emerge ASSOCIATES
Integrated Science & Design

Detailed Flora and Vegetation Assessment

Lot 9 Brookton Highway Karragullen

Project No: EP20-040(04)

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Executive Summary

Vinci Gravel Supplies Pty Ltd (Vinci Gravel) engaged Emerge Associates (Emerge) to undertake a detailed flora and vegetation survey within Lot 9 Brookton Highway in Karragullen (referred to herein as 'the site').

As part of the assessment a desktop review of relevant background information was completed and a field survey was undertaken on multiple dates between May and December 2020. 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 140 native and 19 non-native (weed) species were recorded in the site.
- No threatened or priority flora species were recorded within the site.
- The survey timing was not appropriate to confirm the presence or absence of two priority flora species: *Eriochilus* sp. Roleystone (G. Brockman 1140) (P1) and *Paracaleana ferricola* (P2) but they are considered unlikely to occur. No other threatened or priority flora are considered likely to occur in the site.
- Eight plant communities were identified within the site. Approximately 70% of the site supports plant communities dominated by native vegetation (33.88 ha). The remainder of the site comprises non-native vegetation, cleared areas and water bodies (14.35 ha/30% of the site).
- Vegetation in 'excellent', very good', 'very good – good' and 'good' condition occurs across 31.68 ha (66% of the site). Vegetation in 'degraded' and 'completely degraded' condition occurs across 14.63 ha (30% of the site). A total of 1.92 ha (4% of the site) was not assigned to a vegetation condition category.
- No threatened or priority ecological communities occur within the site.
- Trees within the site, particularly in the eastern portion, may provide potential foraging, roosting and/or nesting habitat for threatened species of black cockatoos which occur in the local area. The native vegetation, particularly that in the northern and eastern portions of the site contributes to ecological linkages in the area.

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Table A1: Abbreviations – Organisations

Organisations	
EPA	Environmental Protection Authority
DBCA	Department of Biodiversity, Conservation and Attractions
DoW	Department of Water (now DWER)
DWER	Department of Water and Environmental Regulation
DPaW	Department of Parks and Wildlife (now DBCA)
WALGA	Western Australia Local Government Association

Table A2: Abbreviations – General terms

General terms	
ESA	Environmentally sensitive area
IBRA	Interim Biogeographic Regionalisation of Australia
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
T	Threatened
TEC	Threatened ecological community

Table A3: Abbreviations –Legislation

Legislation	
BAM Act	*Biosecurity and Agriculture Management Act 2007*
EP Act	*Environmental Protection Act 1986*
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
BC Act	*Biodiversity Conservation Act 2016*
BC Regs	*Biodiversity Conservation Regulations 2018*

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

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1 Introduction

1.1 Project background

Vinci Gravel Supplies Pty Ltd (Vinci Gravel) intends to expand an existing gravel quarry within part of Lot 9 Brookton Highway in Karragullen (referred to herein as 'the site'). The site is located approximately 29 kilometres (km) south-east of the Perth Central Business District within the City of Armadale and is zoned 'rural' under the Metropolitan Region Scheme and 'general rural' under the City of Armadale *Town Planning Scheme No 4.*

The site is approximately 48.23 hectares (ha) in size and is bound by rural residential properties and orchards to the west and south and native vegetation to the north and east. The location and extent of the site is shown in **Figure 1**.

1.2 Purpose and scope of work

Emerge Associates (Emerge) were engaged by Vinci Gravel to provide environmental consultancy services to support the planning process associated with the expansion of the quarry in the site. The purpose of this survey is to provide sufficient information on the flora and vegetation values within the site to inform this process.

The scope of work was specifically to undertake a flora and vegetation assessment to the standard required of a detailed survey in accordance with the Environmental Protection Authority's (EPA's) *Technical Guidance – Flora and Vegetation Surveys for Environmental Impact Assessment* (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.
- Compilation of a comprehensive list of flora species recorded as part of the field survey.
- Mapping of plant communities and vegetation condition.
- Identification of conservation significant flora and vegetation.
- Documentation of the desktop assessment, survey methodology and results into a report.

2 Environmental Context

2.1 Climate

Climate has a strong influence on 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 1019.5 millimetres (mm) of rainfall is recorded annually from the Karragullen North weather station, which is the closest weather station, located approximately 800 m north east of the site. The majority of this rainfall is received between the months of May and September. Mean maximum temperatures at the Bickley weather station, which is the nearest temperature recording station approximately 10 km north of the site, range from 15.1 °C in July to 30.5°C in January and February, while mean minimum temperatures range from 7.3°C in July to 15.9°C in February (BoM 2021).

A total of 885 mm of rain was recorded from April to December 2020 prior to and during the survey, which is approximately 92% of the mean of 964.3 mm for this period (BOM 2021). This indicates that the amount of rainfall was considered to have been sufficient to promote the flowering and emergence of flora.

2.2 Geomorphology and soils

Landform and soils influence vegetation types at regional and local scales. The site occurs on the Darling Plateau which lies directly east of the Darling Scarp. The Darling Plateau is an ancient erosion surface capped with laterite and dissected by drainage channels (Beard 1990). The eastern part of the Plateau is characterised by flat-topped hills bound by breakaways and more prominent hills (monadnocks) which protrude above the general level of the plateau (Gozzard 2011). The western part comprises valleys with steep, rocky slopes and narrow, flat floors (Gozzard 2011).

The site is located on the western side of the Darling Plateau and broad scale soil mapping places the site within the Yarragil and the Dwellingup soil associations (Churchward and McArthur 1980). The Yarragil association occurs in the western portion of the site and is described as gentle valleys with sandy gravels on the slopes and orange earths on flat swampy floors (Churchward and McArthur 1980). The Dwellingup association occurs in the eastern portion of the site and is described as a

'gently undulating landscape with duricrust on ridges; sands and gravels in shallow depressions' (Churchward and McArthur 1980).

Finer scale mapping by DPIRD (2018) shows four soil landscape units as occurring within the site, as described in **Table 1** and shown in **Figure 2**.

Table 1: Soil landscape mapping units within the site (DPIRD 2018)

Soil landscape unit	Location within site	Description
Yarragil 1 Phase	South western portion and small area in south eastern portion	Very gentle to moderately inclined concave sideslopes (with) moderately well drained yellow duplex soils and yellow and brown massive earths and gravels.
Yarragil 4 Phase	Small area in the central southern portion	Valley floors with some poorly drained mottled yellow duplex soils and gentle lower slopes with moderately well to well drained loamy and sandy earths, gravels and duplex soils.
Dwellingup 2 Phase	North western and south eastern portions	Very gently to gently undulating terrain (<10%) with well drained, shallow to moderately deep gravelly brownish sands, pale brown sands and earthy sands overlying lateritic duricrust.
Cooke Subsystem	Eastern portion	Crests and upper slopes dominated by granite outcrop and very shallow yellow duplex soils, and yellow and brown massive earths.

2.3 Topography

The elevation of the site ranges from 265 m in relation to the Australian height datum (mAHD) in the south western part of the site to 350 mAHD in the north eastern part of the site (DoW 2008) (**Figure 2**).

2.4 Hydrology and wetlands

Wetlands include "areas of seasonally, intermittently or permanently waterlogged soils or inundated land, whether natural or otherwise, fresh and saline, e.g. waterlogged soils, ponds, billabongs, lakes, swamps, tidal flats, estuaries, rivers and their tributaries" (Wetlands Advisory Committee 1977). Wetlands can further 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 2017c)
- *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 one minor, non-perennial watercourse in the central portion of the site and part of two non-perennial watercourses in the central southern portion of the site. The locations of these watercourses are shown in **Figure 2**.

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 'JF1' or northern jarrah forest subregion, which is characterised by *Eucalyptus marginata* (jarrah) – *Corymbia calophylla* (marri) forest on laterite gravels with *Eucalyptus wandoo* – marri woodlands in the eastern part (DEC 2002).

Variations in native vegetation within the site can be further classified based on regional vegetation associations. Heddle *et al.* (1980) mapping shows the western portion of the site comprises the 'Yarragil Complex (maximum development swamps) in medium to high rainfall' which is described as 'open forest of *Eucalyptus marginata - Corymbia calophylla* with admixtures of *Eucalyptus patens*.' The eastern portion of the site comprises the 'Dwellingup complex in medium to high rainfall' which is described as 'open forest of *Eucalyptus marginata - Corymbia calophylla* on the uplands.'

More recent Beard *et al.* (2013) mapping shows the majority of the site comprises vegetation association 'West Darling 3'. This association is described as 'mainly jarrah and marri *Eucalyptus marginata*, *Corymbia calophylla*' (Beard *et al.* 2013). A small area in the south western portion of the site comprises vegetation association "West Darling 4' which is described as 'jarrah, marri and wandoo *Eucalyptus marginata, Corymbia calophylla, E. wandoo*' (Beard *et al.* 2013).

Studies have indicated that the loss of biodiversity caused by habitat fragmentation is significantly greater once a habitat type falls below 30% of its original extent (Miles 2001). The national objectives and targets for biodiversity conservation established an objective of retaining 30% of the original extent of each vegetation complex (Environment Australia 2001).

This 'Yarragil Complex (maximum development swamps) in medium to high rainfall' was determined to have 92.47% remaining in 2018, of which 10.58% is under formal protection (Government of Western Australia 2019a). The 'Dwellingup complex in medium to high rainfall' was determined to have 82.50% remaining in 2018, of which 19.31% is under formal protection (Government of Western Australia 2019a).

'West Darling 3' association has 67.10% of its pre-European extent remaining in 2018, with 16.11% protected for conservation purposes (Government of Western Australia 2019b).

The percentage protected for conservation of the above three complexes fall below the 30% retention objective.

2.6 Historic land use

Review of historical images from 1965 onwards indicates that the site supported relatively intact native vegetation from 1965 to sometime before 1974, with imagery from 1974 showing that all of the site except the north eastern portion has been cleared of native vegetation and appears to be used for grazing (WALIA 2020). A quarry is also visible in the central western portion of the site in images from 1974 onwards and gradually increases in size until 1995. Regrowth of native vegetation in the south eastern portion of the site is visible in imagery from 1985 to 2020.

2.7 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**.

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 2020). '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*.

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**.

2.7.3 Local and regional significance

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

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

- The vegetation within the site is associated with wetlands/water courses.
- The vegetation is part of a larger patch that provides extensive habitat for flora and fauna and functions as an ecological linkage.
- The vegetation within the site has potential value as habitat for threatened or priority fauna species including, in particular, species of black cockatoo which are listed under the EPBC Act and the BC Act.

2.7.4 Weeds

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.

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. At a National level, the Australian government has compiled a list of 32 *Weeds of National Significance* (WoNS) (DAWE 2020c). Whilst the WoNS list is non-statuatory, many WoNS are also listed under the BAM Act. Further information on categories of declared pests is provided in **Appendix A**.

Due to historical disturbance weed species are expected to be present at the site.

2.8 Environmentally sensitive areas

'Environmentally sensitive areas' (ESAs) are prescribed under the *Environmental Protection (Clearing of Native Vegetation) Regulations 2004* and have been identified to protect native vegetation values of areas surrounding values such as significant wetlands, threatened flora, threatened communities and *Bush Forever* sites. Within an ESA none of the exemptions under the *Environmental Protection (Clearing of Native Vegetation) Regulations 2004* apply. However, exemptions under Schedule 6 of the EP Act still apply, which includes any clearing in accordance with a subdivision approval under the *Planning and Development Act 2005* (a recognised exemption under the Schedule 6 of the EP Act).

No ESAs occur over the site or in close proximity to the site.

2.9 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 2017a) and *Lands of Interest* (DBCA 2017b) datasets. The *Legislated Lands and Waters* (DBCA 2017a) 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 2017b) dataset includes all other lands of which DBCA is recognised as the manager but is not vested under any act. These lands

comprise 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 Korung National Park, which is listed under the CALM Act, lies adjacent to the north and east of the site.

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).

There are no mapped ecological linkages within or adjacent to the site. One ecological linkage (No. 141) occurs approximately 500 m to the south west of the site but is not connected to the site.

2.11 Previous surveys

No previous relevant surveys are known to have been undertaken within the site.

3 Methods

3.1 Desktop assessment

3.1.1 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 2020a), *NatureMap* (DBCA 2020) and DBCA's threatened and priority flora database (reference no. 31-0520FL).

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 2020a). A search of DBCA's threatened and priority ecological communities' database was also undertaken using a 5 km radius as recommended by DBCA (reference no. 13-0620EC).

3.1.2 Likelihood of occurrence

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.

An assessment of the likelihood of occurrence of threatened and priority flora species and communities within the site was undertaken and each species was assigned to one of the following categories:

- Recorded: the species has been previously recorded in the site or was recorded during the current field survey.
- Likely: suitable habitat for the species occurs in the site.
- Possible: suitable habitat for the species may occur in the site but is sub-optimal and no existing records occur close to the site.
- Unlikely: no suitable habitat for the species is present within the site.

3.2 Field survey

Botanists and ecologists from Emerge visited the site on the following days in 2020 to conduct the flora and vegetation field survey:

- 27 May
- 2 June
- 11 September
- 21 October
- 27 October
- 12 December.

The majority of the vegetation sampling was undertaken on 27 May, 2 June and 11 September. Targeted searches of particular areas were undertaken on the other survey dates.

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 non-permanent 10 x 10 m quadrats and relevés. The quadrats were established using fence droppers bound by measuring tape. 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.

A total of seven locations were sampled, comprised of three quadrats and four relevés. The position of each sample location was recorded with a hand-held GPS unit, as 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 botanist traversed the site. Photographs were taken throughout the field visit to show particular site conditions.

Conservation significant species previously recorded within the site (refer **Section 3.1.2**) were searched for, where appropriate. The site was also assessed to determine whether suitable habitat was present for conservation significant species identified as potentially occurring within the site and (refer **Section 3.1.2**) whether the survey effort was appropriate to determine if they occur in the site.

All plant specimens collected during the field survey 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 methods from Keighery (1994).

Table 2: 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 Plant community identification and description

The local 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) (ESCAVI 2003). 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 locations and notes recorded during the field survey to define areas with differing condition.

3.3.2 Threatened and priority ecological communities

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

3.3.3 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.
		No previous survey information was available.
Experience level of personnel	No limitation	This flora and vegetation assessment was undertaken by a qualified botanist with over ten years of botanical experience in Western Australia. Technical review was undertaken by a senior environmental consultant with 18 years' experience in environmental science in Western Australia.
Suitability of timing	No limitation	The survey was conducted in the main flowering season. High rainfall was recorded in the months preceding the site visit. 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	Comprehensive 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 multiple times in 2020 including within and outside 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	No limitation	A total of 159 species were recorded, of which 87 were recorded from seven samples and 72 were recorded opportunistically. Minimum species richness within site is estimated at between 139 (Jacknife1) and 180 (Chao2) species (refer species accumulation curve and estimates shown in **Plate 10**). This indicates that between 88 and 100% of the estimated 139-180 species in the site were recorded, demonstrating that survey effort was adequate to prepare a near-comprehensive species inventory for the site.
Influence of disturbance	Minor limitation	Time since fire is greater than 50 years as interpreted form aerial imagery and therefore short lived species more common after fire may not have been visible. Some evidence of fire was present on the trunks of trees within the site but it is unclear how recent this is.
	No limitation	Historical ground disturbance was evident in parts 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

The western and southern portions of the site have been subject to intensive historical disturbance and support non-native vegetation and native regrowth vegetation. The north eastern portion of the site supports intact native vegetation that has been subject to lower levels of disturbance.

Soils are generally brown clay and sand with lateritic gravel. Two granitic outcrops occur in the eastern portion of the site. An active gravel quarry exists in the north western portion of the site and a dam is present in the central southern portion. A minor waterway which was dry during most of the surveys runs from the granite outcrop in the north east to a small dam in the centre of the site.

4.2 Flora

4.2.1 Desktop assessment

The database search results identified a total of one extinct, 18 threatened and 28 priority flora species occurring or potentially occurring within a 10 km radius of the site. Information on these species including their habitat preferences is provided in **Appendix B**.

Based on background information available for the site, suitable habitat was considered to potentially occur within the site for 12 threatened flora species and 28 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			
Lasiopetalum pterocarpum	CR	EN	P	Riparian community with species such as flooded gum, marri and swamp peppermint.	Aug-Nov
Darwinia apiculata	EN	EN	P	Open jarrah-marri woodland on shallow gravely soil over laterite, or open heathland over sandy loams with granite boulders.	Oct-Nov
Diplolaena andrewsii	EN	EN	P	Granite outcrops & hillsides.	Jul-Oct
Goodenia arthrotricha	EN	EN	P	Granite rocks, slopes	Oct-Nov
Thelymitra stellata	EN	EN	PG	Sandy loam, clay or gravel over laterite or gravel.	Sep-Nov
Verticordia fimbrilepis subsp. *fimbrilepis*	VU	EN	P	Gravelly sandy or clayey soils. Flats, road verges.	Oct-Dec/Jan
Acacia anomala	VU	VU	P	Shallow sand,loam,clay or gravel	Aug-Sep
Anthocercis gracilis	VU	VU	P	Steep granite slopes along the Darling Scarp in shallow, humis-rich sandy or loamy soils.	Sep-Oct, Apr

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			
Eleocharis keigheryi	VU	VU	P	Clay or sandy loam in freshwater creeks and transient waterbodies such as seasonally wet clay pans.	Aug-Dec
Eriochilus sp. Roleystone (G. Brockman 1140)	P1	-	PG	Lateritic or black sandy gravel.	Jun-Jul (limited information)
Thelymitra magnifica	P1	-	PG	Gravelly soil on stony ridges.	Sep-Oct
Bossiaea modesta	P2	-	P	Soils derived from granite. Damp areas close to stream.	Oct-Dec
Paracaleana ferricola	P2	-	PG	Lateritic gravel in open areas of woodland	Jul
Thysanotus sp. Badgingarra (E.A. Griffin 2511)	P2	-	P	Grey sand with lateritic gravel.	Dec
Andersonia sp. Blepharifolia (F. & J. Hort 1919)	P2	-	P	Sandy clay with gravel.	Sep-Nov
Acacia horridula	P3	-	P	Gravelly soils over granite, sand, rocky hillsides.	May-Aug
Banksia kippistiana var. *paenepeccata*	P3	-	P	Lateritic gravelly soils.	Oct-Nov
Beaufortia purpurea	P3	-	P	Lateritic or granitic soils on rocky slopes.	Oct-Feb
Gonocarpus pycnostachyus	P3	-	A	Sand or clay soils. Wet depressions, granite rocks.	Oct
Meionectes tenuifolia	P3	-	P	Clay loam in seasonally wet areas.	Oct-Dec
Thysanotus anceps	P3	-	P	White or grey sand, lateritic gravel, laterite.	Oct-Dec
Acacia oncinophylla subsp. *oncinophylla*	P3	-	P	Granitic soils	Aug-Oct
Allocasuarina grevilleoides	P3	-	P	Sand over laterite, gravel.	Sep-Nov
Asteridea gracilis	P3	-	A	Sand, clay, gravelly soils.	Sep-Dec
Grevillea manglesii subsp. *dissectifolia*	P3	-	P	Gravelly loam, moist. Roadsides.	Jun, Sep/Nov
Halgania corymbosa	P3	-	P	Gravelly soils, soils over granite.	Aug-Nov
Lasiopetalum glutinosum subsp. *glutinosum*	P3	-	P	Brown clay loam on slopes	Sep-Dec

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			
Stackhousia sp. Red-blotched corolla (A. Markey 911)	P3	-	P	Granitic soils on slopes.	Sep-Nov
Calothamnus graniticus subsp. *leptophyllus*	P4	-	P	Clay over granite, lateritic soils. Hillsides.	Jun-Aug
Pimelea rara	P4	-	P	Lateritic soils.	Dec-Jan
Stylidium striatum	P4	-	P	Brown clay over laterite on hill slopes.	Oct-Nov
Thysanotus glaucus	P4	-	P	White, grey or yellow sand, sandy gravel.	Oct-Mar
Acacia oncinophylla subsp. *patulifolia*	P4	-	P	Granitic soils, occasionally on laterite.	Aug-Nov/Nov-Dec
Boronia tenuis	P4	-	P	Laterite, stony soils, granite.	Aug-Nov
Calothamnus accedens	P4	-	P	Sandy soils over laterite.	Sep-Jan
Grevillea pimeleoides	P4	-	P	Gravelly soils over granite. Rocky hillsides.	May-Nov
Lasiopetalum bracteatum	P4	-	P	Sandy clay, clay, lateritic gravel along drainage lines, creeks, gullies, granite outcrops.	Aug-Nov

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

4.2.2 Species inventory

A total of 140 native and 19 non-native (weed) species were recorded within the site during the field survey, representing 44 families and 111 genera. The dominant families containing native taxa were Asteraceae (11 native taxa and five weed taxa) and Myrtaceae (eleven native taxa and one weed taxa). The most common genera were *Stylidium, Acacia, Lepidosperma and Hibbertia* with seven, six, five and five taxa respectively. The family containing the most taxa was Asteraceae (16 a). Of the species recorded 87 were recorded in samples and 72 were recorded opportunistically.

A complete species list is provided in **Appendix D** and a species list by plant community matrix is provided in **Appendix E**.

4.2.3 Threatened and priority flora

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

The majority of 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. The survey was unable to confirm the presence or absence of two priority flora species, *Eriochilus* sp. Roleystone (G. Brockman 1140) (P1) and *Paracaleana ferricola* (P2), but these species are considered unlikely to occur as discussed in **Section 5.1**.

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

Two species listed as declared pests (C3) pursuant to the BAM Act, **Asparagus asparagoides* (bridal creeper) and **Moraea flaccida* (one-leaf cape tulip), were recorded within the site. A small number of these plants were recorded scattered throughout the site.

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 community listed as a TEC and a PEC, banksia woodlands of the Swan Coastal Plain, as potentially occurring within a 10 km radius of the site. The DBCA database search did not return any results. Information on this community is provided in **Appendix C**.

Since the site is not located on the Swan Coastal Plain (refer to **Section 2.2**), the above TEC is not considered to potentially occur in the site.

4.3.2 Plant communities

Eight plant communities were identified within the site. Plant community **CcEmBa** extends over approximately half of the site (26.25 ha/54%), particularly in the eastern portion. Plant communities **Bs**, **Cd**, **AeGm** and **LeH** are associated with granite outcrops in the eastern portion of the site. Plant communities CcLl and TlBr occur in the central southern portion of the site. The remainder of the site comprises revegetation (1.81 ha/4% of the site) and **cleared and non-native** areas (12.43 ha/26% of the site). Two water bodies which extend over 0.11 ha occur within the site and were not mapped as a plant community.

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 9**. The location of each plant community is shown in **Figure 3**. 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)
AeGm	Closed shrubland *Acacia ephedroides* and *Grevillea manglesii* subsp. *manglesii* (**Plate 1**).	3.70
Bs	Granite outcrop comprising bare rock surfaces and bryophytes and herbland dominated by *Borya sphaerocephala* (**Plate 2**).	3.02
Cd	Low shrubland *Calytrix depressa* over mixed open native herbland (**Plate 3**).	0.51
CcEmBa	Open forest *Corymbia calophylla* and *Eucalyptus marginata* with *Allocasuarina fraseriana* over shrubland to tall shrubland *Banksia grandis* and *Bossiaea aquifolium* over shrubland *Xanthorrhoea preissii* over mixed native herbland *Platysace filiformis*, *Stylidium* spp. and *Scaevola* spp. (**Plate 4**).	26.25
CcLl	*Corymbia calophylla* over scattered shrubs *Taxandria linearifolia* over closed sedgeland *Lepidosperma longitudinale* (**Plate 5**).	0.12
LeH	Tall shrubland *Leptospermum erubescens* and *Hakea undulata* over shrubland *Xanthorrhoea preissii, Melaleuca trichophylla, Allocasuarina humilis* and *Hakea erinacea* over low shrubland *Gastrolobium villosum* over mixed open herbland *Stylidium* spp. (**Plate 6**).	0.22
TlBr	Tall open shrubland *Taxandria linearifolia* over closed sedgeland *Baumea rubiginosa* (**Plate 7**).	0.06
Revegetation	Planted vegetation - closed shrubland dominated by *Calothamnus quadrifidus* (**Plate 8**).	1.81
Cleared and non-native	Cleared areas and predominantly scattered non-native plants including patches of non-native planted trees (**Plate 9**).	12.43

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

*Plate 2: Plant community **Bs** in 'excellent' condition*

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

*Plate 4: Plant community **CcEmBa** in 'very good' condition*

*Plate 5: Plant community **CcLl** in 'very good' condition*

*Plate 6: Plant community **LeH** in 'very good' condition*

*Plate 7: Plant community **TlBr** in 'excellent' condition*

*Plate 8: Plant community **Revegetation** in 'degraded' condition*

*Plate 9: Plant community **Cleared** in 'completely degraded' condition*

4.3.3 Vegetation condition

The most intact vegetation in the site is located within plant community **Bs** which comprises granite rises with exposed rock, mosses and native shrubs and herbs. This vegetation was mapped as being in 'excellent' condition as it comprises a vegetation structure expected of granite outcrops and very low weed cover was recorded. Plant community **TlBr** was also mapped as being in 'excellent' condition as it supports an intact structure, high cover of native species and very low cover of weeds.

Plant communities **CcEmBa**, **LeH** and **Cd** in the north eastern portion of the site comprise relatively intact native vegetation and were mapped as being in 'very good' condition. This vegetation shows some signs of disturbance such as patches of bare ground, altered structure and/or weeds but generally supported moderate to high cover of native species and low weed cover. One patch of plant community **CcEmBa** in the north western portion of the site, and small areas of plant communities **CcLl** and **Bs** in the central southern portion of the site, were also mapped as being in 'very good' condition for the same reasons.

Most of the portion of plant community **CcEmBa** in the south eastern portion of the site was mapped as being in 'very good – good' condition. This vegetation comprises a mosaic of small intact patches with moderately intact structure and native species diversity interspersed with small patches supporting an altered structure and reduced native understorey diversity. Parts of this plant community that were significantly altered and comprises scattered native plants only were mapped as being in 'degraded' condition.

Vegetation in the central portion of the site and southern portions of the site were mapped as being in 'good' condition as they have been subject to disturbance and comprise an altered structure with reduced native species diversity. Vegetation subject to higher levels of disturbance and with minimal native species diversity were mapped as being in 'degraded' condition.

The remainder of the site was mapped as being in 'completely degraded' condition as it mainly consists of bare ground including tracks and the current quarry, with scattered native and non-native plants. The 0.11 ha of open water and the 1.81 ha of revegetation in the site were not assigned a condition category.

The extent of vegetation by condition category is detailed in **Table 6** and shown in **Figure 4**.

Table 6: Extent of vegetation condition categories within the site

Condition category (Keighery 1994)	Size (ha)
Pristine	0
Excellent	3.02
Very good	15.24
Good	6.99
Good – degraded	6.43
Degraded	2.19
Completely degraded	12.44

4.3.4 Threatened and priority ecological communities

The vegetation within the site is not considered to represent a TEC or PEC.

4.3.5 Locally and regionally significant vegetation

Mature eucalypt trees (diameter at breast height larger than 500 mm) including *Corymbia calophylla* (marri) and *Eucalyptus marginata* (jarrah) occur in the site and may provide foraging, roosting and nesting habitat for threatened species of black cockatoos, along with other ecological services. Opportunistic sightings of threatened black cockatoos (Baudin's cockatoo, Carnaby's cockatoo and forest red-tailed black cockatoo) were recorded within and adjacent to the site during the field survey.

Vegetation, particularly that in the northern and eastern portions of the site, is adjacent to extensive areas of intact native vegetation and would contribute to ecological linkages in the area.

4.4 Species richness and sampling adequacy

A total of 87 species were recorded from seven samples. A species accumulation curve derived from sample data is presented in **Plate 10**. After seven 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 139 (Jacknife1) and 180 (Chao2). Based on the trend of the species accumulation curve 70 to 80 samples would be required to capture that many species. Including the 72 additional species recorded opportunistically, a total of 159 species was recorded in the site. This indicates that between 88 and 100% of the estimated 139-180 species in the site were recorded. The survey effort was therefore considered to be adequate to prepare a comprehensive species inventory.

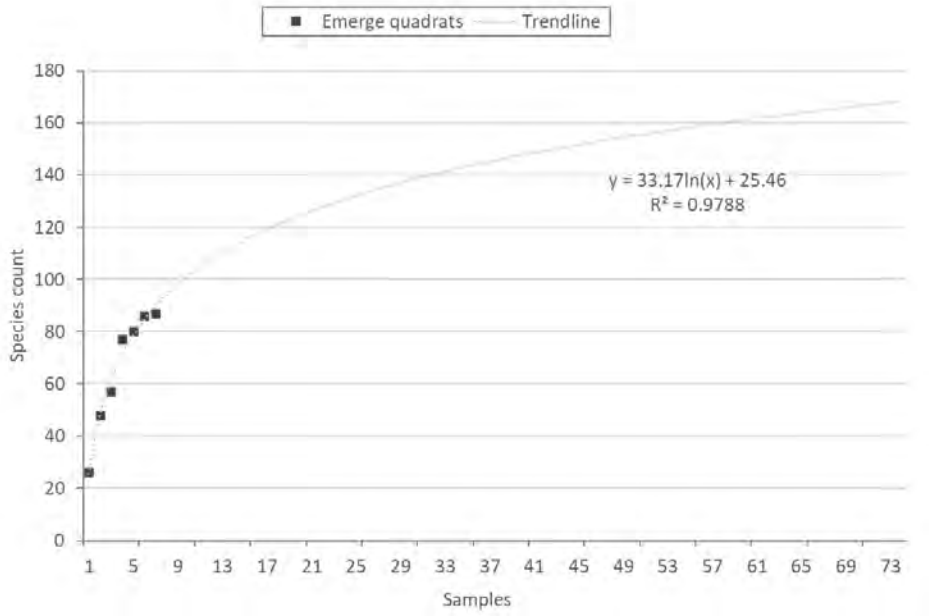

Plate 10: Species accumulation curve derived from sample data (y = 33.17ln(x) + 25.46 R^2 = 0.9788)

5 Discussion

The eastern, and particularly the north eastern, portion of the site supports intact native vegetation. The western portion of the site has been subject to intensive historical and ongoing disturbance and comprises patches of native vegetation and cleared areas.

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, multiple threatened and priority flora species were considered to potentially occur within the site. The field surveys between May and December were considered sufficient to determine that all but two priority species are unlikely to occur. This is because 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 those with dissimilar flowering periods were mostly perennials. Since no unidentified specimens which had potential to comprise conservation significant species were collected, the survey effort is considered sufficient to confirm the absence of these species on the basis that either suitable habitat does not occur or the species were not recorded during traverses within potentially suitable habitat during periods when they should have been detectable.

However, the field survey was outside of the flowering period of two priority flora species: *Eriochilus* sp. Roleystone (G. Brockman 1140) (P1) and *Paracaleana ferricola* (P2). These species are both perennial geophytic orchids, occurring underground for most of the year and developing leaves and flowers above-ground only during a few months in order to reproduce. *Eriochilus* sp. Roleystone (G. Brockman 1140) is known to flower between June and July but limited information is available on this species as only three records exist on DBCA's *Florabase* website (Western Australian Herbarium 2021). These three records occur close together, approximately 7 km west of the site in Banyowla Regional Park. Similarly, *Paracaleana ferricola* (P2) flowers in July and five records occur on *Florabase* (Western Australian Herbarium 2021). These records also occur close together and lie approximately five km north west of the site in Korung National Park. Although suitable habitat for these species is present in the site, they are considered unlikely to occur as the extent of the nearby recorded populations is localised and does not suggest that these taxa are distributed along the scarp such that they would occur in the site.

5.2 Vegetation condition

Assigning a condition category to most of the patches of vegetation within the site was relatively straightforward.

Plant community **Bs**, mapped as being in 'excellent' condition, includes large portions of unvegetated granite areas but this is a natural part of granite outcrop landforms and not considered a sign of disturbance or an indication it should be assigned to a lower condition category.

A compound condition category of 'very good – good' was included for part of plant community **CcEmBa** which comprises a mosaic of patches of vegetation in each category. At the scale of mapping

undertaken within the site it was not appropriate to separate these patches and the compound condition category was considered sufficient to portray the values within this area.

5.3 Threatened and priority ecological communities

The desktop assessment indicated that no TECs or PECs associated with the jarrah forest bioregion occur within 10 km of the site. Therefore, the vegetation within the site is not considered to represent a TEC or a PEC.

5.4 Local and regional significance

Trees within the site, particularly in the eastern portion, may provide potential foraging, roosting and/or nesting habitat for threatened species of black cockatoos which occur in the local area. The native vegetation, particularly that in the northern and eastern portions of the site contributes to ecological linkages in the area.

6 Conclusions

The south west of the site has been subject to intensive historical disturbance and primarily supports non-native vegetation or native regrowth. The north east of the site supports intact native vegetation that has been subject to lower levels of disturbance.

A total of 140 native and 19 non-native (weed) species were recorded in the site.

No threatened or priority flora were recorded in the site.

The survey timing was not appropriate to confirm the presence or absence of two priority flora species: *Eriochilus* sp. Roleystone (G. Brockman 1140) (P1) and *Paracaleana ferricola* (P2) but they are considered unlikely to occur. No other threatened or priority flora are considered likely to occur in the site.

Eight plant communities were identified within the site. Approximately 70% of the site supports plant communities dominated by native vegetation (33.88 ha). The remainder of the site comprises non-native vegetation, cleared areas and water bodies (14.35 ha/30% of the site).

Vegetation in 'excellent', very good', 'very good – good' and 'good' condition occurs across 31.68 ha (66% of the site). Vegetation in 'degraded' and 'completely degraded' condition occurs across 14.63 ha (30% of the site). A total of 1.92 ha (4% of the site) was not assigned to a vegetation condition category.

No TECs or PECs occur within the site.

Vegetation within the site, particularly in the eastern portion, may provide potential foraging, roosting and/or nesting habitat for threatened species of black cockatoos which occur in the local area. The native vegetation, particularly that in the northern and eastern portions of the site contributes to ecological linkages in the area.

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Figures

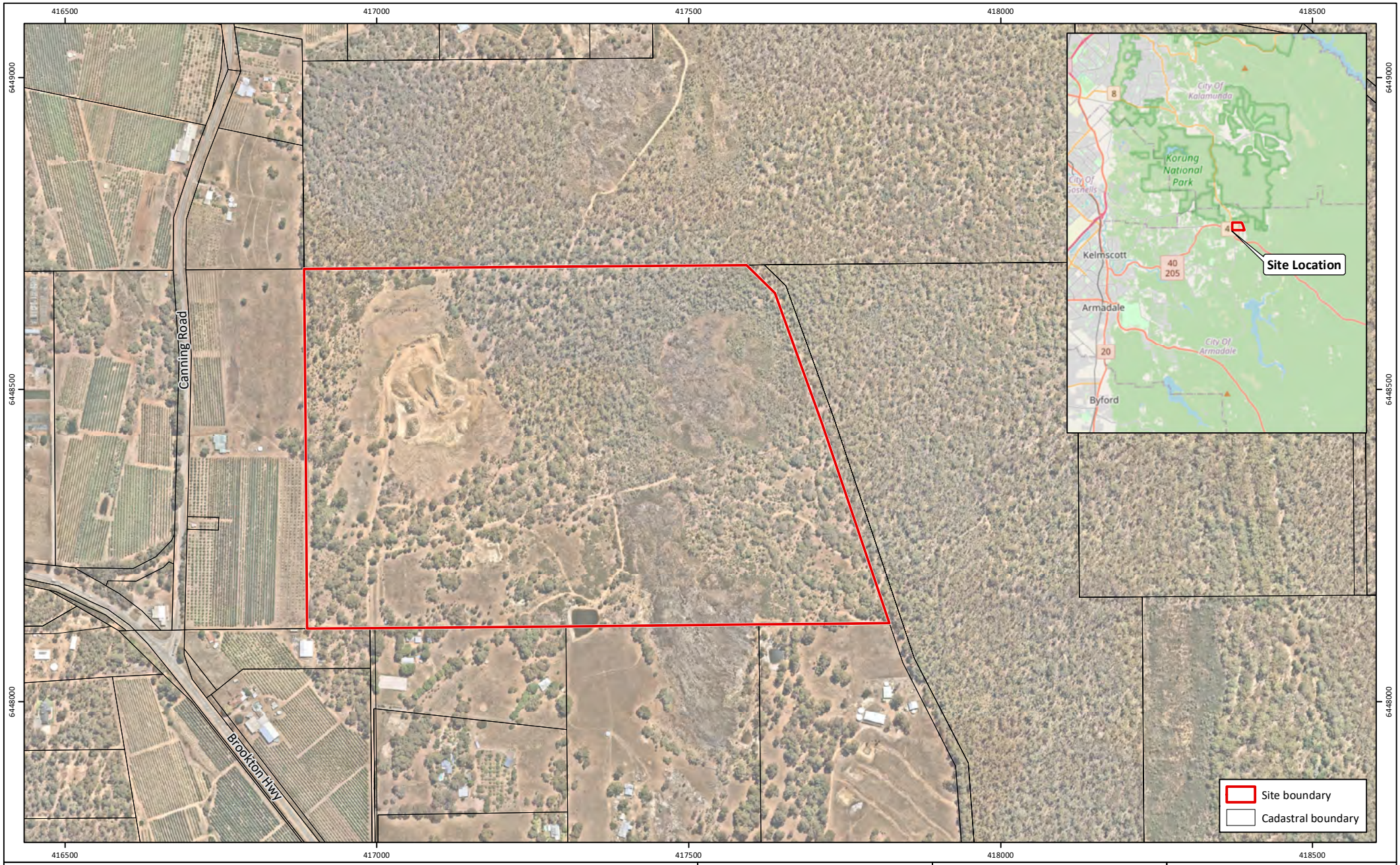

Figure 1: Site Location

Project: Detailed Flora and Vegetation Assessment
Lot 9 Brookton Highway Karragullen
Client: Vinci Gravel Supplies Pty Ltd

Plan Number:
EP20-040(04)--F20
Drawn: GAR
Date: 04/02/2021
Checked: RAW
Approved: TAA
Date: 05/02/2021

N

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Metres
Scale: 1:8,000@A4
GDA 1994 MGA Zone 50

emerge ASSOCIATES

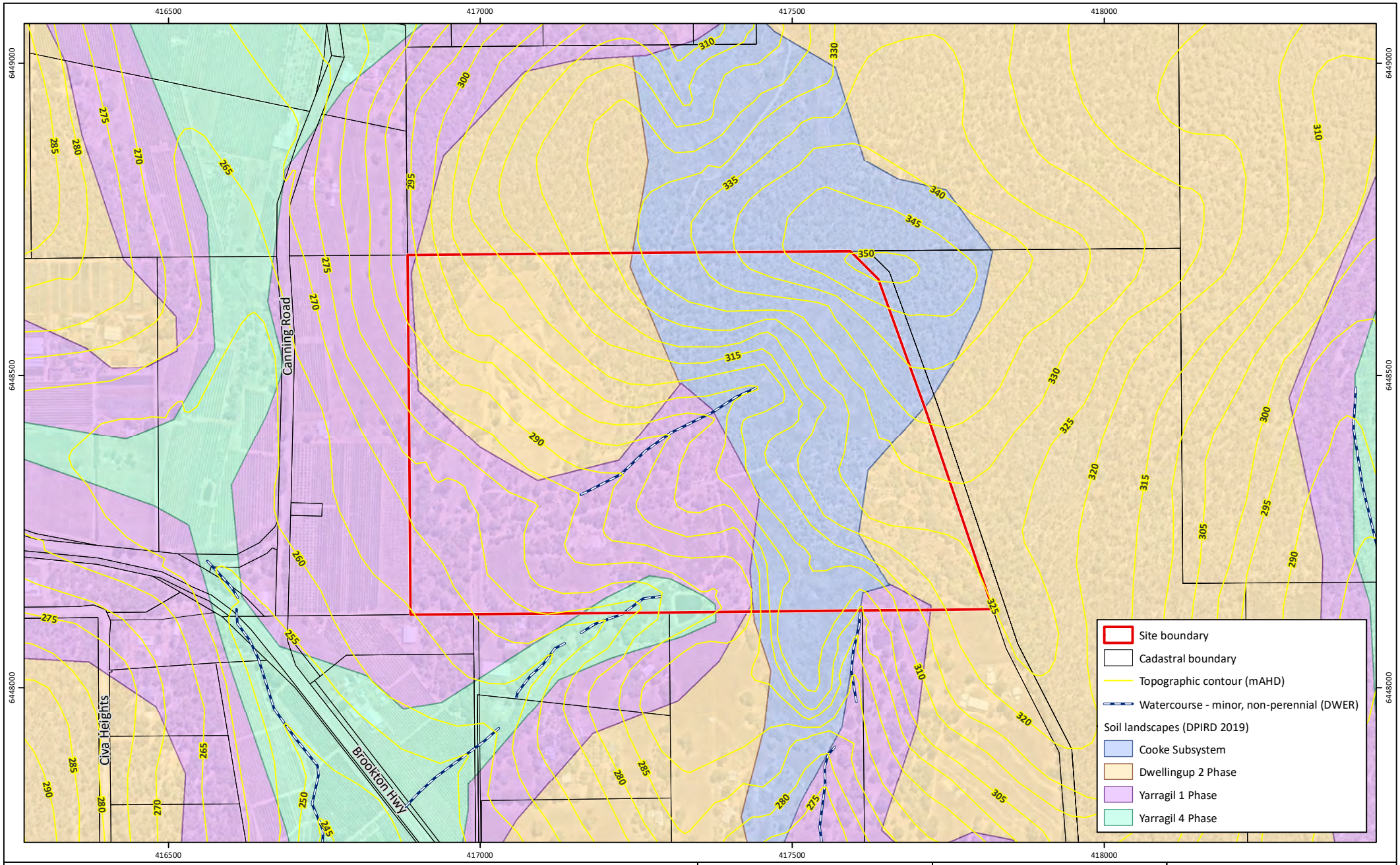

Figure 2: Environmental Features

Project:	Detailed Flora and Vegetation Assessment Lot 9 Brookton Highway Karragullen
Client:	Vinci Gravel Supplies Pty Ltd

Plan Number:
EP20-040(04)--F21

Drawn:	GAR
Date:	04/02/2021
Checked:	RAW
Approved:	TAA
Date:	05/02/2021

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GDA 1994 MGA Zone 50

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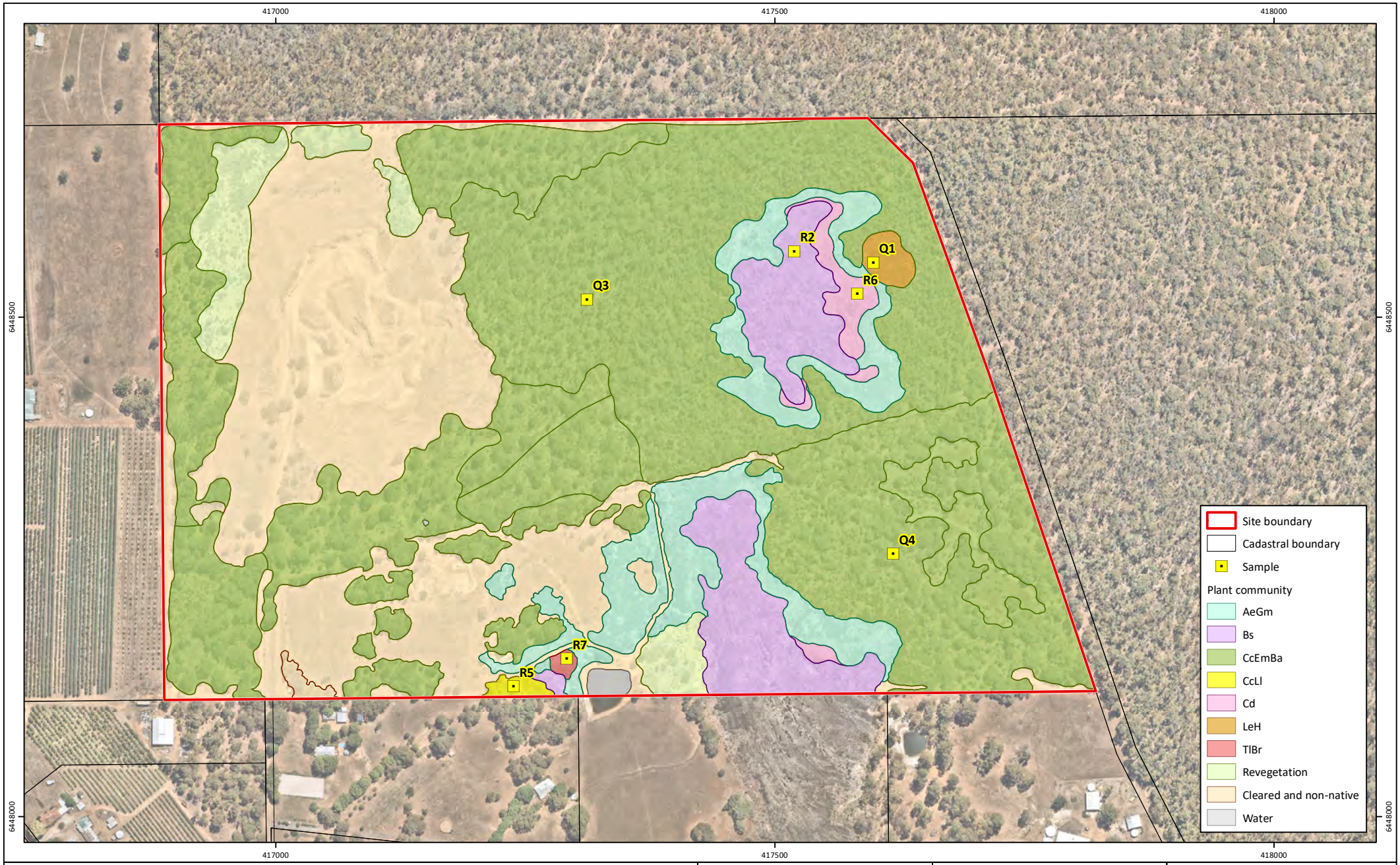

Figure 3: Plant Communities

Project: Detailed Flora and Vegetation Assessment
Lot 9 Brookton Highway Karragullen
Client: Vinci Gravel Supplies Pty Ltd

Plan Number:
EP20-040(04)--F22

Drawn:	GAR
Date:	04/02/2021
Checked:	RAW
Approved:	TAA
Date:	05/02/2021

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Metres

Scale: 1:5,000@A4

GDA 1994 MGA Zone 50

emerge ASSOCIATES

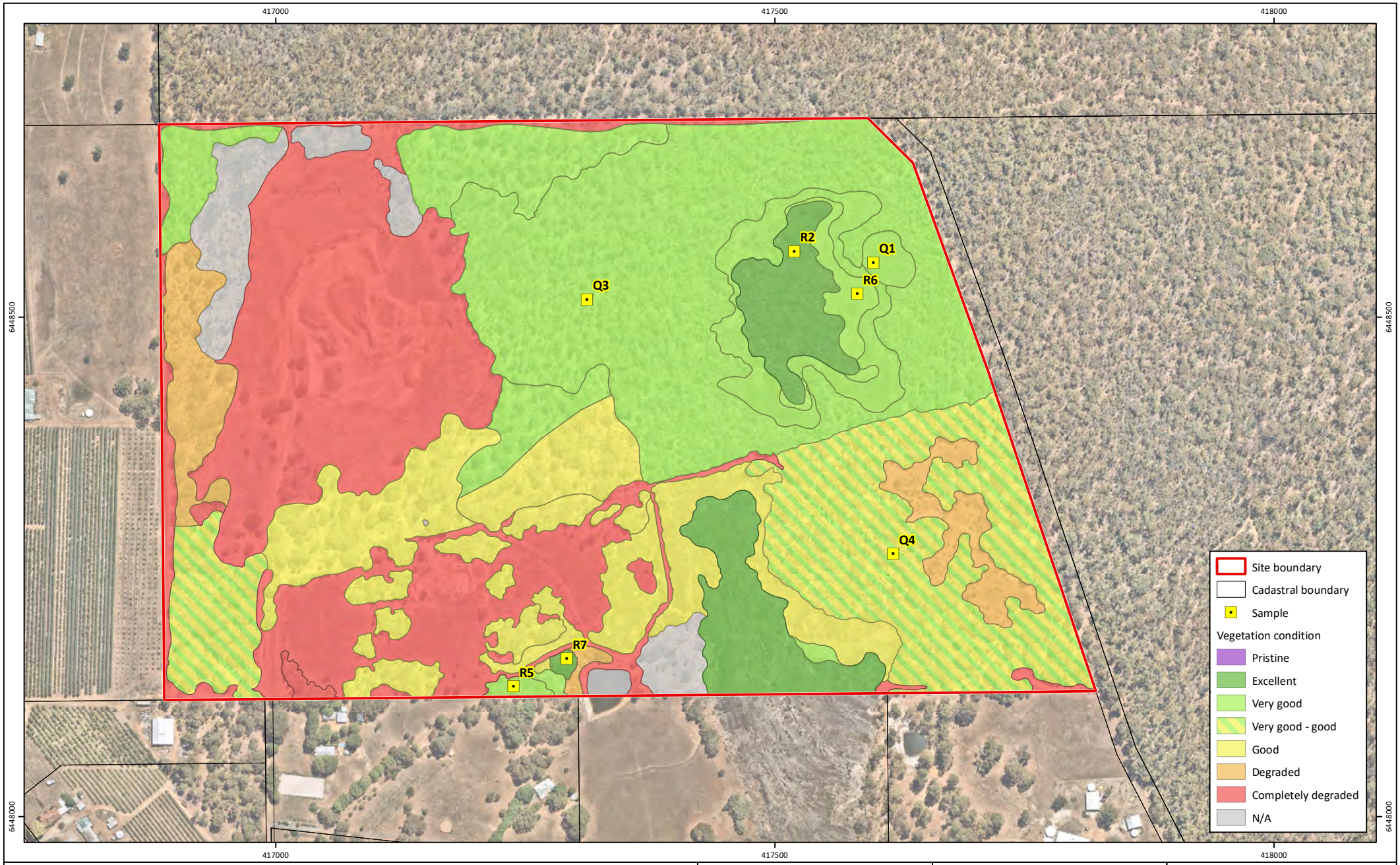

Figure 4: Vegetation Condition

Project: Detailed Flora and Vegetation Assessment
Lot 9 Brookton Highway Karragullen
Client: Vinci Gravel Supplies Pty Ltd

Plan Number:
EP20-040(04)--F23
Drawn: GAR
Date: 04/02/2021
Checked: RAW
Approved: TAA
Date: 05/02/2021

N

0 100 200
Metres
Scale: 1:5,000@A4
GDA 1994 MGA Zone 50

emerge ASSOCIATES

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 2018c). 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 2018c)

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 2018b).

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 2017b).

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

Category	Description
	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.

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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				
Acacia anomala	VU	VU	P	Shallow sand,loam,clay or gravel	Aug-Sep	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
Eleocharis keigheryi	VU	VU	P	Clay or sandy loam in freshwater creeks and transient waterbodies such as seasonally wet clay pans.	Aug-Dec	Unlikely
Diuris drummondii	VU	V	PG	In low-lying depressions in peaty and sandy clay swamps.	Nov-Jan	Unlikely
Conospermum undulatum	VU	V	P	Sand and sandy clay soils, on flat or gently sloping sites between the Swan and Canning Rivers	May-Oct	Unlikely
Diuris micrantha	VU	V	PG	Dark grey-black sandy clay-loam in winter wet depressions or swamps. Often in shallow standing water.	Aug/Sep-early Oct	Unlikely
Drakaea micrantha	EN	V	PG	Open sandy patches often adjacent to winter-wet swamps.	Sept- early Oct	Unlikely
Darwinia apiculata	EN	EN	P	Open jarrah-marri woodland on shallow gravely soil over laterite, or open heathland over sandy loams with granite boulders.	Oct-Nov	Unlikely
Verticordia fimbrilepis subsp. fimbrilepis	VU	EN	P	Gravelly sandy or clayey soils. Flats, road verges.	Oct-Dec/Jan	Unlikely
Diplolaena andrewsii	EN	EN	P	Granite outcrops & hillsides.	Jul-Oct	Unlikely
Lasiopetalum pterocarpum	CR	EN	P	Riparian community with species such as flooded gum, marri and swamp peppermint.	Aug-Nov	Unlikely
Thelymitra stellata	EN	EN	PG	Sandy loam, clay or gravel over laterite or gravel.	Sep-Nov	Unlikely
Goodenia arthrotricha	EN	EN	P	Granite rocks, slopes	Oct-Nov	Unlikely

Species name	Level of significance		Life strategy	Habitat	Flowering period	Likelihood of occurrence
	WA	EPBC Act				
Diuris purdiei	EN	E	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
Thelymitra dedmaniarum	CR	E	PG	Red brown sandy loam with dolerite and granite outcrops.	Oct-Nov	Unlikely
Eucalyptus x balanites	CR	E	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
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
Grevillea thelemanniana	CR	CR	P	Sand, sandy clay. Winter-wet low-lying flats.	May-Nov	Unlikely
Scholtzia sp. Bickley (W.H. Loaring s.n. PERTH 06165184)	EX	-	P	Unknown. One record in Bickley	Unknown	Unlikely
Eriochilus sp. Roleystone (G. Brockman 1140)	P1	-	PG	Lateritic or black sandy gravel.	Jun-Jul (limited information)	Unlikely
Thelymitra magnifica	P1	-	PG	Gravelly soil on stony ridges.	Sep-Oct	Unlikely
Bossiaea modesta	P2	-	P	Soils derived from granite. Damp areas close to stream.	Oct-Dec	Unlikely
Paracaleana ferricola	P2	-	PG	Lateritic gravel in open areas of woodland	Jul	Unlikely
Thysanotus sp. Badgingarra (E.A. Griffin 2511)	P2	-	P	Grey sand with lateritic gravel.	Dec	Unlikely
Andersonia sp. Blepharifolia (F. & J. Hort 1919)	P2	-	P	Sandy clay with gravel.	Sep-Nov	Unlikely

Species name	Level of significance		Life strategy	Habitat	Flowering period	Likelihood of occurrence
	WA	EPBC Act				
Acacia horridula	P3	-	P	Gravelly soils over granite, sand, rocky hillsides.	May-Aug	Unlikely
Banksia kippistiana var. paenepeccata	P3	-	P	Lateritic gravelly soils.	Oct-Nov	Unlikely
Beaufortia purpurea	P3	-	P	Lateritic or granitic soils on rocky slopes.	Oct-Feb	Unlikely
Gonocarpus pycnostachyus	P3	-	A	Sand or clay soils. Wet depressions, granite rocks.	Oct	Unlikely
Meionectes tenuifolia	P3	-	P	Clay loam in seasonally wet areas.	Oct-Dec	Unlikely
Thysanotus anceps	P3	-	P	White or grey sand, lateritic gravel, laterite.	Oct-Dec	Unlikely
Acacia oncinophylla subsp. oncinophylla	P3	-	P	Granitic soils	Aug-Oct	Unlikely
Allocasuarina grevilleoides	P3	-	P	Sand over laterite, gravel.	Sep-Nov	Unlikely
Asteridea gracilis	P3	-	A	Sand, clay, gravelly soils.	Sep-Dec	Unlikely
Grevillea manglesii subsp. dissectifolia	P3	-	P	Gravelly loam, moist. Roadsides.	Jun, Sep/Nov	Unlikely
Halgania corymbosa	P3	-	P	Gravelly soils, soils over granite.	Aug-Nov	Unlikely
Lasiopetalum glutinosum subsp. glutinosum	P3	-	P	Brown clay loam on slopes	Sep-Dec	Unlikely
Stackhousia sp. Red-blotched corolla (A. Markey 911)	P3	-	P	Granitic soils on slopes.	Sep-Nov	Unlikely
Calothamnus graniticus subsp. leptophyllus	P4	-	P	Clay over granite, lateritic soils. Hillsides.	Jun-Aug	Unlikely
Pimelea rara	P4	-	P	Lateritic soils.	Dec-Jan	Unlikely
Stylidium striatum	P4	-	P	Brown clay over laterite on hill	Oct-Nov	Unlikely
Thysanotus glaucus	P4	-	P	White, grey or yellow sand,	Oct-Mar	Unlikely
Acacia oncinophylla	P4	-	P	Granitic soils, occasionally on	Aug-	Unlikely
Boronia tenuis	P4	-	P	Laterite, stony soils, granite.	Aug-Nov	Unlikely
Calothamnus accedens	P4	-	P	Sandy soils over laterite.	Sep-Jan	Unlikely
Grevillea pimeleoides	P4	-	P	Gravelly soils over granite. Rocky hillsides.	May-Nov	Unlikely
Lasiopetalum	P4	-	P	Sandy clay, clay, lateritic gravel	Aug-Nov	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

Conservation Significant Communities and Likelihood of Occurrence Assessment

Code	Community name	TEC/PEC	Level of significance		Likelihood of occurrence
			State	EPBC Act	
-	Banksia woodlands of the Swan Coastal Plain	**TEC/PEC**	EN	P3	Does not occur
Note: TEC=threatened ecological community, PEC=priority ecological community, EN=endangered, P3=priority 3					

Appendix D

Species List

Family	Status	*Species*
Apiaceae		*Actinotus leucocephalus*
	*	*Foeniculum vulgare*
		Pentapeltis peltigera
		Platysace filiformis
		Xanthosia candida
Apocynaceae		
	*DP	*Gomphocarpus fruticosus*
Asparagaceae		
	*DP,WoNS	*Asparagus asparagoides*
		Lomandra purpurea
		Lomandra sericea
		Sowerbaea laxiflora
		Thysanotus manglesianus
Asteraceae		
		Craspedia variabilis
	*	*Erigeron sumatrensis*
		Hyalosperma cotula
	*	*Hypochaeris glabra*
		Lagenophora huegelii
		Millotia myosotidifolia
		Olearia paucidentata
	*	*Osteospermum ecklonis*
		Pithocarpa pulchella var. pulchella
		Quinetia urvillei
		Siloxerus filifolius
	*	*Sonchus oleraceus*
		Trichocline spathulata
	*	*Ursinia anthemoides*
		Waitzia sp.
		Xerochrysum macranthum
Boryaceae		
		Borya ?laciniata
		Borya sphaerocephala
Casuarinaceae		
		Allocasuarina fraseriana
		Allocasuarina humilis
Celastraceae		
		Stackhousia pubescens
Centrolepidaceae		
		Aphelia cyperoides
		Centrolepis aristata
Colchicaceae		
		Burchardia congesta
		Burchardia multiflora
		Wurmbea dioica
Crassulaceae		
		Crassula ?extrorsa
Cyperaceae		

Family	Status	*Species*
		Baumea rubiginosa
		Cyathochaeta avenacea
		Lepidosperma apricola
		Lepidosperma longitudinale
		Lepidosperma pubisquameum
		Lepidosperma sp.
		Lepidosperma ?scabrum
		Schoenus clandestinus
Dilleniaceae		
		Hibbertia amplexicaulis
		Hibbertia aurea
		Hibbertia commutata
		Hibbertia hypericoides
		Hibbertia ?huegelii
Droseraceae		
		Drosera bulbosa subsp. bulbosa
		Drosera gigantea
		Drosera macrantha
Ericaceae		
		Andersonia lehmanniana
		Leucopogon capitellatus
		Leucopogon tenuis
		Leucopogon verticillatus
		Styphelia tenuiflora
Euphorbiaceae		
	*	*Ricinus communis*
Fabaceae		
		Acacia alata var. alata
		Acacia barbinervis
	*	*Acacia dealbata*
		Acacia ephedroides
		Acacia pulchella var. pulchella
		Acacia urophylla
		Bossiaea aquifolium
		Daviesia decurrens
		Daviesia horrida
		Gastrolobium villosum
		Gompholobium polymorphum
		Gompholobium ?polymorphum
		Gompholobium tomentosum
		Hovea sp.
		Kennedia coccinea
Geraniaceae		
	*	*Erodium botrys*
Goodeniaceae		
		Dampiera coronata
		Goodenia trinervis
		Lechenaultia floribunda

Family	Status	*Species*
		Scaevola pilosa
		Scaevola platyphylla
Haemodoraceae		
		Conostylis setosa
		Conostylis sp.
		Haemodorum sp.
		Tribonanthes longipetala
Hemerocallidaceae		
		Arnocrinum preissii
		Dianella revoluta
		Stypandra glauca
		Tricoryne humilis
Iridaceae		
	*DP	*Moraea flaccida*
		Patersonia babianoides
		Patersonia umbrosa var. xanthina
Juncaginaceae		
		Triglochin minutissima
Lentibulariaceae		
		Utricularia multifida
Malvaceae		
		Thomasia foliosa
Moraceae		
	*	*Ficus carica*
Myrtaceae		
		Astartea scoparia
		Babingtonia camphorosmae
		Calothamnus quadrifidus
		Calytrix depressa
		Corymbia calophylla
	*Pl	*Eucalyptus botryoides*
		Eucalyptus marginata
		Hypocalymma sp.
		Leptospermum erubescens
		Melaleuca trichophylla
		Taxandria linearifolia
		Verticordia huegelii var. decumbens
		Verticordia plumosa
Orchidaceae		
		Caladenia macrostylis
		Diuris corymbosa
		Eriochilus helonomos
		Pterostylis recurva
		Pterostylis vittata
		Thelymitra antennifera
		Thelymitra crinita
		Thelymitra macrophylla
Philydraceae		

Family	Status	*Species*
		Philydrella pygmaea subsp. pygmaea
Phyllanthaceae		
		Phyllanthus calycinus
Phytolaccaceae		
	*	*Phytolacca octandra*
Pittosporaceae		
		Billardiera fusiformis
Poaceae		
		Amphipogon amphipogonoides
	*	*Arundo donax*
	*	*Briza maxima*
	*	*Eragrostis curvula*
		Microlaena stipoides var. stipoides
Polygalaceae		
		Comesperma calymega
Proteaceae		
		Adenanthos barbiger
		Banksia grandis
		Banksia nivea
		Conospermum huegelii
		Grevillea bipinnatifida
		Grevillea manglesii subsp. manglesii
		Grevillea pilulifera
		Grevillea synapheae
		Hakea erinacea
		Hakea undulata
		Isopogon dubius
		Persoonia elliptica
		Persoonia longifolia
Pteridaceae		
		Cheilanthes austrotenuifolia
Ranunculaceae		
		Clematis pubescens
Restionaceae		
		Leptocarpus sp.
Rhamnaceae		
		Cryptandra arbutiflora var. arbutiflora
		Trymalium ledifolium var. rosmarinifolium
Sapindaceae		
		Dodonaea ceratocarpa
Solanaceae		
	*	*Solanum nigrum*
Stylidiaceae		
		Stylidium amoenum
		Stylidium androsaceum
		Stylidium brunonianum
		Stylidium eriopodum
		Stylidium repens

Family	Status	*Species*
		Stylidium ?ciliatum
		Stylidium ?perpusillum
Thymelaeaceae		
		Pimelea brevistyla subsp. brevistyla
		Pimelea ?ciliata
Xanthorrhoeaceae		
		Xanthorrhoea gracilis
		Xanthorrhoea preissii
Zamiaceae		
		Macrozamia fraseri

*=non-native, Pl=planted, DP=declared pest under the BAM Act, WoNS=weed of national significance

Appendix E

Species x Plant Community Matrix

	Plant community								
Species	**AeGm**	**Bs**	**CcEmBa**	**CcLl**	**Cd**	**Cleared and non-native**	**LeH**	**Reveg-etation**	**TlBr**
Acacia alata var. alata			**X**						
Acacia barbinervis			**X**						
Acacia dealbata			**X**						
Acacia ephedroides		X		X	X				
Acacia pulchella var. pulchella			X				X		
Acacia urophylla			X						
Actinotus leucocephalus		X							
Adenanthos barbiger			X						
Allocasuarina fraseriana			X						
Allocasuarina humilis							X		
Amphipogon amphipogonoides							X		
Andersonia lehmanniana			X				X		
Aphelia cyperoides		X							
Arnocrinum preissii			X						
Arundo donax						X			
Asparagus asparagoides			X						
Astartea scoparia				X					
Babingtonia camphorosmae					X		X		
Banksia grandis			X						
Banksia nivea			X						
Baumea rubiginosa									X
Billardiera fusiformis			X						
Borya ?laciniata	X								
Borya sphaerocephala		X			X				
Bossiaea aquifolium			X						
Briza maxima			X						
Burchardia congesta			X						
Burchardia multiflora		X							
Caladenia macrostylis			X						
Calothamnus quadrifidus								X	
Calytrix depressa		X			X				
Centrolepis aristata		X							
Cheilanthes austrotenuifolia		X							
Clematis pubescens			X						
Comesperma calymega			X						
Conospermum huegelii					X				
Conostylis setosa			X						
Conostylis sp.							X		
Corymbia calophylla			X	X					
Craspedia variabilis			X						
Crassula ?extrorsa		X							
Cryptandra arbutiflora var. arbutiflora	X								
Cyathochaeta avenacea			X						
Dampiera coronata			X						
Daviesia decurrens			X						
Daviesia horrida					X				

	Plant community								
Species	**AeGm**	**Bs**	**CcEmBa**	**CcLl**	**Cd**	**Cleared and non-native**	**LeH**	**Reveg-etation**	**TlBr**
Dianella revoluta			X						
Diuris corymbosa					X				
Dodonaea ceratocarpa	X								
Drosera bulbosa subsp. bulbosa		X			X				
Drosera gigantea		X							
Drosera macrantha		X	X				X		
Eragrostis curvula						X			
Erigeron sumatrensis			X			X			
Eriochilus helonomos		X							
Erodium botrys						X			
Eucalyptus botryoides			X						
Eucalyptus marginata			X						
Ficus carica			X	X					
Foeniculum vulgare						X			
Gastrolobium villosum							X		
Gomphocarpus fruticosus						X			
Gompholobium ?polymorphum			X						
Gompholobium polymorphum			X						
Gompholobium tomentosum							X		
Goodenia trinervis		X							
Grevillea bipinnatifida					X		X		
Grevillea manglesii subsp. manglesii	X		X		X				
Grevillea pilulifera			X						
Grevillea synapheae			X						
Haemodorum sp.			X						
Hakea erinacea							X		
Hakea undulata							X		
Hibbertia ?huegelii			X						
Hibbertia aurea			X						
Hibbertia commutata			X						
Hibbertia hypericoides			X				X		
Hibbertia amplexicaulis			X						
Hovea sp.			X						
Hyalosperma cotula			X						
Hypocalymma sp.							X		
Hypochaeris glabra			X						
Isopogon dubius							X		
Kennedia coccinea			X						
Lagenophora huegelii			X						
Lechenaultia floribunda			X						
Lepidosperma ?scabrum		X							
Lepidosperma apricola			X				X		
Lepidosperma longitudinale				X					X
Lepidosperma pubisquameum			X						
Lepidosperma sp.				X			X		
Leptocarpus sp.									X

	Plant community									
Species	**AeGm**	**Bs**	**CcEmBa**	**CcLl**	**Cd**	**Cleared and non-native**	**LeH**	**Reveg-etation**	**TlBr**
Leptospermum erubescens							X		
Leucopogon capitellatus			X						
Leucopogon tenuis			X						
Leucopogon verticillatus			X						
Lomandra purpurea			X						
Lomandra sericea			X						
Macrozamia fraseri			X						
Melaleuca trichophylla							X		
Microlaena stipoides subsp. stipoides			X						
Millotia myosotidifolia		X							
Moraea flaccida			X						
Olearia paucidentata			X						
Osteospermum ecklonis						X			
Patersonia babianoides			X						
Patersonia umbrosa var. xanthina			X						
Pentapeltis peltigera			X						
Persoonia elliptica			X						
Persoonia longifolia			X						
Philydrella pygmaea subsp. pygmaea		X							
Phyllanthus calycinus			X						
Phytolacca octandra						X			
Pimelea ?ciliata							X		
Pimelea brevistyla subsp. brevistyla			X						
Pithocarpa pulchella var. pulchella			X						
Platysace filiformis			X				X		
Pterostylis recurva			X						
Pterostylis vittata			X						
Quinetia urvillei					X				
Ricinus communis						X			
Scaevola pilosa			X						
Scaevola platyphylla			X						
Schoenus clandestinus					X		X		
Siloxerus filifolius					X				
Solanum nigrum			X						
Sonchus oleraceus		X							
Sowerbaea laxiflora		X							
Stackhousia pubescens		X							
Stylidium ?ciliatum			X						
Stylidium ?perpusillum					X				
Stylidium amoenum			X						
Stylidium androsaceum					X				
Stylidium brunonianum			X				X		
Stylidium eriopodum					X				
Stylidium repens							X		
Stypandra glauca		X							
Styphelia tenuiflora			X				X		

	Plant community									
Species	**AeGm**	**Bs**	**CcEmBa**	**CcLl**	**Cd**	**Cleared and non-native**	**LeH**	**Reveg-etation**	**TlBr**
Taxandria linearifolia			X	X					X
Thelymitra antennifera					X				
Thelymitra crinita			X						
Thelymitra macrophylla			X						
Thomasia foliosa			X						
Thysanotus manglesianus			X						
Tribonanthes longipetala					X				
Trichocline spathulata			X						
Tricoryne humilis			X						
Triglochin minutissima		X							
Trymalium ledifolium var. rosmarinifolium			X				X		
Ursinia anthemoides			X						
Utricularia multifida		X							
Verticordia huegelii var. decumbens					X				
Verticordia plumosa	X				X				
Waitzia sp.			X						
Wurmbea dioica					X				
Xanthorrhoea gracilis			X						
Xanthorrhoea preissii			X				X		
Xanthosia candida			X						
Xerochrysum macranthum			X						

Appendix F

Sample Data

Vegetation Sample Data

Lot 9 Brookton Highway Karragullen

Sample Name: Q1

Project no.: EP20-040

Date: 27/05/2020, 02/06/2020, 11/09/2020

Status Non-permanent

Author: RAW,other

Quadrat and landform details

Sample type:	quadrat	Size:	10 m x 10 m
NW corner easting:	417598.6033	NW corner northing:	6448554.641
Altitude (m):	340	Geographic datum/zone:	GDA94/Zone 50
Soil water content:	near saturated	Landform:	hilltop
Time since fire:	3-5 yrs	Disturbance:	low - native fauna, fire
Soil type/texture	clay/sand	Bare ground (%):	15
Rocks (%) and type:	15%, laterite	Soil colour:	brown/
Litter:	5% (leaves,twigs,)	Vegetation condition:	very good

Vegetation Sample Data

Lot 9 Brookton Highway Karragullen

Sample Name: Q1

Project no.: EP20-040
Date: 27/05/2020, 02/06/2020, 11/09/ **Status** Non-permanent
Author: RAW,other Q1: Page 2 of 2

Species Data

* denotes non-native species

Status	Confirmed name	Cover (%)
	Acacia pulchella var. pulchella	<1
	Allocasuarina humilis	5
	Amphipogon amphipogonoides	<1
	Andersonia lehmanniana	<1
	Babingtonia camphorosmae	1
	Conostylis sp.	<1
	Drosera macrantha	opp
	Gastrolobium villosum	10
	Gompholobium tomentosum	1
	Grevillea bipinnatifida	5
	Hakea erinacea	10
	Hakea undulata	10
	Hibbertia hypericoides	10
	Hypocalymma sp.	<1
	Lepidosperma apricola	opp
	Lepidosperma sp.	1
	Leptospermum erubescens	15
	Melaleuca trichophylla	5
	Pimelea ?ciliata	1
	Platysace filiformis	<1
	Schoenus clandestinus	<1
	Stylidium brunonianum	<1
	Stylidium repens	1
	Styphelia tenuiflora	1
	Trymalium ledifolium var. rosmarinifolium	<1
	Xanthorrhoea preissii	20

Vegetation Sample Data

Lot 9 Brookton Highway Karragullen

Sample Name: R2

Project no.: EP20-040

Date: 27/05/2020, 02/06/2020, 11/09/2020

Status Non-permanent

Author: RAW,other

Quadrat and landform details

Sample type:	releve	Size:	N/A
NW corner easting:	417519.7128	NW corner northing:	6448566.196
Altitude (m):	330	Geographic datum/zone:	GDA94/Zone 50
Soil water content:	saturated	Landform:	hilltop
Time since fire:	0	Disturbance:	low -
Soil type/texture	clay/	Bare ground (%):	10
Rocks (%) and type:	40%, granite	Soil colour:	black/
Litter:	1% (leaves,twigs,)	Vegetation condition:	very good

Vegetation Sample Data

Lot 9 Brookton Highway Karragullen

Sample Name: R2

Project no.: EP20-040
Date: 27/05/2020, 02/06/2020, 11/09/ **Status** Non-permanent
Author: RAW,other R2: Page 2 of 2

Species Data

* denotes non-native species

Status	Confirmed name	Cover (%)
	Acacia ephedroides	
	Actinotus leucocephalus	
	Aphelia cyperoides	
	Borya sphaerocephala	
	Calytrix depressa	
	Centrolepis aristata	
	Cheilanthes austrotenuifolia	
	Drosera bulbosa subsp. bulbosa	
	Drosera gigantea	
	Drosera macrantha	
	Eriochilus helonomos	
	Goodenia trinervis	
	Lepidosperma ?scabrum	
	Millotia myosotidifolia	
	Philydrella pygmaea subsp. pygmaea	
*	*Sonchus oleraceus*	
	Sowerbaea laxiflora	
	Stackhousia pubescens	
	Stypandra glauca	
	Triglochin minutissima	
	Utricularia multifida	

Vegetation Sample Data

Lot 9 Brookton Highway Karragullen

Sample Name: Q3

Project no.: EP20-040

Date: 27/05/2020, 02/06/2020, 11/09/2020

Status Non-permanent

Author: RAW,other

Quadrat and landform details

Sample type:	quadrat	Size:	10 m x 10 m
NW corner easting:	417311.6459	NW corner northing:	6448518.058
Altitude (m):	316	Geographic datum/zone:	GDA94/Zone 50
Soil water content:	damp	Landform:	upper slope
Time since fire:	> 5 yrs	Disturbance:	low - fauna tracks
Soil type/texture	clay/sand	Bare ground (%):	1
Rocks (%) and type:	10%, laterite	Soil colour:	brown/orange
Litter:	90% (leaves,branches,twigs)	Vegetation condition:	very good

Vegetation Sample Data

Lot 9 Brookton Highway Karragullen

Sample Name: Q3

Project no.: EP20-040
Date: 27/05/2020, 02/06/2020, 11/09/ **Status** Non-permanent
Author: RAW,other Q3: Page 2 of 2

Species Data

* denotes non-native species

Status	Confirmed name	Cover (%)
	Acacia barbinervis	<1
	Acacia urophylla	<1
	Adenanthos barbiger	<1
	Allocasuarina fraseriana	20
	Banksia grandis	2
	Bossiaea aquifolium	25
	Clematis pubescens	<1
	Corymbia calophylla	2
	Daviesia decurrens	<1
	Drosera macrantha	<1
	Eucalyptus marginata	30
	Haemodorum sp.	<1
	Hibbertia commutata	opp
	Lagenophora huegelii	<1
	Lepidosperma apricola	<1
	Lomandra purpurea	<1
	Macrozamia fraseri	<1
	Microlaena stipoides subsp. stipoides	<1
	Patersonia umbrosa var. xanthina	<1
	Pentapeltis peltigera	<1
	Platysace filiformis	2
	Pterostylis vittata	<1
	Scaevola pilosa	<1
	Stylidium ?ciliatum	<1
	Stylidium amoenum	<1
	Styphelia tenuiflora	<1
	Trymalium ledifolium var. rosmarinifolium	<1
	Xanthorrhoea preissii	10

Vegetation Sample Data

Lot 9 Brookton Highway Karragullen

Sample Name: Q4

Project no.: EP20-040

Date: 27/05/2020, 02/06/2020, 11/09/2020

Status Non-permanent

Author: RAW,other

Quadrat and landform details

Sample type:	quadrat	Size:	10 m x 10 m
NW corner easting:	417618.704	NW corner northing:	6448263.249
Altitude (m):	322	Geographic datum/zone:	GDA94/Zone 50
Soil water content:	damp	Landform:	lower slope
Time since fire:	> 5 yrs	Disturbance:	moderate - tracks, historical clearing
Soil type/texture	sand/loam with organic layer	Bare ground (%):	20
Rocks (%) and type:	2%, laterite	Soil colour:	grey/
Litter:	80% (leaves,twigs,branches)	Vegetation condition:	very good

Vegetation Sample Data

Lot 9 Brookton Highway Karragullen

Sample Name: Q4

Project no.: EP20-040
Date: 27/05/2020, 02/06/2020, 11/09/ **Status** Non-permanent
Author: RAW,other Q4: Page 2 of 2

Species Data

* denotes non-native species

Status	Confirmed name	Cover (%)
	Acacia pulchella var. pulchella	1
	Bossiaea aquifolium	5
*	*Briza maxima*	<1
	Corymbia calophylla	40
	Drosera macrantha	<1
	Eucalyptus marginata	1
*	*Ficus carica*	<1
	Gompholobium polymorphum	<1
	Hibbertia commutata	<1
	Hibbertia hypericoides	5
	Kennedia coccinea	opp
	Lagenophora huegelii	<1
	Lepidosperma apricola	10
	Lepidosperma pubisquameum	1
	Leucopogon tenuis	opp
	Patersonia umbrosa var. xanthina	<1
	Phyllanthus calycinus	opp
	Scaevola pilosa	opp
	Thomasia foliosa	opp
	Trymalium ledifolium var. rosmarinifolium	5
	Xanthorrhoea gracilis	10
	Xanthorrhoea preissii	30

Vegetation Sample Data

Lot 9 Brookton Highway Karragullen

Sample Name: R5

Project no.: EP20-040

Date: 2/06/2020, 11/09/2020 **Status** Non-permanent

Author: RAW,other R5: Page 2 of 2

Quadrat and landform details

Sample type:	releve	Size:	N/A
NW corner easting:	417238.2957	NW corner northing:	6448130.535
Altitude (m):	N/A	Geographic datum/zone:	GDA94/Zone 50
Soil water content:	damp	Landform:	waterway
Time since fire:	3-5 yrs	Disturbance:	low -
Soil type/texture	clay/sand	Bare ground (%):	1
Rocks (%) and type:	10%, granite	Soil colour:	brown/
Litter:	20% (leaves,,)	Vegetation condition:	very good

Vegetation Sample Data

Lot 9 Brookton Highway Karragullen

Sample Name: R5

Project no.: EP20-040
Date: 2/06/2020, 11/09/2020 **Status** Non-permanent
Author: RAW,other

Species Data

* denotes non-native species

Status	Confirmed name
	Acacia ephedroides
	Astartea scoparia
	Corymbia calophylla
*	*Ficus carica*
	Lepidosperma longitudinale
	Lepidosperma sp.
	Taxandria linearifolia

Vegetation Sample Data

Lot 9 Brookton Highway Karragullen

Sample Name: R6

Project no.: EP20-040

Date: 27/05/2020, 02/06/2020, 11/09/2020

Status Non-permanent

Author: RAW,other

Quadrat and landform details

Sample type:	releve	Size:	N/A
NW corner easting:	417582.5071	NW corner northing:	6448523.403
Altitude (m):	N/A	Geographic datum/zone:	GDA94/Zone 50
Soil water content:	near saturated	Landform:	hilltop
Time since fire:	no evidence	Disturbance:	low -
Soil type/texture	clay/sand	Bare ground (%):	20
Rocks (%) and type:	10%, laterite	Soil colour:	brown/
Litter:	5% (leaves,twigs,)	Vegetation condition:	very good

Vegetation Sample Data

Lot 9 Brookton Highway Karragullen

Sample Name: R6

Project no.: EP20-040
Date: 27/05/2020, 02/06/2020, 11/09/ **Status** Non-permanent
Author: RAW,other

Species Data

* denotes non-native species

Status	Confirmed name
	Acacia ephedroides
	Babingtonia camphorosmae
	Borya sphaerocephala
	Calytrix depressa
	Conospermum huegelii
	Daviesia horrida
	Diuris corymbosa
	Drosera bulbosa subsp. bulbosa
	Grevillea bipinnatifida
	Grevillea manglesii subsp. manglesii
	Schoenus clandestinus
	Verticordia huegelii var. decumbens
	Verticordia plumosa

Vegetation Sample Data

Lot 9 Brookton Highway Karragullen

Sample Name: R7

Project no.: EP20-040

Date: 2/06/2020, 11/09/2020 **Status** Non-permanent

Author: RAW,other R7: Page 2 of 2

Quadrat and landform details

Sample type:	releve	Size:	N/A
NW corner easting:	417291.4039	NW corner northing:	6448158.248
Altitude (m):	N/A	Geographic datum/zone:	GDA94/Zone 50
Soil water content:	near saturated	Landform:	depression
Time since fire:	no evidence	Disturbance:	low -
Soil type/texture	clay/sand	Bare ground (%):	1
Rocks (%) and type:	No rocks	Soil colour:	brown/
Litter:	5% (leaves,,)	Vegetation condition:	very good

Vegetation Sample Data

Lot 9 Brookton Highway Karragullen

Sample Name: R7

Project no.: EP20-040

Date: 2/06/2020, 11/09/2020 **Status** Non-permanent

Author: RAW,other

Species Data

* denotes non-native species

Status	Confirmed name
	Baumea rubiginosa
	Lepidosperma longitudinale
	Taxandria linearifolia