# Reconnaissance Flora and Vegetation Assessment

## Stock Road Reserve and Adjacent Lots, Bullsbrook

Project No: EP19-005(02)

**Prepared for City of Swan**
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# Document Control

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# Executive Summary

The City of Swan (CoS) intends to upgrade a portion of Stock Road in Bullsbrook, between Great Northern Highway and Northlink WA (referred to herein as 'the site'). The site comprises approximately 38 hectares (ha) and is located approximately 31 kilometres (km) north-east of the Perth Central Business District within the City of Swan.

Botanists from Emerge Associates visited the site on 25 February, 18 and 24 September 2019 and undertook a 'reconnaissance' level flora and vegetation survey. During the survey searches were conducted for 'threatened' and 'priority' flora and 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 historical disturbance and a large portion supports road and rail infrastructure.
- Non-native vegetation is present across 33.88 ha (89%) of the site.
- Remnant native vegetation is present across 4.07 ha (11%) of the site.
- A total of 54 native and 47 non-native (weed) species were recorded in the site.
- No threatened or priority flora species were recorded or are considered likely to occur within the site.
- The native vegetation within the site was classified into eight plant communities: **As**, **Cc**, **CcM**, **Co**, **ErMr**, **Ew**, **M** and **Mixed**.
- All native plant communities were determined to be in 'degraded' condition. The remainder of the site supports non-native vegetation in 'completely degraded' condition.
- No threatened or priority ecological communities were recorded or are considered likely to occur within the site.
- Plant community **ErMr** associated with Ellen Brook represents the highest value vegetation in the site as it is part of a contiguous patch of native vegetation that is an ecological linkage, a *Bush Forever* site and a 'conservation' category wetland. However, the **ErMr** vegetation is disturbed and present mainly as native trees over non-native grasses.
- Three of the mapped wetlands which intersect with the site appear to support values that align with their current management categories. The other wetland feature is currently mapped as a CCW but may support values indicative of a lower level management category. A detailed wetland evaluation would be required to confirm the appropriate management category.
- Planted and remnant trees in the site may be considered significant due to their potential to provide habitat for threatened species of black cockatoo. A fauna assessment has been undertaken to assess fauna habitat values within the site (Emerge Associates 2019).

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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 |
| 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 | |
|---|---|
| LPS | Local planning scheme |
| PSLNA | Potentially significant local natural area |
| MRS | Metropolitan region scheme |
| SLNA | Significant local natural area |

*Table A5: Abbreviations – units of measurement*

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

# 1 Introduction

## 1.1 Project background

The City of Swan (CoS) intends to upgrade a portion of Stock Road in Bullsbrook, between Northlink WA and Great Northern Highway. The upgrade will occur within the Stock Road reserve and portions of adjacent private properties (an area referred to herein as 'the site'). The site is approximately 38 hectares (ha) in size and is shown in **Figure 1**.

The site is located approximately 31 kilometres (km) north east of the Perth Central Business District and is zoned 'rural', 'primary regional roads', 'other regional roads' and 'railways' under the Metropolitan Region Scheme (MRS) and 'general rural', 'landscape', 'regional reserve - other regional road', 'regional reserve – railway' under the City of Swan *Local Planning Scheme* (LPS) 17.

## 1.2 Purpose and scope of work

Emerge Associates (Emerge) were engaged by Cossill & Webley Engineers, on behalf of the CoS, to provide environmental consultancy services to support the planning process for the proposed upgrade of Stock Road. 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 'reconnaissance' survey in accordance with the Environmental Protection Authority's (EPA's) *Technical Guidance – Flora and Vegetation Surveys for Environmental Impact Assessment* (EPA 2016).

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

- Desktop review of relevant background information pertaining to the site and surrounds, including database searches for threatened flora species and ecological communities.
- Compilation of a comprehensive list of flora species recorded as part of the field survey.
- Mapping of plant communities and vegetation condition.
- Identification of conservation significant flora and vegetation.
- Documentation of the desktop assessment, survey methodology and results into a report.

# 2 Background

## 2.1 Environmental context

### 2.1.1 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 life-cycle 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 655.1 millimetres (mm) of rainfall is recorded annually from the Pearce RAAF weather station, which is the closest weather station, located approximately 3.5 km north of the site. The majority of this rainfall is received between the months of June and August. Mean maximum temperatures at the Pearce RAAF station range from 17.9$^{o}$C in July to 33.5$^{o}$C in January, while mean minimum temperatures range from 8.2$^{o}$C in August to 17.5$^{o}$C in February (BoM 2019).

The initial survey was undertaken in February 2019 which had typically low rainfall and high temperatures. The other surveys were undertaken in September 2019 in which a total of 29.6 mm of rain fall was recorded which is below the September mean of 68.2 mm (BoM 2019). However, 102.4 mm of rainfall was recorded in August 2019, near the mean of 106.1 mm. Temperatures recorded at the Pearce RAAF weather during August 2019 were similar to the mean value (September data is not currently available).

### 2.1.2 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 has 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).

The site lies on the eastern side of the Swan Coastal Plain which comprises the Pinjarra Plain geomorphological unit. The Pinjarra Plain comprises a relatively flat landscape, but also supports numerous channels that result in waterlogging and the formation of seasonal swamps (Seddon

2004). Mapping of physiographic regions by Gozzard (2011) places the eastern portion of the site within the Piedmont Zone, which comprises a series of spurs and colluvial slopes that form the foothills of the Darling Scarp.

Examination of soil mapping places the majority of the site within the 'Beermullah' soil association, which is described as 'poorly drained plain; saline and solonetzic soils, bog iron ore and some shallow sands over bog iron' (Churchward and McArthur 1980). The western portion of the site lies within the 'Yanga' soil association, which is described as a 'poorly drained plain with grey sandy benches and intervening swamps; also areas of bog iron ore, marl' (Churchward and McArthur 1980). The eastern portion of the site lies within the 'Guildford' soil association, which is described as a 'flat plain with medium textured deposits; yellow duplex soils' (Churchward and McArthur 1980). The soil associations mapped within the site by (Churchward and McArthur 1980) are shown in **Figure 2**.

The Muchea limestone formation comprises a thin shallow deposit of limestone sandy and marly limestone on the central and eastern portion of the Swan Coastal Plain (DoW 2017). Due to the site's location there is potential for Muchea limestone to occur. Soil landscape mapping also indicates that the central western portion, between the railway and Ellen Brook, supports the 'Yanga 7x Phase' which states that 'marl may be at the surface or deeply buried' (DPIRD 2018).

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

### 2.1.3 Topography

The elevation of the site ranges from 35 m in relation to the Australian height datum (mAHD) on the western side of the site to 41 mAHD on the eastern side of the site, with the central portion of the site being the lowest at 36 mAHD near Ellen Brook (DoW 2008) (**Figure 2**).

### 2.1.4 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 2017b)
- *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 the following three wetland or water related features in the site that are associated with Ellen Brook (as shown in **Figure 3**):

- watercourse - major, non-perennial

- watercourse - minor, non-perennial
- drain – major.

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). 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. Further information on geomorphic wetland types and their management categories is provided in **Appendix A**.

A review of the *Geomorphic Wetlands, Swan Coastal Plain* dataset (DBCA 2018b) indicated that the following wetland features occur within the site:

- Two large 'multiple use' category wetland (MUW) features (UFIs 15282 and 15732) classified as palusplain wetlands occur across the majority of the site. UFI 15282 occurs in the eastern portion of the site and extends beyond the site to the north, east and south. UFI 15732, named 'Ellen Brook Floodplain', occurs in the western portion of the site and extends beyond the site to the north, west and south.
- One 'conservation' category wetland (CCW) feature (UFI 15734) lies between the UFIs 15282 and 15732 in the central portion of the site, and extends beyond the site to the north and south. This feature is named 'Ellen Brook Floodplain' and generally aligns with the Ellen Brook watercourse. A small portion of another 'conservation' category wetland feature (UFI 12433) lies in the south eastern portion of the site. Both of these features are classified as palusplain wetlands.

The locations of the geomorphic wetlands in the site are shown in **Figure 3**.

### 2.1.5 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 located near the eastern boundary of 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. Due to its location on the eastern side of the SWA02 subregion, the site is near the Northern Jarrah Forest subregion which is characterised by lateritic gravel soils predominated by jarrah, marri and *Eucalyptus wandoo* (wandoo).

Variations in native vegetation within the site can be further classified based on regional vegetation associations. Vegetation association mapping by Beard *et al.* (2013) shows the majority of the site as comprising vegetation association 'Pinjarra 4'. This association is described as 'medium woodland; marri (*Corymbia calophylla*) and wandoo (*Eucalyptus wandoo*)' (Beard *et al.* 2013). The eastern

portion of the site is mapped as vegetation association 'Pinjarra 3' which is described as 'medium forest; jarrah (*Eucalyptus marginata*) – marri' (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 (Environment Australia 2001) established an objective of retaining 30% of the original extent of each vegetation complex. However, a lower objective of 10% is applied in 'constrained urban areas' such as the Swan Coastal Plain (Ministry for Planning 1995).

'Pinjarra 3' has 11.53% of its pre-European extent remaining on the Swan Coastal Plain with 1.53% protected for conservation purposes (Government of Western Australia 2018). 'Pinjarra 4' has 10.49% of its pre-European extent remaining on the Swan Coastal Plain with 1.09% protected for conservation purposes (Government of Western Australia 2018).Therefore, the percentage protected for conservation of both these vegetation associations fall below both the 30% and 10% retention objectives.

Vegetation complex mapping by Heddle *et al.* (1980) shows the site as occurring within three complexes:

- The majority of the site lies within the 'Beermullah' complex which is described as a 'mixture of low open forest of *Casuarina obesa* and open woodland of *C. calophylla - Eucalyptus wandoo - Eucalyptus marginata*. Components include closed scrub of *Melaleuca* spp. Minor components include closed scrub of *Melaleuca* spp. and occurrence of *Actinostrobus pyramidalis* (now *Callitris pyramidalis*)' (Heddle *et al.* 1980).
- The far western portion of the site is mapped as the 'Yanga' complex which is described as 'low open forest of *Casuarina obesa* with patches of *Actinostrobus pyramidalis* and *Melaleuca* spp. on low lying flats. Mixture of low open forest of *Banksia* spp. - *Eucalyptus todtiana* and open woodland of *Corymbia calophylla - Banksia* spp.' (Heddle *et al.* 1980).
- The eastern portion of the site is mapped as the 'Guildford' complex which is described as 'a mixture of open forest to tall open forest of *Corymbia calophylla - Eucalyptus wandoo - Eucalyptus marginata* and woodland of *Eucalyptus wandoo* (with rare occurrences of *Eucalyptus lane-poolei*). Minor components include *Eucalyptus rudis - Melaleuca rhaphiophylla'* (Heddle *et al.* 1980).

On the Swan Coastal Plain, the 'Beermullah' complex has 6.6% of its pre-European extent remaining, the 'Yanga' complex has 16.5% of its pre-European extent remaining and the 'Guildford' complex has 5.3% of its pre-European extent remaining (EPA 2015).

### 2.1.6 Historic land use

Review of historical images available from 1965 (WALIA 2019) onwards shows that the portion of Stock Road within the site was present as a dirt track from at least 1965 and was later sealed in parts. The majority of the site was cleared of native vegetation prior to 1965 and vegetation clearing since then appears to have been minor. Vegetation in the western portion of the site within the rail reserve appears to have been subject to disturbance since 1965 and intensive vegetation clearing is visible in the image from 2000 when the railway crossing was bituminised. Revegetation (or natural regeneration) is visible along the railway reserve in the image from 2004.

## 2.2 Significant flora and vegetation

### 2.2.1 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' pursuant to Schedule 1 of the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). 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). 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. Threatened flora species listed under the EPBC Act and/or BC Act are assigned a conservation status according to their national extent.

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**.

A search was conducted for threatened and priority flora within a 10 km radius of the site using the *Protected Matters Search Tool* (DoEE 2019a), *NatureMap* (DPaW 2019) and DBCA's threatened and priority flora database (reference no. 19-0219FL). The search results indicate that no threatened or priority flora species are known occur in the site but that a total of 26 threatened and 43 priority flora species occur or potentially occur within 10 km of the site, as listed in **Table 1**.

Of the flora species potentially occurring in the local area, only those with habitat preferences of flat landscapes with sandy/clay soils, and creeklines, were deemed likely to occur in the site due to the presence of these habitat types. However, the high levels of historic disturbance and alteration to vegetation structure strongly reduces the habitats present for threatened or priority species.

On this basis 13 threatened flora species and 27 priority flora species were identified as having potential to occur within the site (shaded green in **Table 1)**. Note that many of these species, particularly priority flora, have limited habitat information available and have been considered to have potential to occur in the site as a precautionary measure.

*Table 1: 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 | | | | |
| *Calectasia cyanea* | T | CE | P | Heathland on white sand or laterite gravel over laterite. | Jun-Oct | Unlikely |
| *Grevillea althoferorum* subsp. *fragilis* | T | CE | P | Greyish-yellow colluvial sand at the base of the Darling Scarp. | Sep-Nov | **Possible** |
| *Synaphea* sp. Fairbridge Farm (D. Papenfus 696) | T | CE | P | Low woodland on grey, clayey sand with lateritic pebbles (Pinjarra Plain) near winter wet flats. | Sep - Nov | **Possible** |
| *Eucalyptus leprophloia* | T | E | P | White or grey sand over laterite. Valley slopes. | Aug-Oct | Unlikely |
| *Grevillea corrugata* | T | E | P | Gravelly loam. Roadsides. | Aug-Sep | **Possible** |
| *Andersonia gracilis* | T | E | P | Seasonally damp, black sandy clay flats near or on the margins of swamps. | Sep - Nov | Unlikely |
| *Caladenia huegelii* | T | E | PG | Well-drained, deep sandy soils in lush undergrowth in a variety of moisture levels. | Sep-early Nov | Unlikely |
| *Conospermum densiflorum* subsp. *unicephalatum* | T | E | P | Clay in low lying areas. | Sep-Nov | **Possible** |
| *Darwinia foetida* | T | E | P | Grey-white sand on swampy, seasonally wet sites | Oct-Nov | **Possible** |
| *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 fire) | Unlikely |
| *Drakaea elastica* | T | E | PG | Bare patches of sand within otherwise dense vegetation in low-lying areas alongside winter-wet swamps. | Sep-Nov (survey Jul-Aug) | Unlikely |
| *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 christineae* | T | E | P | Clay loam, sandy clay, often moist. | Aug-Sep | **Possible** |
| *Grevillea curviloba* subsp. *curviloba* | T | E | P | Winter wet, deep peaty grey sands over limestone at depth. | Sep-Oct | **Possible** |

*Table 1: Significant flora species known or likely to occur within 10 km of the site (continued)*

| *Species* | Level of significance | | Life strategy | Habitat | Flowering period | Likelihood of occurrence |
|---|---|---|---|---|---|---|
| | State | EPBC | | | | |
| *Grevillea curviloba* subsp. *incurva* | T | E | P | Sand, sandy loam. Winter-wet heath. | Aug to Sep. | **Possible** |
| *Lepidosperma rostratum* | T | E | P | Peaty sand and clay amongst low heath, in winter-wet swamps. | May-Jun (survey Jun-Aug) | Unlikely |
| *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 | **Possible** |
| *Trithuria occidentalis* | T | E | A | Partly submerged on the edge of shallow winter-wet clay pans in very open shrubland. | Oct-Nov | Unlikely |
| *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** |
| *Anthocercis gracilis* | T | V | P | Steep granite slopes along the Darling Scarp in shallow, humus-rich sandy or loamy soils. | Sep-Oct, Apr | Unlikely |
| *Chamelaucium* sp. Gingin (N.G.Marchant 6) | T | V | P | White yellow sand in low woodland. | Sep-Dec | **Possible** |
| *Diuris micrantha* | T | V | PG | Dark grey-black sandy clay-loam in winter wet depressions or swamps. Often in shallow standing water. | August/September to early October | Unlikely |
| *Eleocharis keigheryi* | T | V | P | Clay or sandy loam in freshwater creeks and transient waterbodies such as seasonally wet clay pans. | Aug-Dec | **Possible** |
| *Gastrolobium crispatum* | P1 | | P | Yellow or brown sandy loam, red laterite soils. Steep gullies, slopes, ridges, breakaways. | Sep-Oct | Unlikely |
| *Hibbertia glomerata* subsp. *ginginensis* | P1 | - | P | Sand, brown clay, laterite. | Jul-Sep | **Possible** |
| *Hydrocotyle striata* | P1 | - | A | Sand and clay in springs and creeklines. | Nov | **Possible** |
| *Calectasia elegans* | P2 | - | P | Grey yellow sand on plains. | Sep-Oct | **Possible** |

*Table 1: Significant flora species known or likely to occur within 10 km of the site (continued)*

| *Species* | Level of significance | | Life strategy | Habitat | Flowering period | Likelihood of occurrence |
|---|---|---|---|---|---|---|
| | State | EPBC | | | | |
| *Gastrolobium nudum* | P2 | - | P | Red-brown clay/loam/gravel on flats, slopes, hilltops, valleys, breakaways. | Feb | **Possible** |
| *Millotia tenuifolia* var.*laevis* | P2 | - | A | Granite or lateritic soils. | Sep-Oct | **Possible** |
| *Poranthera moorokatta* | P2 | - | A | Sandy or clay soils. Dampland or low sandy dunes. | | **Possible** |
| *Schoenus* sp. Bullsbrook (J.J. Alford 915) | P2 | - | P | Grey peaty sand. Low-lying flats | | Unlikely |
| *Stylidium squamellosum* | P2 | - | P | Brown to red-brown clay loam in winter-wet habitats and depressions. | Oct-Nov | Unlikely |
| *Acacia oncinophylla* subsp. *oncinophylla* | P3 | - | P | Granitic soils | Aug-Oct | **Possible** |
| *Adenanthos cygnorum* subsp. *chamaephyton* | P3 | - | P | Grey sand, lateritic gravel. | Jul-Jan | **Possible** |
| *Beaufortia purpurea* | P3 | - | P | Lateritic or granitic soils on rocky slopes. | Oct-Feb | **Possible** |
| *Chamaescilla gibsonii* | P3 | - | P | Clay to sandy clay in winter-wet flats, shallow water-filled claypans. | Sep | Unlikely |
| *Cyathochaeta teretifolia* | P3 | - | P | Grey sand, sandy clay in swamps and creek edges. | Oct-Jan | **Possible** |
| *Eryngium pinnatifidum* subsp. Palustre (G.J. Keighery 13459) | P3 | - | P | Grey brown sand or clay in winter wet flats. | Sep-Nov | **Possible** |
| *Guichenotia tuberculata* | P3 | - | P | Sand clay over laterite, sand | Aug-Oct | **Possible** |
| *Haemodorum loratum* | P3 | - | P | Grey or yellow sand, gravel. | Nov | **Possible** |
| *Halgania corymbosa* | P3 | - | P | Gravelly soils, soils over granite. | Aug-Nov | **Possible** |
| *Lasiopetalum glutinosum* subsp. *glutinosum* | P3 | - | P | Brown clay loam on slopes | Sep-Dec | Unlikely |
| *Meionectes tenuifolia* | P3 | - | P | Clay loam in seasonally wet areas. | Oct-Dec | Unlikely |
| *Persoonia rudis* | P3 | - | P | White, grey or yellow sand, often over laterite. | Dec-Jan | **Possible** |
| *Phlebocarya pilosissima* subsp. *pilosissima* | P3 | - | P | White or grey sand, lateritic gravel. | Aug-Oct | **Possible** |
| *Platysace ramosissima* | P3 | - | P | Sandy soils. | Oct-Nov | **Possible** |

*Table 1: Significant flora species known or likely to occur within 10 km of the site (continued)*

| *Species* | Level of significance | | Life strategy | Habitat | Flowering period | Likelihood of occurrence |
|---|---|---|---|---|---|---|
| | State | EPBC | | | | |
| *Schoenus capillifolius* | P3 | - | A | Brown mud in claypans | Oct-Nov | Unlikely |
| *Schoenus* sp. Waroona (G.J. Keighery 12235) | P3 | - | A | Clay or sandy clay. Winter-wet flats. | Oct-Nov | **Possible** |
| *Stylidium aceratum* | P3 | - | A | Sandy soils in swamp heathland. | Oct-Nov | **Possible** |
| *Stylidium asteroideum* | P3 | - | P | Sand, clay, loam in winter wet areas. | Sep-Nov | **Possible** |
| *Stylidium paludicola* | P3 | - | P | Peaty sand over clay. Winter wet habitats. Marri and Melaleuca woodland, Melaleuca shrubland | Oct-Dec | Unlikely |
| *Stylidium trudgenii* | P3 | - | P | Grey sand, dark grey to black sandy peat. Margins of winter-wet swamps, depressions | Sep-Jan | Unlikely |
| *Styphelia filifolia* | P3 | - | P | Brown over pale yellow sand. | Feb-April | **Possible** |
| *Tetratheca pilifera* | P3 | - | P | Gravelly soils. | Aug-Oct | **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** |
| *Cyanicula ixioides* subsp. *ixioides* | P4 | - | PG | Laterite, gravel. | Aug-Oct | **Possible** |
| *Darwinia pimelioides* | P4 | - | P | Loam, sandy loam on granite outcrops. | Sep-Oct | Unlikely |
| *Drosera occidentalis* | P4 | - | P | Flat, brown/white/yellow moist sand/clay/peat, often near swamps. | Oct-Dec or Jan | Unlikely |
| *Hydrocotyle lemnoides* | P4 | - | A | Floating in swamps. | Aug-Oct | Unlikely |
| *Hypolaena robusta* | P4 | - | P | White sand. Sandplains. | Sep-Oct | **Possible** |
| *Oxymyrrhine coronata* | P4 | - | P | Brown loam/laterite on slopes. | Oct-Dec | |
| *Persoonia sulcata* | P4 | - | P | Lateritic or granitic soils. | Sep-Nov | **Possible** |
| *Schoenus griffinianus* | P4 | - | P | White sand | Sep-Oct | **Possible** |
| *Schoenus natans* | P4 | - | A | Aquatic, in winter-wet depressions. | Oct | Unlikely |
| *Stylidium longitubum* | P4 | - | A | Seasonal wetlands. | Oct-Dec | Unlikely |

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

### 2.2.2 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 2017b). '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 section 181 of the EPBC Act. 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 Section 27(1) and 33 of the BC Act and under 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**.

Known locations of TECs and PECs within 10 km of the site were searched for using the publicly available *Weed and native flora dataset* (Keighery *et al.* 2012), *Protected Matters Search Tool* (DoEE 2019a) and DBCA's threatened and priority ecological communities' database (reference no. 21-0219EC). These search results indicate that no TECs or PECs are known to occur within the site, but that 11 TECs and three PECs occur or are likely to occur within 10 km of the site as listed in **Table 2**.

*Table 2: TECs and PECs 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 | Critically endangered | Endangered |
| SCP3a | *Corymbia calophylla - Kingia australis* woodlands on heavy soils, Swan Coastal Plain | TEC | Critically endangered | Endangered |
| SCP3c | *Corymbia calophylla - Xanthorrhoea preissii* woodlands and shrublands of the Swan Coastal Plain | TEC | Critically endangered | Endangered |
| MUCHEA LIMESTONE | Shrublands and Woodlands on Muchea Limestone of the Swan Coastal Plain | TEC | Endangered | Endangered |
| SCP07 | Herb rich saline shrublands in clay pans | TEC | Vulnerable | Critically endangered (Clay Pans of the Swan Coastal Plain) |
| SCP08 | Herb rich shrublands in clay pans | TEC | Vulnerable | |

*Table 2: TECs and PECs known or likely to occur within 10 km of the site (continued)*

| Code | Community name | TEC/ PEC | Level of significance | |
|---|---|---|---|---|
| | | | State | EPBC Act |
| SCP22 | *Banksia ilicifolia* woodlands | TEC/ PEC | Priority 3 | Endangered (Banksia Woodlands of the Swan Coastal Plain) |
| SCP21c | Low lying *Banksia attenuata* woodlands or shrublands | TEC/ PEC | Priority 3 | |
| SCP23b | Swan Coastal Plain *Banksia attenuata - Banksia menziesii* woodlands | TEC/ PEC | Priority 3 | |
| SCP15 | Forests and woodlands of deep seasonal wetlands of the Swan Coastal Plain | TEC | Vulnerable | - |
| SCP18 | Shrublands on calcareous silts of the Swan Coastal Plain | TEC | Vulnerable | - |

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

The following four TECs were considered to have potential to occur in the site based on geomorphology, soils and regional vegetation patterns (shaded green in **Table 2**):

- *Corymbia calophylla - Xanthorrhoea preissii* woodlands and shrublands of the Swan Coastal Plain TEC (endangered under the EPBC Act and critically endangered under the BC Act)
- Shrublands and Woodlands on Muchea Limestone of the Swan Coastal Plain TEC (endangered under the EPBC Act and the BC Act)
- Herb rich saline shrublands in clay pans TEC (critically endangered under the EPBC Act and vulnerable under the BC Act)
- Herb rich shrublands in clay pans TEC (critically endangered under the EPBC Act and vulnerable under the BC Act).

### 2.2.3 Local and regional significance

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

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

- The vegetation is associated with Ellen Brook, which is listed as a 'protection' category 'potential local natural area' within the City of Swan (City of Swan 2015) (see **Section 2.3.2**).
- The vegetation within the site has potential value as habitat for threatened or priority fauna species including, in particular, Carnaby's black cockatoo (endangered under the EPBC Act) and the forest red-tailed black cockatoo ('vulnerable' under the EPBC Act).
- Flora taxon is listed in *Bush Forever* 'significant flora' list for the Pinjarra Plain.

### 2.2.4 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 the 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), of which many 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.

## 2.3 Land use planning considerations

A range of legislation, regulations and polices are relevant to the evaluation of vegetation in Western Australia. Key considerations applicable to the site are described below and also shown in **Figure 3**.

### 2.3.1 Bush Forever

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

Bush Forever Site 296 (Ellen Brook, Upper Swan) lies within the central portion of the site and generally aligns with the Ellen Brook watercourse. This linear site extends beyond to the north and south, connecting to other *Bush Forever* sites. The location of the part of Bush Forever Site 296 associated with the site is shown in **Figure 3**.

### 2.3.2 Local natural areas

The City of Swan's *Local Biodiversity Strategy* includes mapping of 'potentially significant local natural areas' (PSLNAs) which were determined using various environmental factors and 'ecological criteria' (City of Swan 2015). PSLNAs have been classified into proposed protection categories of 'conservation', 'protection', 'retention', 'limited protection' and 'to be determined/negotiated'.

PSLNAs will be considered to be a 'significant local natural area' (SLNA) following a suitable flora and vegetation survey and if that survey determines the vegetation is in 'good' or better condition. *Local Biodiversity Strategy* states that SLNAs should be 'retained and where possible, protected and their biodiversity values managed for the future' (City of Swan 2015).

Ellen Brook is mapped as a PSLNA, and the portion that traverses the site meets '9-11 prioritisation criteria' (City of Swan 2015). This PSLNA has been assigned a 'protection' biodiversity protection level.

### 2.3.3 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 significant, threatened or scheduled flora, vegetation communities or ecosystems. 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, including 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).

Two ESAs are located within the eastern portion of the site. One is a circular shape and extends to the south of the site, appearing to be associated with UFI 12433 (refer **Section 2.1.4**). The other occurs as a linear shape in the site and appears to be associated with the Ellen Brook watercourse, and also extends north and south of the site. The locations of these ESAs in relation to the site are shown in **Figure 3**.

### 2.3.4 Ecological linkages

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

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

One mapped ecological linkage (No. 27) occurs within the site. This linkage is associated with Ellen Brook watercourse and extends beyond the site to the north and south, connecting to other linkages. The location of this linkage is shown in **Figure 3**.

## 2.4 Previous flora surveys

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

# 3 Methods

## 3.1 Field survey

Botanists from Emerge visited the site on 25 February, 18 and 24 September 2019 to conduct the flora and vegetation assessment.

### 3.1.1 Vegetation

The site was traversed on foot and the composition and condition of vegetation was recorded. Searches were conducted for threatened and priority flora species with potential to occur in the site, with a particularly focus on identifying areas of suitable habitat.

Native vegetation within the site was traversed and detailed notes were taken. Data recorded included the following:

- environmental information (slope, aspect, bare-ground, rock outcropping, soil type and colour class, litter layer, topographical position, time since last fire event)
- biological information (vegetation structure and condition, degree of disturbance and species present)
- photographs to show particular site conditions.

All plant specimens collected during the field survey were dried, pressed and then named in accordance with requirements of the Western Australian Herbarium. 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 mapped using methods from Keighery (1994), as shown in **Table 3**.

*Table 3: 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. |

### 3.1.2 Wetlands

The general characteristics of each mapped geomorphic wetland within the site was assessed during the survey (refer **Section 2.1.4**). Notes were taken on aspects such as hydrology, vegetation and landform. The values were compared against the currently assigned management category. Note that a detailed wetland evaluation using the DBCA (2017a) methodology was not undertaken.

## 3.2 Mapping and data analysis

### 3.2.1 Plant community identification and description

The local plant communities within the site were identified from the sample data collected during the field survey. Once the communities were defined, 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 then mapped on aerial photography (1:10,000) from the sample locations and boundaries were interpreted from aerial photography and notes taken in the field. Vegetation condition was mapped on aerial photography (1:10,000) based on notes recorded during the field survey to define areas with differing condition.

### 3.2.2 Floristic community type assignment

No statistical floristic analysis was completed due to the reconnaissance level of the survey and the low native species diversity recorded within patches of vegetation in the site.

### 3.2.3 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.

## 3.3 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 4**.

*Table 4: Evaluation of survey methodology against standard constraints outlined in EPA Technical Guidance – Flora and Vegetation Surveys for Environmental Impact Assessment*

| 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. |
| 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 15 years' experience in environmental science in Western Australia. |
| Suitability of timing | No limitation | The initial survey was conducted in February and thus outside of the main flowering season (spring). The two additional surveys were conducted in spring to record additional flora species that would not have been visible during the first survey. The condition of vegetation within the site was also reassessed within spring to take into account additional native species recorded. Due to the disturbed nature of the site, no detailed vegetation sampling was considered to be required during the spring survey. Therefore, the timing of the three surveys was considered adequate to classify the vegetation in the site and no further surveys are considered to be required. |
| Temporal coverage | No limitation | The site was visited three times which was considered adequate to record a near complete inventory of flora species, due to the small amount of native vegetation present and high level of disturbance. |
| Spatial coverage and access | No limitation | Site coverage was comprehensive (track logged). |
| | No limitation | All parts of the site could be accessed or sufficiently viewed from adjacent lots as required. |
| Sampling intensity | No limitation | A total of 101 species were recorded during traverses of the site. Due to the disturbed nature of the site, no detailed sampling was considered to be required and the survey effort was considered sufficient to characterise the vegetation and prepare a representative species inventory for the site. |
| Influence of disturbance | Minor limitation | Time since fire is greater than 50 years as interpreted from aerial imagery and therefore short lived species more common after fire may not have been visible. |
| | No limitation | Historical ground disturbance was evident within the site and non-native vegetation dominated. 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 located on a flat to gently sloping plain, with a channel present where the Ellen Brook watercourse intersects in a north-south direction. Soils in the site range from grey sand in the western portion including Ellen Brook, to red/brown sand/clay in the eastern portion. Outcropping limestone was recorded between the railway and Ellen Brook and is suspected to be present at depth to the west and east of the outcropping to unknown extent. This limestone is considered likely to be representative of the 'Muchea limestone' geological formation.

All roads within the site are bituminised, excepting the central portion of Stock Road which is a sand track. A single track railway line with level bitumen crossing is present in the western portion of the site, adjacent to Railway Parade. The remainder of the site comprises road reserve and portions of private properties. The private properties are currently used for agricultural purposes such as stock grazing.

The road reserve, rail reserve and private properties in the site support a combination of native and non-native vegetation. The majority of the site comprises agricultural land with occasional native trees and shrubs over non-native pasture grasses. Many of the patches of native vegetation in the site are isolated and support a high cover of non-native grasses. Vegetation along Ellen Brook is part of a larger patch that extends beyond the site but comprises native trees over a predominantly non-native understorey. Similarly, vegetation in the rail reserve extends beyond the site and comprises native shrubs and occasional trees over non-native vegetation, which appears to comprise relatively intact native vegetation to the north of the site.

The majority of native vegetation within the site appears to have regenerated after severe disturbance, but also includes planted vegetation (particularly along Great Northern Highway).

## 4.2 Flora

A total of 54 native and 47 non-native (weed or planted species not native to the local area) species were recorded within the site during the field survey, representing 35 families and 84 genera. The dominant families were Myrtaceae (12 native taxa and three weed taxa) and Poaceae (two native taxa and 14 weed taxa). Some flora taxa recorded in the site that occur naturally in the area were potentially planted but were assumed to be remnant due to lack of definitive evidence.

A complete species list is provided in **Appendix B** and sampled data in **Appendix C**.

### 4.2.1 Threatened and priority flora

No threatened flora taxa were recorded within the site.

### 4.2.2 Locally and regionally significant flora

One species recorded in the site, *Grevillea obtusifolia*, is identified in *Bush Forever* as significant flora of the foothills and Pinjarra plain as it is considered to have significant populations and is endemic

(Government of WA 2000b). Approximately four *G. obtusifolia* individuals were recorded within plant community **M** in the rail reserve in the western portion of the site.

*Grevillea thelemanniana*, which is listed as 'critically endangered' under the EPBC Act and 'threatened' the BC Act, and is also listed as significant flora of the foothills and Pinjarra plain, was recorded in the eastern portion of the site along Great Northern Highway. However, the individual/s in the site are cultivars and located within other planted non-native vegetation which was likely installed during previous works associated with the Great Northern Highway. Therefore, the individual/s recorded within the site do not represent the threatened form of *G. thelemanniana* and are not considered significant flora. This was confirmed by a representative from DBCA (A. Jones 2019, pers. comm., 2 July).

### 4.2.3 Declared pests

One flora species listed as a declared pest under the BAM Act, **Moraea flaccida*, was recorded across the site. No WoNS were recorded within the site.

## 4.3 Vegetation

### 4.3.1 Plant communities

Eight native plant communities and one non-native plant community were identified within the site.

Plant community **Ew** exists in the far eastern portion of the site along Stock Road, east of Great Northern Highway. Plant community **Mixed**, and part of plant community **M**, occur in the eastern portion of the site along Great Northern Highway, and **Mixed** includes many planted non-native species. Plant community **Co** occurs along Stock Road in the eastern portion of the site, and similar vegetation extends beyond the site to the south.

Plant community **ErMr** occurs in the central portion of the site along Stock Road and is associated with Ellen Brook.

Plant communities **As**, **CcM**, and part of **M** occur in the central western portion of the site, along Stock Road. Another patch of plant community **M** occurs in the western portion of the site along the railway corridor. A higher number of native species were recorded in this patch, particularly north of stock road. However, individual plants were few and scattered.

Plant community **Cc** occurs in the western portion of the site, along Stock Road. The remainder of the site contains non-native vegetation such as pasture grasses and planted trees and shrubs, as well as occasional native plants.

A description and the area of each plant community is provided in **Table 5** and representative photographs of each are provided in **Plate 1** to **Plate 9.** The location of each plant community is shown in **Figure 4**.

*Table 5: Plant communities identified within the site*

| Plant community | Description | Area (ha) |
|---|---|---|
| **As** | Tall shrubland *Acacia saligna* over open forbland *Dianella revoluta* over closed non-native grassland (**Plate 1**) | 0.37 |
| **Cc** | Forest *Corymbia calophylla* over non-native grassland (**Plate 2**) | 0.18 |
| **CcM** | Occasional *Corymbia calophylla* over tall shrubland *Melaleuca huegelii* over closed non-native grassland over occasional *Baumea juncea* (**Plate 3**) | 0.26 |
| **Co** | Open forest *Casuarina obesa* over non-native grassland (**Plate 4**) | 0.95 |
| **ErMr** | Open forest *Eucalyptus rudis* and *Melaleuca rhaphiophylla* over sparse herbland *Lobelia anceps* over open non-native grassland (**Plate 5**) | 0.58 |
| **Ew** | Woodland *Eucalyptus wandoo* over occasional native species such as *Hypocalymma* sp. (or absent) over non-native grassland (**Plate 6**) | 0.42 |
| **M** | Shrubland *Melaleuca viminea*/*M. rhaphiophylla*/*M. preissiana* over non-native grassland (**Plate 7**) | 0.57 |
| **Mixed** | Occasional native species such as *Corymbia calophylla* and *Eucalyptus rudis* over planted native and non-native shrubs over non-native grassland (**Plate 8**) | 0.74 |
| **Non-native** | Non-native and planted vegetation with occasional native plants (**Plate 9**) | 33.88 |

*Plate 1: Plant community **As** in degraded condition*

*Plate 2: Plant community **Cc** in degraded condition*

*Plate 3: Plant community **CcM** in degraded condition*

*Plate 4: Plant community **Co** in degraded condition*

*Plate 5: Plant community **ErMr** in degraded condition*

*Plate 6: Plant community **Ew** in degraded condition*

*Plate 7: Plant community **M** in degraded condition*

*Plate 8: Plant community **Mixed** in degraded condition*

*Plate 9: Plant community **non-native** in completely degraded condition*

### 4.3.2 Vegetation condition

All native plant communities within the site were mapped as being in 'degraded' condition. Intensive historical and ongoing disturbance have altered the composition and structure of the vegetation. Furthermore, some patches of vegetation are regrowth after clearing and/or include planted species,

particularly in the eastern portion of the site along Great Northern Highway. The 'degraded' category was considered suitable to assign to these patches as none were considered to be intact, with a significantly altered vegetation structure and with understorey species lacking or present at low cover and diversity.

The non-native plant community in the site was mapped as being in 'completely degraded' condition due to the lack of native species and dominance of non-native species such as pasture grasses. Bitumen and tracks within the site were also mapped as being in 'completely degraded' condition. The extent of vegetation by condition category is detailed in **Table 6** and shown in **Figure 5**.

*Table 6: Vegetation condition categories within the site*

| Condition category (Keighery 1994) | Size (ha) |
|---|---|
| Pristine | 0 |
| Excellent | 0 |
| Very good | 0 |
| Good | 0 |
| Degraded | 4.07 |
| Completely degraded | 33.88 |

### 4.3.3 Threatened and priority ecological communities

The outcropping limestone observed within the site indicates the potential for the 'shrublands and woodlands on Muchea limestone of the Swan Coastal Plain' TEC to be present. Plant communities **As**, **Cc**, **CcM**, **Co**, **ErMr** and **M** contain a range of shrub or overstorey species that are associated with this TEC, including *Casuarina obesa*, *Eucalyptus rudis, Melaleuca huegelii*, *Melaleuca rhaphiophylla*, *Melaleuca viminea*, *Stylobasium australe* and *Xanthorrhoea preissii* (DoEE 2017). These species are generally common and widespread, and only associated with the TEC where they occur in geographic areas influenced by Muchea limestone. Due the fact that the plant communities within the site are lacking in native understory species and overall had extremely low native diversity, no areas of this TEC were recorded within the site.

No other TECs or PECs occur within the site.

### 4.3.4 Locally and regionally significant vegetation

Some mature eucalypt trees (diameter at breast height larger than 300 mm or 500 mm, dependent on species) are present in the site. These trees have the potential to provide foraging, roosting and nesting habitat for black cockatoos, along with other ecological services. Some of the planted non-native eucalypt trees in the site may also provide foraging and roosting habitat for black cockatoos. A fauna assessment has been undertaken to assess fauna habitat values within the site (Emerge Associates 2019).

The portion of the mapped PSLNA within the site (associated with Ellen Brook) supports native vegetation in 'degraded' condition and therefore does not represent a SLNA. However, this PSLNA

extends beyond the site and the remaining portion may be in 'good' or better condition and may represent a SLNA.

## 4.4 Wetlands

The portions of the two MUWs (UFIs 15282 and 15732) in the site support predominantly non-native vegetation and are considered to be consistent with their current 'multiple use' management category.

The portion of the CCW associated with Ellen Brook (UFI 15734) in the site supports native vegetation in 'degraded' condition. This CCW is considered to align with its current 'conservation' management category due to factors such as its association with Ellen Brook and ecological linkage function.

The portion of the other CCW (UFI 12433) in the site supports native vegetation in 'degraded' condition. When viewed from within the site, the remainder of UFI 12433 appears to be similar to the portion within the site, with low native species diversity and cover and is likely to be in 'degraded' condition.

# 5 Discussion

The site has been subject to long-term disturbance and as such is dominated by non-native vegetation. The native vegetation in the site occurs primarily as isolated patches with low species diversity.

Whilst the vegetation mapping was undertaken during the first survey visit in summer, two additional visits were conducted in spring to review vegetation condition and record supplementary flora species. Some additional annual native species were recorded during the spring survey which would not have been visible during summer (or would have been difficult to detect) such as *Amphibromus nervosus*, *Burchardia congesta*, *Bolboschoenus caldwellii* and *Tribonanthes australis.* The spring survey confirmed that the ground layer of the plant communities in the site was dominated by non-native species and that native species diversity was low. Formal sampling was not considered necessary due to the degraded to completely degraded condition of plant communities recorded. The reconnaissance level of the survey was considered suitable to ascertain the condition and composition of flora and vegetation within the site. Further survey is not considered to be required to characterise flora and vegetation values.

## 5.1 Threatened or priority flora

The potential habitat for any threatened or priority flora species is extremely limited in the site due to historic disturbance and subsequent lack of native understory vegetation. Therefore, it is considered unlikely that any threatened or priority flora species occur in the site.

## 5.2 Threatened ecological community

The 'shrublands and woodlands on Muchea limestone of the Swan Coastal Plain' TEC is not linked to a specific FCT and the conservation advice identifies a variety of different forms which are due to the landform and level of limestone outcropping (DoEE 2017). Six forms are identified, comprising:

- *'Melaleuca huegelii* heath or shrubland over *Grevillea evanescens* and *Xanthorrhoea preissii'* (on rises with outcropping limestone)
- 'scattered *Casuarina obesa* over *Melaleuca lateriflora*, *Grevillea evanescens* and *Melaleuca viminea* shrubland and herbs' (on wet flats)
- *'Melaleuca huegelii*, *Grevillea evanescens* and *Melaleuca* species shrubland and herbs' (on wet flats)
- *'Casuarina obesa* open woodland over *Poa* grassland and herbs' (on wet flats)
- *'Eucalyptus rudis* open forest over *Melaleuca rhaphiophylla* open low forest over shrubland over tall sedgeland and grassland' (in creeklines)
- 'Open marri woodland over mixed shrublands usually containing (on damper sands over limestone where the limestone appears to be at greater depth, is more remote or the limestone area is geographically isolated from other limestone areas) (DoEE 2017).

Some of the plant communities recorded in the site include species outlined in the forms described above, indicating that they may share association with Muchea limestone. Given the sites location in close proximity to Muchea and presence of outcropping limestone in part of the site, this is not

unexpected. However, the vegetation within the site is highly disturbed and in 'degraded' condition, with significantly reduced native species diversity.

The DoEE does not recommend size or condition thresholds are applied when identifying shrublands and woodlands on Muchea limestone of the Swan Coastal Plain (DoEE 2017). Rather, DoEE (2017) suggests that the community can be defined by the presence of a limestone influenced substrate. Under this guidance the TEC would be considered to be present in all areas with a Muchea limestone influenced substrate, irrespective of whether native vegetation is present, which could potentially result in the perverse outcome of cleared pasture being mapped as the TEC.

The DoEE describes shrublands and woodlands on Muchea limestone of the Swan Coastal Plain as supporting 'a rich layer of herbaceous annuals under a dense, diverse shrub layer' (DoEE 2019b). Vegetation within the site lacks native understorey and as such, does not align with this description and it was considered inappropriate to conclude such vegetation represents a naturally occurring ecological community. Whilst vegetation within the site and the wider area may once have been representative of the Muchea limestone of the Swan Coastal Plain community, significant historical disturbances to native vegetation as a result of agricultural land uses mean that this vegetation would likely no longer be considered representative of the TEC.

The more intact vegetation within the rail reserve immediately north of the site provides a reference of what some of the vegetation within the site may have once been like. Based on the composition of flora observed, it is probable that this vegetation within the rail reserve outside of the site is representative of the TEC. However, no formal assessment of vegetation outside of the site was undertaken and detailed survey would be required to confirm these observations.

## 5.3 Other vegetation values

Plant community **ErMr** associated with Ellen Brook probably represents the highest value vegetation in the site as it is part of a contiguous patch of native vegetation that is an ecological linkage, a *Bush Forever* site and a 'conservation' category wetland. However, the **ErMr** vegetation supports low native species diversity and non-native grasses dominate the vegetation ground layer. Ongoing disturbance appears to be occurring to the **ErMr** vegetation in the site due to stock access.

Some of the trees in the site have the potential to provide habitat for threatened black cockatoos, which are known to occur in the local area. A fauna assessment has been undertaken to assess fauna habitat values within the site (Emerge Associates 2019).

Whilst a detailed wetland evaluation was not undertaken, the two MUWs and one of the CCWs which occur in the site appear to support values that align with their current management categories. Whether the other CCW in the site, UFI 12433, has values consistent with a 'conservation' management category was unable to be determined due to lack of access to the entire feature. However, when viewed from the Stock Road reserve the feature does not appear to support a 'high level of attributes and functions' associated with CCWs (DBCA 2017a) and may align with a lower management category. To determine the appropriate management category of the feature a survey would need to be undertaken using the DBCA document *A methodology for the evaluation of wetlands on the Swan Coastal Plain, Western Australia* (DBCA 2017a).

Vegetation must be in 'good' or better condition for a PSLNA to be considered a SLNA (City of Swan 2015). The area of the PSLNA in the site is only a small portion of the larger feature. Therefore, although the portion within the site does not meet the SLNA criteria, there is potential for the vegetation within the remainder of the PSLNA and outside of the site to be in 'good' condition and meet the SLNA criteria.

# 6 Conclusions

The vegetation within the site is disturbed and modified. Eight native plant communities occur in the site across approximately 4.07 ha (approximately 11% of the site), none of which represent intact native plant communities given all were determined to be in 'degraded' condition. The remainder of the site (33.88 ha) supports non-native vegetation in 'completely degraded' condition.

No threatened or priority flora were recorded in the site and none are considered likely to occur due to historical disturbance and lack of suitable habitat.

No threatened or priority ecological communities were recorded in the site or are considered likely to occur given the absence of intact native vegetation.

Plant community **ErMr** associated with Ellen Brook represents higher value vegetation as it is part of a contiguous linear patch of native vegetation abutting the Ellen Brook, which is mapped as an ecological linkage, a *Bush Forever* site and a 'conservation' category wetland. However, the **ErMr** vegetation is disturbed and present mainly as native trees over non-native grasses in 'degraded' condition.

The two MUWs and one of the CCWs which intersect with the site appear to support values that align with their current management categories. The other wetland feature is currently mapped as a CCW but may support values indicative of a lower level management category. A detailed wetland evaluation would be required to confirm the appropriate management category.

The planted and remnant trees in the site may be considered significant due to their potential to provide habitat for threatened species of black cockatoo. A fauna assessment has been undertaken to assess fauna habitat values within the site (Emerge Associates 2019).

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# Figures

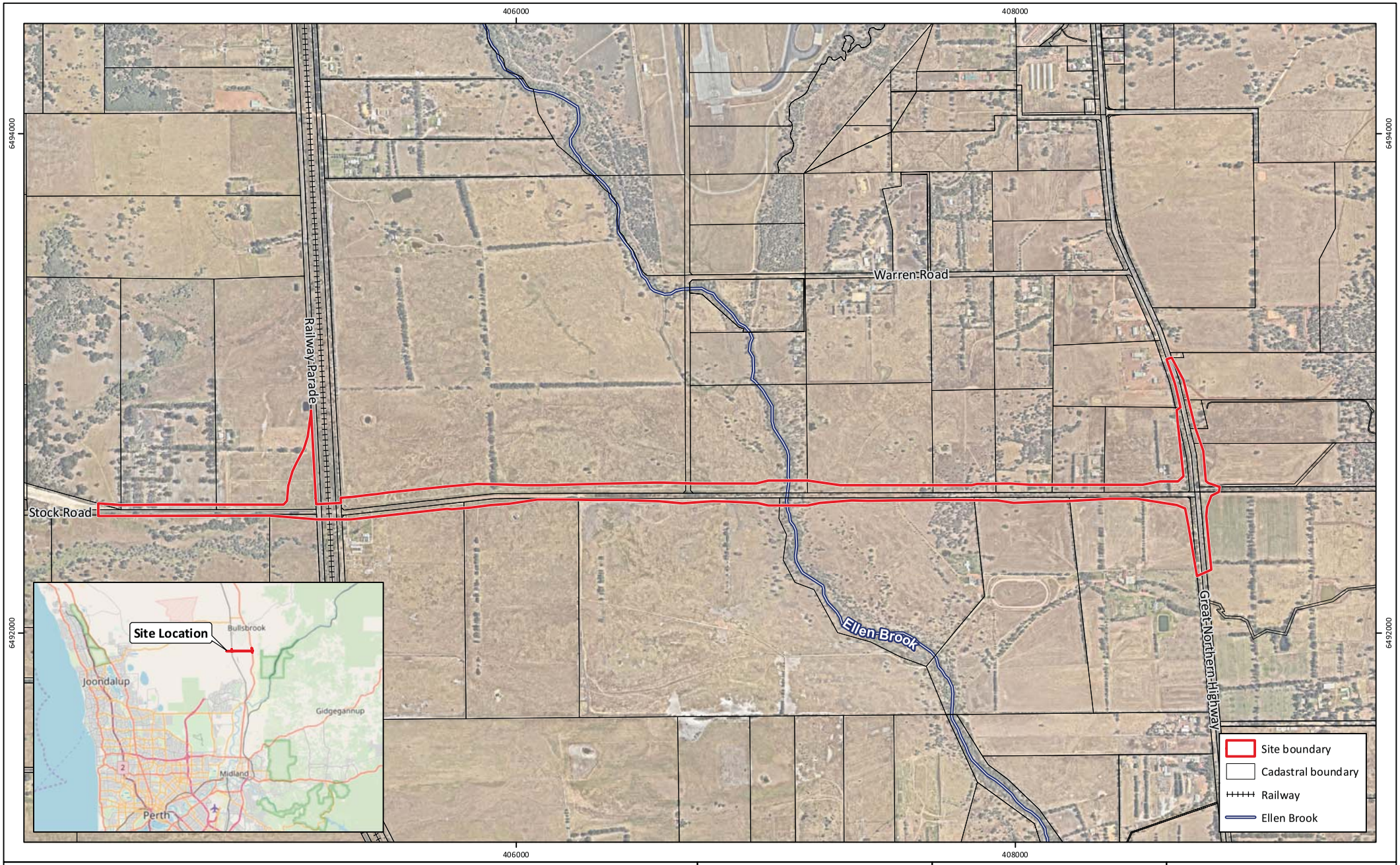


**Figure 1: Site Location**

**Project:** Reconnaissance Flora and Vegetation Assessment
Stock Road Reserve and Adjacent Lots, Bullsbrook

**Client:** City of Swan

**Plan Number:**
**EP19-005(02)--F13b**

| | |
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| Date: | 20/09/2019 |
| Checked: | RAW |
| Approved: | TAA |
| Date: | 27/09/2019 |

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Metres

Scale: 1:860,000@A4

GDA 1994 MGA Zone 50

emerge ASSOCIATES

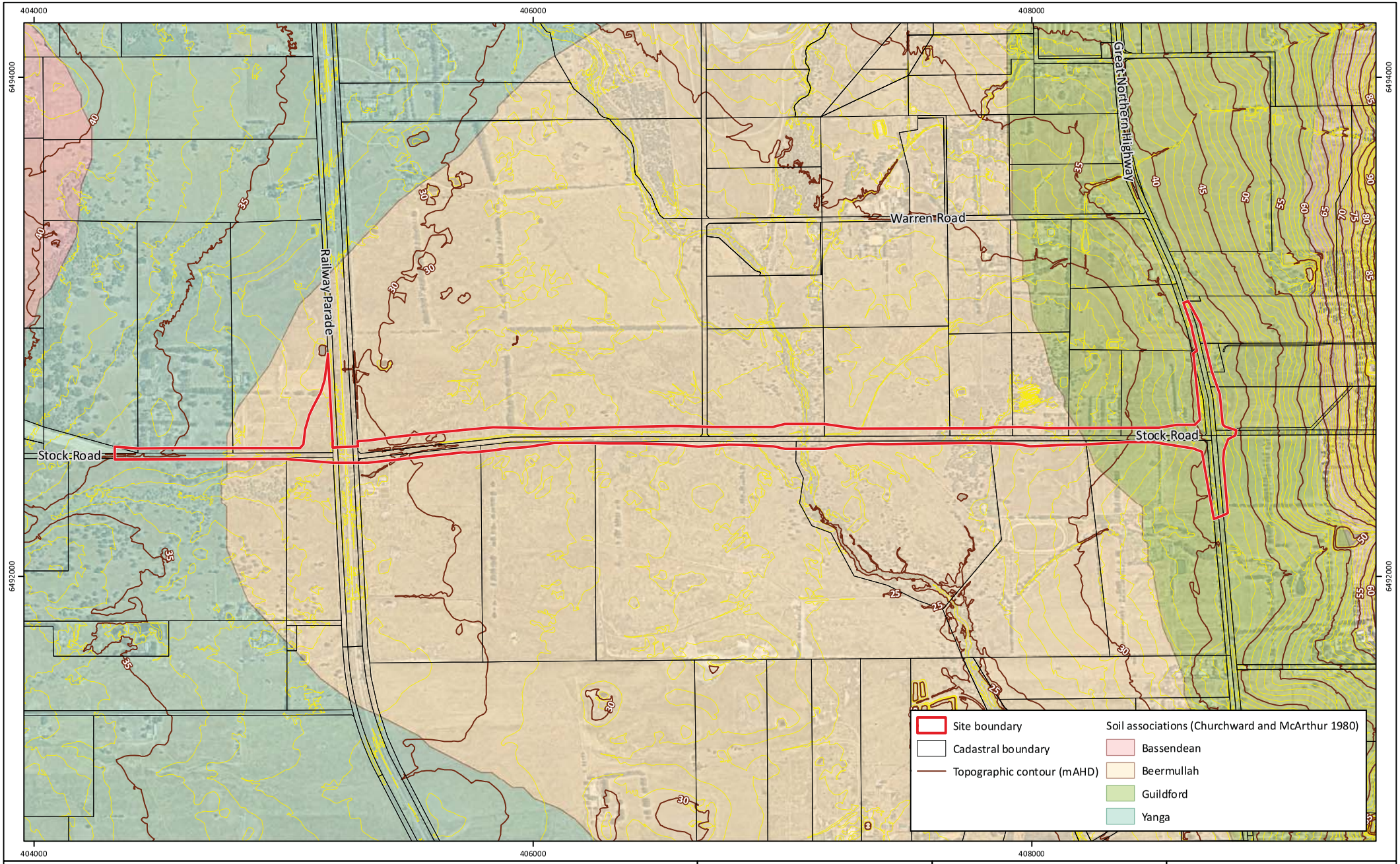


**Figure 2: Soils and Topography**

**Project:** Reconnaissance Flora and Vegetation Assessment
Stock Road Reserve and Adjacent Lots, Bullsbrook

**Client:** City of Swan

**Plan Number:**
**EP19-005(02)--F14b**

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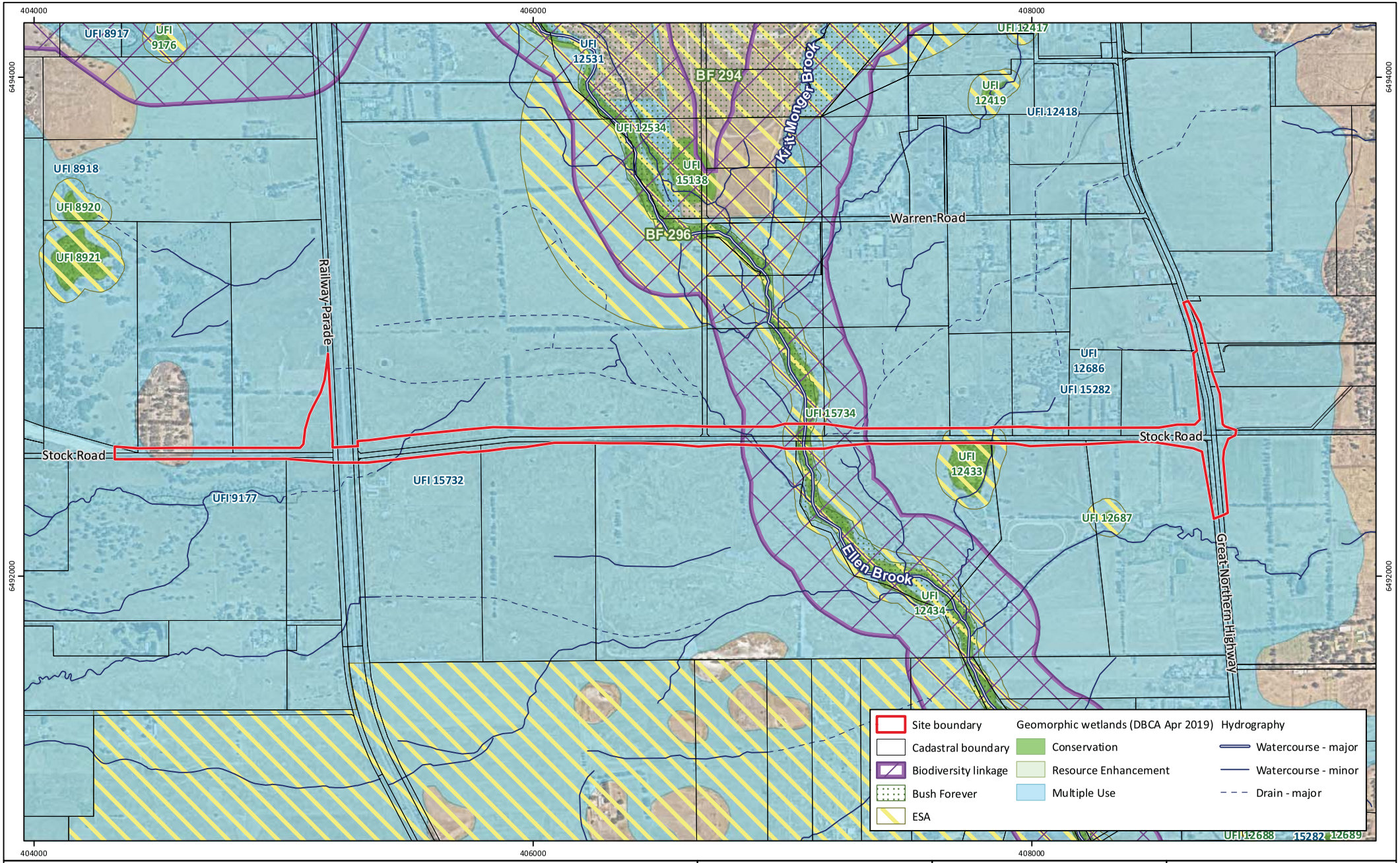


**Figure 3: Environmental Features**

**Project:** Reconnaissance Flora and Vegetation Assessment
Stock Road Reserve and Adjacent Lots, Bullsbrook

**Client:** City of Swan

**Plan Number:**
**EP19-005(02)--F15b**

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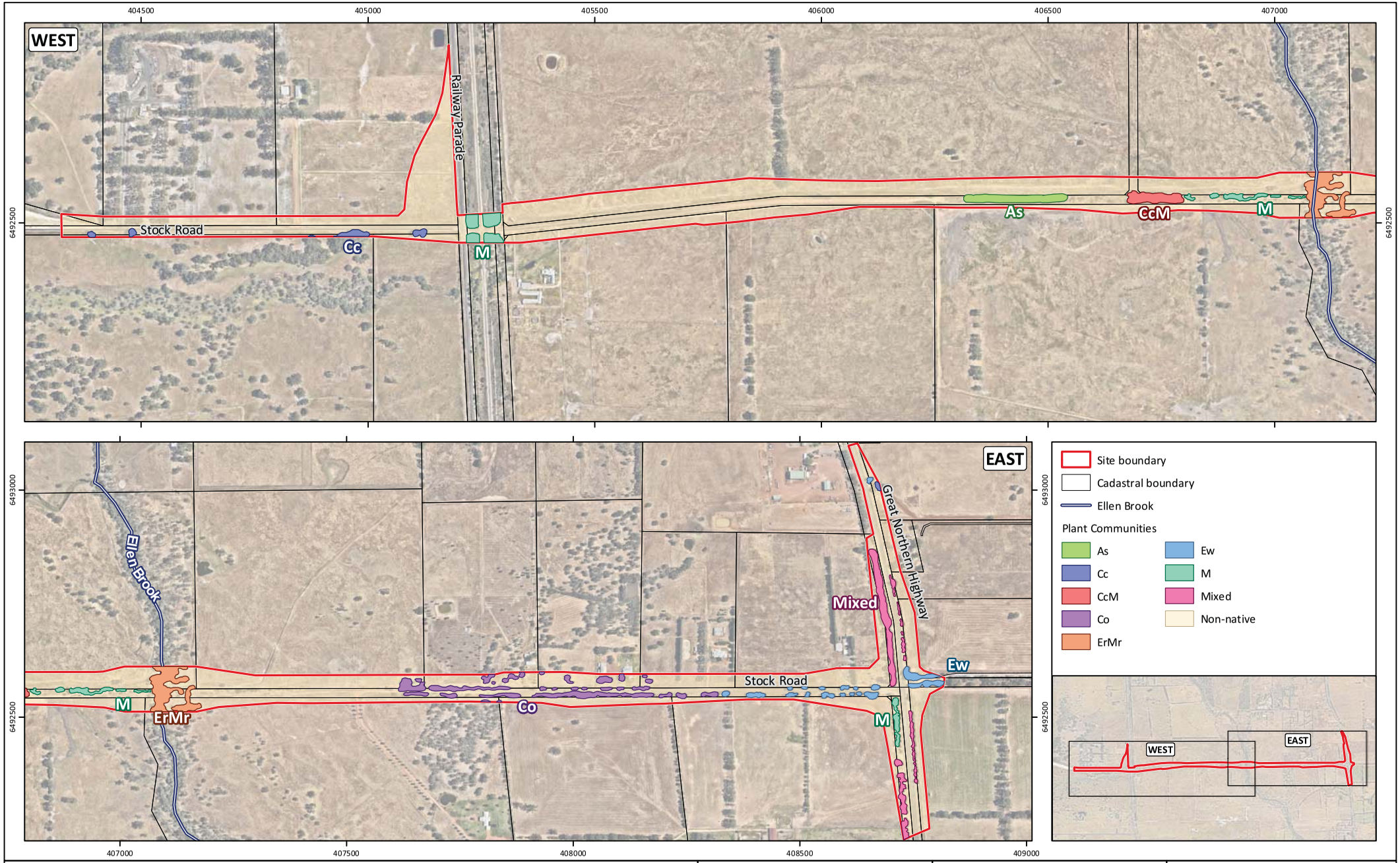


**Figure 4: Plant Communities**

**Project:** Reconnaissance Flora and Vegetation Assessment
Stock Road Reserve and Adjacent Lots, Bullsbrook

**Client:** City of Swan

**Plan Number:**
**EP19-005(02)--F16b**

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GDA 1994 MGA Zone 50

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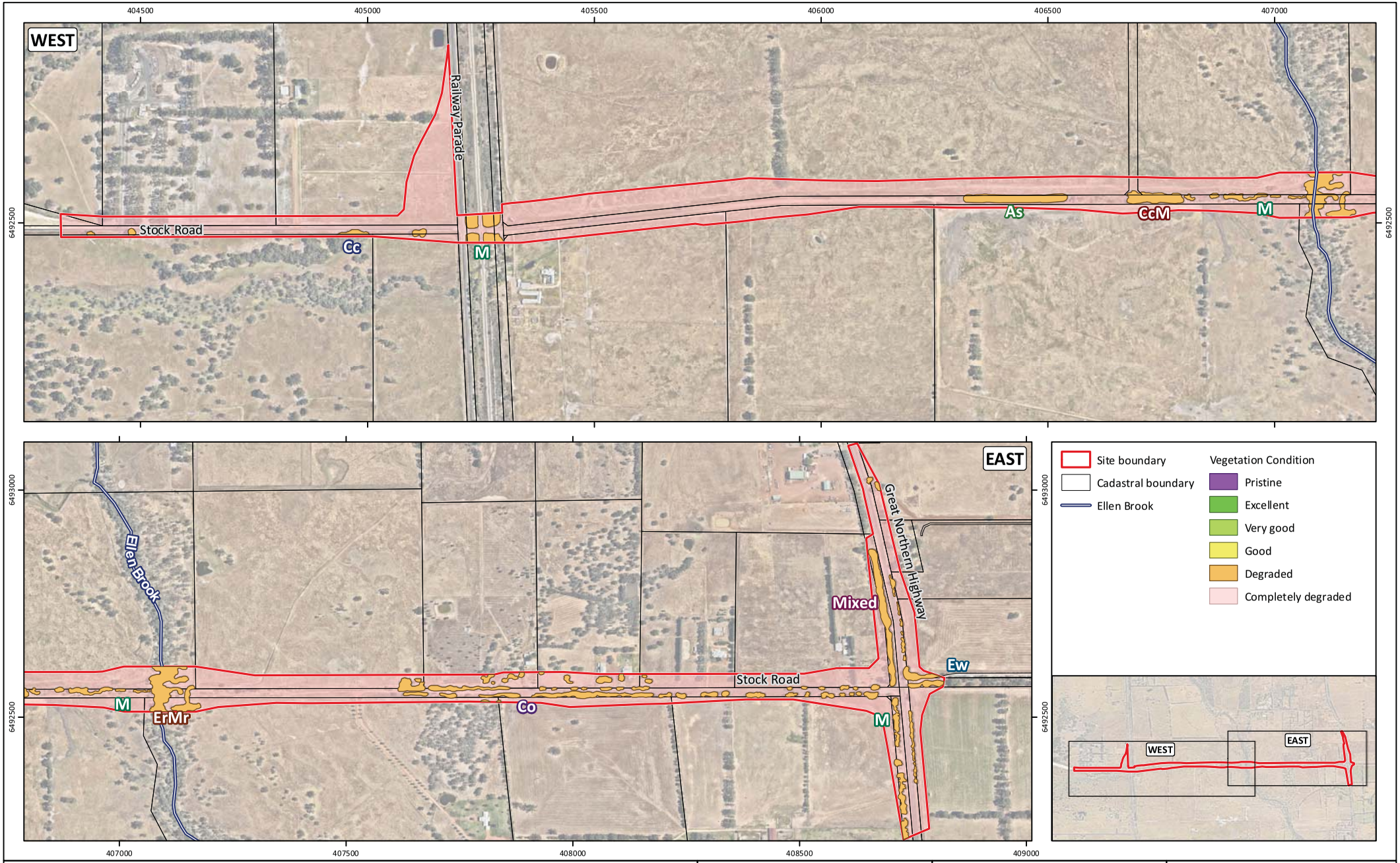


**Figure 5: Vegetation Condition**

**Project:** Reconnaissance Flora and Vegetation Assessment
Stock Road Reserve and Adjacent Lots, Bullsbrook

**Client:** City of Swan

**Plan Number:**
**EP19-005(02)--F17b**

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GDA 1994 MGA Zone 50

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# Appendix A

Additional Background 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<br>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<br>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<br>Taxa which are considered to be facing an extremely high risk of extinction in the wild. |
| EN^ | Threatened Flora – Endangered<br>Taxa which are considered to be facing a very high risk of extinction in the wild. |
| VU^ | Threatened Flora – Vulnerable<br>Taxa which are considered to be facing a high risk of extinction in the wild. |
| P1 | Priority One – Poorly Known<br>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<br>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<br>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<br>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<br>An ecological community that has been adequately searched for but for which no representative occurrences have been located. |
| CE | Critically Endangered<br>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<br>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<br>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<br>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<br>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.<br>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<br>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:<br>(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;<br>(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.<br>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<br>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<br>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<br>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<br>Present in Western Australia in low enough numbers or in sufficiently limited areas that their eradication is still a possibility. |
| C3 | Management<br>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.

# References

## General references

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Semeniuk, C. A. and Semeniuk, V. 1995, *A Geomorphic Approach to Global Classification for Inland Wetlands*, Vegetatio, 118(1/2): 103-124.

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# Appendix B

Species List

## Flora Species List - Various Lots Stock Road, Bullsbrook

*=non-native species, Pl=planted species, DP=declared pest under BAM Act

| Family | Species |
|---|---|
| **Anacardiaceae** | |
| | * *Schinus terebinthifolia* |
| **Araceae** | |
| | *Lemna sp.* |
| **Asparagaceae** | |
| | *Acanthocarpus canaliculatus* |
| | *Laxmannia squarrosa* |
| **Asteraceae** | |
| | * *Arctotheca calendula* |
| | * *Conyza bonariensis* |
| | * *Cotula coronopifolia* |
| | * *Lactuca serriola* |
| | * *Sonchus oleraceus* |
| | * *Symphyotrichum squamatum* |
| | * *Ursinia anthemoides* |
| **Casuarinaceae** | |
| | *Allocasuarina fraseriana* |
| | *Casuarina obesa* |
| **Campanulaceae** | |
| | *Lobelia anceps* |
| **Centrolepidaceae** | |
| | *Aphelia cyperoides* |
| | *Centrolepis aristata* |
| **Chenopodiaceae** | |
| | *Atriplex prostrata* |
| **Colchicaceae** | |
| | *Burchardia congesta* |
| **Cyperaceae** | |
| | *Baumea juncea* |
| | *Bolboschoenus caldwellii* |
| | * *Cyperus tenuiflorus* |
| | *Cyathochaeta avenacea* |
| | *Eleocharis acuta* |
| | *Isolepis marginata* |
| | *Schoenus grammatophyllus* |
| **Droseraceae** | |
| | *Drosera ?glanduligera* |
| | *Drosera menziesii* |

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| Family | | Species |
|---|---|---|
| **Euphorbiaceae** | | |
| | * | *Euphorbia peplus* |
| **Fabaceae** | | |
| | | *Acacia pulchella var. pulchella* |
| | | *Acacia saligna* |
| | | *Jacksonia furcellata* |
| | | *Jacksonia sternbergiana* |
| | * | *Lotus angustissimus* |
| | * | *Trifolium arvense* |
| | * | *Trifolium sp.* |
| | | *Viminaria juncea* |
| **Geraniaceae** | | |
| | * | *Pelargonium capitatum* |
| **Goodeniaceae** | | |
| | | *Dampiera linearis* |
| | | *Scaevola lanceolata* |
| **Haemodoraceae** | | |
| | | *Anigozanthos viridis* |
| | | *Conostylis aculeata* |
| | | *Tribonanthes australis* |
| **Hemerocallidaceae** | | |
| | | *Dianella revoluta var. divaricata* |
| **Iridaceae** | | |
| | * | *Hesperantha falcata* |
| | * **DP** | *Moraea flaccida* |
| | * | *Romulea rosea* |
| | * | *Sparaxis bulbifera* |
| | * | *Watsonia meriana var. bulbillifera* |
| **Juncaceae** | | |
| | | *Juncus kraussii subsp. australiensis* |
| | | *Juncus pallidus* |
| **Lauraceae** | | |
| | | *Cassytha sp.* |
| **Myrtaceae** | Pl* | *Callistemon sp.* |
| | | *Calothamnus quadrifidus* |
| | | *Corymbia calophylla* |
| | | *Eremaea pauciflora* |
| | Pl* | *Eucalyptus gomphocephala* |

## Flora Species List - Various Lots Stock Road, Bullsbrook

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| Family | | Species |
|---|---|---|
| **Myrtaceae** | Pl* | *Eucalyptus leucoxylon rosea* |
| | | *Eucalyptus rudis* |
| | | *Eucalyptus wandoo* |
| | | *Hypocalymma sp.* |
| | | *Melaleuca huegelii* |
| | | *Melaleuca lateritia* |
| | | *Melaleuca preissiana* |
| | | *Melaleuca rhaphiophylla* |
| | | *Melaleuca viminea* |
| | | *Regelia ciliata* |
| **Nyctaginaceae** | | |
| | * | *Bougainvillea sp.* |
| **Oleaceae** | | |
| | * | *Olea europaea* |
| **Orchidaceae** | | |
| | | *Microtis media* |
| **Papaveraceae** | | |
| | * | *Fumaria capreolata* |
| **Poaceae** | | |
| | | *Amphibromus nervosus* |
| | | *Austrostipa sp.* |
| | * | *Avena sp.* |
| | * | *Briza maxima* |
| | * | *Bromus diandrus* |
| | * | *Bromus hordeaceus* |
| | * | *Cenchrus clandestinus* |
| | * | *Chloris gayana* |
| | * | *Cynodon dactylon* |
| | * | *Ehrharta calycina* |
| | * | *Ehrharta longifolia* |
| | * | *Eragrostis curvula* |
| | * | *Hyparrhenia hirta* |
| | * | *Lolium rigidum* |
| | * | *Paspalum sp.* |
| | * | *Phalaris minor* |
| **Polygonaceae** | | |
| | * | *Rumex crispus* |
| **Plantaginaceae** | | |
| | * | *Misopates orontium* |

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| Family | | Species |
|---|---|---|
| **Proteaceae** | | *Banksia dallanneyi* |
| | | *Grevillea obtusifolia* |
| | Pl* | *Grevillea olivacea* |
| | Pl* | *Grevillea thelemanniana* 'Green Gem' cultivar |
| | Pl* | *Grevillea crithmifolia* |
| **Restionaceae** | | |
| | | *Desmocladus flexuosus* |
| | | *Leptocarpus canus* |
| | | *Lyginia ?barbata* |
| **Scrophulariaceae** | | |
| | Pl* | *Eremophila glabra* |
| **Solanaceae** | | |
| | * | *Solanum nigrum* |
| **Surianaceae** | | |
| | | *Stylobasium australe* |
| **Vitaceae** | | |
| | Pl* | *Vitis vinifera* |
| **Xanthorrhoeaceae** | | |
| | | *Xanthorrhoea preissii* |