Detailed Flora and Vegetation Assessment

Middle Swan Brickworks

Project No: EP19-105(07)

Prepared for Linc Property Pty Ltd
November 2019

Document Control

Doc name:	**Detailed Flora and Vegetation Assessment Middle Swan Brickworks**				
Doc no.:	**EP19-105(01)--001 RAW**				
Version	**Date**	**Author**		**Reviewer**	
1	November 2019	Rachel Weber	RAW	Tom Atkinson	TAA
	Report prepared for client review				

Executive Summary

Linc Property Pty Ltd (Linc) engaged Emerge Associates (Emerge) to undertake a detailed flora and vegetation survey within the current Middle Swan Brickworks in Middle Swan (referred to herein as 'the site'). The site, which is approximately 83.36 hectares (ha) in size, is adjacent to the Swan River within the City of Swan.

A botanist from Emerge Associates visited the site on 18 September and 8 October 2019 to conduct the field survey. During the survey an assessment was made on the type, condition and values of vegetation across the site.

Outcomes of the survey include the following:

- The site has been subject to intensive historical and ongoing disturbance.
- A total of 100 native and 56 non-native (weed) species were recorded in the site.
- No threatened or priority flora species were recorded within the site and none are considered likely to occur.
- Non-native vegetation, bare ground and an inundated clay pit occur across 59.27 ha (71%) of the site.
- The highest quality vegetation exists in the central southern portion of the site. Plant communities **ApMtS, Cc** and **ErC** extend over 1.4 ha and are in 'very good', 'excellent - very good' and 'excellent' condition.
- Plant communities **Er** and **ErJsBh** also exist in the central southern portion and comprise 3.43 ha of vegetation in 'degraded' and 'good' condition.
- The remaining 18.82 ha of the site supports vegetation in 'degraded' condition.
- The **ApMtS** and **Cc** vegetation represents a 0.93 ha patch of the 'SCP3c *Corymbia calophylla* - *Xanthorrhoea preissii* woodlands and shrublands, Swan Coastal Plain' TEC, which is listed as 'endangered' under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and 'critically endangered' in WA.

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Abbreviation Tables

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

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*

Table A4: Abbreviations – planning

Planning terms	
MRS	Metropolitan region scheme
LPS	Local planning scheme

Table A5: Abbreviations – units of measurement

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

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1 Introduction

1.1 Project background

Linc Property Pty Ltd (Linc) intends to develop what is currently the Middle Swan Brickworks in Middle Swan for residential purposes. The brickworks comprises multiple Lot 15, 87, 103, 104 Great Northern Highway, Lot 6 Bassett Road, Lot 72 Eveline Road, Lot 23 Winston Crescent, Lot 9000 Cranwood Crescent and multiple smaller undeveloped lots on Winston Crescent and Somerset Street which are referred to herein as 'the site' as shown in **Figure 1**.

The site is located approximately 17 kilometres (km) north east of the Perth Central Business District within the City of Swan and is zoned 'industrial', 'rural' and 'urban' under the Metropolitan Region Scheme (MRS) and 'general industrial', 'light industrial', 'local road' and 'residential development' under the City of Swan's *Local Planning Scheme* (LPS) No. 17.

The site is approximately 82.92 hectares (ha) in size and is bound by the Swan River to the north west, Reid Highway to the north, Great Northern Highway and Leslie Road to the east, Eveline Road and parklands to the south east and Cranwood Crescent to the west.

1.2 Purpose and scope of work

Emerge Associates (Emerge) were engaged by Linc to provide environmental consultancy services to support the planning process for 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 with 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 793.7 millimetres (mm) of rainfall is recorded annually from the Midland weather station, which is the closest weather station, located approximately 240 m east of the site (BoM 2019). The majority of this rainfall is received between the months of May and August. Mean maximum temperatures at the Perth Airport weather station, which is the closest temperature recording station from the site approximately 6 km south west of the site, range from 18.0^{o}C in July to 31.9^{o}C in February, while mean minimum temperatures range from 8.0^{o}C in July to 17.5^{o}C in February (BoM 2019).

A total of 374 mm of rain was recorded from May to August 2019 prior to the survey, of which June was above the average and the other months were below the average (BOM 2019).

2.2 Geomorphology and soils

Landform and soils influence vegetation types at regional and local scales. The site occurs on the Swan Coastal Plain, which is the geomorphic unit that characterises much of the Perth metropolitan area.

The Swan Coastal Plain is approximately 500 km long and 20 to 30 km wide and is roughly bound by the Indian Ocean to the west and the Darling Scarp to the east. Broadly the Swan Coastal Plain consists of two sedimentary belts of different origin. Its eastern side comprises the Pinjarra Plain, which formed from the deposition of alluvial material washed down from the Darling Scarp, while its western side is comprised of three dune systems that run roughly parallel to the Indian Ocean coastline (Seddon 2004).

Examination of broad scale soil mapping places the site in the Pinjarra Plain within the Swan complex, which occurs along watercourses. The site is very close to the Guildford complex which also lies on the Pinjarra Plain and comprises clays and silts on a flat to gently undulating plain (Churchward and McArthur 1980).

Detailed DMIRS (2018) soil mapping shows that the site comprises the following soil types:

- 'Mc1-clayey silt' in the north western portion, which comprises 'yellow brown to strong brown, blocky, mottled, soft, with variable clay content, dispersive in part, of alluvial origin'
- Mgs1-pebbly silt' across the remainder of the site, which comprises 'strong brown silt with common, fine to occasionally coarse-grained, sub-rounded laterite quartz, heavily weathered granite pebble, some fine to medium-grained quartz sand, of alluvial origin'.

The soil types mapped within and adjacent to the site are shown in **Figure 2**.

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

2.3 Topography

The elevation of the site ranges from 15 m in relation to the Australian height datum (mAHD) on the south-western side of the site to 0 m mAHD on towards the Swan river in the western portion 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 2017d)
- *A Directory of Important Wetlands in Australia* (DBCA 2018a).

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 that a perennial lake occurs in the central northern portion of the site and three separate watercourses ('major, perennial') occur in the central northern, northern and central southern portions of the site. The locations of the mapped hydrography features in and near the site is shown in **Figure 3**.

On the Swan Coastal Plain DBCA (2017c) have used the geomorphic wetland classification system developed by Semeniuk (1987) and Semeniuk and Semeniuk (1995) to classify wetlands based on the landform shape and water permanence (hydro-period). The Department of Biodiversity, Conservation and Attractions (DBCA) maintains the *Geomorphic Wetlands of the Swan Coastal Plain* dataset (DBCA 2018b), which further categorises geomorphic wetland features into specific management categories to guide land use and conservation. Note that as this dataset was drafted at

a regional scale the boundaries of mapped wetland features are often inconsistent with physical wetland boundaries.

A review of the *Geomorphic Wetlands, Swan Coastal Plain* dataset (DBCA 2018b) indicated that one 'conservation' category wetland feature, UFI 14356, occurs adjacent to and partially within the western portion of the site. This feature is the Swan River which extends beyond the site to the north and south west. Multiple additional wetland features (UFIs 15136, 12513, 13407, 8945, 12510, 12512, 13407) occur within close proximity to the site. Six of these features are classified as 'multiple use' category wetlands and one is classified as a 'conservation' category wetland.

The locations of the geomorphic wetlands in and near the site is shown in **Figure 3.**

2.5 Regional vegetation

Native vegetation is described and mapped at different scales in order to illustrate patterns in its distribution. At a continental scale the *Interim Biogeographic Regionalisation of Australia* (IBRA) divides the Swan Coastal Plain into two floristic subregions (Environment Australia 2000). The site is contained within the 'SWA02' or Perth subregion, which is characterised as mainly containing *Banksia* low woodland on leached sands with *Melaleuca* swamps where ill-drained; and woodland of *Eucalyptus gomphocephala* (tuart), *E. marginata* (jarrah) and *Corymbia calophylla* (marri) on less leached soils (Beard 1990). This subregion is recognised as a biodiversity hotspot and contains a wide variety of endemic flora and vegetation types.

Variations in native vegetation within the site can be further classified based on regional vegetation associations. Heddle *et al.* (1980) mapping shows the majority of the site as comprising the 'Swan complex', which is described as 'fringing woodland of *Eucalyptus rudis* and *Melaleuca rhaphiophylla* with localised occurrence of low open forest of *Casuarina obesa* and *Melaleuca cuticularis'*.

Beard *et al.* (2013) mapping shows the site comprises vegetation association 'Pinjarra_1009'. This association is described as 'woodland of *Corymbia calophylla* and *Eucalyptus rudis*' (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). However, a lower objective of 10% is applied in 'constrained urban areas' such as the Swan Coastal Plain (Ministry for Planning 1995). The percentage protected for conservation of the 'Swan complex' and the 'Pinjarra_1009' association fall below the 30% retention objective.

The 'Swan complex' was determined to have 13.84% of its pre-European extent remaining in 2013, of which 0.56% is under formal protection (PBP 2013). The 'Pinjarra_1009' association has 16.37% of its pre-European extent remaining on the Swan Coastal Plain with 0.02% protected for conservation purposes (Government of Western Australia 2018). Therefore, both of these complexes fall below the 10% retention objective.

2.6 Historic land use

Review of historical images available from 1953 (WALIA 2019) onwards shows that the majority of the site was cleared of native vegetation prior to 1953, likely for grazing and subsequently brickworks.

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 approval from the Commonwealth Minister for the Environment and Energy.

In Western Australia flora species may also be classed as 'threatened' under the *Biodiversity Conservation Act 2016* (BC Act). 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 (DoEE 2019b). '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 approval from the Commonwealth Minister for the Environment and Energy.

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.

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

- The vegetation is associated with the Swan River.
- The vegetation has potential value as habitat for threatened or priority fauna species including, in particular, Carnaby's black cockatoo and the forest red-tailed black cockatoo, which are listed as 'vulnerable' under the EPBC Act and 'endangered' under the BC Act.
- Listed as significant in the City of Swan *Local Biodiversity Strategy* document (City of Swan 2005).
- Listed in *Bush Forever* 'significant flora' list for region.

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) (DoEE 2019c). 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 Bush Forever

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

Bush Forever Site 302 'Swan River and Jane Brook, Ashfield to Upper Swan', extends into the north western portion of the site. This *Bush Forever* site is associated with the Swan River and extends beyond the site. The location of the part of Bush Forever Site 302 within the site is shown in **Figure 4**.

2.9 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).

One ESA occurs in a small area of the north western portion of the site. This ESA appears to be associated with the Swan River and extends beyond the site. The location of this ESA is shown in **Figure 4**.

2.10 DBCA legislated lands and water

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.

The site is not mapped as occurring within DBCA legislated lands and water. The Swan River adjacent to the site is mapped as being subject to the *Swan and Canning Rivers Management Act 2006*.

2.11 Local natural areas

The City of Swan's *Local Biodiversity Strategy* identifies 'potentially significant local natural areas' (PSLNAs) that are prioritised based on a range of ecological criteria (City of Swan 2005). This document identifies three patches of native vegetation within the site as lower priority PSLNAs, meeting up to nine of the prioritisation criteria. Vegetation along the Swan River adjacent to the site appears to meet up to 13 of the prioritisation criteria but it is difficult to determine whether these patches are within the site. The highest priority PSLNAs meet 15-20 of the criteria.

2.12 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).

One ecological linkage, no. 35, occurs in the north western portion of the site. This linkage appears to be associated with the Swan River and extends beyond the site. The location of this linkage is shown in **Figure 4**.

2.13 Previous surveys

Strategen JBS&G undertook a flora, vegetation and fauna survey of the south eastern portion of the site in April and May 2019, prior to the current survey (Strategen JBS&G 2019). Four 'vegetation types' and two types of planted vegetation were recorded, with the remainder of the site mapped as 'cleared'. Using the Keighery (1994) scale the majority of the site was mapped as being in 'completely degraded' condition with a small portion in 'degraded' condition. No threatened or priority species or communities were recorded in 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* (DoEE 2019a), *NatureMap* (DBCA 2019) and DBCA's threatened and priority flora database (reference no. 47-0919FL).

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* (DoEE 2019a), the *weed and native flora dataset* (Keighery *et al.* 2012) and a five km buffer of the site using DBCA's threatened and priority ecological communities' databases (reference no. 17-01019EC). DBCA advised that a 5 km buffer was an appropriate size for the community database search.

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 was recorded during the current field survey.
- Likely: the species has been previously recorded in the site.
- Possible: suitable habitat for the species may occur in the site.
- Unlikely: no suitable habitat for the species is present within the site.

3.2 Field survey

A botanist from Emerge visited the site on 18 September and 8 October 2019 to conduct the flora and vegetation survey.

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, comprising four quadrats and three relevés. The position of each sample location was recorded with a hand-held GPS unit, as shown in **Figure 5.**

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 1: Vegetation condition scale applied during the field assessment

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

3.3 Mapping and data analysis

3.3.1 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 Floristic community type assignment

The identified plant communities were then compared to the regional 'floristic community type' (FCT) dataset *A floristic survey of the southern Swan Coastal Plain* by Gibson *et al.* (1994). The sample data (presence/absence) was reconciled with Gibson *et al*. (1994) by standardising the names of taxa with those used in the earlier study. This was necessary due to changes in nomenclature in the intervening period. Taxa that were only identified to genus level were excluded, while some infra-species that have been identified since 1994 were reduced to species level. The combined dataset was then imported into the statistical analysis package PRIMER v6 (Clarke and Gorley 2006). As data from a localised survey is often spatially correlated, data for each sample was compared to Gibson *et al.* (1994) separately. This removed the influence of spatial correlation when assigning a FCT. Classification was then undertaken using a group-average hierarchical clustering technique using the Bray-Curtis distance measure (as described above for plant community determination).

Where the sample tended to cluster with a grouping of different FCTs, samples were assessed separately to differentiate between FCTs. Ultimately the cluster analysis, as well as contextual information relating to the soils, landforms and known locations of FCTs within the region, was considered in the final determination of an FCT for vegetation within the site.

3.3.3 Threatened and priority ecological communities

Areas of native vegetation potentially representing a TEC were assessed against key diagnostic characteristics and, if available, size and/or vegetation condition thresholds provided in the following documents (where applicable):

- *Approved Conservation Advice for Corymbia calophylla - Kingia australis woodlands on heavy soils of the Swan Coastal Plain* (DoEE 2017a)
- *Approved Conservation Advice for Corymbia calophylla - Xanthorrhoea preissii woodlands and shrublands of the Swan Coastal Plain* (DoEE 2017b).

3.3.4 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 2**.

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

Constraint	Degree of limitation	Details
Availability of contextual information	No limitation	The broad scale contextual information described in **Section 2** is adequate to place the site and vegetation in context.
		The previous survey provided limited information on the flora and vegetation values within the site.
	Minor limitation	Regarding assignment of FCTs, the authoritative Gibson *et al.* (1994) dataset was derived from a necessarily limited sample of vegetation from largely publicly owned land which is now more than 20 years out of date. Consequently, it is unknown to what degree official FCTs are appropriate reference to biodiverse vegetation across the Swan Coastal Plain. Furthermore, Gibson *et al.* (1994) collected data in the spring main flowering period and in many cases sampled plots multiple times to provide a complete species list. This survey sampled the vegetation twice within the main flowering period and FCT assignment was conclusive for the majority of the higher quality vegetation in the site. FCT assignment was inconclusive for one plant community but an indicative FCT was able to be assigned.
Experience level of personnel	No limitation	This flora and vegetation assessment was undertaken by a qualified botanist with over eight years of botanical experience in Western Australia. Technical review was undertaken by a senior environmental consultant with 16 years' experience in environmental science in Western Australia.
Suitability of timing	No limitation	The survey was conducted in September and October and thus within the main flowering season. Adequate rainfall was recorded in the months preceding the site visit and many plant species were 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 (within areas of suitable habitat).
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 two times in spring 2019. 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.

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

Constraint	Degree of limitation	Details
Sampling intensity	Minor limitation	A total of 156 species were recorded, of which 113 were recorded from seven sample locations and 43 were recorded opportunistically. Minimum species richness within site is estimated at between 178 (Jacknife1) and 305 (Chao2) species (refer species accumulation curve and estimates shown in **Plate 12**). The number of species recorded in the site is between 51 and 88% of the estimated species in the site. However, the small size of the higher quality patches of vegetation, combined with the degraded nature of the majority of the site, indicates that it is unlikely that 178-305 species exist in the site. The survey effort is considered adequate to prepare a representative 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.
	No limitation	Historical ground disturbance was evident across much 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 site is flat except for the north western boundary where it slopes steeply down to the Swan River. The slope of the river bank varies from gentle in the northern and southern portions where the bank is wider, to very steep in the central portion where it is more narrow. The river bank has been subject to erosion along the majority of the waterline. Clay soils are present across the site.

The majority of the site has been subject to long term repeated historical disturbance due to its use as a brickworks and has been devoid of native vegetation for more than 60 years. Planted and opportunistic flora species occur in these areas, particularly planted trees such as *Eucalyptus camaldulensis* (river-red gum). Native plants are scattered amongst the non-native vegetation, and it is uncertain whether they have been planted or have regenerated naturally.

The central southern portion of the site appears to have been subject to lower levels of disturbance and supports native vegetation. This includes areas of high quality intact native vegetation as well as patches of disturbed vegetation with native trees over non-native shrubs and grasses.

The portion of the Swan River foreshore that occurs in the site has been subject to disturbance and is dominated by non-native vegetation. Scattered native species occur primarily along the edge of the banks, with one area of native shrubland recorded.

4.2 Flora

4.2.1 Desktop assessment

The database search results identified a total of 27 threatened and 47 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 existing information available for the site, 19 threatened flora species and 31 priority flora species were identified as having potential to occur within the site as shown in **Table 3**.

Table 3: Conservation significant flora species considered to have potential to occur in the site

Species	Level of significance		Life strategy	Habitat	Flowering period	Likelihood of occurrence
	State	EPBC Act				
Synaphea sp. Fairbridge Farm	T	CE	P	Low woodland on grey, clayey sand with lateritic pebbles (Pinjarra Plain) near winter wet flats.	Sep - Nov	Possible
Synaphea sp. Pinjarra Plain	T	CE	P	White grey clayey sand on edges of seasonally inundated low lying areas.	Sep-Oct	Possible
Andersonia gracilis	T	E	P	Seasonally damp, black sandy clay flats near or on the margins of swamps.	Sep-Nov	Possible
Caladenia huegelii	T	E	P	Well-drained, deep sandy soils in lush undergrowth in a variety of moisture levels.	Sep-early Nov	Possible
Calytrix breviseta subsp. *breviseta*	T	E	P	Seasonally wet sandy-clay soil on swampy flats	Oct-Nov	Possible
Diuris purdiei	T	E	P	Sand to sandy clay soils in areas subject to winter inundation.	Sep-Oct, only after a fire	Possible
Drakaea elastica	T	E	P	Bare patches of sand within otherwise dense vegetation in low-lying areas alongside winter-wet swamps.	Sep-Oct (survey Jul-Aug)	Possible
Grevillea curviloba subsp. *incurva*	T	E	P	Sand, sandy loam. Winter-wet heath.	Aug-Sep.	Possible
Lepidosperma rostratum	T	E	P	Peaty sand and clay amongst low heath, in winter-wet swamps.	May-Jun (survey Jun-Aug)	Possible
Macarthuria keigheryi	T	E	P	Low-lying winter-wet damp gey/white sands in open patches.	Sep-Dec/Feb-Mar	Possible
Trithuria occidentalis	T	E	A	Partly submerged on the edge of shallow winter-wet clay pans in very open shrubland.	Oct-Nov	Possible
Acacia anomala	T	V	P	Shallow sand,loam,clay or gravel	Aug-Sep	Possible
Anigozanthos viridis subsp. *terraspectans*	T	V	P	Grey sand, clay loam. Winter-wet depressions.	Aug-Sep	Possible
Chamelaucium sp. Gingin	T	V	P	White yellow sand in low woodland.	Sep-Dec	Possible
Conospermum undulatum	T	V	P	Sand and sandy clay soils, on flat or gently sloping sites between the Swan and Canning Rivers	May-Oct	Possible
Diuris drummondii	T	V	P	In low-lying depressions in peaty and sandy clay swamps.	Nov-Jan	Possible

Table 3: Conservation significant flora species considered to have potential to occur in the site (continued)

Species	Level of significance		Life strategy	Habitat	Flowering period	Likelihood of occurrence
	State	EPBC Act				
Diuris micrantha	T	V	P	Dark grey-black sandly clay-loam in winter wet depressions or swamps. Often in shallow standing water.	Aug/Sep-early Oct	Possible
Drakaea micrantha	T	V	P	Open sandy patches often adjacent to winter-wet swamps.	Sept- early Oct	Possible
Eleocharis keigheryi	T	V	P	Clay or sandy loam in freshwater creeks and transient waterbodies such as seasonally wet clay pans.	Aug-Dec	Possible
Bolboschoenus fluviatilis	P1	-	P	Floodplain with grey/brown wet sand.	Nov	Possible
Hydrocotyle striata	P1	-	A	Sand and clay in springs and creeklines.	Nov	Possible
Levenhookia preissii	P1	-	A	Grey or black, peaty sand. Swamps	Sep-Dec or Jan	Possible
Senecio gilbertii	P1	-	P	Peaty sand in swamps and on slopes.	Sep-Nov	Possible
Stachystemon sp. Keysbrook	P1	-	P	White grey sand.	Oct	Possible
Lepyrodia curvescens	P2	-	P	Sand, laterite. Seasonally inundated swampland.	Sep-Nov	Possible
Phyllangium palustre	P2	-	A	Winter-wet claypans, low-lying seasonal wetlands on clay	Oct-Nov	Possible
Byblis gigantea	P3	-	P	Sandy-peat swamps. Seasonally wet areas.	Sep-Jan	Possible
Carex tereticaulis	P3	-	P	Black peaty sand.	Sep-Oct	Possible
Cyathochaeta teretifolia	P3	-	P	Grey sand, sandy clay in swamps and creek edges.	Oct-Jan	Possible
Eryngium sp. Subdecumbens	P3	-	P	Claypans	Sep-Jan	Possible
Halgania corymbosa	P3	-	P	Gravelly soils, soils over granite.	Aug-Nov	Possible
Isopogon drummondii	P3	-	P	Yellow/white sand	Feb-Jun	Possible
Lasiopetalum glutinosum subsp. *glutinosum*	P3	-	P	Brown clay loam on slopes	Sep-Dec	Possible
Meionectes tenuifolia	P3	-	P	Clay loam in seasonally wet areas.	Oct-Dec	Possible
Myriophyllum echinatum	P3	-	A	Clay in winter-wet flats.	Nov	Possible
Platysace ramosissima	P3	-	P	Sandy soils.	Oct-Nov	Possible
Schoenus capillifolius	P3	-	A	Brown mud in claypans	Oct-Nov	Possible
Schoenus sp. Waroona	P3	-	A	Clay or sandy clay. Winter-wet flats.	Oct-Nov	Possible

Table 3: Conservation significant flora species considered to have potential to occur in the site (continued)

Species	Level of significance		Life strategy	Habitat	Flowering period	Likelihood of occurrence
	State	EPBC Act				
Sporobolus blakei	P3	-	P	Red sandy clay, loam. Creeks.	Mar or Jun to Jul	Possible
Verticordia serrata var. *linearis*	P3	-	P	White sand, gravel	Sep-Oct	Possible
Anigozanthos humilis subsp. *chrysanthus*	P4	-	P	Grey or yellow sand	Jul-Oct	Possible
Calothamnus accedens	P4	-	P	Sandy soils over laterite.	Sep-Jan	Possible
Drosera occidentalis	P4	-	P	Sand over clay, seasonally wet areas	Oct-Dec/Jan	Possible
Hydrocotyle lemnoides	P4	-	A	Swamps	Aug-Oct	Possible
Lasiopetalum bracteatum	P4	-	P	Sandy clay, clay, lateritic gravel along drainage lines, creeks, gullies, granite outcrops.	Aug-Nov	Possible
Ornduffia submersa	P4	-	A	Sandy clay in inundated wetland/creek.	Aug-Nov	Possible
Schoenus griffinianus	P4	-	P	White sand	Sep-Oct	Possible
Stylidium longitubum	P4	-	A	Seasonal wetlands.	Oct-Dec	Possible
Thysanotus glaucus	P4	-	P	White, grey or yellow sand, sandy gravel.	Oct-Mar	Possible
Verticordia lindleyi subsp. *lindleyi*	P4	-	P	Sand and sandy clay in winter wet areas.	May or Nov-Jan	Possible

4.2.2 Species inventory

A total of 100 native and 56 non-native (weed) species were recorded within the site during the field survey, representing 46 families. The dominant families containing native taxa were Myrtaceae (14 native and eight non-native taxa), Cyperaceae (12 native and two non-native taxa), Fabaceae (11 native and seven non-native taxa) and Proteaceae (10 native taxa only).

Of the species recorded 113 were recorded in sample locations and 43 were recorded opportunistically.

A complete species list is provided in **Appendix C**.

4.2.3 Threatened and priority flora

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

The survey timing was considered suitable to search for threatened and priority flora species identified as potentially occurring in the site (refer **Section 4.2.1**). Therefore, no threatened and priority flora species are considered to occur in the site.

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 a declared pests (C3) pursuant to the BAM Act, **Chrysanthemoides monilifera* subsp. *monilifera* (boneseed) and *Gomphocarpus fruticosus* (narrowleaf cottonbush), was recorded within the site. Boneseed was restricted to the central southern portion of the site within plant community **ErJsBh** (refer Section **4.3.2**). Narrowleaf cottonbush was scattered throughout the site.

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

4.3 Vegetation

4.3.1 Desktop assessment

The database search results identified 10 TECs and two PECs occurring or potentially occurring within a 5-10 km radius of the site. Information on these communities is provided in **Appendix D**.

Based geomorphology, soils and regional vegetation patterns, three TECs are considered to potentially occur in the site:

- '*Corymbia calophylla - Kingia australis* woodlands on heavy soils, Swan Coastal Plain' TEC which is listed as 'endangered' under the EPBC Act and 'critically endangered' under the BC Act.
- '*Corymbia calophylla - Xanthorrhoea preissii* woodlands and shrublands, Swan Coastal Plain' TEC which is listed as 'endangered' under the EPBC Act and 'critically endangered' under the BC Act.
- 'Clay pans of the Swan Coastal Plain' TEC which is which is listed as 'critically endangered' under the EPBC Act and 'vulnerable' or 'endangered' under the BC Act, depending on the vegetation type.

4.3.2 Plant communities

Ten plant communities and one non-native/cleared community were identified within the site.

Plant communities **ApMtS, Cc**, **Er**, **ErC**, and **ErJsBh** occur in the central southern portion of the site and support native vegetation. Plant communities **ErCo** and **M** exist in the north western portion of the site along the Swan River foreshore. Plant community **Ec** exists in the north eastern and south western portions of the site, with **Ew** and **VjMc** lying within the south western portion. The remainder of the site supports 'non-native vegetation' which includes scattered native plants and bare ground. An inundated clay pit (water body) occurs in the northern portion of the site, extending over 1.81 ha.

A description and the area of each plant community is provided in **Table 4** and representative photographs of each are provided in **Plate 1** to **Plate 11**. The location of each plant community is shown in **Figure 5** and raw sample data in **Appendix E**.

Table 4: Description and extent of plant communities identified within the site

Plant community	Description	Area (ha)
ApMtS	Shrubland *Acacia pulchella* var. *pulchella, Hakea undulatum* and *Hypocalymma angustifolium* over sedgeland *Mesomelaena tetragona* over open grassland *Neurachne alopecuroidea* over herbland *Stylidium* spp. (**Plate 1**).	0.22
Cc	Open forest *Corymbia calophylla* over shrubland *Hibbertia sp.* and *Xanthorrhoea preissii* over open sedgeland *Cyathochaeta avenacea* and *Mesomelaena tetragona* over open herbland *Agrostocrinum hirsutum* over open grassland **Eragrostis curvula* (**Plate 2**).	0.71
Ec	Woodland to tall shrubland of various planted species, particularly *Eucalyptus camaldulensis*, with scattered *E. rudis* over shrubland *Genista linifolia* and *Melaleuca viminea* over closed non-native grassland with occasional scattered *Rytidosperma setaceum* (**Plate 3**).	14.50
Er	Woodland to open forest *Eucalyptus rudis* over non-native shrubland (or absent) over closed non-native grassland (**Plate 4**)	3.05
ErC	Open forest *Eucalyptus rudis* over closed sedgeland *Carex* sp. (**Plate 5**)	0.47
ErCo	Woodland to open woodland *Eucalyptus rudis*, *Casuarina obesa*, **Eucalyptus* spp. and various non-native species over tall shrubland **Olea europaea* over non-native grassland and/or herbland (**Plate 6**).	3.72
ErJsBh	Woodland *Eucalyptus rudis* over tall shrubland *Jacksonia sternbergiana* over shrubland *Billardiera heterophylla* and *Phyllanthus calycinus* and *Hakea* spp. over closed non-native grassland (**Plate 7**).	0.38
Ew	Woodland *Eucalyptus wandoo* over open non-native grassland (**Plate 8**).	0.34
M	Open woodland *Eucalyptus rudis* and *Casuarina obesa* (along river) over shrubland *Melaleuca* spp. and *Hakea* spp. over closed non-native herbland *Fumaria capreolata* over closed non-native grassland (**Plate 9**).	0.32
VjMv	Woodland *Eucalyptus rudis* and *E. camaldulensis* over shrubland *Viminaria juncea, Melaleuca viminea* and *Acacia lasiocarpa* over closed grassland *Themeda triandra* and **Eragrostis curvula* (**Plate 10**).	0.38
Non-native/cleared	Heavily disturbed areas comprising planted non-native trees and shrubs over non-native herbs and grasses, with occasional native shrubs and forbs (**Plate 11**).	57.46

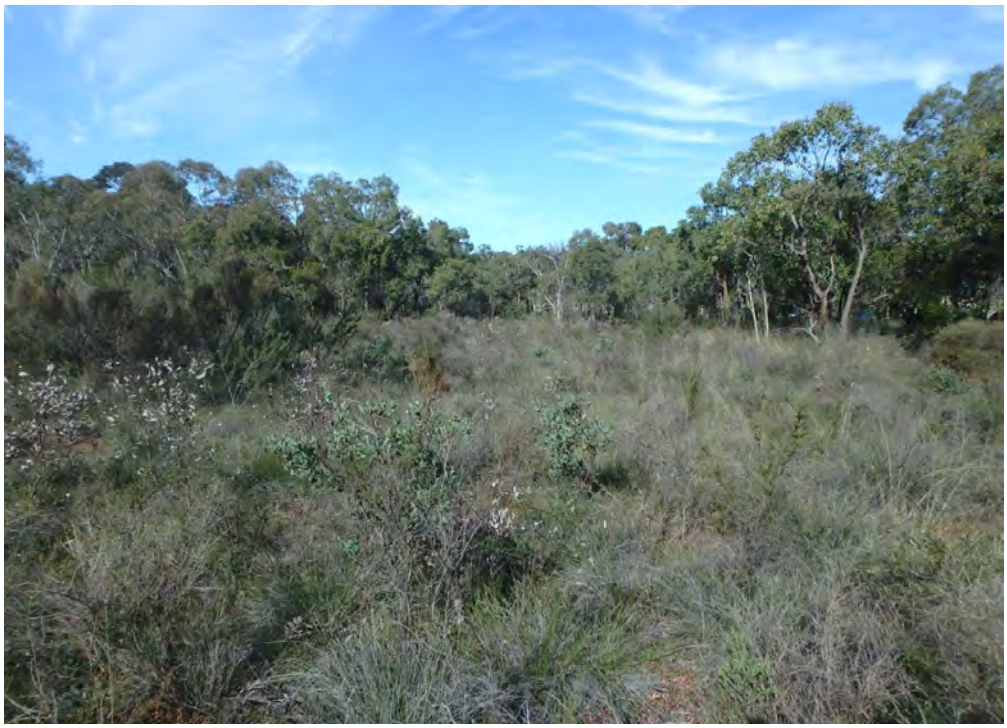

*Plate 1: Plant community **ApMtS** in 'excellent' condition (Q3).*

*Plate 2: Plant community **Cc** in 'very good' condition.*

*Plate 3: Plant community **Ec** in 'degraded' condition.*

*Plate 4: Plant community **Er** in 'degraded' condition.*

*Plate 5: Plant community **ErC** in 'excellent - very good' condition.*

*Plate 6: Plant community **ErCo** in 'degraded' condition.*

*Plate 7: Plant community **ErJsBh** in 'good' condition.*

*Plate 8: Plant community **Ew** in 'degraded' condition.*

*Plate 9: Plant community **M** in 'degraded' condition.*

*Plate 10: Plant community **VjMv** in 'good - degraded' condition.*

Plate 11: Non-native/cleared community in 'completely degraded' condition.

4.3.3 Vegetation condition

The most intact native vegetation is located in the southern portion of the site within plant communities **ApMtS**, **Cc** and **Erc**. Plant community **ApMtS** was mapped as being in 'excellent' condition as the structure was intact and weed cover and diversity was low. Plant community **Erc** were mapped as being in 'excellent – very good' condition as it had low weed species diversity and cover but the structure showed evidence of potential disturbance. Plant community **Cc** was mapped as being in 'very good' condition as the structure was mostly intact and grassy weeds were present at low to moderate cover.

Plant community **VjMv** was mapped as being in 'good – degraded' condition as it supported moderate native species diversity but disturbance was evident with an altered structure and high cover of grassy weeds.

The other plant communities in the site were mapped as being in 'degraded' condition as their structure had been significantly impacted by disturbance and weed cover was high.

The non-native vegetation, including buildings and hardstand, was mapped as being in 'completely degraded' condition.

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

Table 5: Extent of vegetation condition categories within the site

Condition category (Keighery 1994)	Size (ha)
Pristine	0
Excellent	0.22
Excellent - very good	0.47
Very good	0.71
Good	0.38
Good - degraded	0.38
Degraded	21.93
Completely degraded	57.46

4.3.4 Floristic community types

Plant communities **ApMtS** and **Cc** were determined to represent FCT 3a '*Corymbia calophylla* - *Xanthorrhoea preissii* woodlands and shrublands'. This FCT is listed as 'poorly reserved' and 'vulnerable' by Gibson *et al.* (1994). The one sample from **ApMtS** and the two samples from **Cc** grouped with Gibson *et al.* (1994) sites representing FCT 3c with 34-48% similarity (**Table 6**). The relevant portions of the cluster dendrograms showing Q1, Q2 and Q3 are provided in **Appendix F**.

Floristic analysis of Q4 within plant community **ErC** was inconclusive, with weak similarity to multiple Gibson *et al.* (1994) sites representing FCT 15 'forests and woodlands of deep seasonal wetlands' (16% similarity). Based on species and soil type, **ErC** is considered likely to represent either FCT 15 or FCT 13 'deeper wetlands on heavy soils'. FCT 15 is listed as 'well reserved' and 'vulnerable' and FCT 13 is listed as 'well reserved' and 'low risk' by Gibson *et al.* (1994).

Other plant communities in the site were considered too degraded and/or altered to assign to an FCT.

Table 6: Plant community and likely FCT represented within the site for each sample.

Plant community	Sample unit	Most similar Gibson *et al.* (1994) sites	Similarity (%)	Most likely floristic community type (FCT)	Reservation and conservation status (Gibson *et al.* 1994)
ApMtS	**Q1**	PEARCE-2 (FCT3c)	48	FCT 3c: *Corymbia calophylla* - *Xanthorrhoea preissii* woodlands and shrublands	Poorly reserved Vulnerable
Cc	**Q2**	DUCK-1 (FCT 3c) DUCK-2 (FCT 3c)	36		
	Q3	DUCK-1 (FCT 3c) DUCK-2 (FCT 3c)	34		

4.3.5 Threatened and priority ecological communities

FCT 3c is directly linked to the TEC 'SCP3c *Corymbia calophylla* - *Xanthorrhoea preissii* woodlands and shrublands, Swan Coastal Plain'. This TEC, herein referred to as the SCP3c TEC, is 'critically

endangered' in WA and 'endangered' under the EPBC Act. A total of 0.93 ha of the SCP3c TEC occurs in the site.

No condition thresholds apply to the SCP3c TEC due to its 'very restricted distribution' (DoEE 2017b).

No other TECs or PECs occur within the site.

4.3.6 Locally and regionally significant vegetation

A small number of mature *Eucalyptus wandoo* (wandoo) and *Eucalyptus rudi*s (flooded gum) trees (diameter at breast height larger than 500 mm), including some with hollows, are present in the western and north western portions of the site. These trees have the potential to provide foraging, roosting and/or nesting habitat for black cockatoos along with other ecological services.

4.4 Species richness and sampling adequacy

A total of 113 species were recorded from seven samples. A species accumulation curve derived from sample data is presented in **Plate 12.** 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 178 (Jacknife1) and 305 (Chao2). Based on the trend of the species accumulation curve approximately 20 to 30 samples would be required to capture that many species. Including the 43 additional species recorded opportunistically, a total of 156 species was recorded in the site. This indicates that between 51 and 88% of the estimated 178-305 species in the site were recorded. Considering the degraded nature of the majority of the site and the time spent sampling the vegetation, the survey effort was considered to be adequate to prepare a representative species inventory.

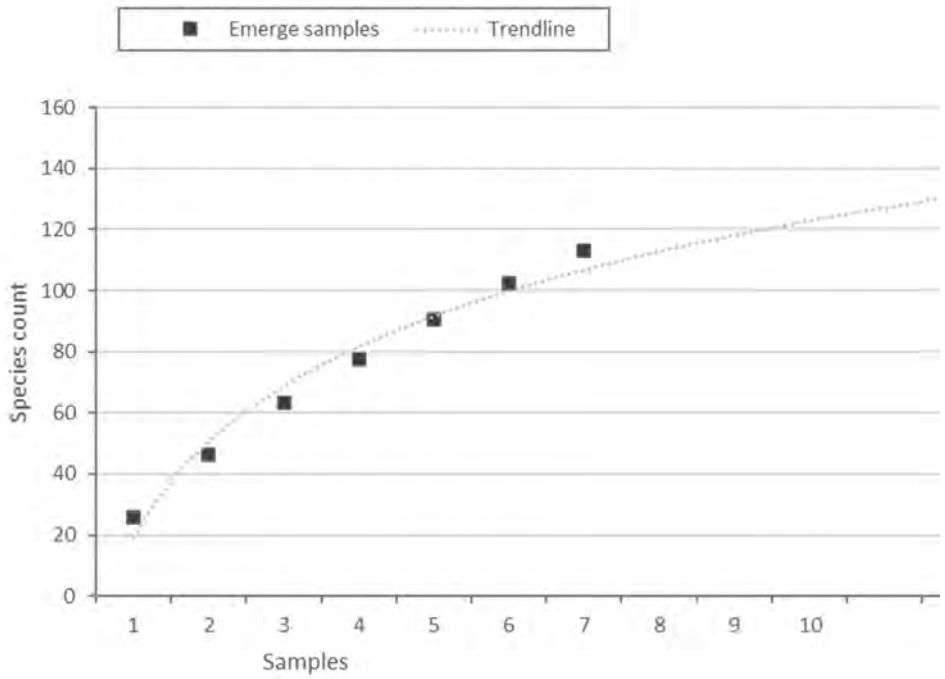

Plate 12: Species accumulation curve derived from sample data (y =44.963ln(x) + 19.318, R^2 = 0.9745)

5 Discussion

The majority of the vegetation within the site has been subject to significant past disturbance, with approximately 95% of the site mapped as being in 'degraded' and 'completely degraded' condition. This includes the vegetation in the north western portion of the site along the Swan River, although native species such as trees are present in this area and would provide ecological benefits.

Intact native vegetation is present in the central southern portion of the site, within plant communities **ApMtS**, **Cc** and **ErC**. The adjacent **Er** and **ErJsBh** vegetation also supports native vegetation but has been subject to disturbance and supports lower native species diversity.

5.1 Threatened and priority flora

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

The desktop flora assessment identified many threatened and priority flora species as having potential to occur in the site, based on landscape and soil mapping. The field survey determined that most of the site does not provide suitable habitat due to the high level of historical disturbance. The intact native vegetation in the central southern portion of the site was identified as the only area with actual potential habitat for threatened and priority flora species.

The two surveys were undertaken within spring, which is the main flowering period for most plants on the Swan Coastal Plain. The September and October timing of the surveys coincides with the known flowering periods of most of the perennial and annual flora species of conservation significance that were considered to have potential to occur in the site. As searches did not record these species they are considered unlikely to occur. Two annual species, *Hydrocotyle striata* and *Myriophyllum echinatum*, flower in November but no evidence such as sterile specimens was recorded in the October survey and they are also considered unlikely to occur.

5.2 Vegetation condition

Assigning vegetation condition categories was relatively straightforward for most of the site. A compound category of 'excellent – very good' was applied to plant community **ErC**. The **ErC** vegetation had low native species diversity which is not unexpected for low-lying areas that are inundated for long periods of time. However, some signs of alteration to the vegetation structure were evident and weeds were present, particularly on the drier edges of the patch.

5.3 Floristic community type assignment

The results of the FCT cluster analysis were conclusive for the samples within plant communities **ApMtS** and **Cc** but inconclusive for Q4 within plant community **ErC**. The ground layer of the **ErC** vegetation was dominated by one sedge taxon which was sterile at the time of the current survey and was therefore not able to be identified by a specialist taxonomist. Subsequently this sedge, referred to as *Carex* sp., was not able to be included in the FCT analysis. However, information such as other flora species, landform, soil and spatial location were able to be used to infer that plant community **ErC** is likely to represent FCT 13 or FCT 15.

Further survey when the *Carex* sp. in **ErC** is flowering would enable identification to species level and may provide more FCT conclusive results. However, the lack of identification of this species is only considered a minor limitation, particularly as the inferred FCTs are not associated with a PEC or TEC.

5.4 Threatened and priority ecological communities

Plant communities **ApMtS** and **Cc** represent the 'SCP3c *Corymbia calophylla - Xanthorrhoea preissii* woodlands and shrublands, Swan Coastal Plain' TEC. The **ApMtS** vegetation represents the shrubland form of the TEC and the **Cc** vegetation represents the woodland form of the TEC. No condition thresholds apply to the SCP3c TEC and all areas are 'critical to its survival' (DoEE 2017b).

No other TECs or PECs are considered to occur in the site.

5.5 Local and regional significance

Plant communities **Ew** and **ErCo** contain mature eucalypt trees which may be considered significant as they represent potential black cockatoo breeding habitat. A separate assessment of fauna habitat within the site will be undertaken by a suitably experienced specialist.

6 Conclusions

The site has been subject to significant past disturbance, with approximately 78.95 ha (95%) of the site mapped as being in 'degraded' and 'completely degraded' condition. An inundated clay pit occurs in the northern portion of the site and extends over 1.8 ha. The remaining 2.2 ha comprises vegetation of varying quality including 1.4 ha of high quality native vegetation in 'very good', 'excellent - very good' and 'excellent' condition.

No threatened or priority flora species were recorded within the site. The survey timing and effort were considered suitable to survey for threatened or priority flora species considered to have potential to occur. Therefore, no threatened or priority flora species are considered likely to occur in the site.

The site contains 0.93 ha of the State and Commonwealth listed TEC 'SCP3c *Corymbia calophylla - Xanthorrhoea preissii* woodlands and shrublands, Swan Coastal Plain'. No other TECs or PECs are considered to occur in the site.

7 References

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Figures

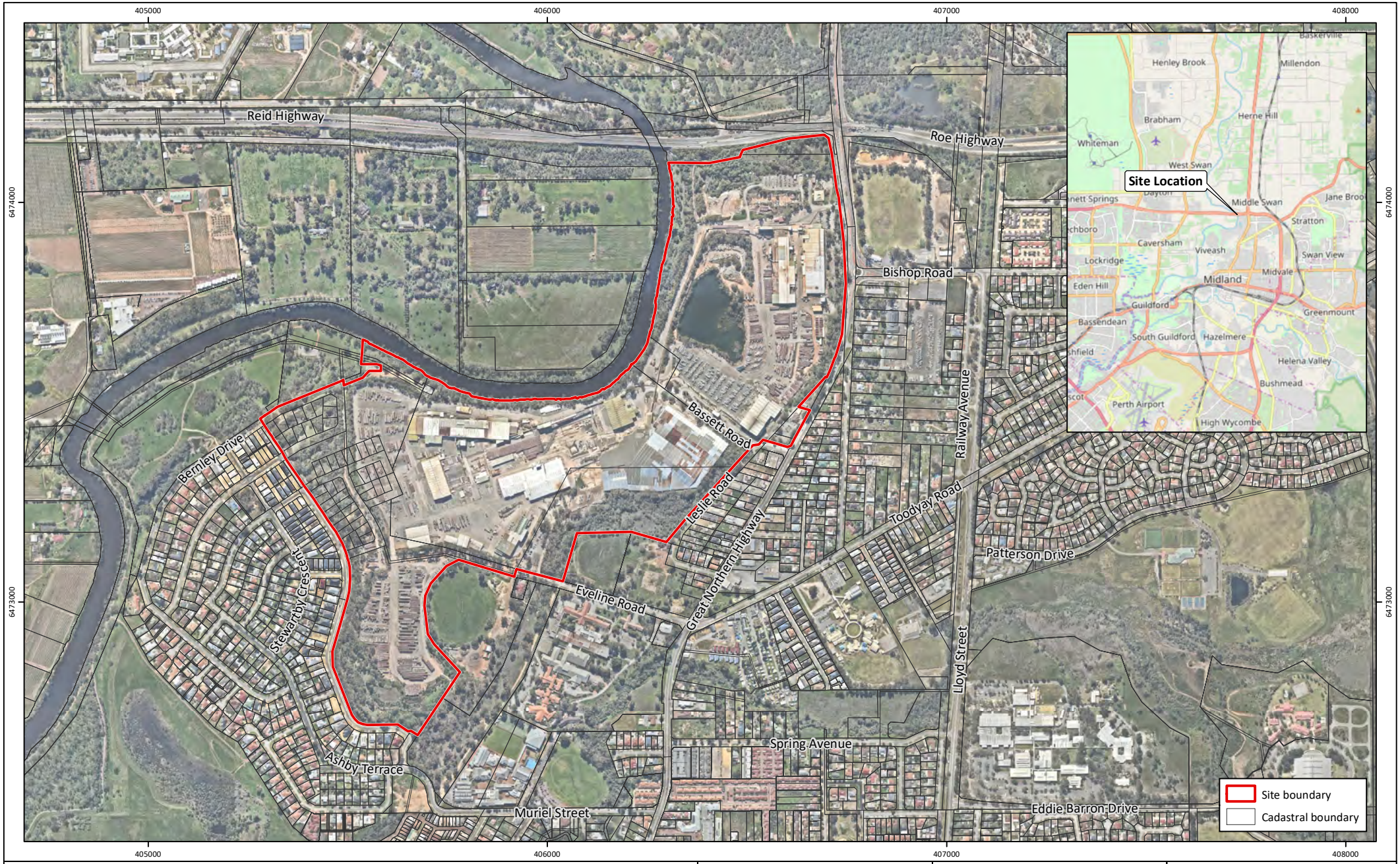

Figure 1: Site Location

Project:	Detailed Flora and Vegetation Assessment Middle Swan Brickworks
Client:	Linc Property Pty Ltd

Plan Number:
EP19-105(07)--F27

Drawn:	KNM
Date:	29/10/2019
Checked:	RAW
Approved:	TAA
Date:	06/11/2019

N

0 200 400
Metres

Scale: 1:12,500@A4

GDA 1994 MGA Zone 50

emerge ASSOCIATES

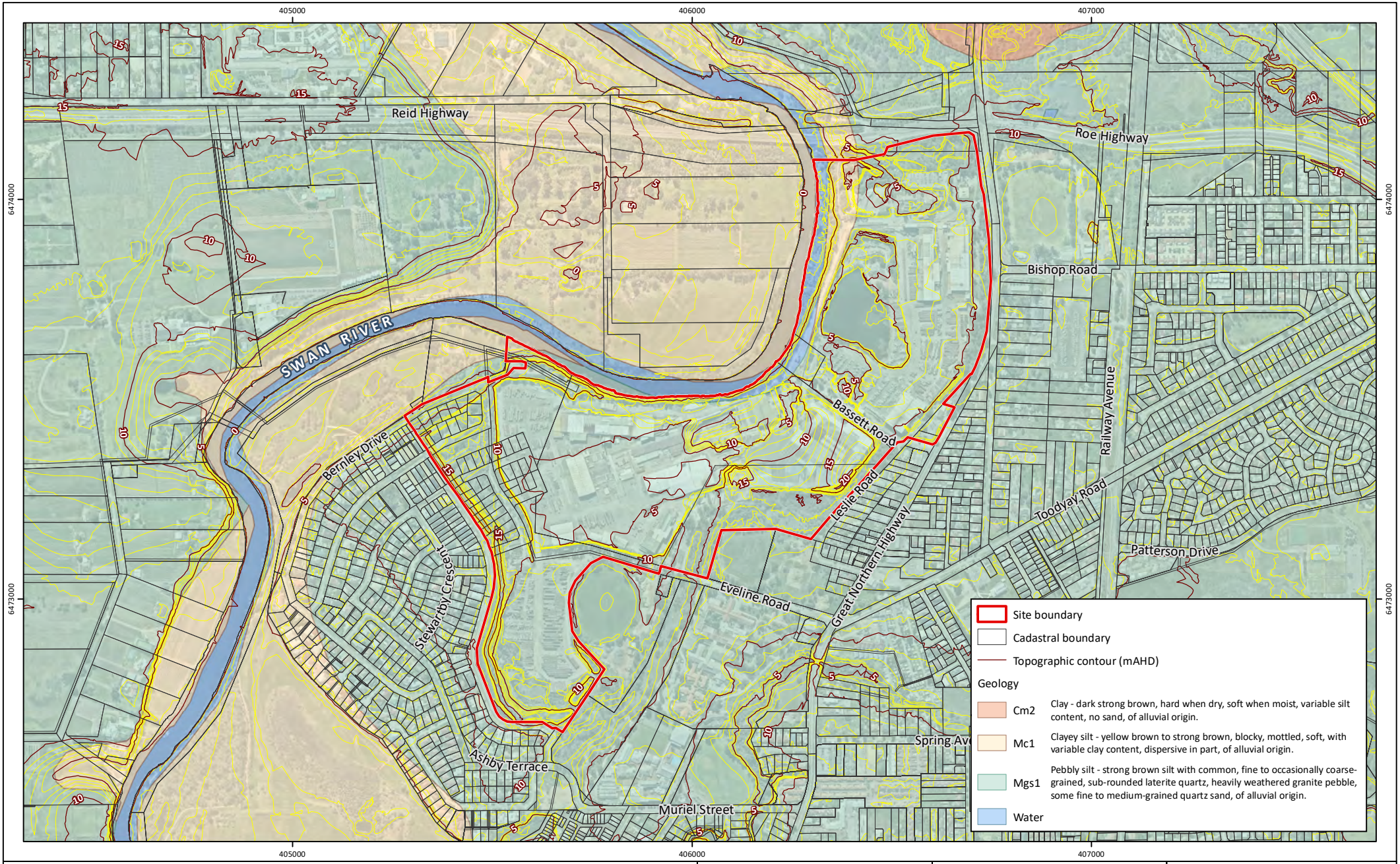

Figure 2: Soils and Topography

Project:	Detailed Flora and Vegetation Assessment Middle Swan Brickworks
Client:	Linc Property Pty Ltd

Plan Number:
EP19-105(07)--F28

Drawn:	KNM
Date:	29/10/2019
Checked:	RAW
Approved:	TAA
Date:	06/11/2019

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Metres

Scale: 1:12,500@A4

GDA 1994 MGA Zone 50

emerge ASSOCIATES

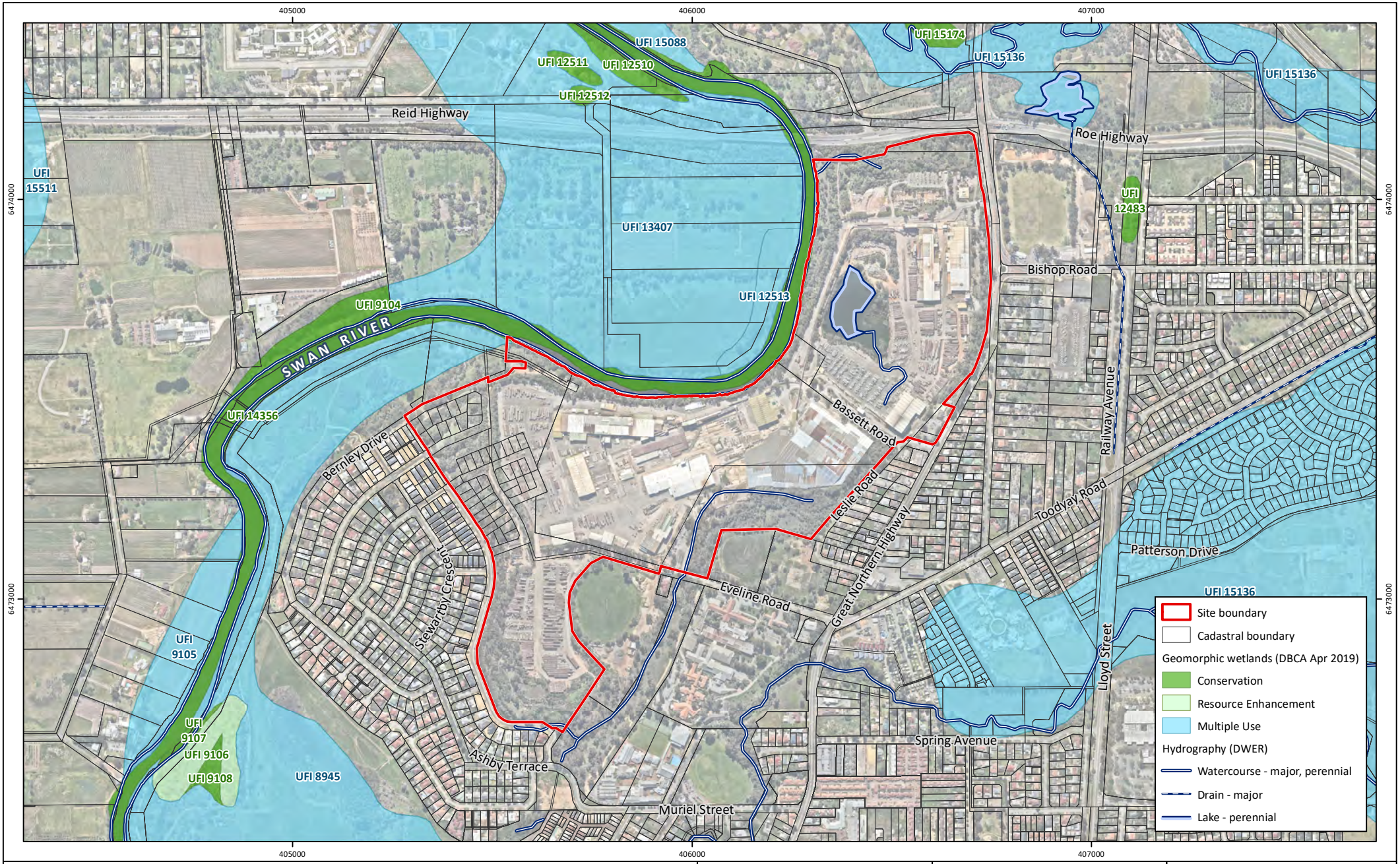

Figure 3: Hydrological Features

Project: Detailed Flora and Vegetation Assessment
Middle Swan Brickworks
Client: Linc Property Pty Ltd

Plan Number:
EP19-105(07)--F29

Drawn:	KNM
Date:	29/10/2019
Checked:	RAW
Approved:	TAA
Date:	06/11/2019

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Metres

Scale: 1:12,500@A4

GDA 1994 MGA Zone 50

emerge ASSOCIATES

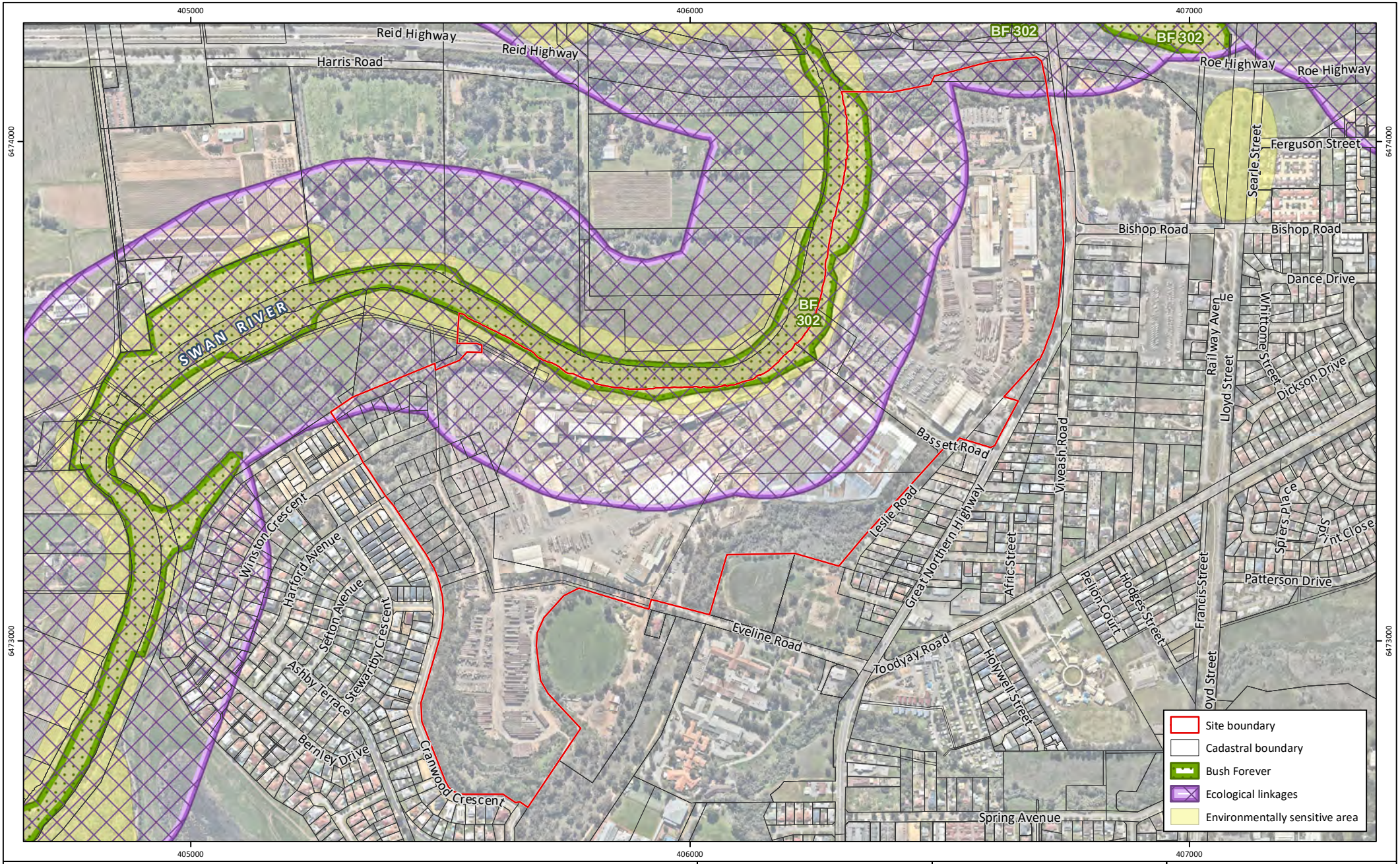

Figure 4: Environmental Features

Project:	Detailed Flora and Vegetation Assessment Middle Swan Brickworks
Client:	Linc Property Pty Ltd

Plan Number:
EP19-105(07)--F30

Drawn:	KNM
Date:	31/10/2019
Checked:	RAW
Approved:	TAA
Date:	06/11/2019

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Metres

Scale: 1:10,000@A4

GDA 1994 MGA Zone 50

emerge ASSOCIATES

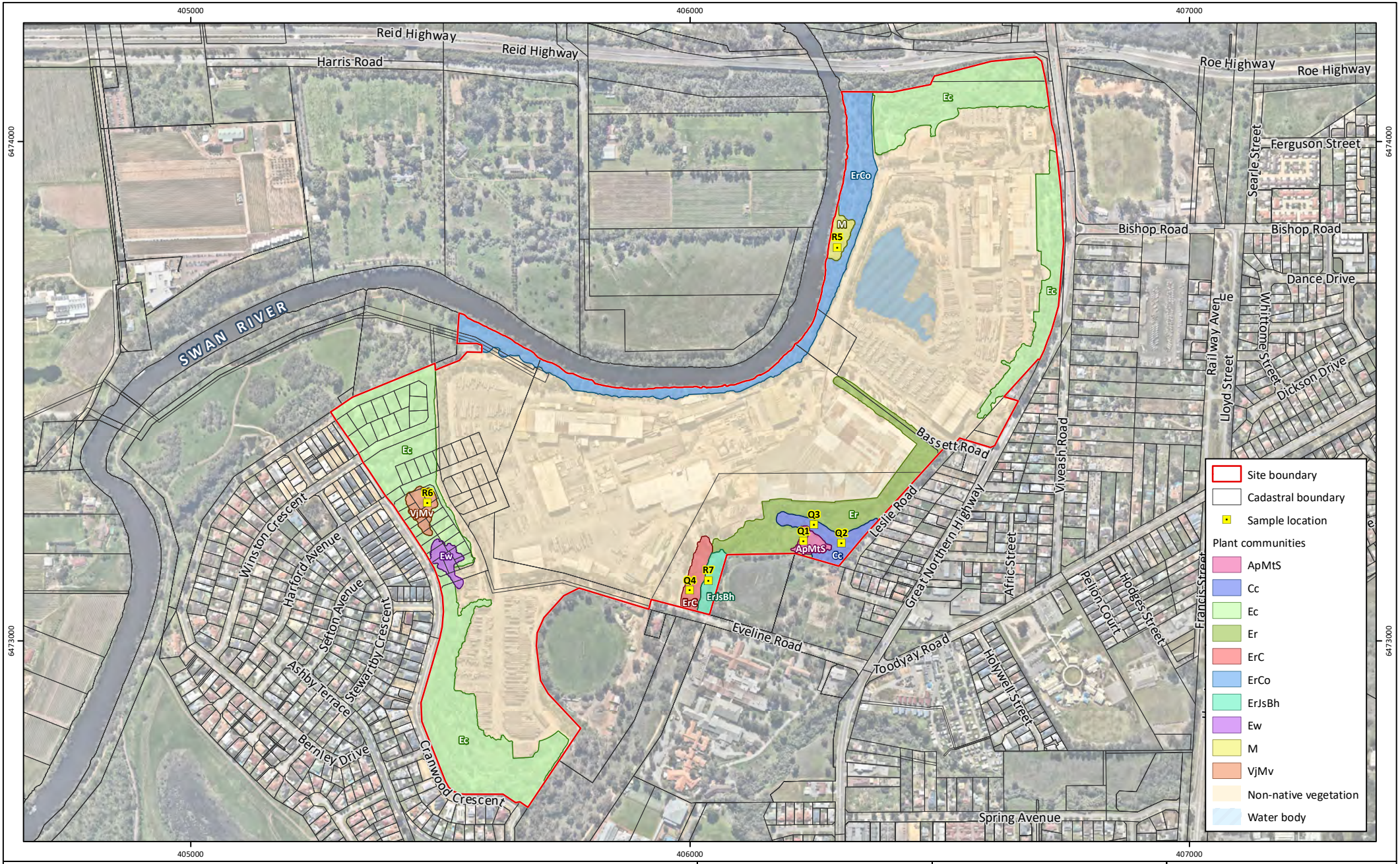

Figure 5: Plant Communities

Project:	Detailed Flora and Vegetation Assessment Middle Swan Brickworks
Client:	Linc Property Pty Ltd

Plan Number:
EP19-105(07)--F31

Drawn:	KNM
Date:	29/10/2019
Checked:	RAW
Approved:	TAA
Date:	06/11/2019

N

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Metres

Scale: 1:10,000@A4

GDA 1994 MGA Zone 50

emerge ASSOCIATES

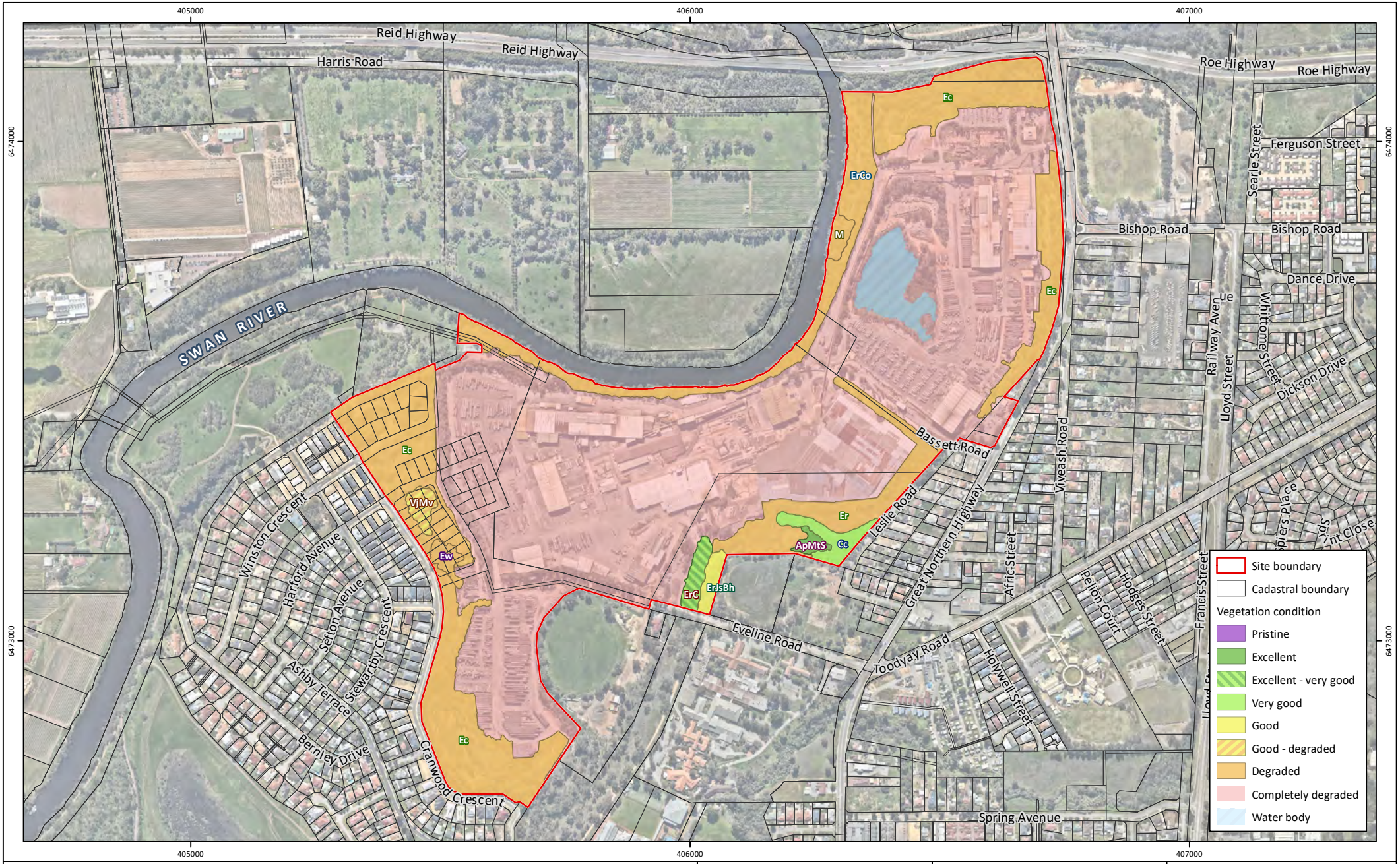

Figure 6: Vegetation Condition

Project:	Detailed Flora and Vegetation Assessment Middle Swan Brickworks
Client:	Linc Property Pty Ltd

Plan Number:
EP19-105(07)--F32

Drawn:	KNM
Date:	29/10/2019
Checked:	RAW
Approved:	TAA
Date:	06/11/2019

N

0 100 200 300
Metres

Scale: 1:10,000@A4

GDA 1994 MGA Zone 50

emerge ASSOCIATES

Figure 7: Threatened Ecological Community

Project: Detailed Flora and Vegetation Assessment
Middle Swan Brickworks
Client: Linc Property Pty Ltd

Plan Number:
EP19-105(07)--F33
Drawn: KNM
Date: 29/10/2019
Checked: RAW
Approved: TAA
Date: 06/11/2019

N

0 100 200 300
Metres
Scale: 1:10,000@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 and Energy. 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 and Energy.

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 2009). Listed PECs are published by DBCA (DBCA 2017b).

Table 3: Categories of priority ecological communities (DEC 2009).

Priority code	Description
P1	Priority One Ecological communities with apparently few, small occurrences, all or most not actively managed for conservation (e.g. within agricultural or pastoral lands, urban areas, active mineral leases) and for which current threats exist. 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 Communities that are known from few small occurrences, all or most of which are actively managed for conservation (e.g. within national parks, conservation parks, nature reserves, State forest, unallocated Crown land, water reserves, etc.) and not under imminent threat 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 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: (i) communities known from a few widespread occurrences, which are either large or within significant remaining areas of habitat in which other occurrences may occur, much of it not under imminent threat, or; (ii) communities made up of large, and/or widespread occurrences, that may or 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, and inappropriate fire regimes. 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.
P5	Priority Five 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 4**. Species assigned to the 'declared pest, prohibited - s12' category are placed in one of three control categories, as described in **Table 5**.

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 6**.

The Western Australian Organism List (WAOL) provides the status of organisms which have been categorised under the BAM Act (DAFWA 2016).

Table 4: Legal status of declared pest species listed under the BAM Act (DAFWA 2016).

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 (DAFWA 2016).

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

Table 6: Keeping categories of declared pest species listed under the BAM Act (DAFWA 2016).

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.

Wetland Habitat

Geomorphic wetland types

On the Swan Coastal Plain DBCA (2017a) have used the geomorphic wetland classification system developed by Semeniuk (1987) and Semeniuk and Semeniuk (1995) to classify wetlands based on the landform shape and water permanence (hydro-period) as outlined in **Table 7**.

Table 7: Geomorphic Wetlands of the Swan Coastal Plain classification categories (DBCA 2017a)

Level of inundation	Geomorphology			
	Basin	Flat	Channel	Slope
Permanently inundated	Lake	-	River	-
Seasonally inundated	Sumpland	Floodplain	Creek	-
Seasonally waterlogged	Dampland	Palusplain	-	Paluslope

Wetland management categories

DBCA maintains the *Geomorphic Wetland of the Swan Coastal Plain* dataset (DBCA 2018a), which also categorises individual wetlands into specific management categories as described in **Table 8**.

Table 8: Geomorphic Wetlands of the Swan Coastal Plain classification categories (DBCA 2017a)

Management category	Description of wetland	Management objectives
Conservation (CCW)	Support high levels of attributes	Preserve wetland attributes and functions through reservation in national parks, crown reserves and state owned land. Protection provided under environmental protection policies.
Resource enhancement (REW)	Partly modified but still supporting substantial functions and attributes	Restore wetland through maintenance and enhancement of wetland functions and attributes. Protection via crown reserves, state or local government owned land, environmental protection policies and sustainable management on private properties.
Multiple use (MUW)	Few wetland attributes but still provide important hydrological functions	Use, development and management considered in the context of water, town and environmental planning through land care.

The management categories of wetland features are determined based on hydrological, biological and human use features. The DBCA document *A methodology for the evaluation of specific wetland types on the Swan Coastal Plain, Western Australia* (DBCA 2017a) details the methodology by which wetlands on the Swan Coastal Plain are assigned management categories based on a two tiered evaluation system, with preliminary and secondary evaluation stages. The preliminary evaluation aims to identify any features of conservation significance that would immediately place the wetland within the CCW management category. Examples of these significant features include presence on significant wetland lists, presence of TECs or PECs (Priority 1 and 2), presence of threatened flora and

over 90% of vegetation in good or better condition based on the Keighery (1994) scale. If such environmental values are identified the wetland would be categorised as CCW without further evaluation.

Should the preliminary evaluation indicate that no such features occur, the secondary evaluation and site assessment are then applied. In the secondary evaluation, an appropriate management category is determined through the assessment of a range of environmental attributes, functions and values.

Wetland reclassification

DBCA have a protocol for proposing changes to the wetland boundaries and management categories of the existing geomorphic wetland dataset (DEC 2007). The procedure involves a wetland desktop evaluation and site assessment which culminates in a recommended management category. Relevant information should be obtained in the optimal season for vegetation condition and water levels, which is usually spring (DEC 2007). In the case of larger wetlands that have undergone a degree of disturbance, a separate management category may be assigned to parts of the wetland in order to reflect the current values.

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Appendix B

Conservation Significant Flora Species and Likelihood of Occurrence Assessment

Table Appendix B1: Conservation significant flora species known or likely to occur within 10 km of the site

Species	Level of significance		Life strategy	Habitat	Flowering period	Likelihood of occurrence
	State	EPBC Act				
Calectasia cyanea	T	CE	P	Heathland on white sand or laterite gravel over laterite.	Jun-Oct	Unlikely
Synaphea sp. Fairbridge Farm	T	CE	P	Low woodland on grey, clayey sand with lateritic pebbles (Pinjarra Plain) near winter wet flats.	Sep - Nov	Possible
Synaphea sp. Pinjarra Plain	T	CE	P	White grey clayey sand on edges of seasonally inundated low lying areas.	Sep-Oct	Possible
Andersonia gracilis	T	E	P	Seasonally damp, black sandy clay flats near or on the margins of swamps.	Sep-Nov	Possible
Caladenia huegelii	T	E	P	Well-drained, deep sandy soils in lush undergrowth in a variety of moisture levels.	Sep-early Nov	Possible
Calytrix breviseta subsp. breviseta	T	E	P	Seasonally wet sandy-clay soil on swampy flats	Oct-Nov	Possible
Darwinia apiculata	T	E	P	Open jarrah-marri woodland on shallow gravely soil over laterite, or open heathland over sandy loams with granite boulders.	Oct-Nov	Unlikely
Diplolaena andrewsii	T	E	P	Granite outcrops & hillsides.	Jul-Oct	Unlikely
Diuris purdiei	T	E	PG	Sand to sandy clay soils in areas subject to winter inundation.	Sep-Oct, only after a summer or early autumn fire	Possible
Drakaea elastica	T	E	PG	Bare patches of sand within otherwise dense vegetation in low-lying areas alongside winter-wet swamps.	Sep-Oct (survey Jul-Aug)	Possible
Eucalyptus x balanites	T	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
Grevillea curviloba subsp. incurva	T	E	P	Sand, sandy loam. Winter-wet heath.	Aug-Sep.	Possible
Lepidosperma rostratum	T	E	P	Peaty sand and clay amongst low heath, in winter-wet swamps.	May-Jun (survey Jun-Aug)	Possible

Species	Level of significance		Life strategy	Habitat	Flowering period	Likelihood of occurrence
	State	EPBC Act				
Macarthuria keigheryi	T	E	P	Low-lying winter-wet damp gey/white sands in open patches.	Sep-Dec/Feb-Mar	Possible
Thelymitra dedmaniarum	T	E	PG	Red brown sandy loam with dolerite and granite outcrops.	Oct-Nov	Unlikely
Thelymitra stellata	T	E	PG	Sandy loam, clay or gravel over laterite or gravel.	Sep-Nov	Unlikely
Trithuria occidentalis	T	E	A	Partly submerged on the edge of shallow winter-wet clay pans in very open shrubland.	Oct-Nov	Possible
Acacia anomala	T	V	P	Shallow sand,loam,clay or gravel	Aug-Sep	Possible
Acacia aphylla	T	V	P	Laterite and granite outcrops on hillsides.	Aug-Oct	Unlikely
Anigozanthos viridis subsp. terraspectans	T	V	P	Grey sand, clay loam. Winter-wet depressions.	Aug-Sep	Possible
Anthocercis gracilis	T	V	P	Steep granite slopes along the Darling Scarp in shallow, humis-rich sandy or loamy soils.	Sep-Oct, Apr	Unlikely
Chamelaucium sp. Gingin	T	V	P	White yellow sand in low woodland.	Sep-Dec	Possible
Conospermum undulatum	T	V	P	Sand and sandy clay soils, on flat or gently sloping sites between the Swan and Canning Rivers	May-Oct	Possible
Diuris drummondii	T	V	PG	In low-lying depressions in peaty and sandy clay swamps.	Nov-Jan	Possible
Diuris micrantha	T	V	PG	Dark grey-black sandly clay-loam in winter wet depressions or swamps. Often in shallow standing water.	Aug/Sep-early Oct	Possible
Drakaea micrantha	T	V	PG	Open sandy patches often adjacent to winter-wet swamps.	Sept- early Oct	Possible
Eleocharis keigheryi	T	V	P	Clay or sandy loam in freshwater creeks and transient waterbodies such as seasonally wet clay pans.	Aug-Dec	Possible
Bolboschoenus fluviatilis	P1	-	P	Floodplain with grey/brown wet sand.	Nov	Possible
Hydrocotyle striata	P1	-	A	Sand and clay in springs and creeklines.	Nov	Possible
Levenhookia preissii	P1	-	A	Grey or black, peaty sand. Swamps	Sep-Dec or Jan	Possible

Species	Level of significance		Life strategy	Habitat	Flowering period	Likelihood of occurrence
	State	EPBC Act				
Senecio gilbertii	P1	-	P	Peaty sand in swamps and on slopes.	Sep-Nov	Possible
Stachystemon sp. Keysbrook	P1	-	P	White grey sand.	Oct	Possible
Thelymitra magnifica	P1	-	PG	Gravelly soil on stony ridges.	Sep-Oct	Unlikely
Acacia benthamii	P2	-	P	Sand, typically on limestone breakaways	Aug - sept	Unlikely
Lepyrodia curvescens	P2	-	P	Sand, laterite. Seasonally inundated swampland.	Sep-Nov	Possible
Phyllangium palustre	P2	-	A	Winter-wet claypans, low-lying seasonal wetlands on clay	Oct-Nov	Possible
Acacia drummondii subsp. affinis	P3	-	P	Lateritic gravelly soils.	Jul-Aug	Unlikely
Acacia horridula	P3	-	P	Gravelly soils over granite, sand, rocky hillsides.	May-Aug	Unlikely
Acacia oncinophylla subsp. oncinophylla	P3	-	P	Granitic soils	Aug-Oct	Unlikely
Banksia pteridifolia subsp. vernalis	P3	-	P	White/grey sand over laterite.	Sep-Oct	Unlikely
Beaufortia purpurea	P3	-	P	Lateritic or granitic soils on rocky slopes.	Oct-Feb	Unlikely
Byblis gigantea	P3	-	P	Sandy-peat swamps. Seasonally wet areas.	Sep-Jan	Possible
Carex tereticaulis	P3	-	P	Black peaty sand.	Sep-Oct	Possible
Cyathochaeta teretifolia	P3	-	P	Grey sand, sandy clay in swamps and creek edges.	Oct-Jan	Possible
Eryngiumsp. Subdecumbens	P3	-	P	Claypans	Sep-Jan	Possible
Grevillea manglesii subsp. dissectifolia	P3	-	P	Gravelly loam, moist. Roadsides.	Jun, Sep or Nov	Unlikely
Halgania corymbosa	P3	-	P	Gravelly soils, soils over granite.	Aug-Nov	Possible
Isopogon drummondii	P3	-	P	Yellow/white sand	Feb-Jun	Possible
Lasiopetalum glutinosum subsp. glutinosum	P3	-	P	Brown clay loam on slopes	Sep-Dec	Possible
Meionectes tenuifolia	P3	-	P	Clay loam in seasonally wet areas.	Oct-Dec	Possible
Myriophyllum echinatum	P3	-	A	Clay in winter-wet flats.	Nov	Possible
Pithocarpa corymbulosa	P3	-	P	Gravelly or sandy loam,	Jan-Apr	Unlikely

Species	Level of significance		Life strategy	Habitat	Flowering period	Likelihood of occurrence
	State	EPBC Act				
				amongst granite outcrops.		
Platysace ramosissima	P3	-	P	Sandy soils.	Oct-Nov	Possible
Schoenus capillifolius	P3	-	A	Brown mud in claypans	Oct-Nov	Possible
Schoenus sp. Waroona	P3	-	A	Clay or sandy clay. Winter-wet flats.	Oct-Nov	Possible
Sporobolus blakei	P3	-	P	Red sandy clay, loam. Creeks.	Mar or Jun to Jul	Possible
Tetratheca pilifera	P3	-	P	Gravelly soils.	Aug-Oct	Unlikely
Thysanotus anceps	P3	-	P	White or grey sand, lateritic gravel, laterite.	Oct-Dec	Unlikely
Verticordia serrata var. linearis	P3	-	P	White sand, gravel	Sep-Oct	Possible
Anigozanthos humilis subsp. chrysanthus	P4	-	P	Grey or yellow sand	Jul-Oct	Possible
Calothamnus accedens	P4	-	P	Sandy soils over laterite.	Sep-Jan	Possible
Darwinia pimelioides	P4	-	P	Loam, sandy loam on granite outcrops.	Sep-Oct	Unlikely
Drosera occidentalis	P4	-	P	Sand over clay, seasonally wet areas	Oct-Dec/Jan	Possible
Hydrocotyle lemnoides	P4	-	A	Swamps	Aug-Oct	Possible
Jacksonia sericea	P4	-	P	Calcareous and sandy soils on Swan Coastal Plain	Dec-Feb	Unlikely
Lasiopetalum bracteatum	P4	-	P	Sandy clay, clay, lateritic gravel along drainage lines, creeks, gullies, granite outcrops.	Aug-Nov	Possible
Ornduffia submersa	P4	-	A	Sandy clay in inundated wetland/creek.	Aug-Nov	Possible
Persoonia sulcata	P4	-	P	Lateritic or granitic soils.	Sep-Nov	Unlikely
Schoenus griffinianus	P4	-	P	White sand	Sep-Oct	Possible
Senecio leucoglossus	P4	-	A	Gravelly lateritic or granitic soils on outcrops or slopes.	Aug-Dec	Unlikely
Stylidium longitubum	P4	-	A	Seasonal wetlands.	Oct-Dec	Possible
Stylidium striatum	P4	-	P	Brown clay over laterite on hill slopes.	Oct-Nov	Unlikely
Thysanotus glaucus	P4	-	P	White, grey or yellow sand, sandy gravel.	Oct-Mar	Possible

Species	Level of significance		Life strategy	Habitat	Flowering period	Likelihood of occurrence
	State	EPBC Act				
Verticordia lindleyi subsp. lindleyi	P4	-	P	Sand and sandy clay in winter wet areas.	May or Nov-Jan	Possible

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

Appendix C

Species List

Flora Species List - Middle Swan Brickworks

Note: * denotes introduced weed species, Pl=planted, DP=declared pest under the BAM Act, WoNS=weed of National significance

Family	Status	Species
Apiaceae		
		Xanthosia huegelii
Apocynaceae		
	*DP	*Gomphocarpus fruticosus*
Arecaceae		
	*	*Washingtonia filifera*
Asparagaceae		
		Lomandra caespitosa
		Lomandra micrantha subsp. micrantha
		Sowerbaea laxiflora
		Thysanotus gracilis
		Thysanotus manglesianus
		Thysanotus manglesianus/pattersonii
Asteraceae		
	*	*Arctotheca calendula*
	*	*Artemisia arborescens*
	*DP, WoNS	*Chrysanthemoides monilifera subsp. monilifera*
		Hypochaeris glabra
Boraginaceae		
	*	*Echium plantagineum*
		Heliotropium curassavicum
Casuarinaceae		
		Allocasuarina humilis
		Casuarina obesa
Centrolepidaceae		
		Centrolepis aristata
Chenopodiaceae		
	*	*Atriplex prostrata*
		Tecticornia sp.
Colchicaceae		
		Burchardia congesta
Cyperaceae		
		Bolboschoenus caldwellii
		Carex sp.

Flora Species List - Middle Swan Brickworks

Note: * denotes introduced weed species, Pl=planted, DP=declared pest under the BAM Act, WoNS=weed of National significance

Family	Status	Species
		Carex appressa
	*	*Carex divisa*
		Cyathochaeta avenacea
		Cyperaceae sp.
	*	*Cyperus congestus*
		Cyperus gymnocaulos
		Eleocharis acuta
		Isolepis sp.
		Lepidosperma costale
		Lepidosperma leptostachyum
		Mesomelaena tetragona
		Tetraria octandra
Dilleniaceae		
		Hibbertia diamesogenos
		Hibbertia hypericoides
Droseraceae		
		Drosera glanduligera
		Drosera ?menziesii
Euphorbiaceae		
	*	*Ricinus communis*
Fabaceae		
		Acacia sp.
	*	*Acacia iteaphylla*
		Acacia lasiocarpa
	*	*Acacia podalyriifolia*
		Acacia pulchella var. pulchella
		Acacia saligna
		Callistachys lanceolata
		Daviesia decurrens subsp. decurrens
		Gastrolobium nervosum
	*	*Genista linifolia*
		Gompholobium marginatum
		Jacksonia sternbergiana
		Kennedia prostrata
	*	*Lupinus angustifolius*
	*	*Trifolium subbiflorus*
	*	*Vachellia karroo*
	*	*Vicia sativa*
		Viminaria juncea
Goodeniaceae		
		Dampiera linearis

Flora Species List - Middle Swan Brickworks

Note: * denotes introduced weed species, Pl=planted, DP=declared pest under the BAM Act, WoNS=weed of National significance

Family	Status	Species
Haemodoraceae		
		Haemodorum laxum
		Tribonanthes longipetala
Haloragaceae		
		Gonocarpus cordiger
Hemerocallidaceae		
		Agrostocrinum hirsutum
		Caesia micrantha
		Tricoryne elatior
Iridaceae		
	*	*Babiana angustifolia*
	*	*Gladiolus caryophyllaceus*
	*	*Hesperantha falcata*
	*	*Ixia maculata*
	*	*Patersonia occidentalis*
	*	*Watsonia marginata*
	*	*Watsonia meriana var. bulbillifera*
Juncaceae		
		Juncus kraussii
		Juncus pallidus
Juncaginaceae		
		Cycnogeton lineare
Lauraceae		
		Cassytha glabella
Loranthaceae		
		Amyema preissii
Malvaceae		
	*	*Lagunaria patersonia*
Moraceae		
	*	*Ficus sp.*
Myrtaceae		
		Babingtonia camphorosmae
		Callistemon phoeniceus
	Pl	*Callistemon sp.*
		Calothamnus quadrifidus

Flora Species List - Middle Swan Brickworks

Note: * denotes introduced weed species, Pl=planted, DP=declared pest under the BAM Act, WoNS=weed of National significance

Family	Status	Species
		Calothamnus rupestris
		Corymbia calophylla
	*Pl	*Eucalyptus sideroxylon*
	*Pl	*Eucalyptus camaldulensis*
	*Pl	*Eucalyptus cladocalyx*
	*Pl	*Eucalyptus lehmannii*
		Eucalyptus rudis
		Eucalyptus wandoo
		Hypocalymma angustifolium
	*Pl	*Kunzea sp.*
		Kunzea micrantha
	*	*Lophostemon confertus*
	*Pl	*Melaleuca sp.*
		Melaleuca incana
		Melaleuca teretifolia
		Melaleuca viminea
		Taxandria linearifolia
		Verticordia densiflora var. densiflora
Oleaceae		
	*	*Olea europea*
Orchidaceae		
		Diuris sp.
		Microtis media
		Thelymitra ?macrophylla
		Thelymitra antennifera
		Thelymitra macrophylla
Orobanchaceae		
	*	*Parentucellia latifolia*
Oxalidaceae		
	*	*Oxalis glabra*
	*	*Oxalis pes-caprae*
	*	*Oxalis purpurea*
Papaveraceae		
	*	*Fumaria capreolata*
Phyllanthaceae		
		Phyllanthus calycinus
Pittosporaceae		
		Billardiera heterophylla

Flora Species List - Middle Swan Brickworks

Note: * denotes introduced weed species, Pl=planted, DP=declared pest under the BAM Act, WoNS=weed of National significance

Family	Status	Species
Plantaginaceae		
	*	*Plantago lanceolata*
Poaceae		
		Austrostipa elegantissima
		Austrostipa macalpinei
	*	*Avena barbata*
	*	*Briza maxima*
	*	*Bromus diandrus*
	*	*Cenchrus setaceus*
	*	*Cynodon dactylon*
	*	*Ehrharta calycina*
	*	*Ehrharta longiflora*
	*	*Eragrostis curvula*
	*	*Lolium rigidum*
		Neurachne alopecuroidea
	*	*Paspalum dilatatum*
		Poa porphyroclados
	*	*Poaceae sp.*
		Rytidosperma setaceum
		Themeda triandra
Polygonaceae		
	*	*Rumex crispus*
Primulaceae		
	*	*Lysimachia arvensis*
Proteaceae		
		Banksia armata var. armata
		Banksia dallanneyi
		Grevillea preissii
		Hakea undulatum
		Hakea erinacea
		Hakea lissocarpha
		Hakea prostrata
		Hakea trifurcata
		Hakea varia
		Synaphea ?spinulosa
Pteridaceae		
		Cheilanthes austrotenuifolia
Restionaceae		
		Desmocladus asper
		Leptocarpus canus

Flora Species List - Middle Swan Brickworks

Note: * denotes introduced weed species, Pl=planted, DP=declared pest under the BAM Act, WoNS=weed of National significance

Family	Status	Species
Rosaceae		
	*	*Rosa sp.*
Rubiaceae		
		Opercularia vaginata
Solanaceae		
	*	*Solanum nigrum*
Stylidiaceae		
		Stylidium dichotomum
		Stylidium repens
		Stylidium thesioides
Thymelaeaceae		
		Pimelea imbricata var. piligera
Xanthorrhoeaceae		
		Chamaescilla corymbosa
		Xanthorrhoea preissii

Appendix D

Conservation Significant Communities and Likelihood of Occurrence Assessment

Table Appendix D1: Significant communities known or likely to occur within 10 km of the site

Code	Community name	TEC/ PEC	Level of significance	
			State	EPBC Act
Mound Springs SCP	Assemblages of plants and invertebrate animals of tumulus (organic mound) springs of the Swan Coastal Plain	TEC	Endangered	Critically Endangered
SCP3a	*Corymbia calophylla - Kingia australi*s woodlands on heavy soils, Swan Coastal Plain	TEC	Endangered	Critically Endangered
SCP3c	*Corymbia calophylla - Xanthorrhoea preissii* woodlands and shrublands, Swan Coastal Plain	TEC	Endangered	Critically Endangered
Multiple	Claypans of the Swan Coastal Plain	TEC	-	Critically Endangered
SCP20c	Shrublands and woodlands of the eastern Swan Coastal Plain	TEC	Critically Endangered	Endangered
-	Tuart (*Eucalyptus gomphocephala*) woodlands and forests of the Swan Coastal Plain ecological community	TEC/ PEC	Priority 3	Endangered
SCP20a	*Banksia attenuata* woodlands over species rich dense shrublands	TEC	Endangered	Endangered (Banksia woodlands of the Swan Coastal Plain)
SCP20b	*Banksia attenuata* and/or *Eucalyptus marginata* woodlands of the eastern side of the Swan Coastal Plain	TEC	Endangered	
SCP 21c	Low lying *Banksia attenuata* woodlands or shrublands	TEC/ PEC	Priority 3	
Coastal Saltmarsh	Subtropical and temperate coastal saltmarsh	TEC	Priority 3	Vulnerable
Multiple	Banksia dominated woodlands of the Swan Coastal Plain IBRA region	PEC	Priority 3	-
-	Central Northern Darling Scarp Granite Shrubland Community	PEC	Priority 4	-

*Communities considered to be potentially present within the site shaded green.

Appendix E

Sample Data

Vegetation Sample Data

Sample Name: Q1

Project no.: EP19-105(07)
Date: 18/09/2019
Author: RAW,other

Status Non-permanent
Q1: Page 1 of 3

Quadrat and landform details

Sample type:	quadrat	Size:	10 m x 10 m
NW corner easting:	406227	NW corner northing:	6473199
Altitude (m):	N/A	Geographic datum/zone:	GDA94/Zone 50
Soil water content:	slightly damp	Landform:	flat
Time since fire:	no evidence	Disturbance:	low - weeds
Soil type/texture	clay	Bare ground (%):	5
Rocks (%) and type:	No rocks	Soil colour:	brown
Litter:	5% (leaves,twigs)	Vegetation condition:	excellent-very good

Vegetation Sample Data

Sample Name: Q1

Project no.: EP19-105(07)
Date: 18/09/2019 **Status** Non-permanent
Author: RAW,other Q1: Page 2 of 3

Species Data

* denotes non-native species

Status	Confirmed name	Cover (%)
	Acacia pulchella var. pulchella	10
	Babingtonia camphorosmae	1
	Banksia dallanneyi	<1
*	*Briza maxima*	<1
	Burchardia congesta	<1
	Cassytha glabella	<1
	Centrolepis aristata	<1
	Chamaescilla corymbosa	<1
	Cyathochaeta avenacea	<1
	Cyperaceae sp.	<1
	Drosera ?menziesii	<1
	Drosera glanduligera	<1
	Gompholobium marginatum	<1
	Hakea erinacea	<1
	Hakea undulatum	2
*	Hesperantha falcata	<1
	Hypocalymma angustifolium	15
	Isolepis sp.	<1
	Lepidosperma leptostachyum	1
	Lomandra caespitosa	<1
	Mesomelaena tetragona	70
	Neurachne alopecuroidea	10
	Opercularia vaginata	<1
*	Oxalis glabra	10
*	Oxalis purpurea	<1
*	Parentucellia latifolia	<1
	Phyllanthus calycinus	<1
	Pimelea imbricata var. piligera	<1
	Sowerbaea laxiflora	<1
	Stylidium dichotomum	<1
	Stylidium repens	1
	Stylidium thesioides	<1
	Tetraria octandra	<1
	Thelymitra antennifera	<1
	Thysanotus manglesianus	<1

Vegetation Sample Data

Sample Name: Q1

Project no.: EP19-105(07)
Date: 18/09/2019 **Status** Non-permanent
Author: RAW,other Q1: Page 2 of 3

Species Data

* denotes non-native species

Status	Confirmed name	Cover (%)
	Tribonanthes longipetala	Opp.
	Verticordia densiflora var. densiflora	<1
*	*Watsonia meriana var. bulbillifera*	<1
	Xanthorrhoea preissii	Opp.
	Xanthosia huegelii	<1

Vegetation Sample Data

Sample Name: Q2

Project no.: EP19-105(07)
Date: 18/09/2019
Author: RAW,other

Status Non-permanent
Q2: Page 1 of 3

Quadrat and landform details

Sample type:	quadrat	Size:	10 m x 10 m
NW corner easting:	406303	NW corner northing:	6473196
Altitude (m):	N/A	Geographic datum/zone:	GDA94/Zone 50
Soil water content:	slightly damp	Landform:	flat
Time since fire:	no evidence	Disturbance:	low - weeds
Soil type/texture	clay/loam with organic layer	Bare ground (%):	1
Rocks (%) and type:	No rocks	Soil colour:	brown
Litter:	30% (leaves)	Vegetation condition:	very good

Vegetation Sample Data

Sample Name: Q2

Project no.: EP19-105(07)
Date: 18/09/2019 **Status** Non-permanent
Author: RAW,other Q2: Page 2 of 3

Species Data

* denotes non-native species

Status	Confirmed name	Cover (%)
	Acacia pulchella var. pulchella	10
	Agrostocrinum hirsutum	15
	Allocasuarina humilis	<1
	Austrostipa elegantissima	2
	Banksia armata var. armata	<1
	Banksia dallanneyi	1
*	*Briza maxima*	<1
	Burchardia congesta	<1
	Caesia micrantha	<1
	Cassytha glabella	<1
	Corymbia calophylla	25
	Cyathochaeta avenacea	<1
	Dampiera linearis	<1
	Daviesia decurrens subsp. decurrens	<1
	Desmocladus asper	<1
*	*Ehrharta calycina*	<1
*	*Eragrostis curvula*	30
*	*Fumaria capreolata*	<1
	Gompholobium marginatum	<1
	Gonocarpus cordiger	opp
	Haemodorum laxum	<1
	Hakea undulatum	10
*	*Hesperantha falcata*	<1
	Hibbertia hypericoides	10
	Lepidosperma leptostachyum	<1
	Mesomelaena tetragona	15
	Microtis media	<1
*	*Oxalis glabra*	5
	Phyllanthus calycinus	<1
*	*Plantago lanceolata*	<1
*	*Poaceae sp.*	<1
	Stylidium dichotomum	<1
	Stylidium repens	<1
	Synaphea ?spinulosa	<1
	Tetraria octandra	<1

Vegetation Sample Data

Sample Name: Q2

Project no.: EP19-105(07)
Date: 18/09/2019 **Status** Non-permanent
Author: RAW,other Q2: Page 2 of 3

Species Data

* denotes non-native species

Status	Confirmed name	Cover (%)
	Thysanotus gracilis	<1
	Tricoryne elatior	<1
	Xanthorrhoea preissii	5

Vegetation Sample Data

Sample Name: Q3

Project no.: EP19-105(07)
Date: 18/09/2019
Author: RAW,other

Status Non-permanent
Q3: Page 1 of 2

Quadrat and landform details

Sample type:	quadrat	Size:	10 m x 10 m
NW corner easting:	406248	NW corner northing:	6473232
Altitude (m):	N/A	Geographic datum/zone:	GDA94/Zone 50
Soil water content:	slightly damp	Landform:	flat
Time since fire:	no evidence	Disturbance:	low - weeds
Soil type/texture	clay	Bare ground (%):	2
Rocks (%) and type:	No rocks	Soil colour:	brown/yellow
Litter:	30% (leaves,twigs)	Vegetation condition:	very good

Vegetation Sample Data

Sample Name: Q3

Project no.: EP19-105(07)
Date: 18/09/2019 **Status** Non-permanent
Author: RAW,other Q3: Page 2 of 2

Species Data

* denotes non-native species

Status	Confirmed name	Cover (%)
	Acacia pulchella var. pulchella	<1
	Agrostocrinum hirsutum	<1
	Austrostipa macalpinei	opp
	Babingtonia camphorosmae	1
	Banksia dallanneyi	<1
	Billardiera heterophylla	opp
*	*Briza maxima*	<1
	Burchardia congesta	Opp.
	Cassytha glabella	Opp.
	Cheilanthes austrotenuifolia	opp
	Corymbia calophylla	40
	Cyathochaeta avenacea	60
*	*Ehrharta calycina*	<1
*	*Gladiolus caryophyllaceus*	<1
	Hakea erinacea	2
*	*Hesperantha falcata*	<1
	Hibbertia diamesogenos	opp
	Hypocalymma angustifolium	Opp.
	Kunzea micrantha	Opp.
	Lepidosperma leptostachyum	<1
	Lomandra micrantha subsp. micrantha	<1
	Mesomelaena tetragona	5
	Neurachne alopecuroidea	<1
	Opercularia vaginata	1
*	*Oxalis glabra*	10
	Phyllanthus calycinus	<1
	Poa porphyroclados	opp
	Rytidosperma setaceum	opp
	Stylidium dichotomum	1
	Tetraria octandra	<1
	Thelymitra macrophylla	<1
	Thysanotus manglesianus/pattersonii	<1
	Tricoryne elatior	<1
	Xanthorrhoea preissii	Opp.

Vegetation Sample Data

Sample Name: Q4

Project no.: EP19-105(07)
Date: 18/09/2019
Author: RAW,other

Status Non-permanent
Q4: Page 1 of 2

Quadrat and landform details

Sample type:	quadrat	Size:	10 m x 10 m
NW corner easting:	405999	NW corner northing:	6473101
Altitude (m):	N/A	Geographic datum/zone:	GDA94/Zone 50
Soil water content:	near saturated	Landform:	flat
Time since fire:	> 5 yrs	Disturbance:	low - weeds
Soil type/texture	clay with organic layer	Bare ground (%):	1
Rocks (%) and type:	No rocks	Soil colour:	grey
Litter:	10% (leaves)	Vegetation condition:	excellent-very good

Vegetation Sample Data

Sample Name: Q4

Project no.: EP19-105(07)
Date: 18/09/2019 **Status** Non-permanent
Author: RAW,other Q4: Page 2 of 2

Species Data

* denotes non-native species

Status		Confirmed name	Cover (%)
	*	*Babiana angustifolia*	<1
		Billardiera heterophylla	1
		Carex appressa	1
		Carex sp.	90
		Cycnogeton lineare	<1
	*	*Cynodon dactylon*	1
	*	*Cyperus congestus*	<1
		Eucalyptus rudis	30
	*	*Paspalum dilatatum*	<1

Vegetation Sample Data

Sample Name: R5

Project no.: EP19-105(07)
Date: 8/10/2019
Author: RAW

Status Non-permanent
R5: Page 1 of 2

Quadrat and landform details

Sample type:	releve	Size:	other
NW corner easting:	406294	NW corner northing:	6473788
Altitude (m):	N/A	Geographic datum/zone:	GDA94/Zone 50
Soil water content:	slightly damp	Landform:	flat
Time since fire:	no evidence	Disturbance:	high - weeds
Soil type/texture	clay with organic layer	Bare ground (%):	5
Rocks (%) and type:	No rocks	Soil colour:	brown
Litter:	10% (leaves,twigs)	Vegetation condition:	degraded

Vegetation Sample Data

Sample Name: R5

Project no.: EP19-105(07)
Date: 18/09/2019 **Status** Non-permanent
Author: RAW R5: Page 2 of 2

Species Data

* denotes non-native species

Status	Confirmed name
*	*Acacia iteaphylla*
*	*Avena barbata*
*	*Bromus diandrus*
	Callistachys lanceolata
*Pl	*Callistemon sp.*
	Calothamnus rupestris
	Casuarina obesa
	Eucalyptus rudis
*	*Fumaria capreolata*
	Hakea trifurcata
	Hakea varia
*	*Kunzea sp.*
	Melaleuca incana
	Melaleuca sp.
	Melaleuca teretifolia
	Melaleuca viminea
*	*Oxalis pes-caprae*

Vegetation Sample Data

Sample Name: R6

Project no.: EP19-105(07)
Date: 8/10/2019
Author: RAW

Status Non-permanent
R6: Page 1 of 2

Quadrat and landform details

Sample type:	releve	Size:	other
NW corner easting:	405473	NW corner northing:	6473276
Altitude (m):	N/A	Geographic datum/zone:	GDA94/Zone 50
Soil water content:	dry	Landform:	flat
Time since fire:	no evidence	Disturbance:	high - weeds, previous clearing
Soil type/texture	clay	Bare ground (%):	30
Rocks (%) and type:	No rocks	Soil colour:	brown
Litter:	30% (leaves,twigs)	Vegetation condition:	degraded-good

Vegetation Sample Data

Sample Name: R6

Project no.: EP19-105(07)
Date: 18/09/2019 **Status** Non-permanent
Author: RAW R6: Page 2 of 2

Species Data

* denotes non-native species

Status	Confirmed name
	Acacia lasiocarpa
	Acacia saligna
*	*Briza maxima*
	Calothamnus quadrifidus
*	*Eragrostis curvula*
	Gompholobium marginatum
	Hakea lissocarpha
	Hakea varia
	Hypocalymma angustifolium
*	*Ixia maculata*
	Melaleuca viminea
*	*Oxalis glabra*
	Taxandria linearifolia
	Thelymitra macrophylla
	Themeda triandra
	Viminaria juncea

Vegetation Sample Data

Sample Name: R7

Project no.: EP19-105(07)
Date: 18/09/2019
Author: RAW

Status Non-permanent
R7: Page 1 of 2

Quadrat and landform details

Sample type:	releve	Size:	other
NW corner easting:	406036	NW corner northing:	6473121
Altitude (m):	N/A	Geographic datum/zone:	GDA94/Zone 50
Soil water content:	slightly damp	Landform:	mid-slope
Time since fire:	no evidence	Disturbance:	moderate - weeds
Soil type/texture	clay	Bare ground (%):	5
Rocks (%) and type:	No rocks	Soil colour:	brown
Litter:	60% (leaves,branches,logs)	Vegetation condition:	good

Vegetation Sample Data

Sample Name: R7

Project no.: EP19-105(07)
Date: 18/09/2019 **Status** Non-permanent
Author: RAW R7: Page 2 of 2

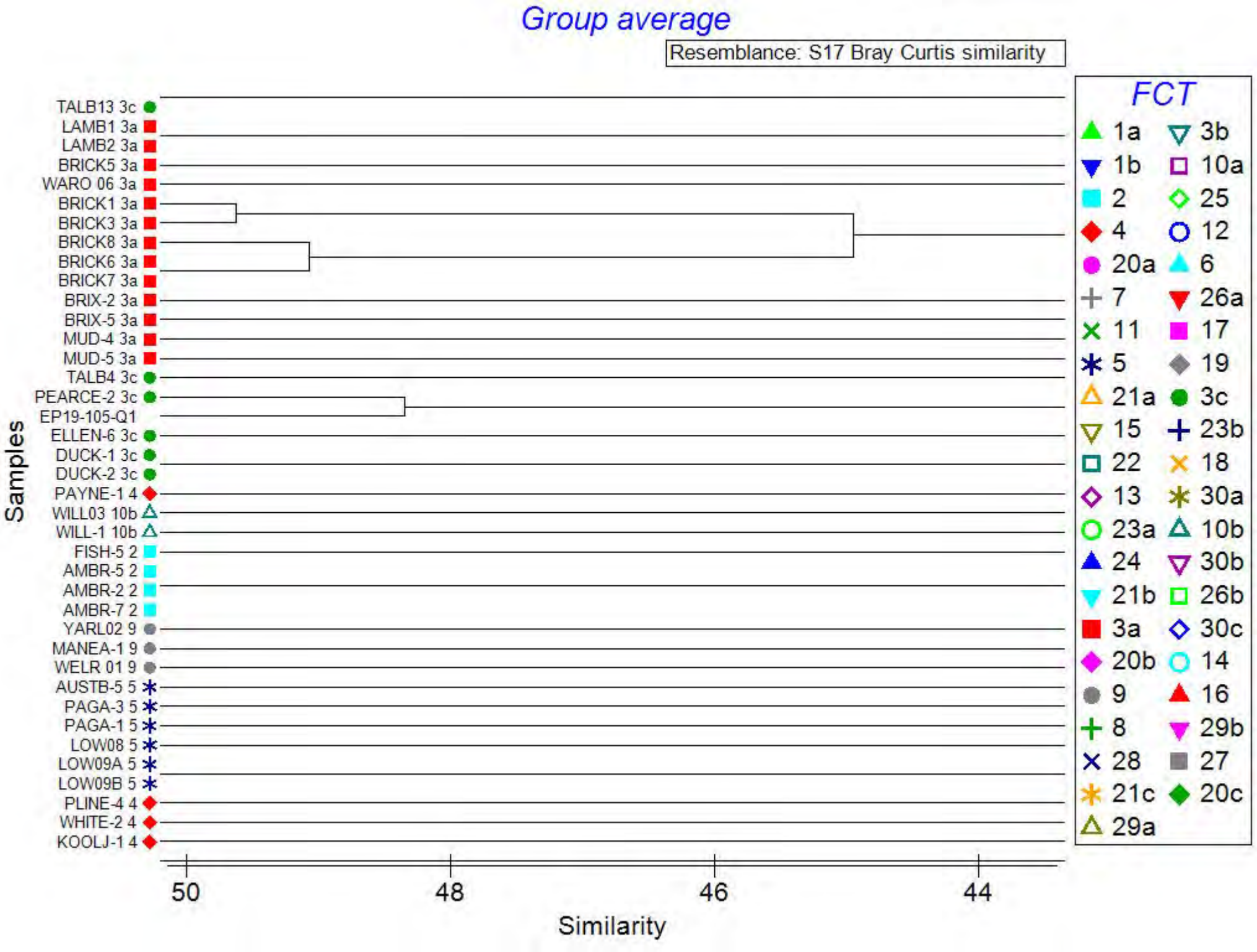
Species Data

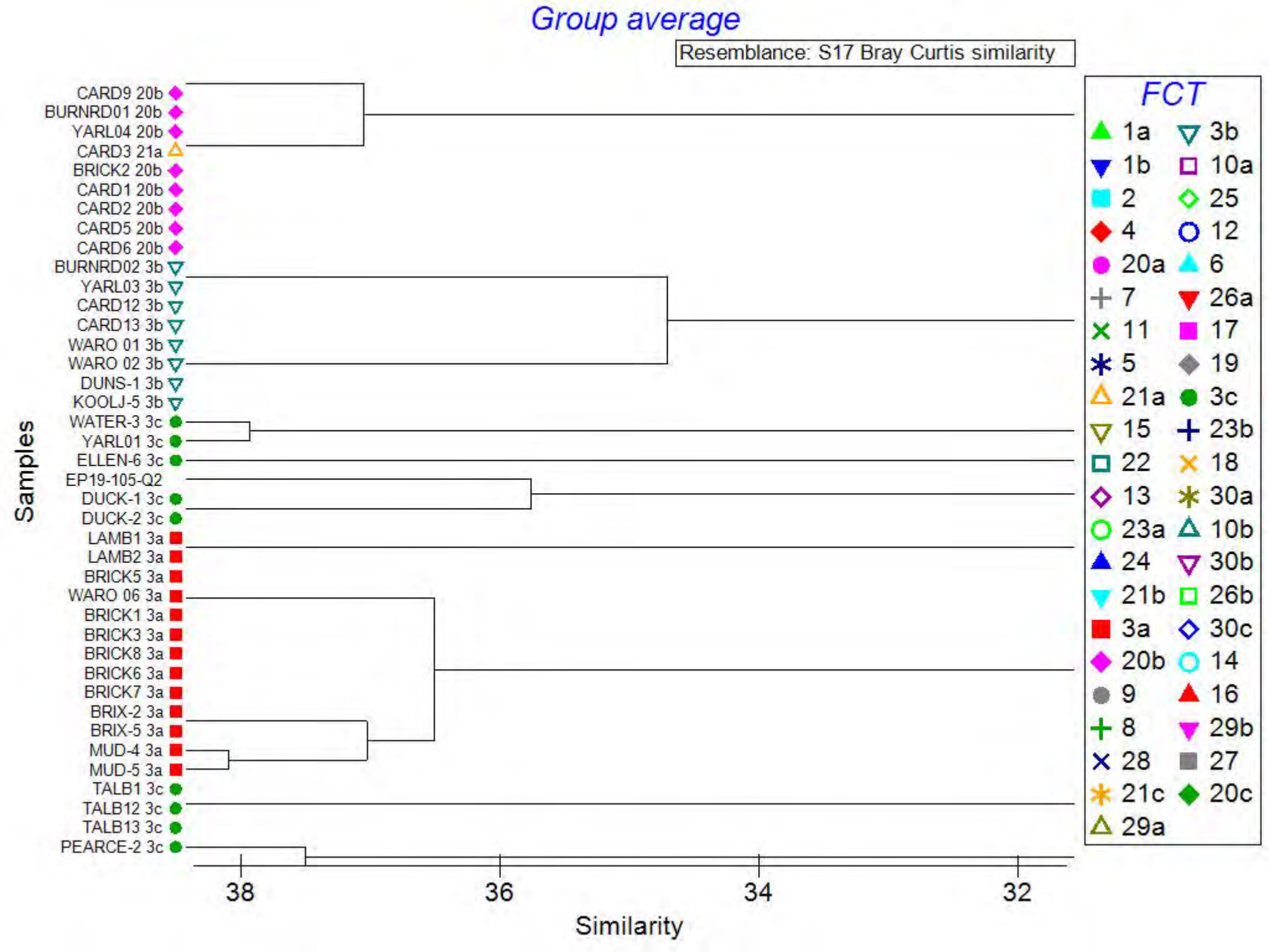
* denotes non-native species

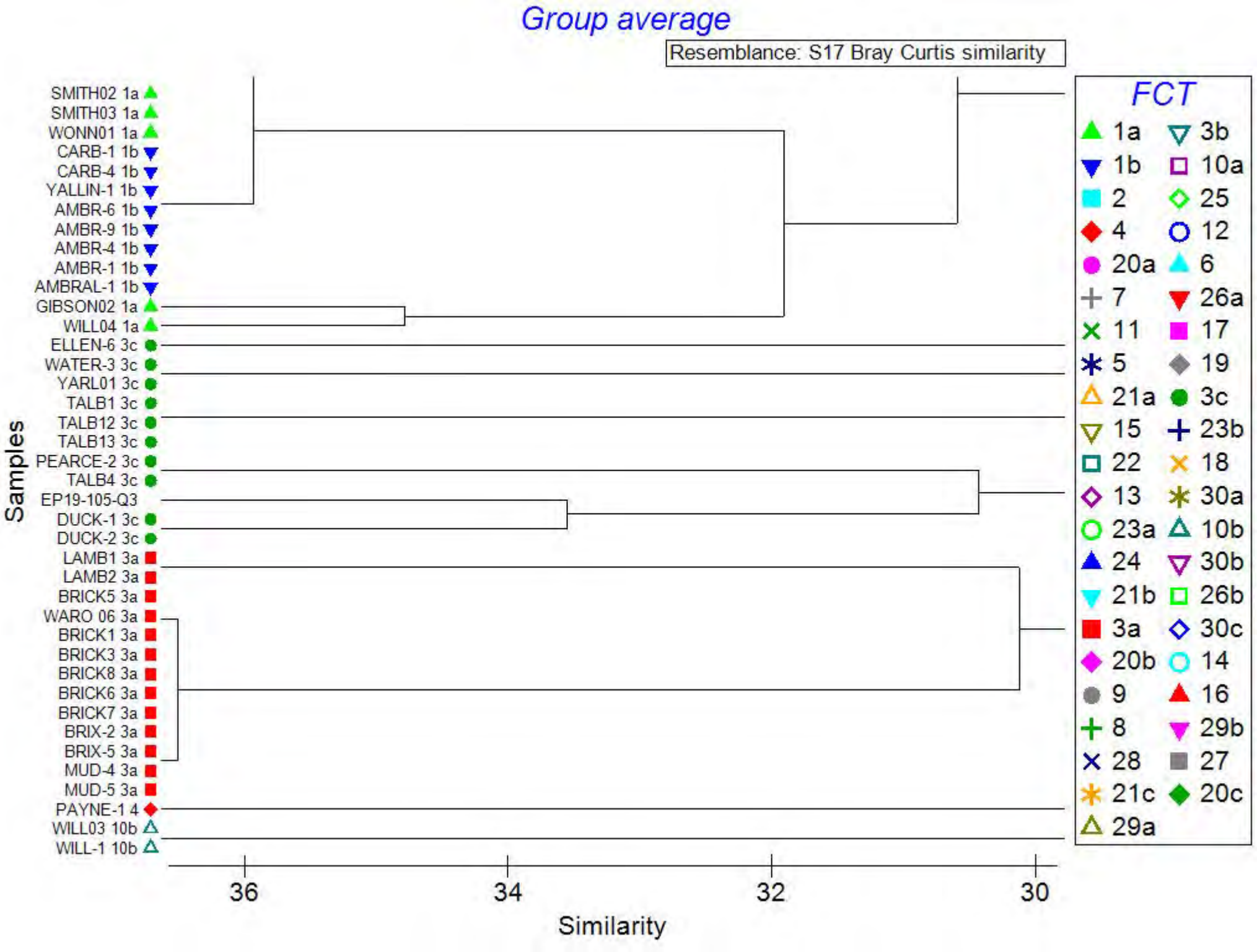
Status	Confirmed name	Cover (%)
	Acacia pulchella var. pulchella	
	Acacia saligna	
	Acacia sp.	
	Billardiera heterophylla	
*	*Briza maxima*	
*	*Cenchrus setaceus*	
*DP,WONS	*Chrysanthemoides monilifera subsp. monilifera*	
*	*Ehrharta calycina*	
*	*Ehrharta longiflora*	
*	*Eragrostis curvula*	
	Eucalyptus rudis	
	Gastrolobium nervosum	
	Haemodorum laxum	
	Hakea erinacea	
	Hakea prostrata	
	Hakea trifurcata	
	Hakea undulatum	
*	*Hesperantha falcata*	
	Hypocalymma angustifolium	
	Jacksonia sternbergiana	
	Kennedia prostrata	
*	*Oxalis glabra*	
*	*Oxalis pes-caprae*	
	Patersonia occidentalis	
	Phyllanthus calycinus	
	Thelymitra ?macrophylla	

Appendix F

Cluster Dendrograms


Group average
Resemblance: S17 Bray Curtis similarity
TALB13 3c
LAMB1 3a
LAMB2 3a
BRICK5 3a
WARO 06 3a
BRICK1 3a
BRICK3 3a
BRICK8 3a
BRICK6 3a
BRICK7 3a
BRIX-2 3a
BRIX-5 3a
MUD-4 3a
MUD-5 3a
TALB4 3c
PEARCE-2 3c
EP19-105-Q1
ELLEN-6 3c
DUCK-1 3c
DUCK-2 3c
PAYNE-1 4
WILL03 10b
WILL-1 10b
FISH-5 2
AMBR-5 2
AMBR-2 2
AMBR-7 2
YARL02 9
MANEA-1 9
WELR 01 9
AUSTB-5 5
PAGA-3 5
PAGA-1 5
LOW08 5
LOW09A 5
LOW09B 5
PLINE-4 4
WHITE-2 4
KOOLJ-1 4
Samples
50
48
46
44
Similarity
FCT
1a
3b
1b
10a
2
25
4
12
20a
6
7
26a
11
17
5
19
21a
3c
15
23b
22
18
13
30a
23a
10b
24
30b
21b
26b
3a
30c
20b
14
9
16
8
29b
28
27
21c
20c
29a


Group average
Resemblance: S17 Bray Curtis similarity
CARD9 20b
BURNRD01 20b
YARL04 20b
CARD3 21a
BRICK2 20b
CARD1 20b
CARD2 20b
CARD5 20b
CARD6 20b
BURNRD02 3b
YARL03 3b
CARD12 3b
CARD13 3b
WARO 01 3b
WARO 02 3b
DUNS-1 3b
KOOLJ-5 3b
WATER-3 3c
YARL01 3c
ELLEN-6 3c
EP19-105-Q2
DUCK-1 3c
DUCK-2 3c
LAMB1 3a
LAMB2 3a
BRICK5 3a
WARO 06 3a
BRICK1 3a
BRICK3 3a
BRICK8 3a
BRICK6 3a
BRICK7 3a
BRIX-2 3a
BRIX-5 3a
MUD-4 3a
MUD-5 3a
TALB1 3c
TALB12 3c
TALB13 3c
PEARCE-2 3c
Samples
38
36
34
32
Similarity
FCT
1a
3b
1b
10a
2
25
4
12
20a
6
7
26a
11
17
5
19
21a
3c
15
23b
22
18
13
30a
23a
10b
24
30b
21b
26b
3a
30c
20b
14
9
16
8
29b
28
27
21c
20c
29a


Group average
Resemblance: S17 Bray Curtis similarity
SMITH02 1a
SMITH03 1a
WONN01 1a
CARB-1 1b
CARB-4 1b
YALLIN-1 1b
AMBR-6 1b
AMBR-9 1b
AMBR-4 1b
AMBR-1 1b
AMBRAL-1 1b
GIBSON02 1a
WILL04 1a
ELLEN-6 3c
WATER-3 3c
YARL01 3c
TALB1 3c
TALB12 3c
TALB13 3c
PEARCE-2 3c
TALB4 3c
EP19-105-Q3
DUCK-1 3c
DUCK-2 3c
LAMB1 3a
LAMB2 3a
BRICK5 3a
WARO 06 3a
BRICK1 3a
BRICK3 3a
BRICK8 3a
BRICK6 3a
BRICK7 3a
BRIX-2 3a
BRIX-5 3a
MUD-4 3a
MUD-5 3a
PAYNE-1 4
WILL03 10b
WILL-1 10b
Samples
36
34
32
30
Similarity
FCT
1a
3b
1b
10a
2
25
4
12
20a
6
7
26a
11
17
5
19
21a
3c
15
23b
22
18
13
30a
23a
10b
24
30b
21b
26b
3a
30c
20b
14
9
16
8
29b
28
27
21c
20c
29a