12 26a
YAN-15 26a
YAN-2 26a
YAN-24 26a
WHILL-2 29b
PB-5 29b
PB-3 29b
PB-2 29b
PB-4 29b
SEAB-4 29a
SEAB-5 29a
SEAB-7 29b
SEAB-2 29b
SEAB-3 29b
NWIL-1 29b
NWIL-3 29b
NPRES-1 29b
WHILL-1 29b
TRIG-1 29b
COOL08 24
EP15-020(17)_R1
NAVB-4 24
MTB-2 24
MTB-3 24
MTB-4 24
COOL02 24
COOL03 24
NAVB-3 24
PTWALT-1 24
BOLD-3 24
BOLD-4 24
TRIG-5 24
BOLD-1 24
BOLD-2 24
SEAB-1 30c
MHENRY-1 30c
MHENRY-2 30c
CHIDPT-1 24
PEPGRV-1 30a
50
48
46
44
Similarity
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


Group average
Resemblance: S17 Bray Curtis similarity
PB-2 29b
PB-4 29b
SEAB-4 29a
SEAB-5 29a
SEAB-7 29b
SEAB-2 29b
SEAB-3 29b
NWIL-1 29b
NWIL-3 29b
NPRES-1 29b
WHILL-1 29b
TRIG 1 29b
EP15-020(17)_R2
SEAB-1 30c
MHENRY-1 30c
MHENRY-2 30c
CHIDPT-1 24
PEPGRV-1 30a
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30a
10b
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