

APPENDIX 5: FLORA AND VEGETATION SURVEYS

- A. **Survey 1** – Detailed, Reconnaissance and Targeted Flora and Vegetation Survey, Lot 64 Elliot Road Keysbrook, WA (Ecoedge, 2021).
- B. **Survey 2** – Detailed, Reconnaissance and Targeted Flora and Vegetation Survey, Lot 57, 508, 201 Elliot Road and Part Lot 56 Westcott Road Keysbrook, WA (Ecoedge, 2022).
- C. **Survey 3** – Detailed, Reconnaissance and Targeted Flora and Vegetation Survey, Lots 20, 62, 63 and 211, Keysbrook, WA (Ecoedge, 2023).

APPENDIX 5A: FLORA AND VEGETATION SURVEY LOT 64

Detailed, Reconnaissance and Targeted Flora and
Vegetation Survey
Lot 64 Elliot Road Keysbrook
Western Australia



Prepared for Doral Mineral Sands
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Executive summary

Ecoedge Environmental Services was engaged by Doral Mineral Sands in October 2020 and July 2021 to undertake Detailed, Reconnaissance and Targeted Flora and Vegetation surveys over Lot 64 Elliot Rd, Keysbrook within the Shire of Serpentine-Jarrahdale. This survey is part of the investigations into potential mining opportunities across the lot.

The 238.06 ha survey area occurs in a predominantly cleared agricultural landscape and comprised approximately 23.2 ha of planted and native vegetation.

The surveys were undertaken on 27 October 2020, 10 November 2020 and 18 August 2021 in accordance with the EPA (2016) Technical Guidance: Flora and Vegetation Surveys for Environmental Impact Assessment.

Ninety-eight species of vascular flora were identified within the survey area, of which 32 (33%) were introduced taxa.

No flora listed as Threatened under the EPBC Act or the BC Act were found within the survey area, including *Drakea elastica* and *Drakea micrantha*.

No Priority-listed flora or flora of other significance was found.

A small infestation of the Declared Pest Plant *Zantedeschia aethiopica* (Arum lily) was found in the north-east corner of the survey area.

Three native vegetation units were identified within the survey area:

- Jarrah-Banksia-Sheoak woodland, subunits A1 and A2
- Jarrah-Marri open forest, subunits B1 and B2,
- Melaleuca preissiana dampland, subunits C1, C2 and C3.

None of the vegetation units on site were regarded as occurrences of Threatened Ecological Communities under either the EPBC Act or BC Act. Nor were any of the units regarded as occurrences of a State listed Priority Ecological Community.

Most of the native vegetation was in a Completely Degraded (65.9%) or Degraded (29.8%) condition due to ongoing grazing and impacts of Phytophthora dieback.

Two vegetation complexes are mapped for the survey area: the Bassendean Complex – Central and South (26.87%) and the Southern River Complex (18.43%). Both of these complexes are below the desired 30% pre-European retention target on the Swan Coastal Plain.

There are no Conservation Category wetlands within the boundary of the survey area. The nearest Conservation Category wetlands are located approximately 1.35 km north and west

of the survey area. There are no Environmentally Sensitive Areas within the survey area. There are two Environmentally Sensitive Areas located approximately 1.35 km to the north and west of the survey area, both associated with Conservation Category wetlands

A Resource Enhancement wetland in mostly Cleared (93.3%) to Completely Degraded (5.1%) condition is mapped across the eastern portion of the survey area. This is approximately 107.4 ha in size.

The north-east parcel of survey area vegetation has some limited ecological linkage values due to its narrow connection with a large block of vegetation north to north-east of the survey area. This vegetation block forms part of a networked corridor of vegetation associated with the Dirk Brook, in an otherwise predominantly cleared agricultural landscape.

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Statement of limitations

Reliance on data

In the preparation of this report, Ecoedge has relied on data, surveys, analyses, designs, plans and other information provided by the Client and other individuals and organisations, most of which are referred to in the report. Unless stated otherwise in the report, Ecoedge has not verified the accuracy or completeness of the data. To the extent that the statements, opinions, facts, information, conclusions and/or recommendations in the report are based in whole or in part on the data, those conclusions are contingent upon the accuracy and completeness of the data. Ecoedge will not be liable in relation to incorrect conclusions should any data, information or condition be incorrect or have been concealed, withheld, unavailable, misrepresented or otherwise not fully disclosed to Ecoedge.

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The report has been prepared for the benefit of the Client and no other party. Ecoedge assumes no responsibility and will not be liable to any other person or organisation for or in relation to any matter dealt with or conclusions expressed in the report or for any loss or damage suffered by any other person or organisation arising from matters dealt with or conclusions expressed in the report (including, without limitation, matters arising from any negligent act or omission of Ecoedge or for any loss or damage suffered by any other party relying on the matters dealt with or conclusions expressed in the report). Other parties should not rely upon the report or the accuracy or completeness of any conclusions and should make their own enquiries and obtain independent advice in relation to such matters.

1 Introduction

Ecoedge was engaged by Doral Mineral Sands (Doral) to undertake a Detailed and Targeted flora and vegetation survey in October 2020 of a portion of Lot 64 Elliot Rd, Keysbrook within the Shire of Serpentine-Jarrahdale. Ecoedge was further engaged to undertake a Reconnaissance and Targeted survey over the balance of Lot 64 in July of 2021¹ This 2021 survey, included a targeted search in potential habitat, for the early-identifiable Threatened orchids *Drakea elastica* and *Drakea micrantha*. The survey area in relation to Keysbrook townsite and surrounding land use is shown in **Figure 1**. **Figure 2** shows both 2020 and 2021 survey areas.

The surveys were undertaken on 27 October 2020, 10 November 2020 and 18 August 2021 in accordance with the EPA (2016) Technical Guidance: Flora and Vegetation Surveys for Environmental Impact Assessment. The surveys were required as part of investigations into future mining opportunities across the landholdings. The total survey area comprised 238.06 ha and included approximately 23.2 ha of planted and native vegetation.

This report compiles the findings of both the 2020 and 2021 surveys.

1.1 Scope

The scope required the Reconnaissance, Detailed and Targeted flora and vegetation surveys to be conducted in accordance with the Environmental Protection Authority's (EPA) Technical Guidance: Flora and Vegetation Surveys for Environmental Impact Assessment (December 2016). This entailed:

Desktop survey

- Identification of flora and vegetation biological features and constraints, which may exist within, or adjacent to the survey area, including presentation and review of data from the Department of Agriculture, Water and Environment (DAWE) Protected Matters Search Tool, Department of Biodiversity, Conservation and Attractions (DBCA) NatureMap and FloraBase, and database searches from DBCA's Species & Communities Branch
- Identification of significant flora, vegetation/ecological communities' values and potential sensitivity to impact
- Identification of broad pre-European vegetation type(s) (Beard various); and Webb et al. (2016) vegetation complexes for south-west and Swan Coastal Plain areas.

Field survey

- Verification/ground-truthing the desktop assessment findings through detailed, reconnaissance and targeted surveys within the appropriate survey timing for any Threatened flora that may occur.

¹ The early survey was regarded as appropriate given the highly degraded nature of the balance of survey area which comprised of predominantly native trees over pasture in a degraded to completely degraded condition.

- Installation and assessment of 10 m x 10 m floristic quadrats.
- Compilation of a comprehensive species list for the survey area.
- Vegetation community/type mapping to a scale appropriate for the bioregion and described according to the National Vegetation Information System (NVIS) structure and floristics.
- Assessment of the survey area's plant species diversity, composition, structure.
- Vegetation condition mapping using EPA (2016) condition scale.
- A Targeted survey for Threatened and Priority flora based on desktop likelihood of occurrence and habitat availability. Threatened flora potentially occurring within the area will be targeted by searches which maximise the chances of finding the flora. When populations are identified, survey and map the extent of populations to determine the number and habitat area for each population. Provide shapefiles with point data indicating the number of plants identified at each point and if more than 100, the edges of the population boundary can be mapped. If the population extends outside the survey area, the extent of the population will be mapped where possible (e.g. land access permitted). All Threatened flora to be mapped with a GPS.
- Identify the location of any Weeds of National Significance or Declared Pests.

Analysis and Reporting

A multivariate analysis was carried out on the floristic quadrats to assist with mapping the vegetation, in addition to a comparison with other quadrats from surveys on the southern Swan Coastal Plain. Unmarked relevés will also be used to assist with vegetation mapping. The vegetation will be mapped as vegetation types (or units) at NVIS Level V. The conservation significance of flora and vegetation types and the vegetation as a whole will be discussed.

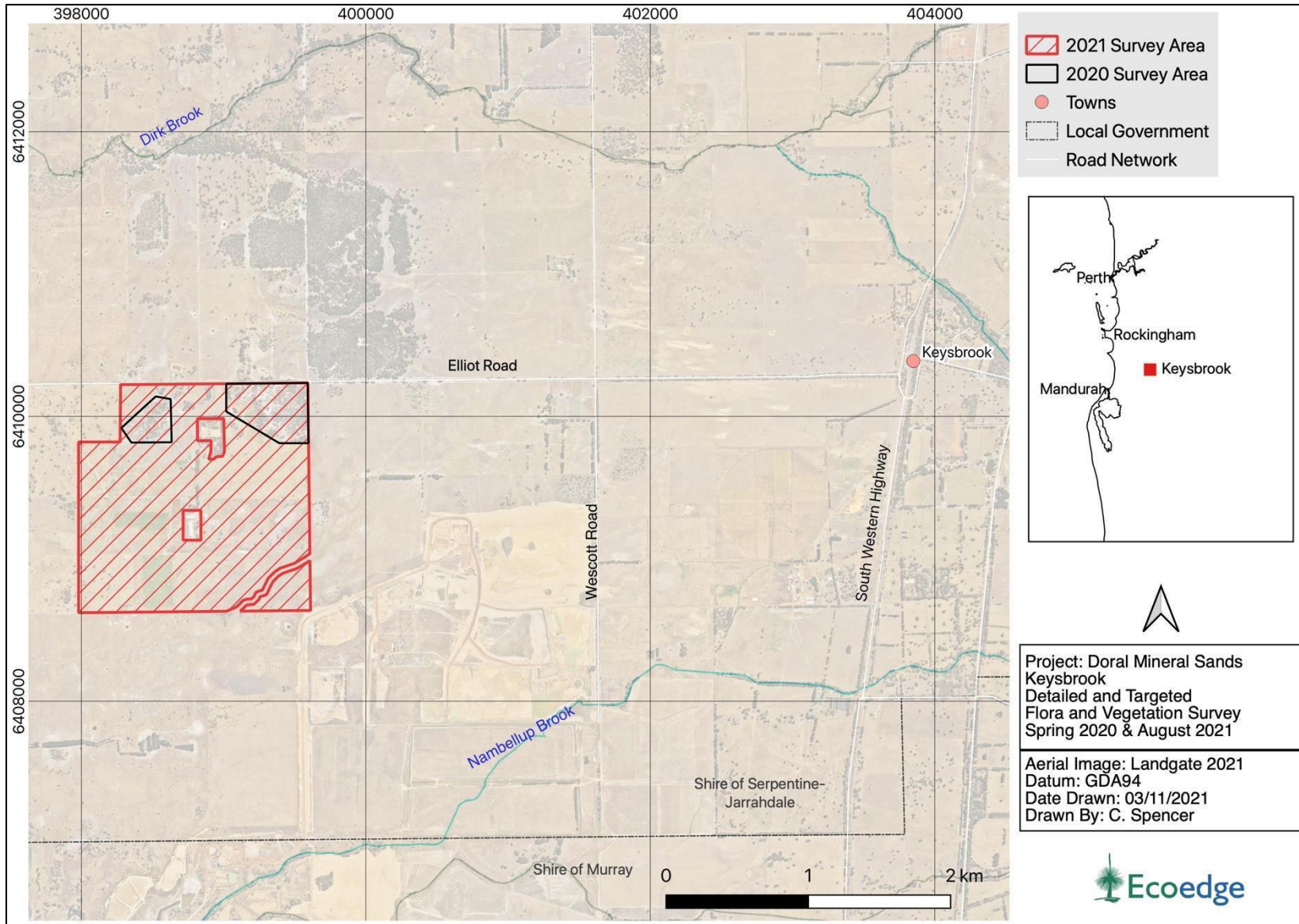


Figure 1. Aerial photograph showing the survey area in relation to Keysbrook, WA.

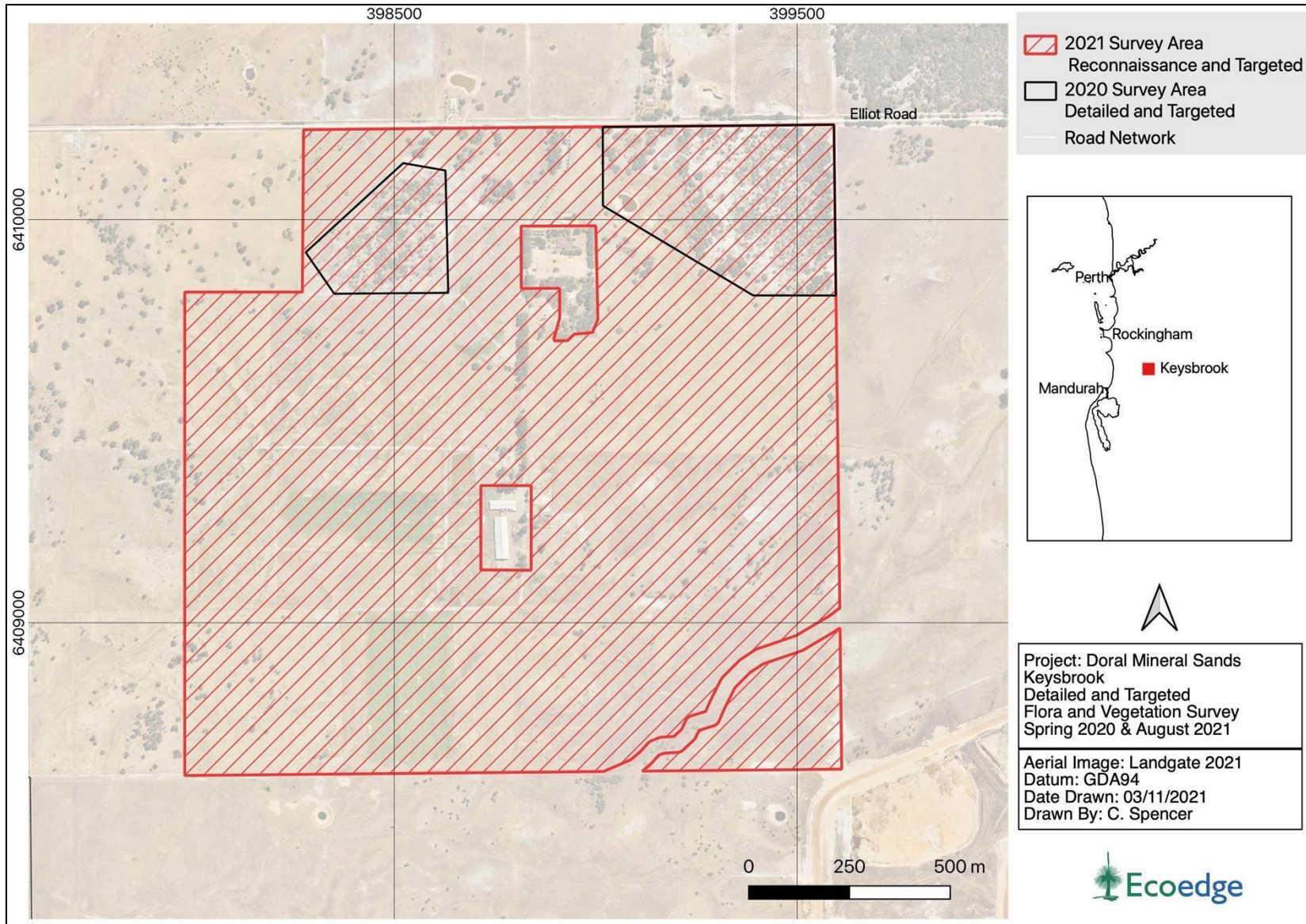


Figure 2. Aerial photograph showing the location of the 2020 survey area and expanded area in 2021.

2 Methods

2.1 Desktop assessment

Prior to the survey, a desktop study over a 10 km buffer area was undertaken to gather contextual information on the area to be surveyed from existing surveys, literature, database searches and spatial information. The information collated during the desktop study provided background information for the field survey and subsequent reporting and included:

- Regional geology and soil mapping
- Vegetation complex mapping of the Swan Coastal Plain of Western Australia (WA)
- WA Threatened and Priority Ecological Communities DBCA database extracts and Threatened Ecological Community (TEC) and Priority Ecological Community (PEC) listings
- Federal Protected Matters Search Tool (PMST) results
- Threatened and Priority flora Naturemap search results
- State Threatened and Priority flora extracts from DBCA and the Western Australian Museum's (WAM's) Threatened and Priority flora databases and Naturemap search results
- Environmentally Sensitive Areas (ESA) distribution maps and data
- Geomorphic wetland of the Swan Coastal Plain distribution maps and data
- Regional Ecological Linkage mapping (Molloy et al. 2009)
- Review of previous flora and vegetation surveys in proximity to the survey area.

2.2 Field survey

The initial survey was carried out on 27 October and 10 November 2020 by Russell Smith (flora permit FB62000192) and Ben Eckermann (FB62000262) according to the requirements of EPA (2016). The second survey, conducted by Russell Smith and Colin Spencer (FB62000169) on 18 August 2021, was a Targeted and Reconnaissance flora and vegetation survey of the remainder of the Lot 64 (not surveyed in 2020). This 2021 survey included a Targeted *Drakaea elastica* and *D. micrantha* survey of all suitable habitat, within Lot 64.

A list of all vascular flora encountered during the survey was compiled, either in the field or from photographs and notes taken to enable later identification. Taxonomy and conservation status were checked against the latest WA Herbarium census download (DBCA 2021a).

Six 100 m² floristic quadrats were installed during the 2020 survey as per the requirements of EPA (2016). Three of these quadrats were placed in the Banksia woodland on low sandy ridges that constitute a large proportion of the survey area vegetation. The other three quadrats were placed in lower-lying vegetation. Two of these in *Melaleuca preissiana*-dominated woodland and the other in *Corymbia calophylla*-dominated open forest with *M. preissiana* in the mid-storey.

Plant communities were described using data collected at 285 relevés (including vegetation condition records), the six floristic quadrats, and recent aerial photography.

Vegetation condition was assessed using the method of the EPA (2016). (**Appendix 1**).

2.3 Multivariate analysis

In order to assist in determining the relationship of the vegetation within the survey area with the floristic community types described in Gibson et al. (1994) and DEP (1996), a multivariate analysis (MVA) was carried out. The six new floristic quadrats were compared with quadrat data from these two regional surveys.

The MVA used two-way classification (Agglomerative Hierarchical Fusion) of the presence/absence of data for each quadrat. The flexible UPGMA classification strategy was used ($\beta = -0.1$), together with the Bray-Curtis site similarity measure. The default settings for the number of groups to be produced by the classification (i.e., the “cut-off level”) were accepted in each case.

The data from the comparison datasets was subjected to taxonomic updating. Taxonomic updating was required because many taxonomic changes have taken place since the original surveys used in the comparison MVAs were carried out (e.g., *Dryandra* to *Banksia*, *Eucalyptus calophylla* to *Corymbia calophylla*, etc.).

The input to the MVA was a 1,113 quadrat x 1,743 taxon table of presence/absence data. The primary output of the classification were dendrograms and a two-way table of taxa and quadrats.

2.4 Survey limitations

Potential limitations with regard to the assessment are addressed in **Table 1**.

Table 1. Limitations of the field survey with regard to assessment adequacy and accuracy.

Aspect	Constraint	Comment
Scope	Negligible	The survey scope was prepared in consultation with the client and was designed to comply with EPA requirements.
Proportion of flora identified	Minimal	The 2020 survey was carried out in late spring, which is within the prime season for flowering in the southwest of Western Australia. The 2021 survey carried out in late winter allowed some herbaceous taxa not seen during the 2020 survey to be identified.
Climatic and seasonal effects	Minimal	Rainfall in the period May-September in 2020 was 95% of the mean for that period. Plant growth and flowering were good. Rainfall for the 3-month period May-July 2021 was average.
Availability of contextual information	Negligible	Comprehensive regional surveys of remnant vegetation, as well as more localised surveys, have been carried out on the southern Swan Coastal Plain.
Completeness of the survey	Negligible	The whole search area was covered on foot. Flowering was good.
Skill and knowledge of the botanists	Negligible	The senior field botanist conducting the survey has had extensive experience in botanical surveys in south-west Australia (and this IBRA region) over a period of 25 years.
Disturbance (fire, grazing, clearing etc.)	Moderate	The survey area has historically been grazed by livestock, and it is ongoing.

3 Desktop assessment results

3.1 Biogeographic region and location

The survey area is situated within the Swan Coastal Plain (SWA02) sub-region of the Swan Coastal Plain biogeographic region, as defined in the Interim Biogeographical Regionalisation for Australia (IBRA) (Commonwealth of Australia 2016). The total survey area comprised of 238.06ha with 23.2 ha of vegetation and is situated approximately 4.3 kilometres east of the Keysbrook townsite, within the Shire of Serpentine-Jarrahdale. The surrounding land has been predominantly cleared for agriculture (**Figure 1**).

3.2 Geology

The survey area occurs on the Swan Coastal Plain (SCP), which is bounded by the Darling Scarp to the east, Indian Ocean to the west, Moore River to the north and Dunsborough to the south. The SCP is built up of two belts of sediments that differ in origin: aeolian sediments in the west and alluvial sediments in the east. The aeolian sediments comprise three major dune systems: The Bassendean Dune System is the most easterly and oldest system; the Quindalup System is the most westerly and youngest system, with the Spearwood system located in between. These wind deposited dunes press up against the Pinjarra plain, which is built up of alluvium deposited by streams from the Darling Plateau. Its alluvial soils are predominantly clays and silts; in places, low dunes of aeolian sands from the west may overlay the alluvial soils (Seddon 1972).

The survey area is situated on the Bassendean Plains land system (212_BS), comprising predominantly of sand dunes and sand plains of deep, pale grey, siliceous sand intervened with sandy and clayey swamps with some black, peaty soils (van Gool 1990).

This system has been divided into six subsystems, of which two have been mapped over the survey area. These are described in **Table 2** and shown in **Figure 3**.

Table 2. Soil Mapping Units occurring within the survey area (van Gool 1990).

System	Subsystem	Description
212 Bassendean	212_BS_B1	Extremely low to very low relief dunes, undulating sandplain, and discrete sand rises with deep bleached grey sands, sometimes with a pale-yellow B horizon or a weak iron-organic hardpan at depths generally greater than 2 m; banksia dominant.
	212_BS_B4	Broad poorly drained sandplain with deep grey siliceous sands or bleached sands, underlain at depths generally greater than 1.5 m by clay or less frequently a strong iron-organic hardpan.

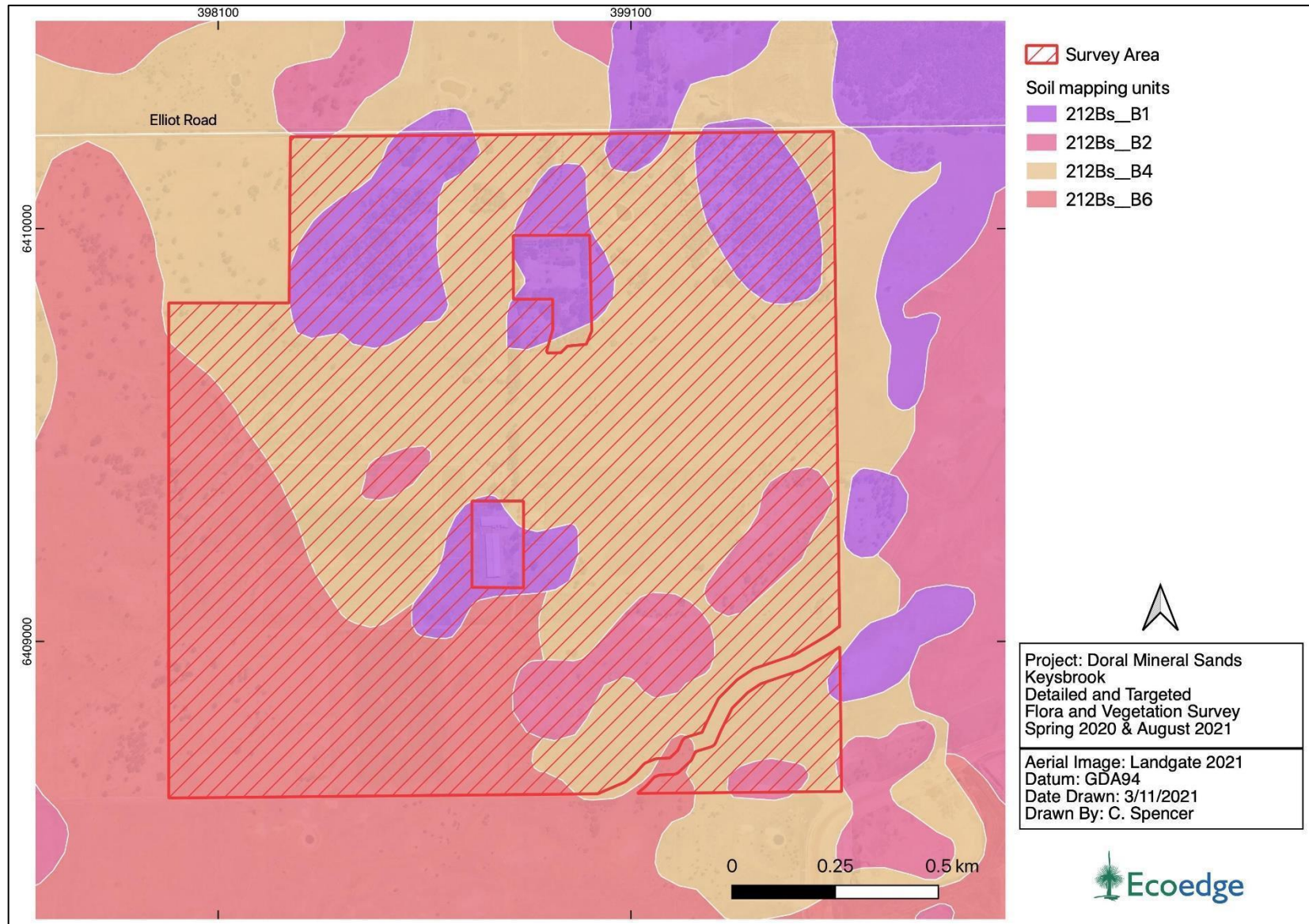


Figure 3. Soil subsystems mapped in and nearby the survey area (van Gool, 1990).

3.3 Vegetation description according to pre-European mapping datasets

The 238.06 ha survey area contains approximately 23.2 ha of native or planted vegetation.

In 2016, the Department of Parks and Wildlife (DPaW) revised the vegetation mapping datasets for the Darling Scarp and Plateau Regional Forest Agreement (RFA) mapping of Mattiske and Havel (1998) and the Swan Coastal Plain mapping of Heddle et al. (1980). The purpose of the revision was to fill data gaps and improve alignment and correlation between the two datasets (Webb et al. 2016)².

Two vegetation complexes occur within the survey area, according to the 1:250,000 mapping of vegetation complexes in the Swan Coastal Plain of Western Australia (Heddle et al. 1980) as updated by Webb et al. (2016). These are described in **Table 3** and shown in **Figure 4**.

Table 3. Vegetation complexes mapped for the survey area (Webb et al. 2016).

Vegetation Complex	Description
Bassendean Complex – Central and South (44)	Vegetation ranges from woodland of <i>Eucalyptus marginata</i> (Jarrah) - <i>Allocasuarina fraseriana</i> (Sheoak) - Banksia species to low woodland of Melaleuca species and sedge lands on the moister sites. This area includes the transition of <i>Eucalyptus marginata</i> (Jarrah) to <i>Eucalyptus todtiana</i> (Pricklybark) in the vicinity of Perth.
Southern River Complex (42)	Open woodland of <i>Corymbia calophylla</i> (Marri) - <i>Eucalyptus marginata</i> (Jarrah) - Banksia species with fringing woodland of <i>Eucalyptus rudis</i> (Flooded Gum) - <i>Melaleuca raphiophylla</i> (Swamp Paperbark) along creek beds.

² At the time of preparation of this report, DBCA was transitioning to the use of a revised mapping dataset for both the Swan Coastal Plain and Southern Jarrah Forest that filled data gaps and addressed differences in the Swan Coastal Plain mapping of Heddle et al. (1980) and the Jarrah Forest mapping of Mattiske and Havel (1988) (Webb et al. 2016).

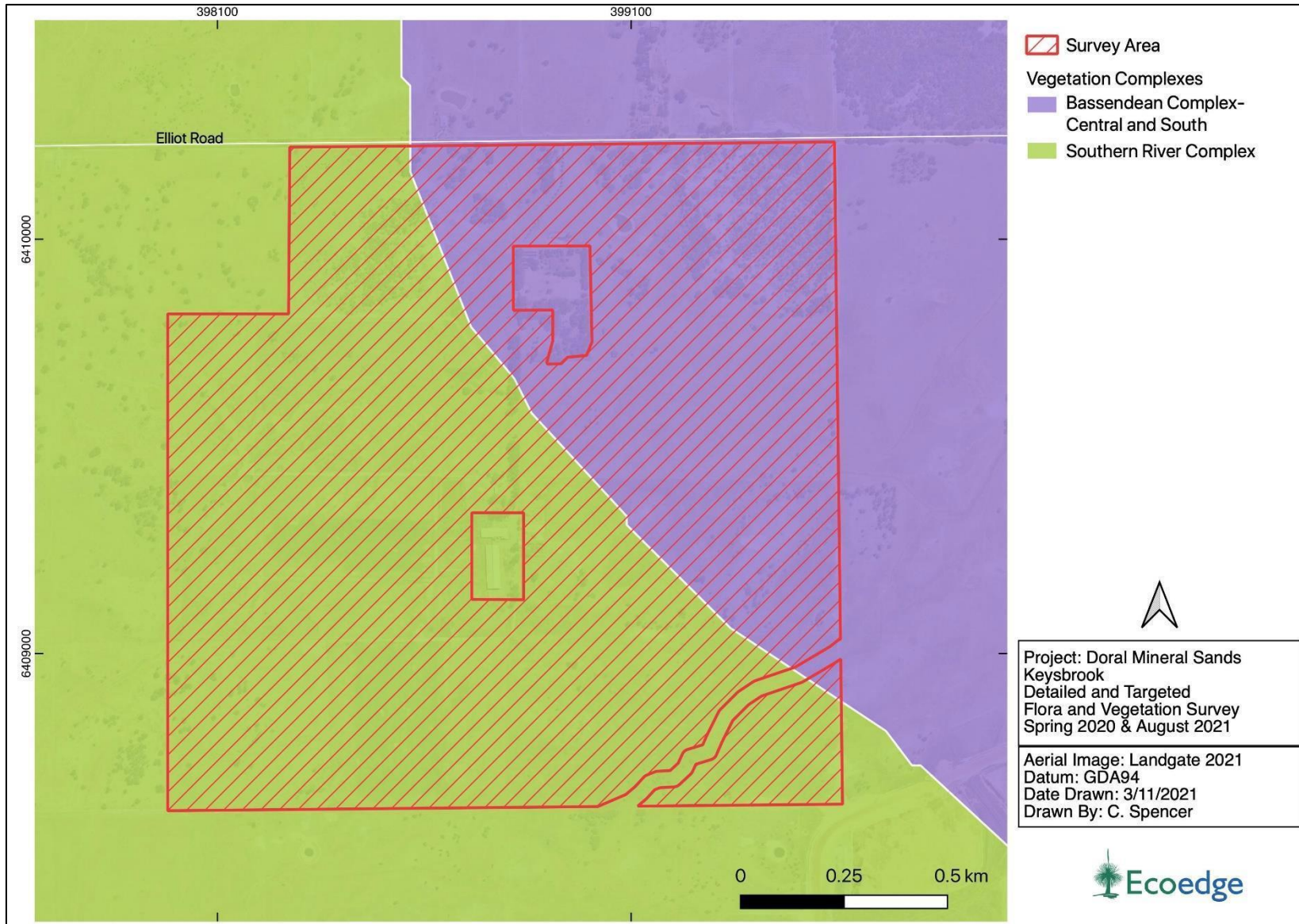


Figure 4. Vegetation complexes mapped in and nearby the survey area.

3.3.1 Assessment of remaining extent against pre-European extent

In 2001, the Commonwealth of Australia stated National Targets and Objectives for Biodiversity Conservation, which recognised that the retention of 30%, or more, of the pre-clearing extent of each ecological community was necessary if Australia's biological diversity was to be protected (Environment Australia, 2001).

In its report on the Statewide Vegetation Statistics incorporating the Comprehensive, Adequate and Representative (CAR) Reserve Analysis, the Government of Western Australia provides information on the pre-European and current extent of the ecological communities of Western Australia and reports on the status of the CAR reserve system for WA (Government of Western Australia, 2019). This system is also based on the National retention targets of 30% overall. Only reserves managed by DBCA under the *Conservation and Land Management Act 1984* are considered for inclusion in the “CAR Reserve Analysis”.

An assessment of both the Bassendean Complex – Central and South and Southern River Complex vegetation complexes against the Statewide Vegetation Statistics (Government of Western Australia, 2019) is presented in **Table 4**. The extent remaining of both these complexes fall below the 30% statewide retention target. At the local government level, the Southern River Complex is also poorly represented, but the Bassendean Complex – Central and South exceed the retention target.

The red, orange and yellow shading in the tables indicates the status of the Commonwealth 30% retention target.

Status of the commonwealth retention target	>30%	<30%	<10%
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Table 4. Vegetation complexes mapped within the survey area with regard to the Commonwealth retention targets (Government of Western Australia 2019).

Vegetation Complex	Pre-European (ha)	Current Extent (ha)	% Remaining	% Remaining in DBCA Reserves
Bassendean Complex - Central and South (44)				
Swan Coastal Plain	87,476.25	23,508.66	26.87	5.0
Shire of Serpentine-Jarrahdale	9,852.42	3,166.25	32.14	-
Southern River Complex (42)				
Swan Coastal Plain	58,781.48	10,832.18	18.43	1.60
Shire of Serpentine-Jarrahdale	7,653.19	674.36	8.81	-

* Excludes Crown Freehold Department Interest Lands that are managed under Section 8(a) of the CALM Act.

3.4 Threatened and Priority Ecological Communities

Ecological communities are defined by Western Australia's DBCA (previously DPaW and the Department of Environment and Conservation (DEC)) as "...naturally occurring biological assemblages that occur in a particular type of habitat. They are the sum of species within an ecosystem and, as a whole, they provide many of the processes which support specific ecosystems and provide ecological services." (DEC 2013).

Under Section 27 of the *Biodiversity Conservation Act 2016* (BC Act), the Western Australian Minister for Environment may list communities considered to be under significant threat as a TEC. These TECs can be listed under one of three conservation categories: Critically Endangered (CR), Endangered (EN), Vulnerable (V). The BC Act also provides for listing communities as collapsed ecological communities.

Possible TECs that do not meet survey criteria are added to the DBCA's Priority ecological community lists under Priorities 1, 2 or 3 (referred to as P1, P2, P3). Ecological communities that are adequately known, 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 (P4). These ecological communities require regular monitoring. Conservation Dependent ecological communities are placed in Priority 5 (P5) (DEC 2013).

The current listing of Threatened and Priority ecological communities is specified in DBCA (2018a, 2020b). The conservation categories for these Threatened and Priority ecological communities are defined in **Appendix 2**.

TECs can also be listed under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). There are three categories of TEC under the EPBC Act: Critically Endangered (CR), Endangered (E) and Vulnerable (V) (Department of Agriculture, Water and the Environment) (DAWE 2020a). These are defined in **Appendix 3**.

Under both the State BC Act and the Federal EPBC Act, ministerial authorisation is required where significant permanent modification to a TEC will occur.

If an occurrence of a TEC is found during a survey conducted under the auspices of the *Environmental Protection Act 1986* (EP Act), it must be mandatorily reported to the Chief Executive Officer of the DBCA under Section 49 of the BC Act.

The desktop assessment found five EPBC Act listed TEC and three BC Act listed TEC occurring within ten km of the survey area, based on results generated from an extract from the DBCA databases (DBCA 2020c) and a 10 km radius Protected Matters Search Tool (PMST) query (DAWE 2020b). Two PECs were recorded in the search area. These communities are listed in **Table 5**.

Of these communities, only the Banksia Woodlands of the Swan Coastal Plain TEC PEC have buffers mapped over the survey area **Figure 5** (DBCA 2021c).

Copies of the NatureMap and PMST data searches are provided in **Appendix 4**.

Table 5. Threatened and Priority ecological communities occurring and possibly within 10 km of the survey area (DBCA 2020c, DAWE 2020b).

Community Name	Status (WA)	Status (EPBC Act)
Claypans of the Swan Coastal Plain – comprising of four state-listed ecological communities <ul style="list-style-type: none"> • Herb rich saline shrublands in clay pans (SCP07) – Vulnerable • Herb rich shrublands in clay pans (SCP08) – Vulnerable • Dense shrublands on clay flats (SCP09) – Vulnerable • Shrubbylands on dry clay flats. (SCP10a) – Endangered. 	VU-EN	CR
Tuart (<i>Eucalyptus gomphocephala</i>) Woodlands and Forests of the Swan Coastal Plain ecological community	P3	CR
‘Banksia Woodlands of the Swan Coastal Plain’ – a federally listed TEC consisting of numerous State-listed communities.	P3	EN
<i>Corymbia calophylla</i> - <i>Kingia australis</i> woodlands on heavy soils of the Swan Coastal Plain (SCP 3a)	CR	EN
<i>Corymbia calophylla</i> - <i>Xanthorrhoea preissii</i> woodlands and shrublands of the Swan Coastal Plain (SCP 3c)	CR	EN

Note: This table only includes formally recognised TECs that are known of and mapped, and included in the DBCA’s database.

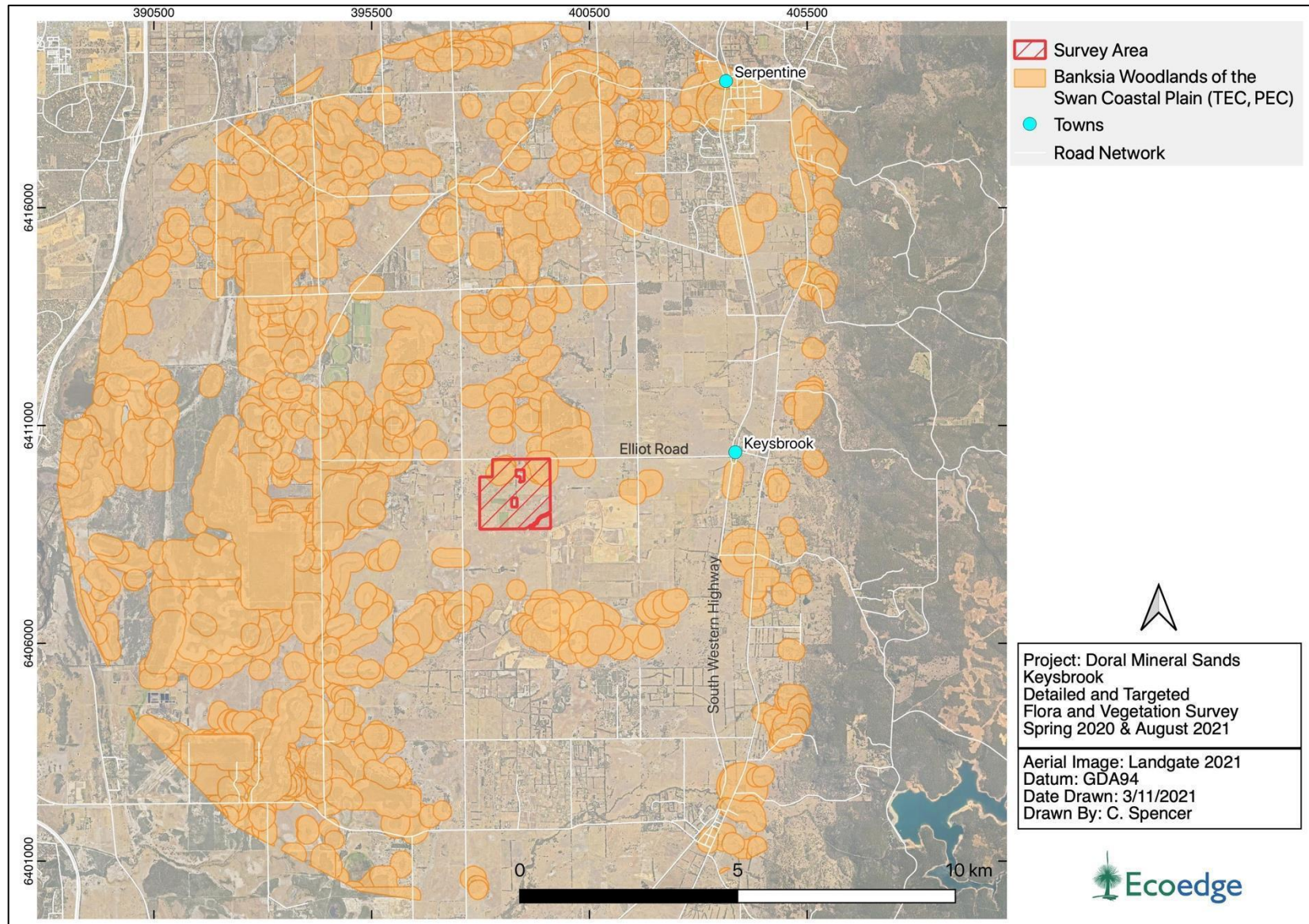


Figure 5. Location of TECs and PECs within a 10 km radius of the survey area (DBCA 2020c).

3.5 Threatened and priority flora

Species of flora and fauna are defined as having a Threatened or Priority conservation status where their extant populations are restricted geographically and/or under threat of possible extinction. The DBCA recognises these threats and consequently applies regulations towards population and species protection.

Threatened extant flora species are listed under Section 19 of the BC Act. They are ranked according to their level of threat using the International Union for Conservation of Nature (IUCN) Red List categories and criteria of Critically Endangered (CR), Endangered (EN), Vulnerable (VU). It is an offence to “take” or damage Threatened flora without Ministerial approval. Section 5 of the Act defines “to take” as “... to gather, pluck, cut, pull up, destroy, dig up, remove, harvest or damage flora by any means”.

Priority flora is under consideration for future declaration as “Threatened flora”, dependent on more information. Species classified as Priority One to Three (referred to as P1, P2 and P3) require further survey to determine their status. Priority Four (P4) species are adequately known rare or Threatened species that require regular monitoring.

Threatened flora lists are formally reviewed annually, whilst the Priority flora list is subject to a less formal ongoing review. The current listing of Threatened and Priority flora was updated on the 5 December 2018 (DBCA, 2018b).

Categories of Threatened and Priority flora as defined by the BC Act are presented in **Appendix 5** (DBCA 2019a).

Threatened flora may also be protected under the Commonwealth EPBC Act and be listed in one of six categories; the definitions of these categories are summarised in **Appendix 6** (DAWE 2020c).

Threatened or Priority flora occurring within 10 km of the project area generated from a NatureMap search, DBCA Threatened and Priority data search query and a Protected Matters Search Tool query, **Appendix 4** (DBCA 2020d, DBCA 2020e, DAWE 2020b) are provided in a likelihood of occurrence table in **Appendix 7**. A number of the species listed in **Appendix 7** could potentially occur within the survey area, based on an assessment of their preferred habitats. Location of Threatened and Priority flora within a 10 km radius of the survey area (DBCA 2020e) are shown in **Figure 6**.

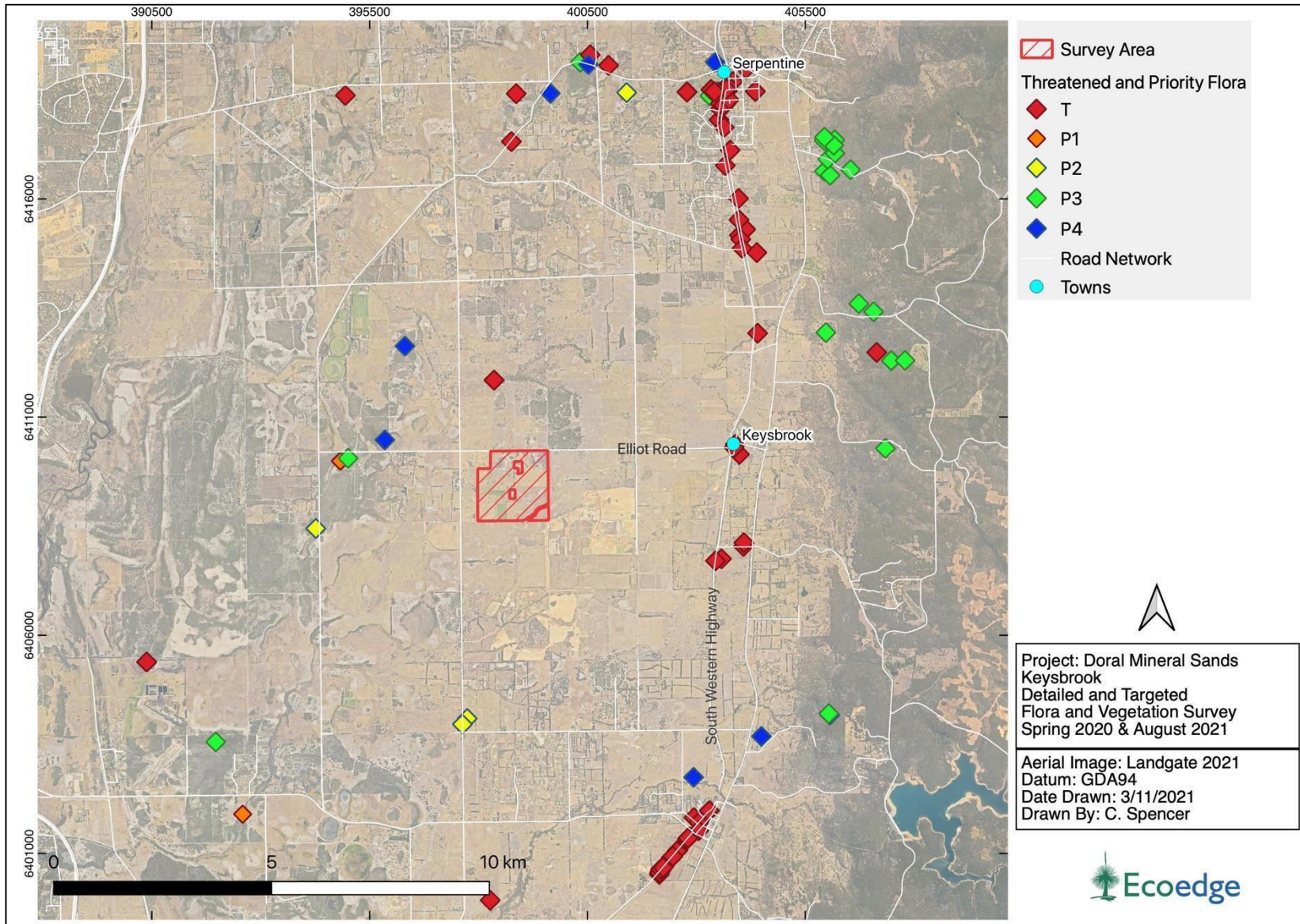


Figure 6. Location of Threatened and Priority flora within a 10 km radius of the survey area (DBCA 2020e).

3.6 Geomorphic wetlands

Wetlands on the Swan Coastal Plain have been classified into types using the geomorphic wetland classification system of Semeniuk & Semeniuk (1995), which is based on the characteristics of landform and water permanence, for example, lakes, palusplains and damplands. These are described in **Table 6**. The Swan Coastal Plain wetlands have also been evaluated and assigned an appropriate management category and corresponding category objective, providing guidance on the nature of the management and protection the wetland should be afforded. These categories are described in **Table 7**.

Table 6. Wetland types (adapted from Semeniuk & Semeniuk, 1995).

Management Category	Basin	Flat	Channel	Slope	Highland
Permanently inundated	Lake		River		
Seasonally inundated	Sumpland	Floodplain	Creek/ Brook		
Intermittent inundation	Playa	Barlkarra	Wadi		
Seasonally waterlogged	Dampland	Palusplain	Trough	Paluslope	Palusmont

Table 7. Definitions of and objectives for the different wetland management categories (modified from Essential Environmental Services, 2005).

Management Category	Definition	Category Objective
Conservation	Wetlands with high conservation value for both natural and human use.	To preserve wetland (natural) attributes and functions.
Resource Enhancement	Wetlands with moderate natural and human use attributes that can be restored or enhanced.	To restore wetlands through maintenance and enhancement of wetland functions and attributes.
Multiple Use	Wetlands that score poorly on both natural and human use attributes.	To use, develop and manage wetlands in the context of water, town, and environmental planning.

There are no Conservation Category (CC) wetlands within the boundary of the survey area. The closest CC wetland is located approximately 1.4 km to the N of the survey area (**Figure 7**).

According to the latest SCP Geomorphic wetland data set (DBCA 2020f), a system of wetlands is mapped across and adjacent to low lying portions of the survey area. This system occurs as expressions of predominantly seasonally inundated sumplands and seasonally waterlogged damplands with a small seasonally waterlogged palusplain wetland. The sumpland and dampland components are mapped as Resource Enhancement (RE) wetlands, and the palusplain wetland is mapped as a Multiple Use wetland **Figure 8**. The RE wetland comprises approximately 10.1 ha of the area, and the MU wetland comprises approximately 0.92 ha.

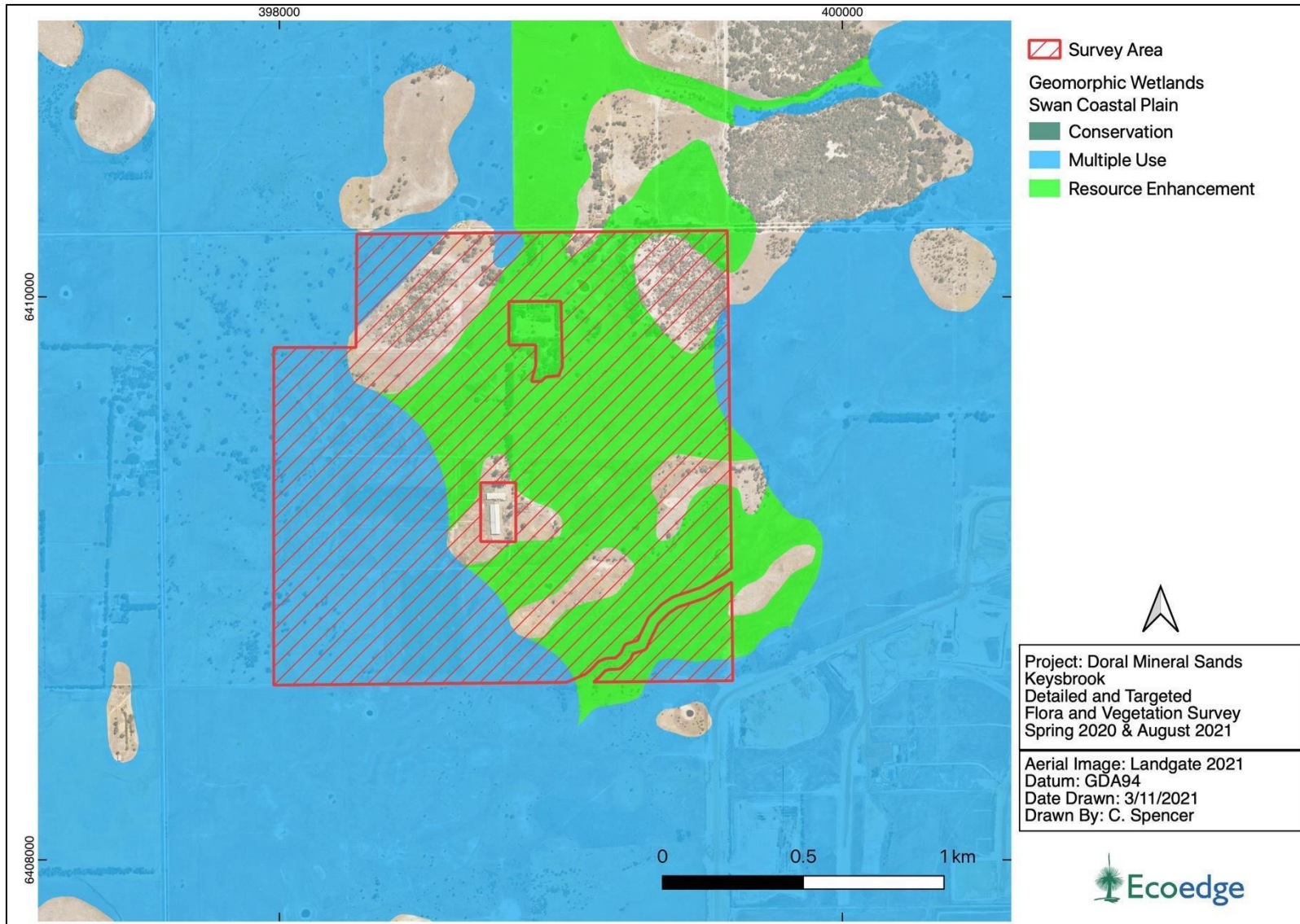


Figure 7. Geomorphic wetlands within and in proximity to the survey area (DBCA 2020f).

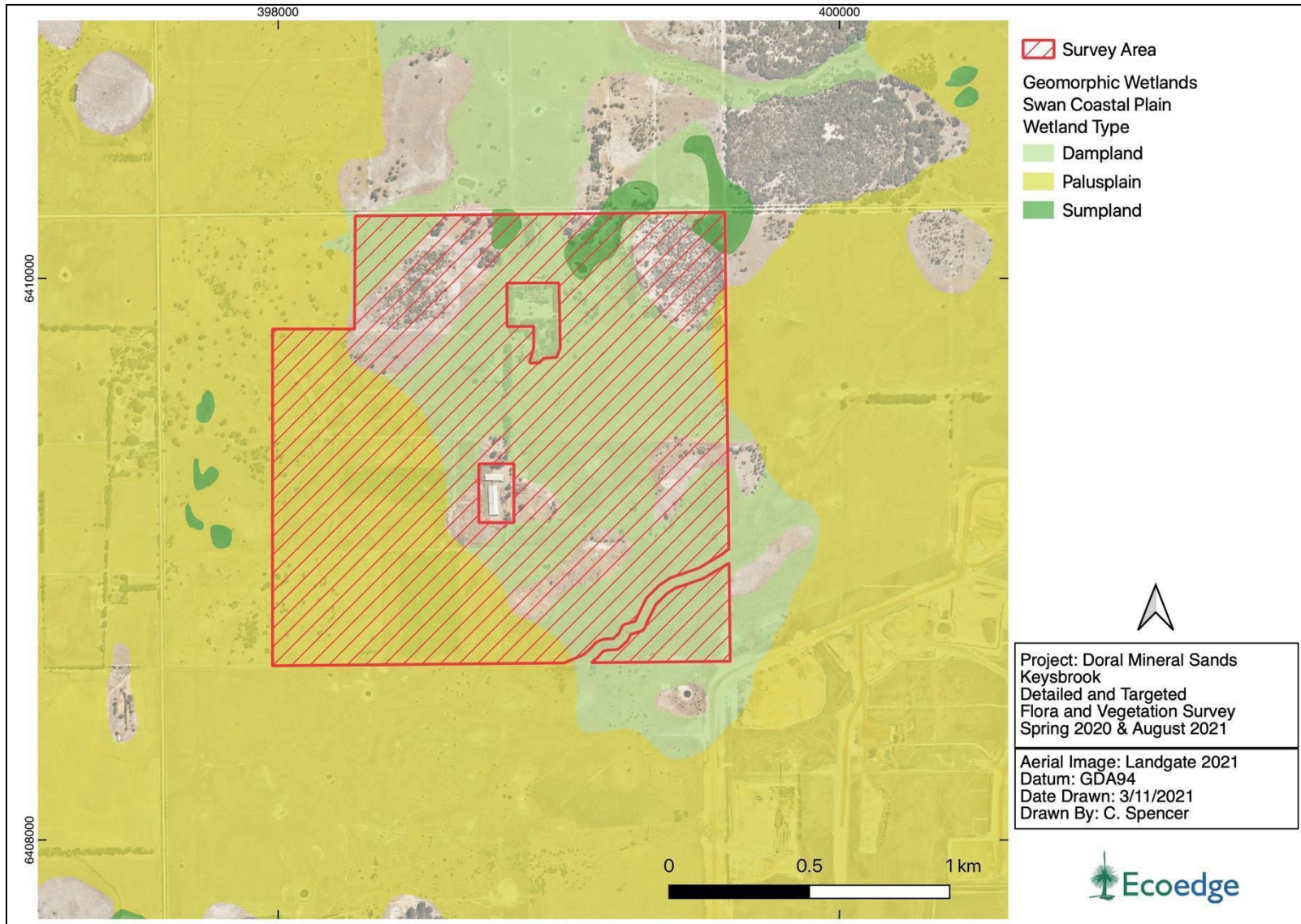


Figure 8. Geomorphic wetland type within and in proximity to the survey area (DBCA 2020f).

3.7 Ecological linkages and connectivity

There are no formally mapped ecological linkages within the survey area. The Molloy et al. (2009) Regional Ecological Linkage mapping ceased approximately 1 km south of the survey area.

The parcels of vegetation within the survey area are narrowly connected in the north-east corner, to a block of vegetation, linked to vegetation associated with the Dirk Brook and its associated tributaries (**Figure 1**). This sequence of connected vegetation may be considered to have ecological linkage values, as it occurs in a predominantly cleared agricultural landscape.

3.8 Environmentally sensitive areas

Environmentally Sensitive Areas (ESAs) are protected under the Environmental Protection (Clearing of Native Vegetation) Regulations 2004. They are selected for their environmental values at State or National levels (Government of Western Australia, 2005). They include:

- Defined wetlands and riparian vegetation within 50 m
- Areas covered by Threatened ecological communities
- Area of vegetation within 50 m of Threatened flora
- Bush Forever sites
- Declared World Heritage property sites.

According to the latest ESA dataset (DWER 2020), there are no ESAs within the survey area. There are two located approximately 1.3 km to the north and west of the survey area, both of which are associated with CC wetlands (**Figure 9**).

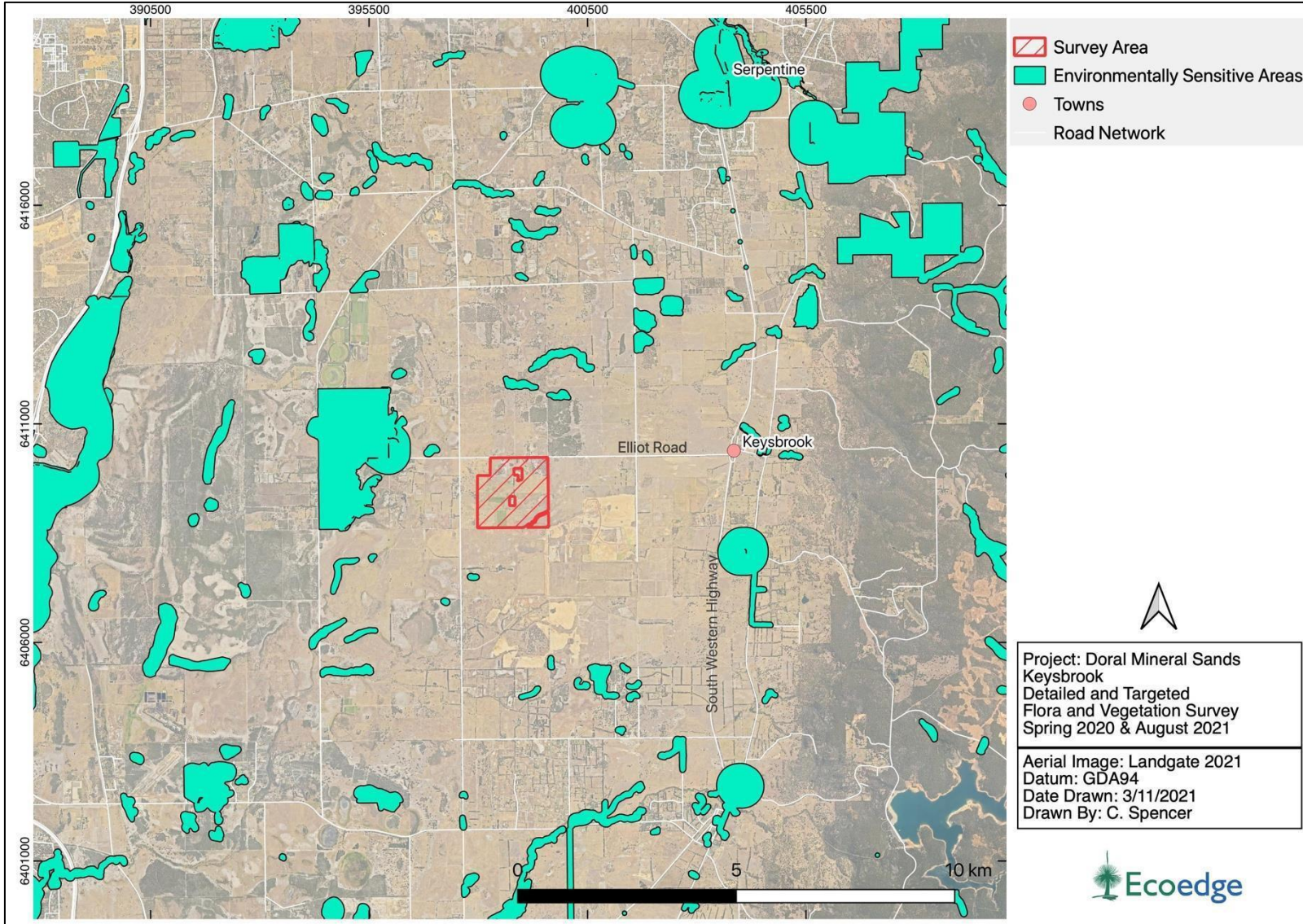


Figure 9. Environmentally sensitive areas in proximity to the survey area (DWER 2020).

3.9 Previous surveys

Two previous flora and vegetation studies have been undertaken over the current survey area, these are:

1. MBS (2004) Vegetation and Fauna Assessment of Exploration Licence 70/2407 Keysbrook, Prepared for Olympia Resources Limited.
2. Bennett Environmental Consulting (BEC) (2004) Vegetation and Flora of Exploration Licence 70/2407 Keysbrook Western Australia, Prepared for MBS Environmental Pty Ltd.

Both of these 2004 surveys encompassed a larger area than the current 2020 survey area. The relevant portions for this survey were referred to in the MBS (2004) and BEC (2004) report as “Linga East” and “Linga West”. Linga East is the eastern parcel of vegetation of this survey, and Linga West is the western parcel of vegetation for this survey.

The outcomes of these surveys are summarised below.

3.9.1 MBS (2004)

Level of survey – Preliminary field assessment ~ reconnaissance survey.

Time of survey: 19-20 May 2004.

Objectives: The objectives of the MBS (2004) survey were to: identify, assess and map vegetation types, identify habitats where significant flora may occur, and provide recommendations on further flora surveys if required.

The results of this survey are summarised in **Table 8** below:

Table 8. Summary of MBS (2004) survey outcomes

	Linga East	Linga West
Vegetation condition	Very Good	Good
Vegetation type	Marri and Banksia Woodland Seasonal Wetland	Kunzea glabrescens thicket
Threatened or Priority flora	Nil	Nil
Inferred TEC PEC	Nil	Nil

No specific recommendations were made with regards to potential occurrences of significant flora and the need or otherwise for further survey. However, four conservation significant flora species were recommended in the likelihood of occurrence table as having a moderate or higher chance of occurring within the survey area (**Table 9**).

Table 9. MBS (2004) significant flora with a moderate or higher rating.

Species	Likelihood
<i>Anthotium juniforme</i>	Moderate
<i>Aponogeton hexatepalus</i>	Moderate
<i>Calothamnus graniticus</i>	High
<i>Drakea elastica</i>	Moderate

3.9.2 Bennett Environmental Consulting (2004)

Level of survey: Detailed and targeted survey.

Time of survey: 27 – 28 October 2004.

Objectives: Map the vegetation and list the flora of the lease. Locate and record the presence of any Declared Rare and Priority Flora.

Bennett’s survey area focused on all remnant vegetation within the exploration lease area, including Linga East and Linga West. Summaries of the outcomes of the survey of these areas are presented in **Table 10**.

Table 10. Summary of BEC (2004) survey outcomes

	Linga East	Linga West
Vegetation condition	Excellent to Completely Degraded	Degraded to Completely Degraded
Vegetation type	*Mosaic of Rc, Aa, CcPe and BaBm, CcPe, BiKg, Mp	*Mp, BiKg
Threatened or priority flora	Nil	Nil
Inferred TEC PEC	No TEC or PEC were identified at the time of survey. BaBm was inferred to be FCT 21a/FCT 21c via MVA, which are part of the 2016 EPBC listed Banksia Woodlands of the Swan Coastal Plain TEC. However, the expressions of these communities within the survey area do not meet the condition and area thresholds to be considered the TEC (TSSC, 2016).	Nil

*Rc - Closed Tall Scrub of *Regelia ciliata*, *Kunzea micrantha* subsp. *micrantha* and *Pericalymma ellipticum*.

CcPe - Low Open Woodland of *Corymbia calophylla* over Tall Shrubland of *Pericalymma ellipticum* over a Low Shrubland of *Hypocalymma angustifolium*.

Aa - Open Heath of *Astartea affinis* over Open Sedgeland/Grassland.

Mp - Low Open Forest of *Melaleuca preissiana* over Sedgeland.

BiKg - Closed to Low Open Forest of *Banksia ilicifolia* and *Kunzea glabrescens* over Open Grassland.

BaBm Low Closed Forest of *Banksia attenuata* with scattered *Banksia menziesii* and *Eucalyptus marginata* subsp. *marginata* over Shrubland of *Xanthorrhoea brunonis* over Open Low Heath dominated by *Hibbertia hypericoides*.

4 Survey results

A map showing the location of quadrats data, data collection points and survey track files together with all quadrat details is provided in **Appendix 8**.

4.1 Flora

Ninety eight species of vascular flora were identified within the survey area, of which 32 (33%) were introduced taxa. No Threatened or Priority flora or other flora of conservation significance were found.

The list of vascular flora for the survey area is presented in **Appendix 9**.

4.1.1 Threatened and priority flora

There are no Threatened or Priority flora or other flora of conservation significance in the survey area.

4.1.2 Environmental weeds and declared pest plants

A small population of the Declared Pest Plant *Zantedeschia aethiopica* (Arum lily) was found in the north-east of the survey area **Figure 10**.

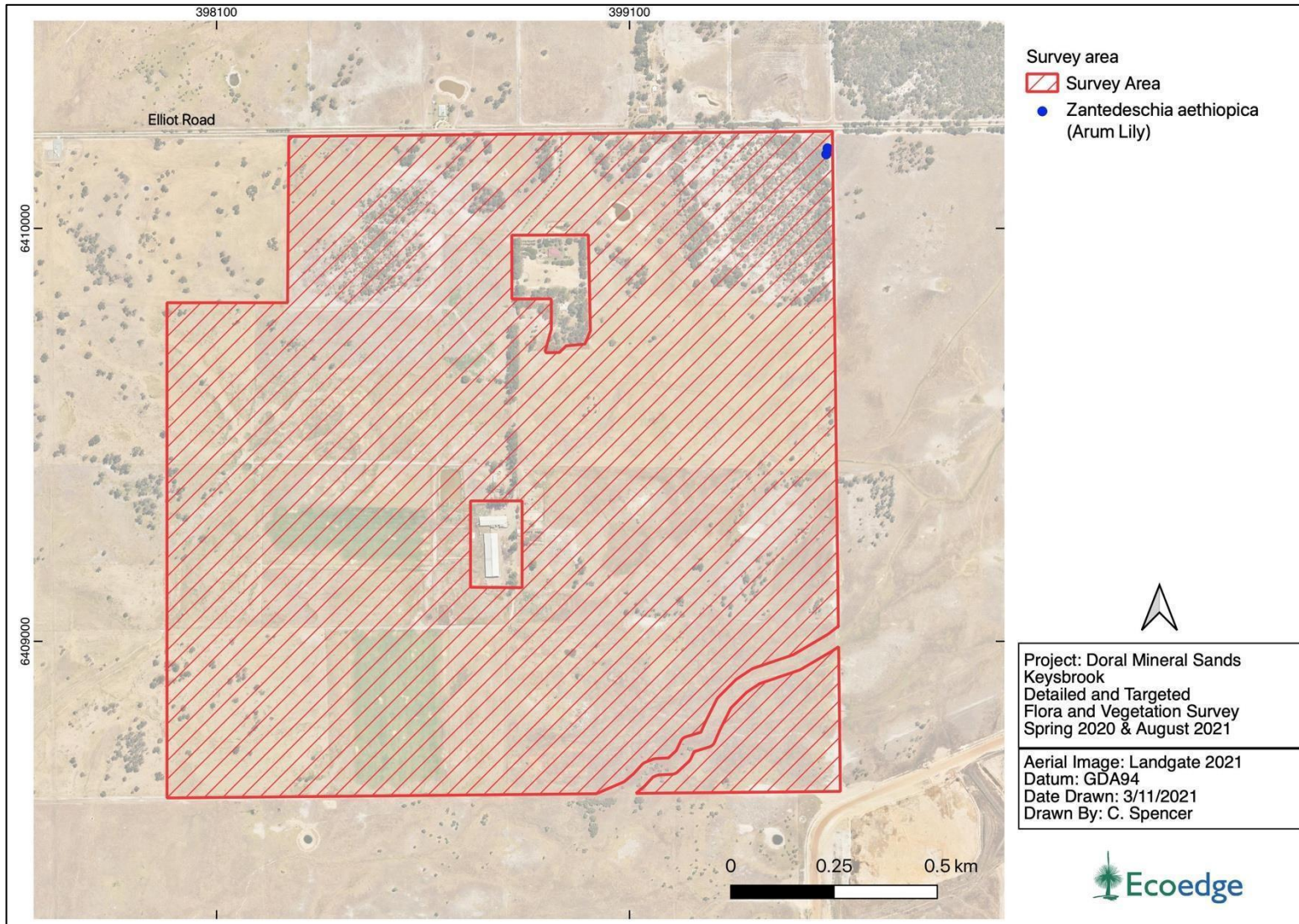


Figure 10. Declared pest plants within the survey area.

4.2 Vegetation units

Three native vegetation units were identified within the survey area:

- Jarrah-Banksia-Sheoak woodland, subunits A1 and A2
- Jarrah-Marri open forest, subunits B1 and B2,
- *Melaleuca preissiana* dampland, subunits C1, C2 and C3.

Vegetation subunit A1 is the most widespread vegetation unit.

There were also two other vegetation mapping units, not comprised primarily of native vegetation, these being:

- Pasture (with very scattered Jarrah, Marri and *M. preissiana*) and
- Areas of planted amenity trees, mainly around sheds and houses.

The vegetation subunits are described in **Table 11** below and mapped in **Figure 11**. Photographs of the vegetation units and subunits are provided in **Appendix 10**.

Table 11. Description of vegetation subunits in the survey area.

Unit/Subunit	Description
A1	Low woodland/open woodland of <i>Banksia attenuata</i> , <i>B. menziesii</i> , <i>B. ilicifolia</i> , <i>Nuytsia floribunda</i> , <i>Xylomelum occidentale</i> with isolated mid-height <i>Allocasuarina fraseriana</i> and <i>Eucalyptus marginata</i> trees over sparse mid-height shrubland of <i>Xanthorrhoea brunonis</i> (sometimes with patches of tall shrubland of <i>Kunzea glabrescens</i>) over grassland of <i>Austrostipa flavescens</i> , <i>*Briza maxima</i> , <i>B. minor</i> , <i>*Ehrharta calycina</i> , <i>Microlaena stipoides</i> and forbland of <i>*Arctotheca calendula</i> , <i>*Hypochaeris glabra</i> and <i>*Ornithopus pinnatus</i> on grey sand. [In some places, <i>B. attenuata</i> and <i>B. menziesii</i> are missing from this subunit].
A2	Mid-height open woodland of <i>Corymbia calophylla</i> and <i>Allocasuarina fraseriana</i> over open low woodland of <i>Banksia attenuata</i> and <i>Xylomelum occidentale</i> over grassland of <i>*Briza maxima</i> , <i>B. minor</i> , <i>*Ehrharta calycina</i> , <i>Microlaena stipoides</i> and forbland of <i>*Arctotheca calendula</i> , <i>*Hypochaeris glabra</i> and <i>*Ornithopus pinnatus</i> on grey sand.
B1	Mid-height open forest of <i>Corymbia calophylla</i> and <i>Eucalyptus marginata</i> over <i>Melaleuca preissiana</i> open low woodland over low open shrubland of <i>Banksia dallanneyi</i> , <i>Dasypogon bromeliifolius</i> and <i>Xanthorrhoea brunonis</i> over sparse forbland of <i>Burchardia multiflora</i> , <i>Desmocladus fascicularis</i> and <i>Microtis media</i> , very open sedgeland of <i>Cyathochaeta avenacea</i> and open grassland of <i>*Briza maxima</i> and <i>*B. minor</i> on grey sand.
B2	Mid-height open forest or woodland of <i>Corymbia calophylla</i> (occasionally with <i>Allocasuarina fraseriana</i> and <i>Xylomelum occidentale</i>) over pasture species including <i>*Arctotheca calendula</i> , <i>*Lolium</i> spp., <i>*Lotus subbiflorus</i> , <i>*Rumex</i> spp., <i>*Trifolium repens</i> on grey loamy sand or sand.
C1	Mid-height shrubland of <i>Astartea scoparia</i> , <i>Kunzea recurva</i> and <i>Xanthorrhoea preissii</i> , with emergent mid-height <i>Corymbia calophylla</i> and <i>Melaleuca preissiana</i> low trees, over low open shrubland of <i>Boronia spathulata</i> and <i>Hypocalymma angustifolium</i> , over open sedgeland of <i>Cyathochaeta avenacea</i> and <i>Lepidosperma longitudinale</i> , forbland of <i>*Arctotheca calendula</i> , <i>*Hypochaeris glabra</i> , <i>*Ornithopus pinnatus</i> and grassland of <i>*Cynodon dactylon</i> and <i>Lolium multiflorum</i> on grey-brown loamy sand.

C2	Low woodland of <i>Melaleuca preissiana</i> with fringing mid-height <i>Corymbia calophylla</i> trees over sedgeland of <i>Lepidosperma longitudinale</i> over forbland of * <i>Hypochaeris glabra</i> , * <i>Lotus subbiflorus</i> and * <i>Ursinia anthemoides</i> and grassland of * <i>Briza maxima</i> , * <i>B. minor</i> , * <i>Ehrharta longiflora</i> , * <i>Lolium multiflorum</i> on grey-brown sand. [The ground-layer of <i>L. longitudinale</i> is missing from most areas].
C3	Low woodland to open woodland of <i>Melaleuca preissiana</i> over pasture species including <i>Arctotheca calendula</i> , * <i>Lolium</i> spp., * <i>Lotus subbiflorus</i> , * <i>Rumex</i> spp., * <i>Trifolium repens</i> on grey loamy sand or sandy clay-loam.

* Denotes introduced species.

4.3 Multivariate analysis

An MVA was conducted to assist in determining the relationship of the vegetation within the survey area with the floristic community types described in Gibson et al. (1994) and DEP (1996) and therefore highlight which vegetation units may be TECs.

The outcome of the MVA is summarized in **Table 12** below. The high proportion of weeds in most survey area quadrats and relatively low species-richness in all of them had an impact on the MVA. Quadrat species-richness ranged from 13 taxa in KEYS02 to 22 in KEYS01, compared to around 47 taxa/quadrat for the Swan Coastal Plain as a whole (Gibson et al. 1994). Weeds comprised 9 of the 13 taxa (69%) in quadrat KEYS02 and were lowest in KEYS01, comprising 22% of the species in that quadrat. By contrast, introduced species, on average, comprised 11% of the taxa in the Swan Coastal Plain survey quadrats.

Table 12. Assignment of survey area quadrats to Swan Coastal Plain floristic community types

Quadrats	Grouped With	FCT Name	Veg Unit
KEYS02, KEYS03, KEYS05, KEYS06	SWAFCT06	"Weed dominated wetlands on heavy soils."	C1, C2, A1
KEYS04	SWAFCT04	" <i>Melaleuca preissiana</i> damplands"	B
KEYS01	SWAFCT20b (SWAFCT21c)	"Eastern <i>Banksia attenuata</i> and/or <i>Eucalyptus marginata</i> woodlands" ("Low-lying <i>Banksia attenuata</i> woodlands or shrublands")	A1

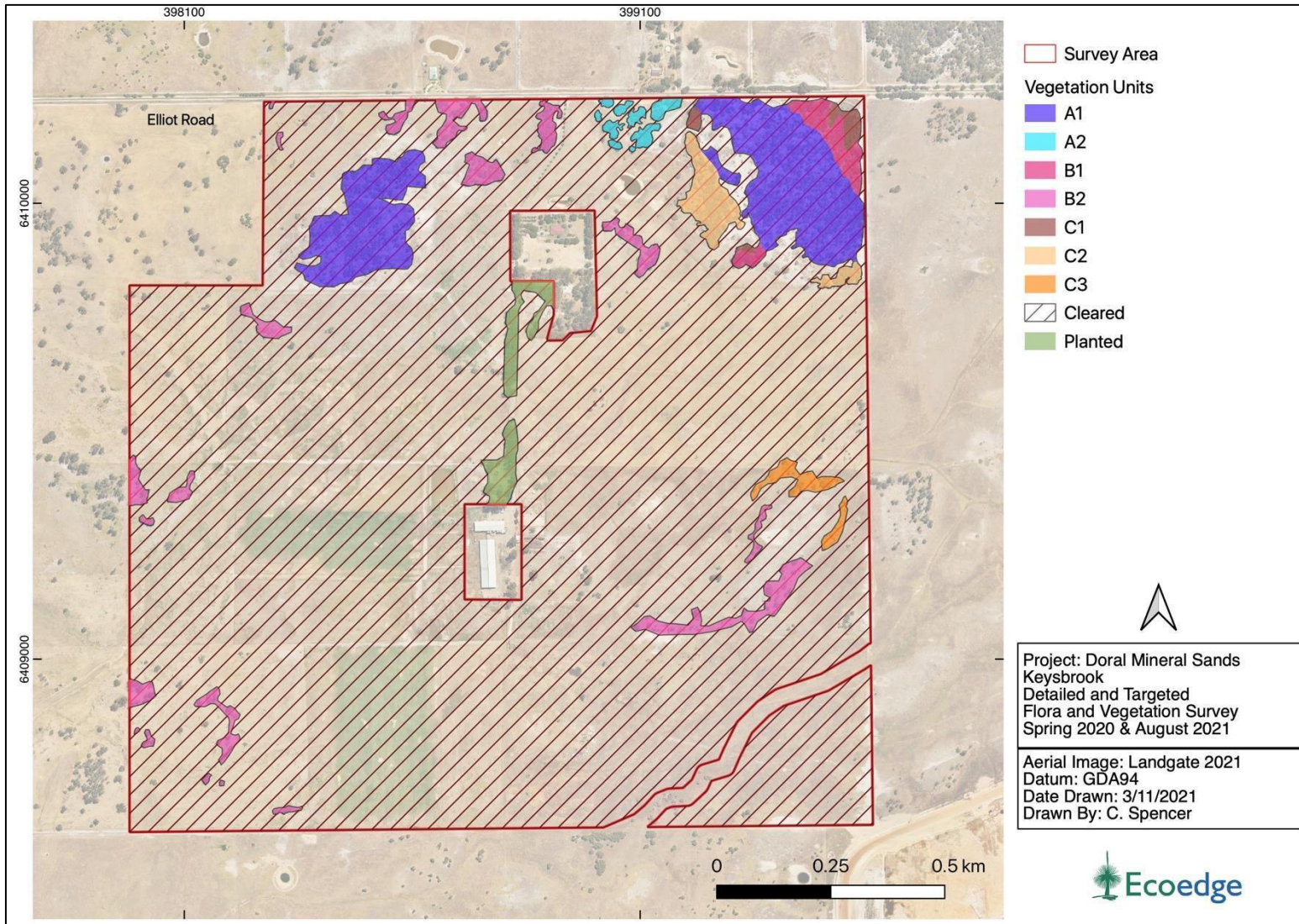


Figure 11. Vegetation subunits for the survey area.

4.4 Vegetation condition

The majority of the remnant vegetation in the survey area (almost 66%) was classed as Completely Degraded. Only 4.31% was in the Good category. The survey area is situated in an agricultural landscape and has been grazed by dairy cattle for many years. It is likely, also, that *Phytophthora* dieback disease has played a role in degrading the vegetation.

An overall breakdown of vegetation condition across the site is provided in **Table 13**. Vegetation condition across the site is shown in **Figure 12**. A breakdown of condition per vegetation unit is provided in **Table 14**. The RE wetland vegetation condition is provided in **Table 15** and shown in **Figure 13**. There is 0.965ha (0.9%) vegetation in good condition in the RE area.

Table 13. Vegetation condition in the survey area.

Condition	Area (ha)	%
Good	1.00	4.31
Degraded	6.93	29.84
Completely Degraded	15.30	65.86
Total Native Vegetation	23.23	100.00
Cleared	212.98	
Planted	1.87	

Table 14. Areas and percentages of the vegetation units and subunits in various condition categories.

Veg. Unit/Subunit	Condition	Area (ha)	%
A1	Degraded	4.99	40.32
	Completely Degraded	7.38	59.68
	Total	12.37	100.00
A2	Degraded	0.21	25.18
	Completely Degraded	0.63	74.82
	Total	0.85	100.00
B1	Good	0.59	44.36
	Degraded	0.75	55.64
	Total	1.34	100.00
B2	Completely Degraded	5.32	100.00
C1	Good	0.27	46.92
	Degraded	0.13	21.92

Veg. Unit/Subunit	Condition	Area (ha)	%
	Completely Degraded	0.18	31.16
	Total	0.58	100.00
C2	Good	0.13	7.01
	Degraded	0.86	45.20
	Completely Degraded	0.91	47.78
	Total	1.90	100.00
C3	Completely Degraded	0.88	100.00
Planted	Completely Degraded	1.87	100.00
Pasture	Cleared	212.98	
Total area		238.06	

Table 15. Condition of the Resource Enhancement wetland.

Condition	Area (ha)	%
Good	0.965	0.9
Degraded	1.1	1.02
Completely Degraded	5.12	4.77
Cleared	100.2	93.31
Total	107.4	100

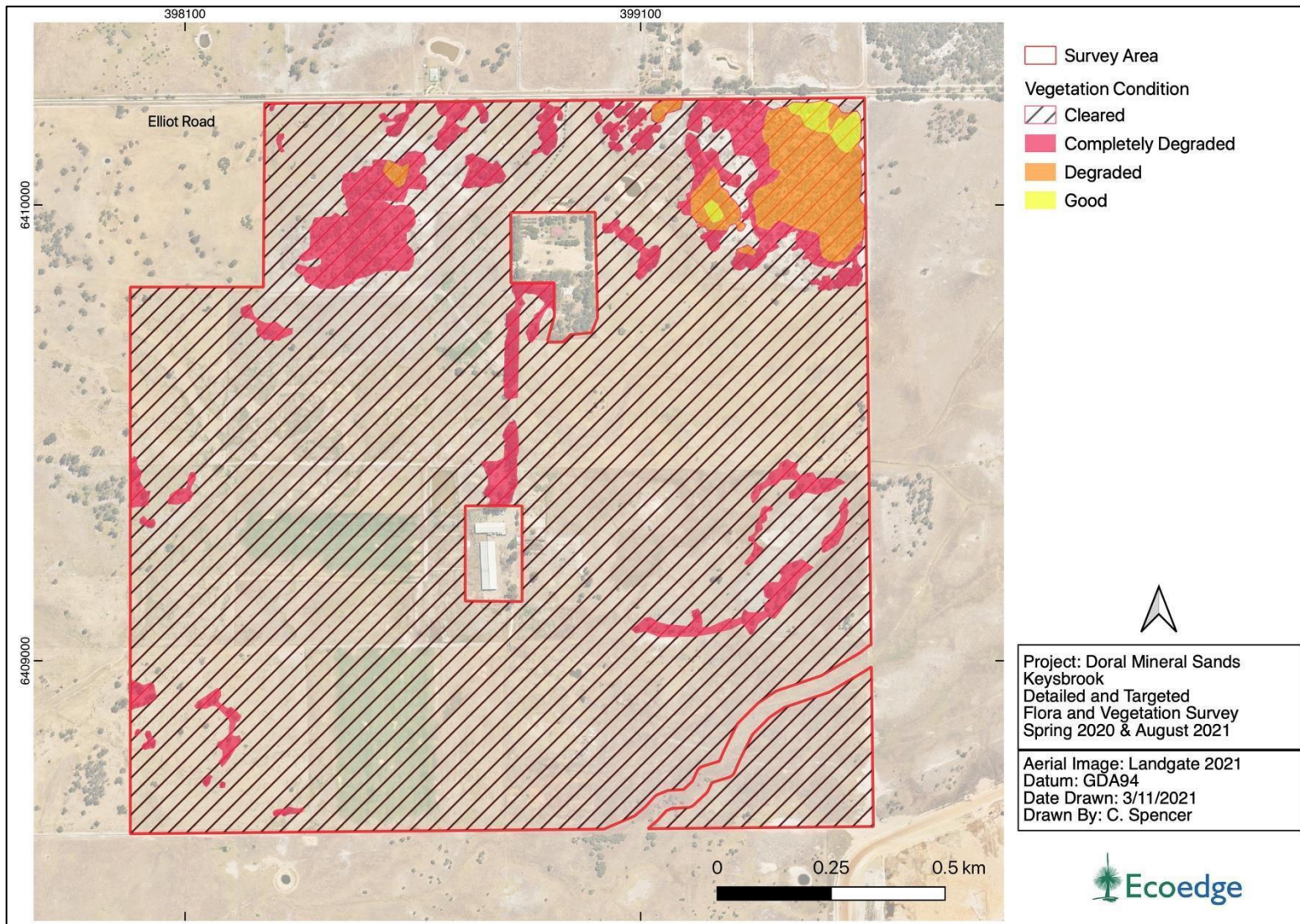


Figure 12. Vegetation units and vegetation condition for the survey area.

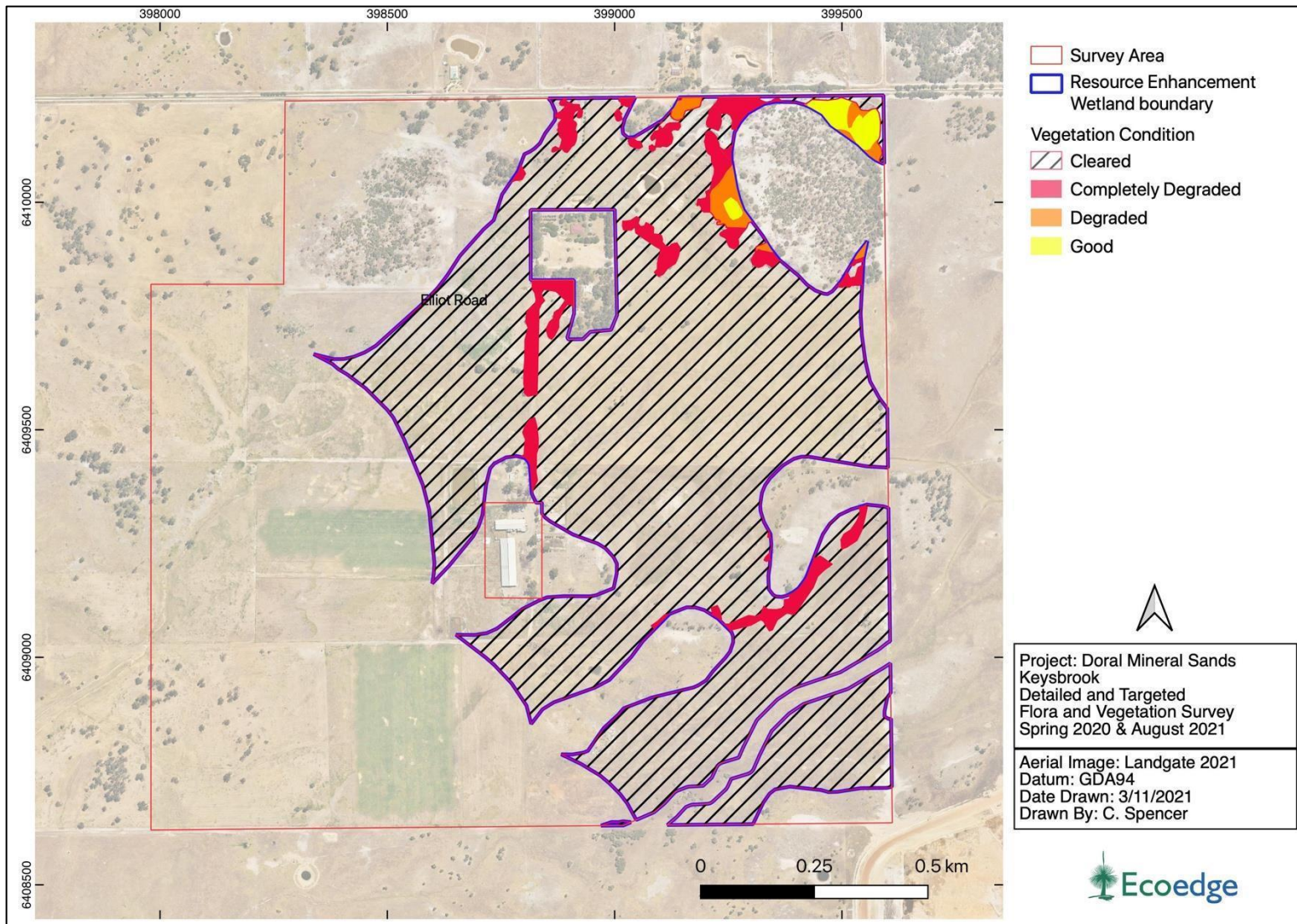


Figure 13. Vegetation condition of the Resource Enhancement wetland.

5 Discussion

5.1 Significance of the flora

5.1.1 Threatened and Priority flora

There are no Threatened or Priority flora or other flora of conservation significance in the survey area. Hence the flora does not have particular conservation value.

After completing the 2020 and 2021 surveys, an assessment was made of the residual likelihood of 42 Threatened and Priority list flora known or potentially occurring within 10 km of the survey area (**Appendix 7**). Of this flora, 23 were deemed to have an “Extremely Low” residual likelihood of occurring within the survey area. That is, they were not found, suitable habitat was not present, and if they had been present, they would have been seen. The other 19 taxa were deemed to have a “Very Low” residual likelihood of occurring in the survey area. With regard to these species, particularly the eight orchid species, although potentially suitable habitat occurred in the survey area in the past, it is probable that the continued grazing of livestock in the area over many years would have resulted in the loss of these species had they occurred in the survey area. It is notable that none of them were found by Bennett during a previous survey 17 years ago BEC, (2004). The growth and flowering times also would have allowed them to have been found during the present survey.

5.2 Significance of the vegetation

One of the quadrats installed in the survey area within subunit A1 was grouped most closely with two FCTs (FCT20b, FCT21c). These are regarded as part of the Federally-listed Threatened ecological community ‘Banksia Woodlands of the Swan Coastal Plain’ (which is also a State-listed PEC). However, subunit A1, which is dominated by several Banksia species, is all in Degraded or Completely Degraded condition and is not considered an occurrence of the TEC or PEC. All of this subunit was rated as Degraded or Completely Degraded³ because of the low number of native understory species typical of that community and high cover of weed species. For the same reason, subunit A2 is not considered part of the ‘Banksia Woodlands of the Swan Coastal Plain’ TEC.

A survey of the same vegetation in 2004 mapped the vegetation comprising subunits A1 and A2 as Good to Degraded (Bennett 2004). A further 16 years of livestock grazing has reduced the condition of this vegetation to its present state of Degraded or Completely Degraded.

Vegetation subunit B1 resemble the ‘*Melaleuca preissiana* damplands’ (SWAFCT04) of Gibson et al. (1994). Quadrat KEYS04 (situated within unit B) appears to have been correctly placed in SWAFCT04 (*Melaleuca preissiana* damplands), which is not a Threatened or Priority ecological community and therefore subunit B1 is not a TEC or PEC.

³ There is a very small area of vegetation (circa 200 m²) around quadrat KEYS01 which was rated as Good condition, however this was too small to map.

Subunits C1 and C2 also resemble the ‘*Melaleuca preissiana* damplands’ (SWAFCT04) of Gibson et al. (1994). This floristic community type is not a TEC or PEC.

Four of the Keysbrook quadrats were grouped with SWAFCT06 (“Weed dominated wetlands on heavy soils”), which is not surprising given their high proportion of weeds. However, they differ from typical SWAFCT06 vegetation in that they are on sandy rather than “heavy” soils. It is likely that the vegetation (subunits C1 and C2) in which quadrats KEYS02 and KEYS05 were placed should properly be placed in SWAFCT04 because they are dominated by *M. preissiana* in the upper storey.

5.3 Wetland communities

Vegetation units B, C1 and C2 comprise wetland vegetation, though the latter two subunits contain a higher proportion of wetland-dependent vegetation. Whereas *Melaleuca preissiana* is one of the few wetland species in unit B, subunits C1 and C1 contain *M. preissiana* contain other such phreatophytic taxa⁴ as *Astartea scoparia*, *Kunzea recurva*, *Hypocalymma angustifolium* and *Lepidosperma longitudinale*.

While subunits C1, C2 and C3 particularly fit the definition of wetland vegetation because they have an important component of groundwater-dependent species, this wetland vegetation is mainly in Degraded or Completely Degraded condition.

5.3.1 Resource enhancement wetland

The RE wetland mapped across the survey comprises approximately 107.4 ha of the survey area and is in a mostly Cleared (100.2 ha) and Completely Degraded condition (5.12 ha). A small portion of 0.965 ha was rated in Good condition, with the balance (1.1ha) in Degraded condition.

Consideration may need to be given to down grading the Cleared and Completely Degraded portions of the RE management wetland to a Multiple Use Wetland as these areas of the wetland area would be regarded as scoring poorly on both natural and human use attributes.

5.4 Regional ecological linkages

The parcel of vegetation at north-east of the survey area has some limited ecological linkage values. This is due to its narrow connection with a 0.5 km wide block of vegetation which extends 1.4 km north to connect with vegetation associated with the Dirk Brook which runs generally east to west across the Pinjarra Plain in an otherwise predominantly cleared agricultural landscape.

These linkage values are limited due to the overall degraded condition of vegetation, its narrow point of connection (which only occurs in its north-east corner) and because the

⁴ Phreatophytic taxa are to varying degrees dependant for their survival on access to groundwater.

linkage 'ends' at the southern, eastern and western boundaries of the survey area with the onset of extensively cleared pasture.

The parcel in the north-west of the survey area is perceived to have very limited ecological linkage values due to separation from other parcels of vegetation by expanses of pasture.

There is no statutory basis for the protection of this vegetation as an ecological linkage. However, the importance of ecological linkages, in general, has been recognised as an environmental policy consideration in EPA and Planning policy (EPA, 2008 and references therein).

6 Conclusions

The Targeted and Reconnaissance survey was conducted on 27 October and 10 November 2020 and 18 August 2021 in accordance with the EPA (2016) Technical Guidance: Flora and Vegetation Surveys for Environmental Impact Assessment.

Ninety-eight (98) species of vascular flora were identified within the survey area, 32 (33%) of which are introduced species. No species of Threatened or Priority flora were found, nor were there any other flora taxa of conservation significance.

However, because the survey was carried out in late spring early flowering herbaceous species may have been missed. The post-survey residual-likelihood analysis found that 19 taxa were deemed to have a “Very Low” residual likelihood of occurring in the survey area. With regard to the eight orchid species in this group of 19 (including the threatened species *Drakaea elastica*), potentially suitable habitat occurred in the survey area in the past. However, it is probable that the continued grazing of livestock in the area over many years would have resulted in the loss of these species had they occurred in the survey area.

A small population of the Declared Pest Plant *Zantedeschia aethiopica* (Arum lily) was found in the north-east of the survey area.

Three vegetation units were identified within the survey area, with two of them being divided into subunits:

1. Jarrah-Banksia-Sheoak woodland, subunits A1 and A2
2. Jarrah-Marri open forest, subunits B1 and B2,
3. *Melaleuca preissiana* dampland, subunits C1, C2 and C3.

Most of the native vegetation was in Completely Degraded (65.8%) or Degraded (29%) condition. Because of this level of degradation, the Jarrah-Banksia-Sheoak woodland was not deemed an occurrence of either the Federally listed Threatened ecological community ‘Banksia Woodlands of the Swan Coastal Plain’ or State-listed PEC of the same name.

Two vegetation complexes are mapped for the survey area: the Bassendean Complex – Central and South (26.87%) and the Southern River Complex (18.53%). Both of these complexes are below the desired 30% pre-European retention target.

There are no CC wetlands within the boundary of the survey area. The nearest CC wetlands are located approximately 1.35 km N and W of the survey area.

An RE wetland in mostly Completely Degraded to Degraded condition is mapped across the eastern portion of the survey area. It may be reasonable to downgrade the Cleared and Completely Degraded portions of the RE management category to a MU wetland due to its overall Cleared and Completely Degraded condition.

The survey area vegetation has ecological linkage values as it is linked to a large block of vegetation that forms part of a networked corridor of vegetation associated with the Dirk Brook tributaries, part of the Serpentine River in an otherwise predominantly cleared agricultural landscape.

There are no ESAs within the survey area. There are two located approximately 1.35 km to the north and west of the survey area, both associated with CC wetlands.

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Appendix 1. Vegetation condition scale (EPA, 2016).

Appendix 2. Categories of State listed of Threatened and Priority ecological communities.

Appendix 3. Categories of Threatened Ecological Communities under the EPBC Act.

Appendix 4. Protected Matters Search Tool and NatureMap reports

Appendix 5. Categories of State-listed Threatened and Priority list flora (DBCA, 2019b).

Appendix 6. Categories of Threatened Species under the EPBC Act (DAWE 2020c).

Appendix 7. Likelihood of occurrence table for threatened and priority flora.

Appendix 8. Quadrat details, track files and relevés map.

Appendix 9. List of vascular flora found within survey area.

Appendix 10. Vegetation units within the survey area.

Appendix 1. Vegetation condition scale (EPA, 2016).

Vegetation Condition	South West and Interzone Botanical Provinces
Pristine	Pristine or nearly so, no obvious signs of disturbance or damage caused by human activities since European settlement.
Excellent	Vegetation structure intact, disturbance affecting individual species and weeds are non-aggressive species. Damage to trees caused by fire, the presence of non-aggressive weeds and occasional vehicle tracks.
Very Good	Vegetation structure altered, obvious signs of disturbance. 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. Disturbance to vegetation structure caused by very frequent fires, the presence of very aggressive weeds, 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. Disturbance to vegetation structure caused by very frequent fires, the presence of very aggressive weeds at high density, 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 and shrubs.

Appendix 2. Categories of State listed of Threatened and Priority ecological communities.

Conservation code	Category
(T) Threatened ecological community pursuant to Sect 27 of the <i>Biodiversity Conservation Act 2016</i> .	
T	<p>(T) CR – Critically endangered</p> <p>An ecological community that has been adequately surveyed and found to have been subject to a major contraction in area and/or that was originally of limited distribution and is facing severe modification or destruction throughout its range in the immediate future, or is already severely degraded throughout its range but capable of being substantially restored or rehabilitated.</p>
	<p>(T) EN - Endangered</p> <p>An ecological community that has been adequately surveyed and found to have been subject to a major contraction in area and/or was originally of limited distribution and is in danger of significant modification throughout its range or severe modification or destruction over most of its range in the near future.</p>
	<p>(T) VU - Vulnerable</p> <p>An ecological community that has been adequately surveyed and is found to be declining and/or has declined in distribution and/or condition and whose ultimate security has not yet been assured and/or a community that is still widespread but is believed likely to move into a category of higher threat in the near future if threatening processes continue or begin operating throughout its range.</p>
(P) Priority species – possible threatened communities.	
P1	<p>Poorly known communities</p> <p>Ecological communities that are known from very few occurrences with a very restricted distribution (generally ≤ 5 occurrences or a total area of ≤ 100ha). Occurrences are believed to be under threat either due to limited extent, or being on lands under immediate threat (e.g. within agricultural or pastoral lands, urban areas, active mineral leases) or for which current threats exist. May include communities with occurrences on protected lands. Communities may be included if they are comparatively well-known from one or more localities but do not meet adequacy of survey requirements, and/or are not well defined, and appear to be under immediate threat from known threatening processes across their range.</p>

Conservation code	Category
P2	<p>Poorly known communities</p> <p>Communities that are known from few occurrences with a restricted distribution (generally ≤ 10 occurrences or a total area of ≤ 200ha). At least some occurrences are not believed to be under immediate threat (within approximately 10 years) of destruction or degradation. Communities may be included if they are comparatively well known from one or more localities but do not meet adequacy of survey requirements, and/or are not well defined, and appear to be under threat from known threatening processes.</p>
P3	<p>Poorly known communities</p> <ul style="list-style-type: none"> a) 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: b) communities known from a few widespread occurrences, which are either large or with significant remaining areas of habitat in which other occurrences may occur, much of it not under imminent threat (within approximately 10 years), or; c) communities made up of large, and/or widespread occurrences, that may or may not be represented in the reserve system, but are under threat of modification across much of their range from processes such as grazing by domestic and/or feral stock, inappropriate fire regimes, clearing, hydrological change etc. <p>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.</p>
P4	<p>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.</p> <ul style="list-style-type: none"> a) Rare. Species that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection but could be if present circumstances change. These species are usually represented on conservation lands. b) Near Threatened. Species that are considered to have been adequately surveyed and that are close to qualifying for vulnerable but are not listed as Conservation Dependent. c) Species that have been removed from the list of threatened species during the past five years for reasons other than taxonomy.
P5	<p>Conservation dependent ecological communities</p> <p>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.</p>

Appendix 3. Categories of Threatened Ecological Communities under the EPBC Act.

Category	Definition
Critically endangered (CR)	If, at that time, an ecological community is facing an extremely high risk of extinction in the wild in the immediate future (indicative timeframe being the next 10 years).
Endangered (EN)	If, at that time, an ecological community is not critically endangered but is facing a very high risk of extinction in the wild in the near future (indicative timeframe being the next 20 years).
Vulnerable (V)	If, at that time, an ecological, community is not critically endangered or endangered but is facing a high risk of extinction in the wild in the medium-term future (indicative timeframe being the next 50 years).

Appendix 4. Protected Matters Search Tool and NatureMap reports.

Keysbrook NatureMap Species Report_10km_31032021

Created By Guest user on 30/03/2021

Kingdom Plantae
 Conservation Status Conservation Taxon (T, X, IA, S, P1-P5)
 Current Names Only Yes
 Core Datasets Only Yes
 Method 'By Circle'
 Centre 115° 55' 32" E, 32° 26' 33" S
 Buffer 10km
 Group By Family

Family	Species	Records
Apiaceae	1	1
Aponogetonaceae	1	1
Asparagaceae	1	2
Asteraceae	1	2
Boraginaceae	1	1
Celastraceae	1	1
Cyperaceae	1	21
Droseraceae	1	3
Ericaceae	1	1
Euphorbiaceae	1	1
Fabaceae	4	18
Haloragaceae	1	2
Hemerocallidaceae	1	4
Malvaceae	1	2
Myrtaceae	3	8
Orchidaceae	3	4
Proteaceae	6	111
Restionaceae	1	1
Rutaceae	2	11
Solanaceae	1	1
Stylidiaceae	1	3
Thymelaeaceae	1	1
TOTAL	35	200

Name ID	Species Name	Naturalised	Conservation Code	¹ Endemic To Query Area
Apiaceae				
1.	41801 <i>Eryngium pinnatifidum</i> subsp. <i>Palustre</i> (G.J. Keighery 13459)		P3	
Aponogetonaceae				
2.	141 <i>Aponogeton hexatepalus</i> (Stalked Water Ribbons)		P4	
Asparagaceae				
3.	1317 <i>Thysanotus anceps</i>		P3	
Asteraceae				
4.	8212 <i>Senecio leucoglossus</i>		P4	
Boraginaceae				
5.	6686 <i>Halgania corymbosa</i>		P3	
Celastraceae				
6.	43540 <i>Stackhousia</i> sp. <i>Red-blotched corolla</i> (A. Markey 911)		P3	
Cyperaceae				
7.	1033 <i>Tetragia australiensis</i>		T	
Droseraceae				
8.	3115 <i>Drosera occidentalis</i> (Western Sundew)		P4	
Ericaceae				
9.	48297 <i>Styphelia filifolia</i>		P3	
Euphorbiaceae				
10.	20666 <i>Stachystemon</i> sp. <i>Keysbrook</i> (R. Archer 17/11/99)		P1	
Fabaceae				

Name ID	Species Name	Naturalised	Conservation Code	¹ Endemic To Query Area
11.	3237 <i>Acacia benthamii</i>		P2	
12.	3373 <i>Acacia horridula</i>		P3	
13.	14129 <i>Acacia oncinophylla</i> subsp. <i>oncinophylla</i>		P3	
14.	14131 <i>Acacia oncinophylla</i> subsp. <i>patulifolia</i>		P4	
Haloragaceae				
15.	33638 <i>Meionectes tenuifolia</i>		P3	
Hemerocallidaceae				
16.	19272 <i>Johnsonia pubescens</i> subsp. <i>cygnorum</i>		P2	
Malvaceae				
17.	45081 <i>Lasiopetalum glutinosum</i> subsp. <i>glutinosum</i>		P3	
Myrtaceae				
18.	11333 <i>Calothamnus graniticus</i> subsp. <i>leptophyllus</i>		P4	
19.	14714 <i>Verticordia lindleyi</i> subsp. <i>lindleyi</i>		P4	
20.	12448 <i>Verticordia plumosa</i> var. <i>ananeotes</i>		T	
Orchidaceae				
21.	1596 <i>Caladenia huegelii</i> (<i>Grand Spider Orchid</i>)		T	
22.	13862 <i>Caladenia speciosa</i>		P4	
23.	1639 <i>Drakaea elastica</i> (<i>Glossy-leaved Hammer Orchid</i>)		T	
Proteaceae				
24.	29775 <i>Isopogon drummondii</i>		P3	
25.	16865 <i>Synaphea odocoileops</i>		P1	
26.	18590 <i>Synaphea</i> sp. <i>Fairbridge Farm (D. Papenfus 696)</i>		T	
27.	19055 <i>Synaphea</i> sp. <i>Pinjarra (R. Davis 6578)</i>		T	
28.	30751 <i>Synaphea</i> sp. <i>Pinjarra Plain (A.S. George 17182)</i>		T	
29.	28354 <i>Synaphea</i> sp. <i>Serpentine (G.R. Brand 103)</i>		T	
Restionaceae				
30.	1086 <i>Lepyrodia heleocharoides</i>		P3	
Rutaceae				
31.	11612 <i>Boronia capitata</i> subsp. <i>gracilis</i>		P3	
32.	4444 <i>Boronia tenuis</i> (<i>Blue Boronia</i>)		P4	
Solanaceae				
33.	6946 <i>Anthocercis gracilis</i> (<i>Slender Tailflower</i>)		T	
Stylidiaceae				
34.	7756 <i>Stylidium longitubum</i> (<i>Jumping Jacks</i>)		P4	
Thymelaeaceae				
35.	5260 <i>Pimelea rara</i> (<i>Summer Pimelea</i>)		P4	

Conservation Codes
T - Rare or likely to become extinct
X - Presumed extinct
IA - Protected under international agreement
S - Other specially protected fauna
1 - Priority 1
2 - Priority 2
3 - Priority 3
4 - Priority 4
5 - Priority 5

¹ For NatureMap's purposes, species flagged as endemic are those whose records are wholly contained within the search area. Note that only those records complying with the search criterion are included in the calculation. For example, if you limit records to those from a specific datasource, only records from that datasource are used to determine if a species is restricted to the query area.

EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected.

Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

Information is available about [Environment Assessments](#) and the EPBC Act including significance guidelines, forms and application process details.

Report created: 30/03/21 18:38:34

[Summary](#)

[Details](#)

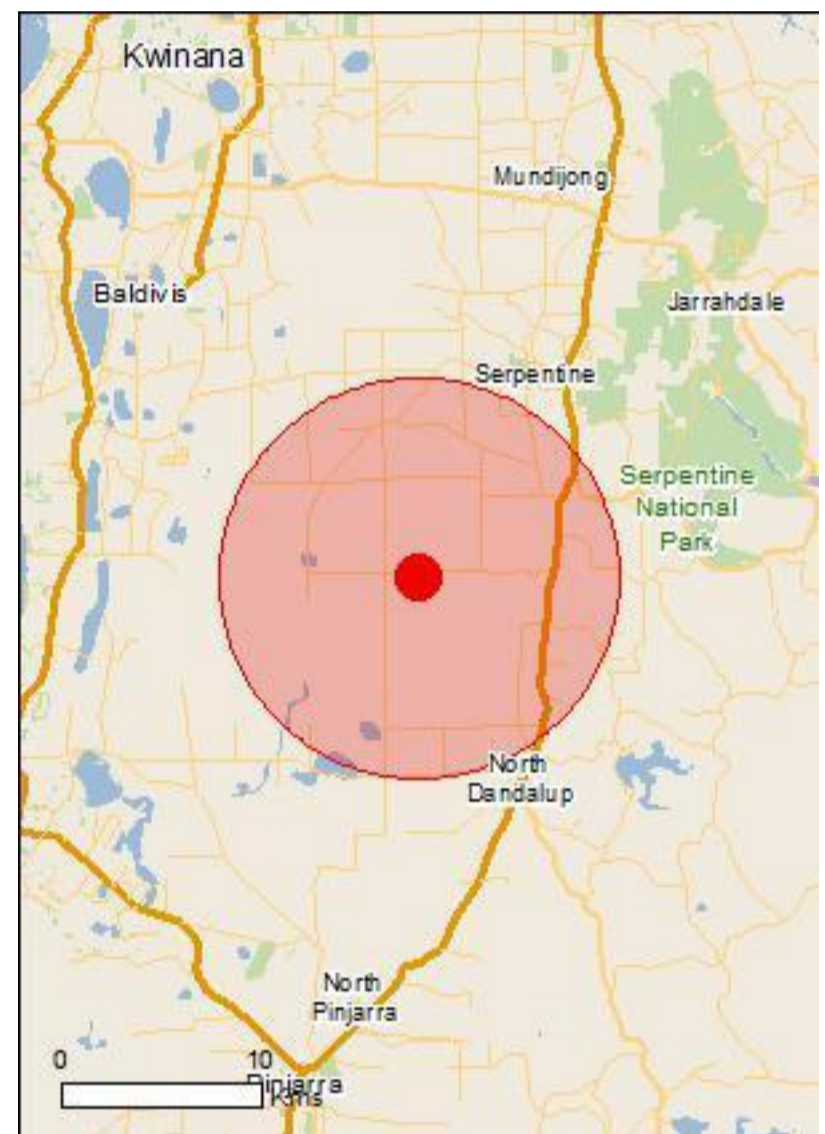
[Matters of NES](#)

[Other Matters Protected by the EPBC Act](#)

[Extra Information](#)

[Caveat](#)

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[Coordinates](#)

[Buffer: 10.0Km](#)



Summary

Matters of National Environmental Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the [Administrative Guidelines on Significance](#).

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance:	2
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	None
Listed Threatened Ecological Communities:	5
Listed Threatened Species:	34
Listed Migratory Species:	10

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at <http://www.environment.gov.au/heritage>

A [permit](#) may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Land:	1
Commonwealth Heritage Places:	None
Listed Marine Species:	16
Whales and Other Cetaceans:	None
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	None

Extra Information

This part of the report provides information that may also be relevant to the area you have nominated.

State and Territory Reserves:	6
Regional Forest Agreements:	1
Invasive Species:	39
Nationally Important Wetlands:	None
Key Ecological Features (Marine)	None

Details

Matters of National Environmental Significance

Wetlands of International Importance (Ramsar)

[\[Resource Information \]](#)

Name	Proximity
Becher point wetlands	Within 10km of Ramsar
Peel-yalgorup system	10 - 20km upstream

Listed Threatened Ecological Communities

[\[Resource Information \]](#)

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Name	Status	Type of Presence
Banksia Woodlands of the Swan Coastal Plain ecological community	Endangered	Community likely to occur within area
Clay Pans of the Swan Coastal Plain	Critically Endangered	Community likely to occur within area
Corymbia calophylla - Kingia australis woodlands on heavy soils of the Swan Coastal Plain	Endangered	Community known to occur within area
Corymbia calophylla - Xanthorrhoea preissii woodlands and shrublands of the Swan Coastal Plain	Endangered	Community known to occur within area
Tuart (Eucalyptus gomphocephala) Woodlands and Forests of the Swan Coastal Plain ecological community	Critically Endangered	Community likely to occur within area

Listed Threatened Species

[\[Resource Information \]](#)

Name	Status	Type of Presence
Birds		
Botaurus poiciloptilus Australasian Bittern [1001]	Endangered	Species or species habitat likely to occur within area
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat may occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat likely to occur within area
Calyptorhynchus banksii naso Forest Red-tailed Black-Cockatoo, Karrak [67034]	Vulnerable	Species or species habitat known to occur within area
Calyptorhynchus baudinii Baudin's Cockatoo, Long-billed Black-Cockatoo [769]	Endangered	Roosting known to occur within area
Calyptorhynchus latirostris Carnaby's Cockatoo, Short-billed Black-Cockatoo [59523]	Endangered	Species or species habitat known to occur within area
Falco hypoleucos Grey Falcon [929]	Vulnerable	Species or species habitat may occur within area
Leipoa ocellata Malleefowl [934]	Vulnerable	Species or species habitat likely to occur

Name	Status	Type of Presence within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat likely to occur within area
Rostratula australis Australian Painted Snipe [77037]	Endangered	Species or species habitat likely to occur within area
Sternula nereis nereis Australian Fairy Tern [82950]	Vulnerable	Species or species habitat may occur within area
Mammals		
Dasyurus geoffroii Chuditch, Western Quoll [330]	Vulnerable	Species or species habitat likely to occur within area
Pseudocheirus occidentalis Western Ringtail Possum, Ngwayir, Womp, Woder, Ngoor, Ngoolangit [25911]	Critically Endangered	Species or species habitat likely to occur within area
Setonix brachyurus Quokka [229]	Vulnerable	Species or species habitat known to occur within area
Other		
Westralunio carteri Carter's Freshwater Mussel, Freshwater Mussel [86266]	Vulnerable	Species or species habitat known to occur within area
Plants		
Andersonia gracilis Slender Andersonia [14470]	Endangered	Species or species habitat may occur within area
Anthocercis gracilis Slender Tailflower [11103]	Vulnerable	Species or species habitat likely to occur within area
Caladenia huegelii King Spider-orchid, Grand Spider-orchid, Rusty Spider-orchid [7309]	Endangered	Species or species habitat known to occur within area
Diuris drummondii Tall Donkey Orchid [4365]	Vulnerable	Species or species habitat likely to occur within area
Diuris micrantha Dwarf Bee-orchid [55082]	Vulnerable	Species or species habitat likely to occur within area
Diuris purdiei Purdie's Donkey-orchid [12950]	Endangered	Species or species habitat likely to occur within area
Drakaea elastica Glossy-leaved Hammer Orchid, Glossy-leaved Hammer Orchid, Warty Hammer Orchid [16753]	Endangered	Species or species habitat known to occur within area
Drakaea micrantha Dwarf Hammer-orchid [56755]	Vulnerable	Species or species habitat likely to occur within area
Eleocharis keigheryi Keighery's Eleocharis [64893]	Vulnerable	Species or species habitat may occur within area
Eucalyptus x balanites Cadda Road Mallee, Cadda Mallee [87816]	Endangered	Species or species habitat may occur within area

Name	Status	Type of Presence
Lasiopetalum pterocarpum Wing-fruited Lasiopetalum [64922]	Endangered	Species or species habitat likely to occur within area
Synaphea sp. Fairbridge Farm (D. Papenfus 696) Selena's Synaphea [82881]	Critically Endangered	Species or species habitat known to occur within area
Synaphea sp. Pinjarra (R. Davis 6578) Club-leafed Synaphea [82880]	Critically Endangered	Species or species habitat known to occur within area
Synaphea sp. Pinjarra Plain (A.S. George 17182) [86878]	Endangered	Species or species habitat known to occur within area
Synaphea sp. Serpentine (G.R. Brand 103) [86879]	Critically Endangered	Species or species habitat known to occur within area
Synaphea stenoloba Dwellingup Synaphea [66311]	Endangered	Species or species habitat likely to occur within area
Tetraria australiensis Southern Tetraria [10137]	Vulnerable	Species or species habitat likely to occur within area
Thelymitra stellata Star Sun-orchid [7060]	Endangered	Species or species habitat may occur within area
Verticordia plumosa var. ananeotes Tufted Plumed Featherflower [23871]	Endangered	Species or species habitat may occur within area

Listed Migratory Species [[Resource Information](#)]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Migratory Marine Birds		
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Migratory Terrestrial Species		
Motacilla cinerea Grey Wagtail [642]		Species or species habitat may occur within area
Migratory Wetlands Species		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat known to occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat likely to occur within area
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat may occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat likely to occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat likely to occur within area

Name	Threatened	Type of Presence
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat likely to occur within area
Pandion haliaetus Osprey [952]		Species or species habitat likely to occur within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat likely to occur within area

Other Matters Protected by the EPBC Act

Commonwealth Land [\[Resource Information \]](#)

The Commonwealth area listed below may indicate the presence of Commonwealth land in this vicinity. Due to the unreliability of the data source, all proposals should be checked as to whether it impacts on a Commonwealth area, before making a definitive decision. Contact the State or Territory government land department for further information.

Name
Commonwealth Land -

Listed Marine Species [\[Resource Information \]](#)

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Birds		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat known to occur within area
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardea alba Great Egret, White Egret [59541]		Breeding known to occur within area
Ardea ibis Cattle Egret [59542]		Species or species habitat may occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat likely to occur within area
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat may occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat likely to occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat likely to occur within area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat likely to occur within area

Name	Threatened	Type of Presence
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area
Motacilla cinerea Grey Wagtail [642]		Species or species habitat may occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat likely to occur within area
Pandion haliaetus Osprey [952]		Species or species habitat likely to occur within area
Rostratula benghalensis (sensu lato) Painted Snipe [889]	Endangered*	Species or species habitat likely to occur within area
Thinornis rubricollis Hooded Plover [59510]		Species or species habitat may occur within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat likely to occur within area

Extra Information

State and Territory Reserves	[Resource Information]
Name	State
Karnet	WA
Lambkin	WA
NTWA Bushland covenant (0077)	WA
NTWA Bushland covenant (0086)	WA
NTWA Bushland covenant (0089)	WA
North Dandalup	WA

Regional Forest Agreements [[Resource Information](#)]

Note that all areas with completed RFAs have been included.

Name	State
South West WA RFA	Western Australia

Invasive Species [[Resource Information](#)]

Weeds reported here are the 20 species of national significance (WoNS), along with other introduced plants that are considered by the States and Territories to pose a particularly significant threat to biodiversity. The following feral animals are reported: Goat, Red Fox, Cat, Rabbit, Pig, Water Buffalo and Cane Toad. Maps from Landscape Health Project, National Land and Water Resources Audit, 2001.

Name	Status	Type of Presence
Birds		
Acridotheres tristis Common Myna, Indian Myna [387]		Species or species habitat likely to occur within area
Anas platyrhynchos Mallard [974]		Species or species habitat likely to occur within area

Name	Status	Type of Presence
Carduelis carduelis European Goldfinch [403]		Species or species habitat likely to occur within area
Columba livia Rock Pigeon, Rock Dove, Domestic Pigeon [803]		Species or species habitat likely to occur within area
Passer domesticus House Sparrow [405]		Species or species habitat likely to occur within area
Passer montanus Eurasian Tree Sparrow [406]		Species or species habitat likely to occur within area
Streptopelia chinensis Spotted Turtle-Dove [780]		Species or species habitat likely to occur within area
Streptopelia senegalensis Laughing Turtle-dove, Laughing Dove [781]		Species or species habitat likely to occur within area
Sturnus vulgaris Common Starling [389]		Species or species habitat likely to occur within area
Turdus merula Common Blackbird, Eurasian Blackbird [596]		Species or species habitat likely to occur within area
Mammals		
Bos taurus Domestic Cattle [16]		Species or species habitat likely to occur within area
Canis lupus familiaris Domestic Dog [82654]		Species or species habitat likely to occur within area
Capra hircus Goat [2]		Species or species habitat likely to occur within area
Felis catus Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
Feral deer Feral deer species in Australia [85733]		Species or species habitat likely to occur within area
Funambulus pennantii Northern Palm Squirrel, Five-striped Palm Squirrel [129]		Species or species habitat likely to occur within area
Mus musculus House Mouse [120]		Species or species habitat likely to occur within area
Oryctolagus cuniculus Rabbit, European Rabbit [128]		Species or species habitat likely to occur within area
Rattus norvegicus Brown Rat, Norway Rat [83]		Species or species habitat likely to occur within area
Rattus rattus Black Rat, Ship Rat [84]		Species or species habitat likely to occur within area

Name	Status	Type of Presence
Sus scrofa Pig [6]		Species or species habitat likely to occur within area
Vulpes vulpes Red Fox, Fox [18]		Species or species habitat likely to occur within area
Plants		
Asparagus asparagoides Bridal Creeper, Bridal Veil Creeper, Smilax, Florist's Smilax, Smilax Asparagus [22473]		Species or species habitat likely to occur within area
Brachiaria mutica Para Grass [5879]		Species or species habitat may occur within area
Cenchrus ciliaris Buffel-grass, Black Buffel-grass [20213]		Species or species habitat may occur within area
Chrysanthemoides monilifera Bitou Bush, Boneseed [18983]		Species or species habitat may occur within area
Chrysanthemoides monilifera subsp. monilifera Boneseed [16905]		Species or species habitat likely to occur within area
Eichhornia crassipes Water Hyacinth, Water Orchid, Nile Lily [13466]		Species or species habitat likely to occur within area
Genista sp. X Genista monspessulana Broom [67538]		Species or species habitat may occur within area
Lantana camara Lantana, Common Lantana, Kamara Lantana, Large-leaf Lantana, Pink Flowered Lantana, Red Flowered Lantana, Red-Flowered Sage, White Sage, Wild Sage [10892]		Species or species habitat likely to occur within area
Lycium ferocissimum African Boxthorn, Boxthorn [19235]		Species or species habitat likely to occur within area
Olea europaea Olive, Common Olive [9160]		Species or species habitat may occur within area
Pinus radiata Radiata Pine Monterey Pine, Insignis Pine, Wilding Pine [20780]		Species or species habitat may occur within area
Rubus fruticosus aggregate Blackberry, European Blackberry [68406]		Species or species habitat likely to occur within area
Salix spp. except S.babylonica, S.x calodendron & S.x reichardtii Willows except Weeping Willow, Pussy Willow and Sterile Pussy Willow [68497]		Species or species habitat likely to occur within area
Salvinia molesta Salvinia, Giant Salvinia, Aquarium Watermoss, Kariba Weed [13665]		Species or species habitat likely to occur within area
Solanum elaeagnifolium Silver Nightshade, Silver-leaved Nightshade, White Horse Nettle, Silver-leaf Nightshade, Tomato Weed, White Nightshade, Bull-nettle, Prairie-berry, Satansbos, Silver-leaf Bitter-apple, Silverleaf-nettle, Trompillo [12323]		Species or species habitat likely to occur within area

Name	Status	Type of Presence
Tamarix aphylla Athel Pine, Athel Tree, Tamarisk, Athel Tamarisk, Athel Tamarix, Desert Tamarisk, Flowering Cypress, Salt Cedar [16018]		Species or species habitat likely to occur within area
Reptiles		
Hemidactylus frenatus Asian House Gecko [1708]		Species or species habitat likely to occur within area

Caveat

The information presented in this report has been provided by a range of data sources as acknowledged at the end of the report.

This report is designed to assist in identifying the locations of places which may be relevant in determining obligations under the Environment Protection and Biodiversity Conservation Act 1999. It holds mapped locations of World and National Heritage properties, Wetlands of International and National Importance, Commonwealth and State/Territory reserves, listed threatened, migratory and marine species and listed threatened ecological communities. Mapping of Commonwealth land is not complete at this stage. Maps have been collated from a range of sources at various resolutions.

Not all species listed under the EPBC Act have been mapped (see below) and therefore a report is a general guide only. Where available data supports mapping, the type of presence that can be determined from the data is indicated in general terms. People using this information in making a referral may need to consider the qualifications below and may need to seek and consider other information sources.

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Threatened, migratory and marine species distributions have been derived through a variety of methods. Where distributions are well known and if time permits, maps are derived using either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc) together with point locations and described habitat; or environmental modelling (MAXENT or BIOCLIM habitat modelling) using point locations and environmental data layers.

Where very little information is available for species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc). In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More reliable distribution mapping methods are used to update these distributions as time permits.

Only selected species covered by the following provisions of the EPBC Act have been mapped:

- migratory and
- marine

The following species and ecological communities have not been mapped and do not appear in reports produced from this database:

- threatened species listed as extinct or considered as vagrants
- some species and ecological communities that have only recently been listed
- some terrestrial species that overfly the Commonwealth marine area
- migratory species that are very widespread, vagrant, or only occur in small numbers

The following groups have been mapped, but may not cover the complete distribution of the species:

- non-threatened seabirds which have only been mapped for recorded breeding sites
- seals which have only been mapped for breeding sites near the Australian continent

Such breeding sites may be important for the protection of the Commonwealth Marine environment.

Coordinates

-32.4425 115.9256

Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

- [-Office of Environment and Heritage, New South Wales](#)
- [-Department of Environment and Primary Industries, Victoria](#)
- [-Department of Primary Industries, Parks, Water and Environment, Tasmania](#)
- [-Department of Environment, Water and Natural Resources, South Australia](#)
- [-Department of Land and Resource Management, Northern Territory](#)
- [-Department of Environmental and Heritage Protection, Queensland](#)
- [-Department of Parks and Wildlife, Western Australia](#)
- [-Environment and Planning Directorate, ACT](#)
- [-Birdlife Australia](#)
- [-Australian Bird and Bat Banding Scheme](#)
- [-Australian National Wildlife Collection](#)
- [-Natural history museums of Australia](#)
- [-Museum Victoria](#)
- [-Australian Museum](#)
- [-South Australian Museum](#)
- [-Queensland Museum](#)
- [-Online Zoological Collections of Australian Museums](#)
- [-Queensland Herbarium](#)
- [-National Herbarium of NSW](#)
- [-Royal Botanic Gardens and National Herbarium of Victoria](#)
- [-Tasmanian Herbarium](#)
- [-State Herbarium of South Australia](#)
- [-Northern Territory Herbarium](#)
- [-Western Australian Herbarium](#)
- [-Australian National Herbarium, Canberra](#)
- [-University of New England](#)
- [-Ocean Biogeographic Information System](#)
- [-Australian Government, Department of Defence Forestry Corporation, NSW](#)
- [-Geoscience Australia](#)
- [-CSIRO](#)
- [-Australian Tropical Herbarium, Cairns](#)
- [-eBird Australia](#)
- [-Australian Government – Australian Antarctic Data Centre](#)
- [-Museum and Art Gallery of the Northern Territory](#)
- [-Australian Government National Environmental Science Program](#)
- [-Australian Institute of Marine Science](#)
- [-Reef Life Survey Australia](#)
- [-American Museum of Natural History](#)
- [-Queen Victoria Museum and Art Gallery, Inveresk, Tasmania](#)
- [-Tasmanian Museum and Art Gallery, Hobart, Tasmania](#)
- [-Other groups and individuals](#)

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the [Contact Us](#) page.

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Appendix 5. Categories of Threatened Species under the EPBC Act (DAWE 2020c).

Conservation code	Category
(T) Threatened species pursuant to Sect 19 of the BC Act 2016.	
T	<p>(T) CR – Critically endangered</p> <p>Threatened species considered to be “<i>facing an extremely high risk of extinction in the wild in the immediate future, as determined in accordance with criteria set out in the ministerial guidelines</i>”.</p>
	<p>(T) EN - Endangered</p> <p>Threatened species considered to be “<i>facing a very high risk of extinction in the wild in the near future, as determined in accordance with criteria set out in the ministerial guidelines</i>”.</p>
	<p>(T) VU - Vulnerable</p> <p>Threatened species considered to be “<i>facing a high risk of extinction in the wild in the medium-term future, as determined in accordance with criteria set out in the ministerial guidelines</i>”.</p>
(P) Priority species – possible Threatened species.	
P1	<p>Species that are known from one or a few locations (generally five or less) which are potentially at risk. All occurrences are either: very small; or on lands not managed for conservation, e.g. agricultural or pastoral lands, urban areas, road and rail reserves, gravel reserves and active mineral leases; or otherwise under threat of habitat destruction or degradation. Species may be included if they are comparatively well known from one or more locations but do not meet adequacy of survey requirements and appear to be under immediate threat from known threatening processes. Such species are in urgent need of further survey.</p>
P2	<p>Species that are known from one or a few locations (generally five or less), some of which are on lands managed primarily for nature conservation, e.g. national parks, conservation parks, nature reserves and other lands with secure tenure being managed for conservation. Species may be included if they are comparatively well known from one or more locations but do not meet adequacy of survey requirements and appear to be under threat from known threatening processes. Such species are in urgent need of further survey.</p>

Conservation code	Category
P3	<p>Species that are known from several locations, and the species does not appear to be under imminent threat, or from few but widespread locations with either large population size or significant remaining areas of apparently suitable habitat, much of it not under imminent threat. Species may be included if they are comparatively well known from several locations but do not meet adequacy of survey requirements and known threatening processes exist that could affect them. Such species are in need of further survey.</p>
P4	<p>(a) Rare. Species that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection but could be if present circumstances change. These species are usually represented on conservation lands.</p> <p>(b) Near Threatened. Species that are considered to have been adequately surveyed and that are close to qualifying for vulnerable but are not listed as Conservation Dependent.</p> <p>(c) Species that have been removed from the list of threatened species during the past five years for reasons other than taxonomy.</p>

Appendix 6. Categories of Threatened Species under the EPBC Act (DAWE 2020c).

Category	Definition
Extinct (Ex)	A native species is eligible to be included in the <i>extinct</i> category at a particular time if, at that time, there is no reasonable doubt that the last member of the species has died.
Extinct in the Wild (ExW)	A native species is eligible to be included in the extinct in the wild category at a particular time if, at that time (a) it is known only to survive in cultivation, in captivity or as a naturalised population well outside its past range; or (b) it has not been recorded in its known and/or expected habitat, at appropriate seasons, anywhere in its past range, despite exhaustive surveys over a time frame appropriate to its life cycle and form.
Critically Endangered (CE)	A native species is eligible to be included in the critically endangered category at a particular time if, at that time, it is facing an extremely high risk of extinction in the wild in the immediate future, as determined in accordance with the prescribed criteria.
Endangered (EN)	A native species is eligible to be included in the endangered category at a particular time if, at that time (a) it is not critically endangered; and (b) it is facing a very high risk of extinction in the wild in the near future, as determined in accordance with the prescribed criteria.
Vulnerable (VU)	A native species is eligible to be included in the vulnerable category at a particular time if, at that time (a) it is not critically endangered or endangered; and (b) it is facing a high risk of extinction in the wild in the medium term future, as determined in accordance with the prescribed criteria.
Conservation Dependent (CD)	A native species is eligible to be included in the conservation dependent category at a particular time if, at that time, the species is the focus of a specific conservation program, the cessation of which would result in the species becoming vulnerable, endangered or critically endangered within a period of 5 years.

Appendix 7. Likelihood of occurrence table for threatened and priority flora.

Likelihood and post survey likelihood table for threatened and priority flora known to occur, or potentially occurring with 10 km of the survey area.(DBCA 2020c, DBCA 2020d, DAWE 2020b).

Species	Cons Status*	Flowering	Description and Habitat	**Likelihood	***Post-Survey Likelihood
<i>Synaphea</i> sp. Fairbridge Farm (D. Papenfus 696)	T (CR)	Oct	Dense, clumped shrub, to 0.3 m high, to 0.4 m wide. Fl. Yellow. Sandy with lateritic pebbles. Near winter-wet flats, in low woodland with weedy grasses.	Unlikely	Extremely Low
<i>Synaphea</i> sp. Serpentine	T (CR)	Sep-Oct	Shrublands and woodlands on loamy soils	Unlikely	Extremely Low
<i>Thelymitra stellata</i>	T (EN)	Oct to Nov.	Tuberous, perennial, herb, 0.15-0.25 m high. Fl. yellow & brown. Sand, gravel, lateritic loam.	Unlikely	Very Low
<i>Andersonia gracilis</i>	T (EN)	Sep-Nov	Slender erect or open straggly shrub, 0.1-0.5(-1) m high. Fl. white-pink-purple. White/grey sand, sandy clay, gravelly loam. Winter-wet areas, near swamps.	Possible	Extremely Low
<i>Caladenia huegelii</i>	T (EN)	Sep-Oct	Tuberous, perennial, herb, 0.25-0.6 m high. Fl. green, cream, red. Grey or brown sand, clay loam.	Possible	Very Low
<i>Diuris purdiei</i>	T (EN)	Sep-Oct	Tuberous, perennial, herb, 0.15-0.35 m high. Fl. yellow. Grey-black sand, moist. Winter-wet swamps. Found between Perth and Yarloop.	Possible	Very Low
<i>Drakaea elastica</i>	T (EN)	Oct-Nov	Tuberous, perennial, herb, 0.12-0.3 m high. Fl. red, green, yellow. White or grey sand. Low-lying situations adjoining winter-wet swamps.	Possible	Low
<i>Eucalyptus x balanites</i>	T (EN)	Oct to Dec or Jan to Feb	(Mallee), to 5 m high, bark rough, flaky. Fl. white. Sandy soils with lateritic gravel.	Unlikely	Extremely Low

Species	Cons Status*	Flowering	Description and Habitat	**Likelihood	***Post-Survey Likelihood
<i>Lasiopetalum pterocarpum</i>	T (EN)	Aug-Dec	Open, multi-stemmed shrub (with distinctly winged fruit), to 1.2 m high. Fl. pink. Dark red-brown loam or clayey sand over granite. On sloping banks near creeklines.	Unlikely	Extremely Low
<i>Synaphea</i> sp. Pinjarra Plain (A.S. George 17182)	T (EN)	Sep to Nov	Erect, clumped shrub (sub-shrub), to 0.8 m high. Fl. yellow. Grey sandy loam or clay, grey-brown clayey sand, brown clayey loam, laterite. Flats, seasonally wet areas, railroad reserves often with wet depressions or drains.	Unlikely	Extremely Low
<i>Synaphea stenoloba</i>	T (EN)	Aug-Oct	Caespitose shrub, 0.3–0.45 m high. Fl. Yellow. Sandy or sandy clay soils. Winter-wet flats, granite. Shrublands and woodlands on loamy soils.	Possible	Extremely Low
<i>Verticordia plumosa</i> var. <i>ananeotes</i>	T (EN)	Nov-Dec	Erect, sparsely branched shrub, 0.3-0.5 m high. Fl. pink-purple/white. Sandy loam. Seasonally inundated plains.	Unlikely	Very Low
<i>Tetraria australiensis</i>	T (VU)	Nov-Dec	Rhizomatous, tufted perennial, grass-like or herb (sedge), to 1 m high. Fl. brown. Sandy soils associated with heavy soils on the Pinjarra Plain.	Unlikely	Extremely Low
<i>Anthocercis gracilis</i>	T (VU)	Sep - Oct	Erect, spindly shrub, to 0.6(-1) m high. Fl. yellow-green. Sandy or loamy soils. Granite outcrops.	Unlikely	Extremely Low
<i>Diuris drummondii</i>	T (VU)	Nov-Jan	Tuberous, perennial, herb, 0.5-1.05 m high. Fl. yellow. Low-lying depressions, swamps.	Possible	Very Low
<i>Diuris micrantha</i>	T (VU)	Sep-Oct	Tuberous, perennial, herb, 0.3–0.6 m high. Fl. yellow, brown. Brown loamy clay. Winter-wet swamps, in shallow water.	Unlikely	Very Low
<i>Drakaea micrantha</i>	T (VU)	Sep-Oct	Tuberous, perennial, herb, 0.15–0.3 m high. Fl. red, yellow. White-grey sand.	Possible	Very Low
<i>Eleocharis keigheryi</i>	T (VU)	Aug-Nov	Rhizomatous, clumped perennial, grass-like or herb (sedge), to 0.4 m high. Fl. green. Clay, sandy loam. Emergent in freshwater: creeks, claypans	Unlikely	Extremely Low

Species	Cons Status*	Flowering	Description and Habitat	**Likelihood	***Post-Survey Likelihood
<i>Acacia lasiocarpa</i> var. <i>bracteolata</i> long peduncle variant (G.J. Keighery 5026)	P1	May or Aug	Shrub, 0.4-1.5 m high. Fl. yellow. Grey or black sand over clay. Swampy areas, winter wet lowlands.	Possible	Very Low
<i>Stachystemon exilis</i>	P1	Oct-Nov	Monoecious shrub/herb to 0.2 m high. Fl. Green yellow. Open, low-lying Banksia woodland in which <i>B. ilicifolia</i> is a significant component of the upper canopy. Other associated species are <i>Melaleuca preissiana</i> , <i>M. thymoides</i> , <i>Adenanthos meisneri</i> and <i>Hypocalymma angustifolium</i> .	Possible	Very Low
<i>Synaphea odocoileops</i>	P1	Aug-Oct	Tufted, compact shrub, 0.2–0.5 m high. Fl. yellow. Brown-orange loam & sandy clay, granite. Swamps, winter-wet areas.	Unlikely	Extremely Low
<i>Acacia benthamii</i>	P2	Aug-Sep	Shrub, ca 1 m high. Fl. Yellow. Sand. Typically on limestone breakaways.	Unlikely	Extremely Low
<i>Johnsonia pubescens</i> subsp. <i>cygnorum</i>	P2	Sep	Grey-white-yellow sands. Flats, seasonally-wet sites.	Possible	Very Low
<i>Acacia horridula</i>	P3	May-Aug	Harsh, slender, single-stemmed shrub, 0.3-0.6(-1) m high. Fl. yellow. Gravelly soils over granite, sand. Rocky hillsides.	Unlikely	Extremely Low
<i>Acacia oncinophylla</i> subsp. <i>oncinophylla</i>	P3	Aug-Oct	Shrub, 0.9-2.5 m high, 'minni-ritchi' bark, phyllodes mostly 8-13 cm long, 1-2 mm wide. Fl. yellow. Granitic soils.	Unlikely	Extremely Low
<i>Boronia capitata</i> subsp. <i>gracilis</i>	P3	Jun-Nov	Slender shrub, 0.3-0.6(-3) m high, branches pilose. Fl. pink. White/grey or black sand. Winter-wet swamps,	Possible	Very Low
<i>Eryngium pinnatifidum</i> subsp. <i>palustre</i>	P3	No info avail	No information available	Possible	Very Low
<i>Halgania corymbosa</i>	P3	Aug to Nov	Erect shrub, 0.35-1 m high. Fl. blue-purple. Gravelly soils, soils over granite.	Unlikely	Extremely Low

Species	Cons Status*	Flowering	Description and Habitat	**Likelihood	***Post-Survey Likelihood
<i>Lasiopetalum glutinosum</i> <i>subsp. glutinosum</i>	P3	Sep	Perennial erect open shrub, 0.4-0.6 m high. 0.6 m wide. Fl. pink. Open, low scrub over heath, on steep slopes of lateritic gravel, clay or sandy loam near granite outcrops and creeklines.	Unlikely	Extremely Low
<i>Meionectes tenuifolia</i>	P3	Nov	Suckering spreading decumbent shrub with cream-green flowers - red style. Height to ca 25 cm. Broadly distributed across the Swan Coastal Plain, northern and southern Jarrah forests associated with ephemeral wetlands.	Possible	Very Low
<i>Stackhousia</i> sp. <i>Red-blotched corolla</i> (A. Markey 911)	P3		No information available	Possible	Very Low
<i>Styphelia filifolia</i>	P3	Mar - May	Erect shrubs to 0.9 m high, 0.7 m wide, Fl white - Occurs sporadically from north of Eneabba to the Harvey area. Geraldton Sandplains and Swan Coastal Plain bioregions. Sandy soils of the coastal plain (with one known occurrence from the northern Darling Scarp), usually in Banksia or Jarrah woodland and in low-lying situations.	Possible	Very Low
<i>Thysanotus anceps</i>	P3	Oct - Dec	Rhizomatous, leafless perennial, herb, to 0.4 m high. Fl. purple. White or grey sand, lateritic gravel, laterite.	Unlikely	Extremely Low
<i>Aponogeton hexatepalus</i>	P4	Jul-Oct	Rhizomatous or cormous, aquatic perennial, herb, leaves floating. Fl. green, white. Mud. Freshwater: ponds, rivers, claypans.	Possible	Extremely Low
<i>Boronia tenuis</i>	P4	Aug-Nov	Procumbent or erect & slender shrub, 0.1–0.5 m high. Fl. blue, pink, white. Laterite, stony soils, granite.	Unlikely	Extremely Low
<i>Caladenia speciosa</i>	P4	Sep-Oct	Tuberous, perennial, herb, 0.35-0.6 m high. Fl. white, pink. White, grey or black sand.	Unlikely	Very Low
<i>Calothamnus graniticus</i> <i>subsp. leptophyllus</i>	P4	Jun-Aug	Erect, multi-stemmed shrub, 1-2 m high. Fl. red. Clay over granite, lateritic soils. Hillsides.	Unlikely	Extremely Low

Species	Cons Status*	Flowering	Description and Habitat	**Likelihood	***Post-Survey Likelihood
<i>Drosera occidentalis</i>	P4	Oct-Dec or Jan	Fibrous-rooted, rosetted perennial, herb, to 0.025 m high. Fl. pink/white. Peaty sand, margins of swamps, winter wet depressions and watersheds in open areas.	Possible	Very Low
<i>Pimelea rara</i>	P4	Dec or Jan	Shrub, 0.2-0.35 m high. Fl. white. Lateritic soils.	Unlikely	Extremely Low
<i>Senecio leucoglossus</i>	P4	Aug-Nov	Erect annual, herb, to 1.3 m high. Fl. white. Gravelly lateritic or granitic soils. Granite outcrops, slopes.	Unlikely	Extremely Low
<i>Stylidium longitubum</i>	P4	Oct-Dec	Erect annual (ephemeral), herb, 0.05-0.12 m high. Fl. Pink. Sandy clay, clay. Seasonal wetlands.	Possible	Extremely Low
<i>Verticordia lindleyi</i> subsp. <i>lindleyi</i>	P4	May or Nov-Dec or Jan	Erect shrub, 0.2-0.75 m high. Fl. pink. Sand, sandy clay. Winter-wet depressions.	Possible	Very Low

*Note: The BC Act Conservation Status is shown, EPBC Act status, where relevant, is in brackets.

**

Likely – Known to occur within one kilometre of the survey area with suitable habitat within the survey area.

Possible – Suitable habitat within the survey area.

Unlikely – No suitable habitat existing within the survey area.

Unknown – Data deficient.

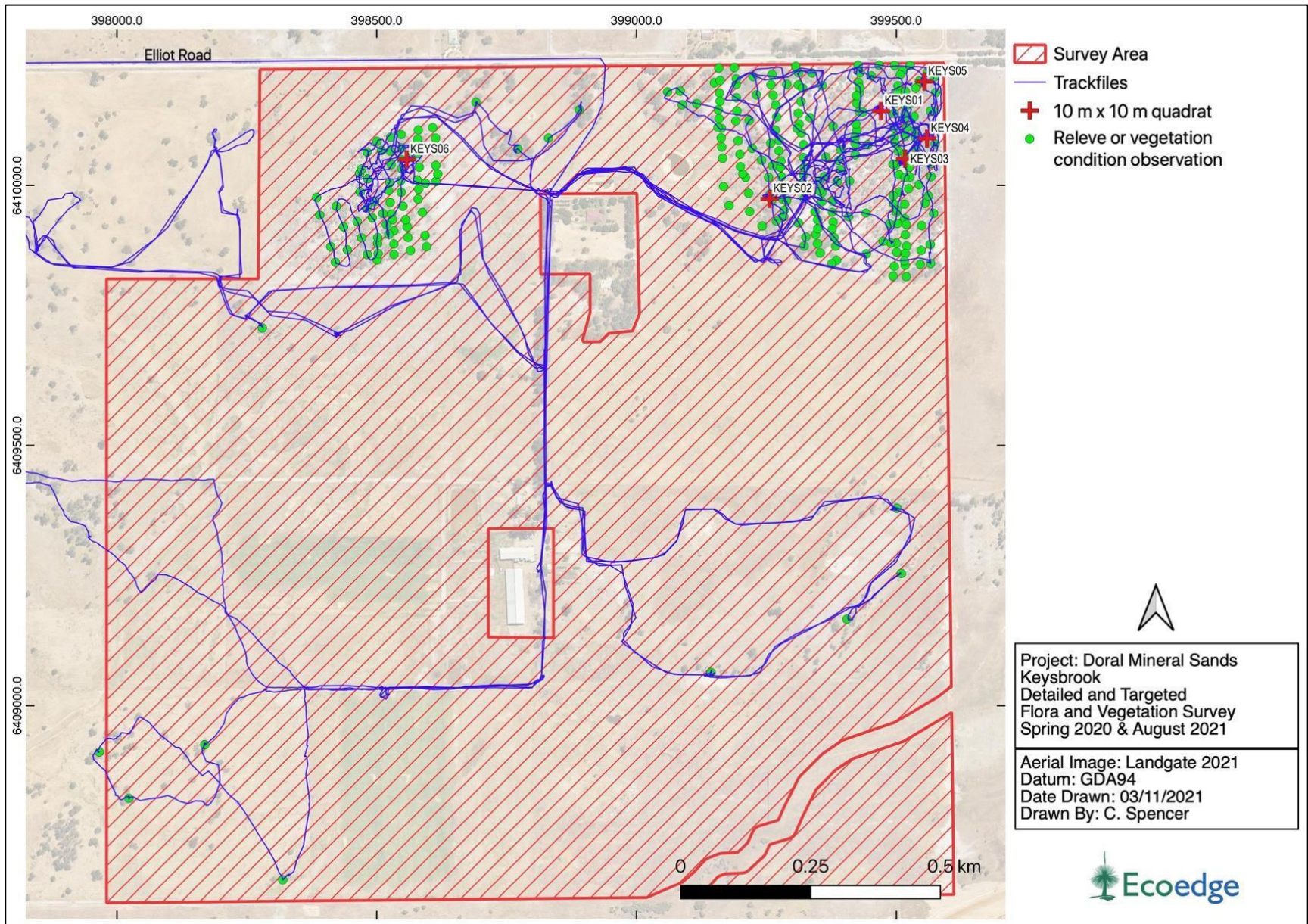
Moderate - The taxon was not observed, but suitable habitat was observed. The survey was conducted outside the recorded flowering season, and it is difficult to distinguish or see in the absence of flowers.

Low – The taxon was not observed, but suitable habitat was observed. The survey was conducted just outside the main flowering season, or the taxon can be cryptic and difficult to find.

Very Low - The taxon was not observed, but suitable habitat was observed. The survey was conducted within the main flowering season, or the taxon can easily be identified even in the absence of flowers.

Extremely Low - The taxon was not observed, and suitable habitat was not observed. The survey was conducted within the main flowering season, or the taxon can easily be identified even in the absence of flowers.

Appendix 8. Quadrat details, track files and relevés map





Quadrat: KEYS01	Date: 27/10/2020
Latitude: 6410051 N	Longitude: 399517 E
Soil: grey sand	Condition: Degraded

LATIN NAME	COVER
* <i>Arctotheca calendula</i>	1
<i>Banksia attenuata</i>	2
<i>Banksia menziesii</i>	4
* <i>Briza maxima</i>	3
<i>Dasypogon bromeliifolius</i>	1
<i>Drosera porrecta</i>	1
<i>Gompholobium tomentosum</i>	1
<i>Hovea trisperma</i>	1
* <i>Hypochaeris glabra</i>	3
<i>Lomandra hermaphrodita</i>	1
<i>Loxocarya cinerea</i>	2
<i>Lyginia barbata</i>	2
<i>Microlaena stipoides</i>	4
* <i>Ornithopus pinnatus</i>	1
<i>Patersonia occidentalis</i>	1
<i>Phyllangium paradoxum</i>	1
<i>Pyrorchis nigricans</i>	1
<i>Stylidium amoenum</i>	1
<i>Trachymene pilosa</i>	2
<i>Tricoryne elatior</i>	1
* <i>Ursinia anthemoides</i>	3
<i>Xanthorrhoea brunonis</i>	3



Quadrat: KEYS02	Date: 10/11/2020
Latitude: 6410090 N	Longitude: 399559 E
Soil: grey sand	Condition: Good

LATIN NAME	COVER
* <i>Briza maxima</i>	4
* <i>Briza minor</i>	3
<i>Corymbia calophylla</i>	1
* <i>Ehrharta calycina</i>	1
* <i>Ehrharta longiflora</i>	1
* <i>Hypochaeris glabra</i>	3
<i>Lepidosperma longitudinale</i>	5
* <i>Lolium multiflorum</i>	1
<i>Melaleuca preissiana</i>	4
* <i>Ornithopus pinnatus</i>	2
<i>Thelymitra</i> sp.	1
* <i>Ursinia anthemoides</i>	3
* <i>Vulpia bromoides</i>	2



Quadrat: KEYS03	Date: 10/11/2020
Latitude: 6410143 N	Longitude: 399470 E
Soil: grey sand	Condition: Degraded

LATIN NAME	COVER
* <i>Arctotheca calendula</i>	1
<i>Banksia attenuata</i>	2
<i>Banksia ilicifolia</i>	2
<i>Banksia menziesii</i>	4
* <i>Briza maxima</i>	3
* <i>Ehrharta calycina</i>	3
* <i>Hypochaeris glabra</i>	2
* <i>Hypochaeris radicata</i>	1
<i>Microlaena stipoides</i>	3
<i>Nuytsia floribunda</i>	2
* <i>Ursinia anthemoides</i>	3
* <i>Vicia</i> sp.	1
<i>Xanthorrhoea preissii</i>	2
<i>Xylomelum occidentale</i>	1



Quadrat: KEYS04	Date: 10/11/2020
Latitude: 6409974 N	Longitude: 399256 E
Soil: grey sand	Condition: Degraded

LATIN NAME	COVER
<i>Banksia nivea</i> subsp. <i>nivea</i>	1
* <i>Briza maxima</i>	3
* <i>Briza minor</i>	1
<i>Corymbia calophylla</i>	4
<i>Cyathochaeta avenacea</i>	3
<i>Dasypogon bromeliifolius</i>	2
<i>Desmocladius fasciculatus</i>	1
* <i>Eragrostis curvula</i>	1
<i>Eucalyptus marginata</i>	2
<i>Hovea trisperma</i>	1
<i>Hypocalymma angustifolium</i>	1
* <i>Hypochaeris glabra</i>	2
* <i>Hypochaeris radicata</i>	1
<i>Hypolaena exsulca</i>	1
<i>Kunzea recurva</i>	1
<i>Lomandra suaveolens</i>	1
<i>Melaleuca preissiana</i>	2
<i>Xanthorrhoea preissii</i>	2



Quadrat: KEYS05	Date: 10/11/2020
Latitude: 6410199 N	Longitude: 399554 E
Soil: grey sand	Condition: Good

LATIN NAME	COVER
* <i>Arctotheca calendula</i>	1
<i>Astartea scoparia</i>	4
* <i>Briza minor</i>	1
<i>Cyathochaeta avenacea</i>	3
* <i>Cynodon dactylon</i>	3
* <i>Eragrostis curvula</i>	2
* <i>Hypochaeris glabra</i>	3
<i>Kunzea recurva</i>	2
<i>Lepidosperma longitudinale</i>	1
<i>Leptocarpus coangustatus</i>	3
* <i>Lolium multiflorum</i>	1
<i>Melaleuca preissiana</i>	1
* <i>Ornithopus pinnatus</i>	2
* <i>Vulpia bromoides</i>	2



Quadrat: KEYS06	Date: 10/11/2020
Latitude: 6410050 N	Longitude: 398558 E
Soil: grey sand	Condition: Degraded

LATIN NAME	COVER
<i>Austrostipa flavescens</i>	1
<i>Banksia attenuata</i>	1
<i>Banksia ilicifolia</i>	4
<i>Desmocladius fasciculatus</i>	1
* <i>Disa bracteata</i>	1
* <i>Ehrharta calycina</i>	4
<i>Hypochaeris glabra</i>	3
<i>Isolepis cernua</i>	1
<i>Kunzea glabrescens</i>	3
* <i>Lolium multiflorum</i>	2
<i>Microlaena stipoides</i>	3
* <i>Rumex acetosella</i>	1
* <i>Trifolium incarnatum</i>	1
* <i>Ursinia anthemoides</i>	4
* <i>Vulpia bromoides</i>	1

Appendix 9. List of vascular flora found within the survey area.

No	FAMILY NAME	SPECIES NAME	NATURALISED	CONSV CODE
1	Anarthriaceae	<i>Lyginia barbata</i>		
2	Araceae	<i>Zantedeschia aethiopica</i>	*	
3	Araliaceae	<i>Trachymene pilosa</i>		
4	Asparagaceae	<i>Chamaescilla corymbosa</i>		
5	Asparagaceae	<i>Lomandra hermaphrodita</i>		
6	Asparagaceae	<i>Lomandra nigricans</i>		
7	Asparagaceae	<i>Lomandra suaveolens</i>		
8	Asparagaceae	<i>Thysanotus arbuscula</i>		
9	Asparagaceae	<i>Thysanotus multiflorus</i>		
10	Asteraceae	<i>Arctotheca calendula</i>	*	
11	Asteraceae	<i>Hypochaeris glabra</i>	*	
12	Asteraceae	<i>Hypochaeris radicata</i>	*	
13	Asteraceae	<i>Ursinia anthemoides</i>	*	
14	Brassicaceae	<i>Raphanus raphanistrum</i>	*	
15	Casuarinaceae	<i>Allocasuarina fraseriana</i>		
16	Colchicaceae	<i>Burchardia congesta</i>		
17	Crassulaceae	<i>Crassula natans</i>	*	
18	Cucurbitaceae	<i>Citrullus amarus</i>	*	
19	Cucurbitaceae	<i>Cucumis myriocarpus</i>	*	
20	Cyperaceae	<i>Cyathochaeta avenacea</i>		
21	Cyperaceae	<i>Isolepis cernua</i>		
22	Cyperaceae	<i>Lepidosperma longitudinale</i>		
23	Dasyogonaceae	<i>Dasyogon bromeliifolius</i>		
24	Dasyogonaceae	<i>Kingia australis</i>		
25	Droseraceae	<i>Drosera glanduligera</i>		
26	Droseraceae	<i>Drosera porrecta</i>		
27	Droseraceae	<i>Drosera erythrorhiza</i>		

No	FAMILY NAME	SPECIES NAME	NATURALISED	CONSV CODE
28	Fabaceae	<i>Acacia applanata</i>		
29	Fabaceae	<i>Acacia stenoptera</i>		
30	Fabaceae	<i>Daviesia incrassata</i>		
31	Fabaceae	<i>Euchilopsis linearis</i>		
32	Fabaceae	<i>Gastrolobium capitatum</i>		
33	Fabaceae	<i>Gompholobium tomentosum</i>		
34	Fabaceae	<i>Hovea trisperma</i>		
35	Fabaceae	<i>Jacksonia furcellata</i>		
36	Fabaceae	<i>Kennedia prostrata</i>		
37	Fabaceae	<i>Lotus subbiflorus</i>	*	
38	Fabaceae	<i>Lupinus angustifolius</i>	*	
39	Fabaceae	<i>Ornithopus pinnatus</i>	*	
40	Fabaceae	<i>Trifolium incarnatum</i>	*	
41	Fabaceae	<i>Trifolium repens</i>	*	
42	Goodeniaceae	<i>Dampiera linearis</i>		
43	Haemodoraceae	<i>Conostylis aculeata</i>		
44	Haemodoraceae	<i>Haemodorum spicatum</i>		
45	Hemerocallidaceae	<i>Tricoryne elatior</i>		
46	Iridaceae	<i>Patersonia occidentalis</i>		
47	Juncaceae	<i>Juncus gregiflorus</i>		
48	Lauraceae	<i>Cassytha racemosa</i>		
49	Loganiaceae	<i>Phyllangium paradoxum</i>		
50	Loranthaceae	<i>Nuytsia floribunda</i>		
51	Lythraceae	<i>Lythrum hyssopifolia</i>	*	
52	Malvaceae	<i>Malva parviflora</i>	*	
53	Myrtaceae	<i>Astartea affinis</i>		
54	Myrtaceae	<i>Corymbia calophylla</i>		

No	FAMILY NAME	SPECIES NAME	NATURALISED	CONSV CODE
55	Myrtaceae	<i>Eucalyptus marginata</i>		
56	Myrtaceae	<i>Hypocalymma angustifolium</i>		
57	Myrtaceae	<i>Kunzea glabrescens</i>		
58	Myrtaceae	<i>Melaleuca preissiana</i>		
59	Myrtaceae	<i>Pericalymma ellipticum</i>		
60	Myrtaceae	<i>Regelia ciliata</i>		
61	Orchidaceae	<i>Caladenia flava</i>		
62	Orchidaceae	<i>Disa bracteata</i>	*	
63	Orchidaceae	<i>Leporella fimbriata</i>		
64	Orchidaceae	<i>Microtis media</i>		
65	Orchidaceae	<i>Pyrorchis nigricans</i>		
66	Orobanchaceae	<i>Orobanche minor</i>	*	
67	Poaceae	<i>Amphipogon turbinatus</i>		
68	Poaceae	<i>Austrostipa flavescens</i>		
69	Poaceae	<i>Briza maxima</i>	*	
70	Poaceae	<i>Briza minor</i>	*	
71	Poaceae	<i>Cynodon dactylon</i>	*	
72	Poaceae	<i>Ehrharta calycina</i>	*	
73	Poaceae	<i>Ehrharta longiflora</i>	*	
74	Poaceae	<i>Eragrostis curvula</i>	*	
75	Poaceae	<i>Lolium multiflorum</i>	*	
76	Poaceae	<i>Lolium perenne</i>	*	
77	Poaceae	<i>Lolium rigidum</i>	*	
78	Poaceae	<i>Microlaena stipoides</i>		
79	Poaceae	<i>Vulpia bromoides</i>	*	
80	Polygalaceae	<i>Comesperma calymega</i>		
81	Polygonaceae	<i>Rumex acetosella</i>	*	

No	FAMILY NAME	SPECIES NAME	NATURALISED	CONSV CODE
82	Polygonaceae	<i>Rumex acetosella</i>	*	
83	Polygonaceae	<i>Rumex crispus</i>	*	
84	Proteaceae	<i>Banksia attenuata</i>		
85	Proteaceae	<i>Banksia grandis</i>		
86	Proteaceae	<i>Banksia ilicifolia</i>		
87	Proteaceae	<i>Banksia menziesii</i>		
88	Proteaceae	<i>Banksia nivea</i> subsp. <i>nivea</i>		
89	Proteaceae	<i>Xylomelum occidentale</i>		
90	Restionaceae	<i>Desmocladus fasciculatus</i>		
91	Restionaceae	<i>Hypolaena exsulca</i>		
92	Restionaceae	<i>Loxocarya cinerea</i>		
93	Restionaceae	<i>Meeboldina roycei</i>		
94	Rutaceae	<i>Boronia spathulata</i>		
95	Stylidiaceae	<i>Stylidium amoenum</i>		
96	Stylidiaceae	<i>Stylidium diversifolium</i>		
97	Xanthorrhoeaceae	<i>Xanthorrhoea brunonis</i>		
98	Xanthorrhoeaceae	<i>Xanthorrhoea preissii</i>		

Appendix 10. Vegetation units within the survey area.

Sub-unit A1



Sub-unit A1: Low woodland/open woodland of *Banksia attenuata*, *B. menziesii*, *B. ilicifolia*, *Nuytsia floribunda*, *Xylomelum occidentale* with isolated mid-height *Allocasuarina fraseriana* and *Eucalyptus marginata* trees over sparse mid-height shrubland of *Xanthorrhoea brunonis* (sometimes with patches of tall shrubland of *Kunzea glabrescens*) over grassland of *Austrostipa flavescens*, **Briza maxima*, *B. minor*, **Ehrharta calycina*, *Microlaena stipoides* and forbland of **Arctotheca calendula*, **Hypochaeris glabra* and **Ornithopus pinnatus* on grey sand. [In some places *B. attenuata* and *B. menziesii* are missing from this sub-unit] (Banksia woodlands of the Swan Coastal Plain TEC; FCT21a).

Sub-unit A2



Sub-unit A2: Mid-height open woodland of *Corymbia calophylla* and *Allocasuarina fraseriana* over open low woodland of *Banksia attenuata* and *Xylomelum occidentale* over grassland of **Briza maxima*, *B. minor*, **Ehrharta calycina*, *Microlaena stipoides* and forbland of **Arctotheca calendula*, **Hypochaeris glabra* and **Ornithopus pinnatus* on grey sand.

Unit B1



Unit B1: Mid-height open forest of *Corymbia calophylla* and *Eucalyptus marginata* over low open shrubland of *Banksia dallanneyi*, *Dasyopogon bromeliifolius* and *Xanthorrhoea brunonis* over sparse forbland of *Burchardia multiflora*, *Desmocladus fascicularis* and *Microtis media*, very open sedgeland of *Cyathochaeta avenacea* and open grassland of **Briza maxima* and **B. minor* on grey sand.

Unit B2



Unit B2: Mid-height open forest or woodland of *Corymbia calophylla* (occasionally with *Allocasuarina fraseriana* and *Xylomelum occidentale*) over pasture species including *Arctotheca calendula*, *Lolium* spp., *Lotus subbiflorus*, *Rumex* spp., *Trifolium repens* on grey loamy sand or sand.

Sub-unit C1



Sub-unit C1: Mid-height shrubland of *Astartea affinis*, *Regelia ciliata* and *Xanthorrhoea preissii*, with emergent mid-height *Corymbia calophylla* and *Melaleuca preissiana* low trees, over low open shrubland of *Boronia spathulata* and *Hypocalymma angustifolium*, over open sedgeland of *Cyathochaeta avenacea* and *Lepidosperma longitudinale*, forbland of **Arctotheca calendula*, **Hypochaeris glabra*, **Ornithopus pinnatus* and grassland of **Cynodon dactylon* and *Lolium multiflorum* on grey-brown loamy sand

Sub-unit C2



Sub-unit C2: Low woodland of *Melaleuca preissiana* with fringing mid-height *Corymbia calophylla* trees over sedgeland of *Lepidosperma longitudinale* over forbland of *Hypochaeris glabra*, *Lotus subbiflorus* and *Ursinia anthemoides* and grassland of *Briza maxima*, *B. minor*, *Ehrharta longiflora*, *Lolium multiflorum* on grey-brown sand. [The ground-layer of *L. longitudinale* is missing from most areas].

Sub-unit C3



Sub-unit C3: Low woodland to open woodland of *Melaleuca preissiana* over pasture species including *Arctotheca calendula*, *Lolium* spp., *Lotus subbiflorus*, *Rumex* spp., *Trifolium repens* on grey loamy sand or sandy clay-loam.

Planted amenity trees



APPENDIX 5B: FLORA AND VEGETATION SURVEY LOT 56, 57, 508, 201

Detailed, Reconnaissance and Targeted Flora and Vegetation Survey

Lot 507, 508, 201 Elliot Road and Part Lot 56 Wescott Road
Keysbrook, Western Australia



Prepared for Doral Mineral Sands
March 2022



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Version	Origin	Review	Review date	Release approval	Issue date
V1	C. Spencer	R. Smith			
V2	R. Smith	C. Spencer	18/03/22		
Final draft	D. Brace	R. Smith	28/3/2022	Ecoedge	29/3/2022
Final	Doral			Ecoedge	27/5/2022

Executive Summary

Ecoedge Environmental Services was engaged by Doral Mineral Sands to undertake a Detailed and Targeted Flora and Vegetation Survey in June 2021, over portions of Lot 507, 508, 201 Elliot Road and Part Lot 56 Wescott Road, Keysbrook, within the Shire of Serpentine-Jarrahdale.

The survey was required as part of the investigations into potential mining opportunities across the area.

The 530 hectare survey area occurs in a predominantly cleared agricultural landscape and comprised approximately 130 hectares of vegetation.

The surveys were undertaken on 9 and 20 August 2021 and 22 and 23 September 2021 and 25 March 2022, in accordance with the Environmental Protection Authority (2016) Technical Guidance: Flora and Vegetation Surveys for Environmental Impact Assessment.

One hundred and nineteen species of vascular flora were identified within the survey area, of which 25 (21%) were introduced taxa. None of the introduced species was a Declared Pest plant or Weed of National Significance.

No flora listed as Threatened under the *The Environment Protection and Biodiversity Conservation Act 1999* or the *Biodiversity Conservation Act 2016*, Priority-listed Flora or Flora of other significance, were found within the survey area.

Five vegetation units were identified and mapped in the survey area:

- EmCcBaBmOF is found on low sandy rises,
- CcEmAfOF is found on the transition between these rises and the surrounding loamy flats,
- CcEmXpOF and CcOF are found on loamy flats,
- Unit ErMrOW occurs along the creekline in the north-west part of the survey area.

Unit EmCcBaBmOF, on the basis of multivariate analysis of floristic quadrat data, was found to be similar to Floristic Community Types, FCT 21a and FCT 21c, which are both part of the of Banksia Woodlands of the Swan Coastal Plain Threatened Ecological Community. However, due to area and vegetation condition criteria constraints none of unit EmCcBaBmOF in the survey area can be recognised as an occurrence of the Threatened Ecological Community.

Units CcEmAfOF, CcEmXpOF and CcOF on the basis of multivariate analysis of floristic quadrat data were found to belong FCT 3c (*Corymbia calophylla – Xanthorrhoea preissii* woodlands and shrublands, Swan Coastal Plain ecological community) which has been listed Endangered under the *The Environment Protection and Biodiversity Conservation Act 1999* and Critically Endangered under the *Biodiversity Conservation Act 2016*. There is a total of 34.4 ha of this

Threatened Ecological Community in the survey area represented by the areas of these communities in Degraded or better condition.

Most of the native vegetation was in Degraded or Completely Degraded condition, only about 10% was in Good condition. Degradation of the vegetation has been caused by ongoing grazing and impacts of *Phytophthora dieback*.

Three vegetation complexes are mapped for the Survey Area: the Bassendean Complex – Central and South (26.87%), the Guilford Complex (5.09%) and Southern River Complex (18.53%). All of these complexes are below the desired 30% pre-European retention target.

There is only one of Beard's vegetation associations mapped within the survey area, association 968 'Medium woodland; marri & wandoo'. This association exceeds the 30% retention target at a statewide level, but is significantly below this level *at the* Interim Biogeographic Regionalisation for Australia (IBRA) region (6.62%), subregion (6.62%) and local government level (4.60%). The discrepancy between the statewide and other levels is due to a large area of this association in a mostly uncleared state within the Darling Plateau.

There are two Conservation Category wetlands and number of Resource Enhancement wetlands mapped across the survey, most of these have been cleared or in a Degraded to Completely Degraded Condition, including the Conservation Category wetlands.

The survey area vegetation has limited value as part of an ecological corridor. It occurs as a generally isolated parcel in a cleared agricultural context and is only loosely connected to other isolated parcels of vegetation via a scattered and generally narrow corridor of vegetation along the Dirk brook and its associated tributaries.

There are two Environmentally Sensitive Area within the survey area both of which are associated with Conservation Category wetlands.

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Statement of Limitations

Reliance on Data

In the preparation of this report, Ecoedge has relied on data, surveys, analyses, designs, plans and other information provided by the Client and other individuals and organisations, most of which are referred to in the report. Unless stated otherwise in the report, Ecoedge has not verified the accuracy or completeness of the data. To the extent that the statements, opinions, facts, information, conclusions and/or recommendations in the report are based in whole or in part on the data, those conclusions are contingent upon the accuracy and completeness of the data. Ecoedge will not be liable in relation to incorrect conclusions should any data, information or condition be incorrect or have been concealed, withheld, unavailable, misrepresented or otherwise not fully disclosed to Ecoedge.

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The report has been prepared for the benefit of the Client and no other party. Ecoedge assumes no responsibility and will not be liable to any other person or organisation for or in relation to any matter dealt with or conclusions expressed in the report or for any loss or damage suffered by any other person or organisation arising from matters dealt with or conclusions expressed in the report (including, without limitation, matters arising from any negligent act or omission of Ecoedge or for any loss or damage suffered by any other party relying on the matters dealt with or conclusions expressed in the report). Other parties should not rely upon the report or the accuracy or completeness of any conclusions and should make their own enquiries and obtain independent advice in relation to such matters.

1 Introduction

Ecoedge Environmental Services (Ecoedge) was engaged by Doral Mineral Sands (Doral) to undertake a Detailed and Targeted Flora and Vegetation Survey in June 2021 over portions of Lot 507, 508, 201 Elliot Road and Part Lot 56 Wescott Road, Keysbrook, within the Shire of Serpentine-Jarrahdale. The survey area comprises two separate areas and is located within an agricultural setting approximately 4.3 kilometres east of the Keysbrook townsite, within the Shire of Serpentine-Jarrahdale (**Figure 1** and **Figure 2**).

Doral is investigating mining opportunities for the site and required the survey to inform project planning and any environmental approvals that may be required as part of a future proposal.

The flora and vegetation survey was undertaken on 9 and 20 August, and the 22 and 23 September 2021 in accordance with the Environmental Protection Authority (EPA) (2016) Technical Guidance, Flora and Vegetation Surveys for Environmental Impact Assessment.

This report compiles findings of the survey.

1.1 Scope

1.1.1 Desktop assessment

Doral required a desktop assessment to be conducted prior to the field survey to identify relevant key features and constraints which were in or nearby the survey area, such as Threatened and Priority Flora, Threatened and Priority Ecological Communities (TEC and PECs), riparian vegetation, unusual soil/landscape systems, conservation estates, poorly represented vegetation associations and or vegetation complexes and Environmentally Sensitive Areas (ESA's). The desktop assessment area (study area) encompassed a ten-kilometre (km) buffer to the survey area.

1.1.2 Significant flora likelihood of occurrence

Prior to undertaking the survey, an assessment of the likelihood of occurrence of Threatened and Priority flora occurring within the survey area was undertaken. The rationale for determining the pre and post likelihood of occurrence is provided in **Appendix 1**.

1.1.3 Field survey

The field survey was required to ground-truth the desktop assessment findings and delineate all significant flora and vegetation components within the survey area, including TECs and PECs and Threatened and Priority flora. The focus of the targeted survey was the Threatened orchid *Drakea elastica* which has the potential to occur in the survey area.

The survey and report were required to be undertaken in accordance with the Environmental Protection Authority (EPA) Technical Guidance - Flora and Vegetation Surveys for Environmental Impact Assessment (EPA 2016) and meet requirements of other relevant State, and Commonwealth guidelines for threatened species and communities, such as approved conservation advice for *Environmental Protection and Biodiversity Act 1999* (EPBC Act) threatened species and communities.

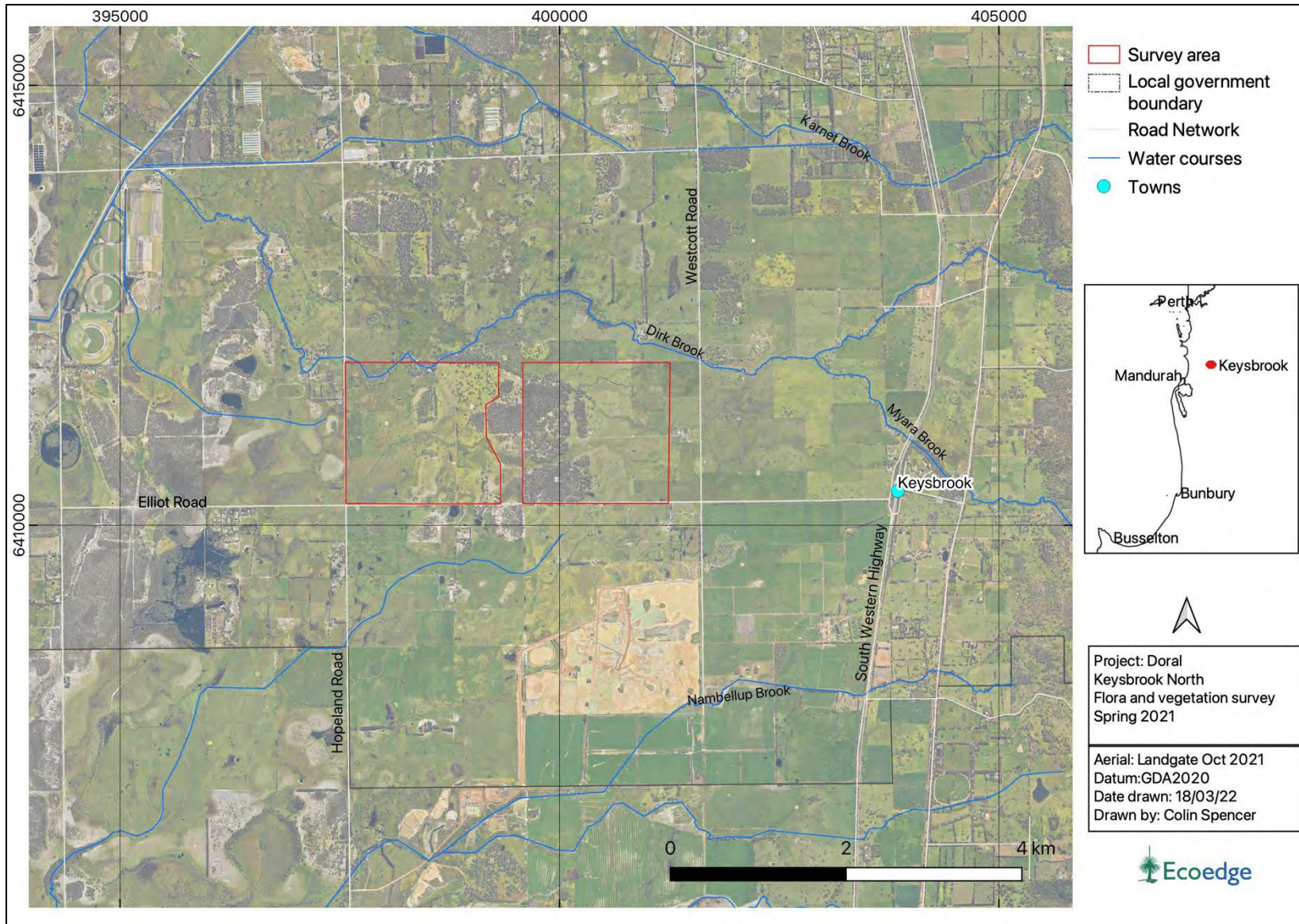


Figure 1. Aerial photograph showing the context of the survey area.

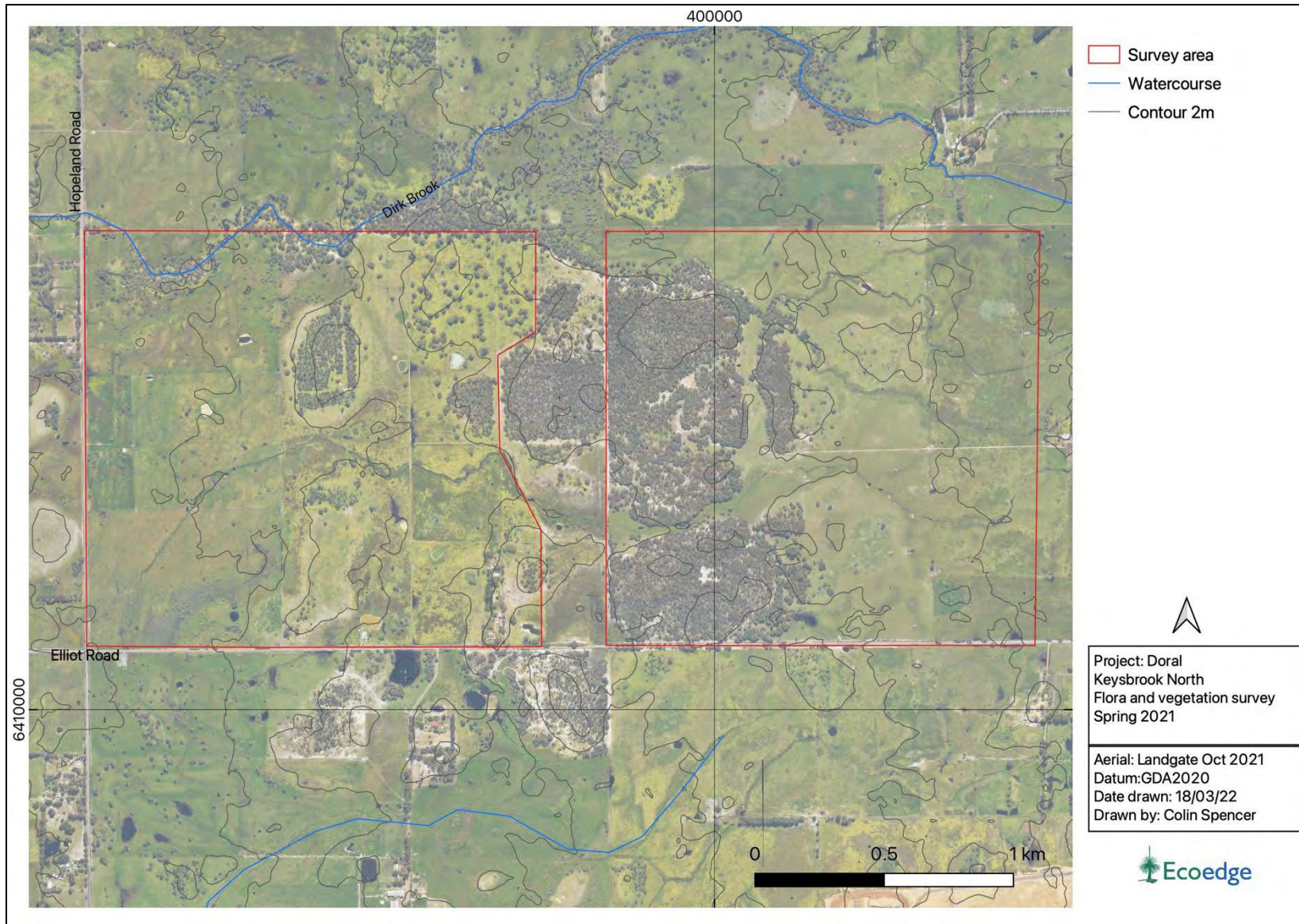


Figure 2. Aerial photograph of the survey area.

2 Methods

2.1 Desktop Assessment

Prior to the survey, a desktop study over a 10 km buffer area was undertaken to gather contextual information on the area to be surveyed. The information collated during the desktop study provided background information for the field survey and subsequent reporting and included:

- Regional geology and soil mapping (van Gool, 1990).
- Vegetation complex mapping of the South West Forest Region of Western Australia (Mattiske and Havel 1998) and the System 6 area (Heddle et al. 1980) as updated by Webb et al. (2016).
- Beard's Pre-European vegetation association mapping dataset (DPIRD-006) (Beard et al. 2013).
- WA Threatened and Priority Ecological Communities from the Department of Biodiversity, Conservation and Attractions (DBCA) database extracts (DBCA 2021a) and TEC and PEC listings (DBCA 2018a, DBCA 2021b).
- Federal Protected Matters Search Tool results (DAWE 2021).
- Threatened and Priority flora Naturemap search results (DBCA 2021c).
- Extract from the Department's Threatened Flora database and the Western Australian Herbarium database (DBCA 2020d).
- Geomorphic Wetlands, Swan Coastal Plain Data Set DBCA-019 (DBCA 2021e).
- Environmentally sensitive areas distribution maps and data (DWER 2020).
- Surface Hydrology Lines (National) (Crossman & Li 2015).
- Regional Ecological Linkages (Molloy et al. 2009).

Previous flora and vegetation surveys in proximity to the survey area:

1. Ecoedge (2021) Detailed, Reconnaissance and Targeted Flora and Vegetation Survey, Lot 64 Elliot Road Keysbrook, Western Australia.
2. Onshore Environmental (2019). Field Assessment of Keysbrook Leucosene Conservation Areas & Revegetation Considerations, prepared for Keysbrook Leucosene Pty Ltd.
3. MBS (2004) Vegetation and Fauna Assessment of Exploration Licence 70/2407 Keysbrook, Prepared for Olympia Resources Limited.
4. Bennett Environmental Consulting (BEC) (2004) Vegetation and Flora of Exploration Licence 70/2407 Keysbrook Western Australia, Prepared for MBS Environmental Pty Ltd.

2.2 Field Survey

The survey was carried out on 19 and 20 August 2021 and 22 and 23 September 2021 and 25 March 2022 by Russell Smith (flora permit FB61000473) and Colin Spencer (flora permit FB62000169) in accordance with the Environmental Protection Authority (EPA) Technical Guidance - Flora and Vegetation Surveys for Environmental Impact Assessment (EPA 2016). The earlier visit included a targeted survey for *Drakaea elastica* and *D. micrantha*.

A list of all vascular flora encountered during the survey was compiled, either in the field or from photographs and notes taken to enable later identification. Taxonomy and conservation status were checked against the latest WA Herbarium census download (DBCA 2021f).

Six 100 m² floristic quadrats were installed during the survey as per the requirements of EPA (2016). Three of these quadrats were placed in the *Eucalyptus marginata* (Jarrah)-*Banksia* woodland on low sandy ridges. The other three quadrats were placed in lower-lying vegetation dominated by *Corymbia calophylla* (Marri).

Plant communities were described using data collected at 165 relevés, 369 vegetation condition points and other vegetation information records, the six floristic quadrats, and mapped using this information and recent aerial photography.

Location of data collection points (vegetation condition assessment points and relevés) and survey track files was recorded.

Vegetation condition was assessed using the method of the EPA (2016). (**Appendix 2**).

2.3 Multivariate Analysis

The floristic quadrat data from the survey area was subjected to a multivariate analysis (MVA) using the software PATN (Belbin 2003) to determine the relationship of these quadrats to the floristic community types derived for the Swan Coastal Plain (Keighery et al. 2012).

The MVA used two-way classification (Agglomerative Hierarchical Fusion) of the presence/absence data for each quadrat. The flexible (unweighted pair group method with arithmetic mean (UPGMA) classification strategy was used ($\beta = -0.1$), together with the Bray-Curtis site similarity measure. The default settings for number of groups to be produced by the classification (i.e., the “cut-off level”) was accepted in each case. The primary output of the classification were dendrograms and a two-way table of taxa and quadrats.

Data from all relevant quadrats from the Southern Swan Coastal Plain (SCP) survey dataset (Keighery et al. 2012) was used in the initial MVA. In the reduced SCP dataset used for the MVA reported here, quadrats with assigned floristic community types (FCTs) that only occur north of Perth, or which occur on soils or landscapes not found in or near the survey area

were removed from the dataset.¹ For the quadrats from the Keighery *et al.* (2012) dataset, the assigned FCT code was affixed to the quadrat name to facilitate understanding the MVA outputs.

In total 1,452 taxa and 559 quadrats were used in the reduced SCP dataset comparison and 1,738 taxa and 1,102 quadrats were used in the full SCP dataset analysis. Output from the MVA is in the form of dendrograms and quadrat group/species group tables and quadrat group association scores.

2.4 Survey Limitations

Potential limitations with regard to the assessment are addressed in **Table 1**.

Table 1. Limitations of the field survey with regard to assessment adequacy and accuracy.

Aspect	Constraint	Comment
Scope	Negligible	The survey scope was prepared in consultation with the client and was designed to comply with EPA requirements.
Proportion of flora identified	Slight	The survey was carried out during the peak flowering season for the southern Swan Coastal Plain.
Climatic and seasonal effects	Minimal	Rainfall for the year till the end of September 2021 was 109% of average for the Serpentine weather station. ²
Availability of contextual information	Negligible	Comprehensive regional surveys of remnant vegetation, as well as more localised surveys, have been carried out on the southern Swan Coastal Plain.
Completeness of the survey	Negligible	The whole search area was covered on foot. Flowering was good.
Skill and knowledge of the botanists	Negligible	The senior field botanist conducting the survey has had extensive experience in botanical surveys in south-west Australia over a period of 25 years.
Disturbance (fire, grazing, clearing etc.)	Moderate	The survey area has historically been grazed by livestock, and it is ongoing.

¹ FCTs 1a, 15, 23a, 23b, 23c, 26a, 26b, 29a, 29b, 30a, 30b, 30c, 10b, 19, S01 to S20 were removed.

²

http://www.bom.gov.au/jsp/ncc/cdio/weatherData/av?p_nccObsCode=136&p_display_type=dailyDataFile&p_startYear=2021&p_c=-16348511&p_stn_num=009039

3 Desktop Assessment Results

3.1 Biogeographic region and location

The survey area is situated within the Swan Coastal Plain (SWA02) sub-region of the SCP biogeographic region, as defined in the Interim Biogeographical Regionalisation for Australia (IBRA) (Commonwealth of Australia 2016).

3.2 Landform and soils

The survey area occurs on the SCP, which is bounded by the Darling Scarp to the east, Indian Ocean to the west, Moore River to the north and Dunsborough to the south. The SCP is built up of two belts of sediments that differ in origin: aeolian sediments in the west and alluvial sediments in the east. The aeolian sediments comprise three major dune systems: The Bassendean Dune System (213BS) is the most easterly and oldest system; the Quindalup System (211Qu) is the most westerly and youngest system, with the Spearwood system (211Sp) located in between. These wind deposited dunes press up against the Pinjarra plain (213 PJ), which is built up of alluvium deposited by streams from the Darling Plateau. Its alluvial soils are predominantly clays and silts; in places, low dunes of aeolian sands from the west may overlay the alluvial soils (Seddon 1972).

According to van Gool's (1990) the survey area comprises of deep, pale grey, low relief Bassendean sand dunes including some shallowly incised ephemeral stream channels and poorly drained flats. The northern portion of the survey area occurs at the boundary of the Bassendean and Pinjarra plain system where the grey white siliceous sands of the Bassendean system meet the alluvial sediments of Dirk Brook (van Gool 1990). A breakdown of the soil units mapped for the survey area are shown in **Table 2** and shown in **Figure 3**.

Table 2. Soil mapping units occurring within the survey area (van Gool 1990).

System	Subsystem	Description
212 Bassendean	212BS_B1	Extremely low to very low relief dunes, undulating sandplain, and discrete sand rises with deep bleached grey sands, sometimes with a pale yellow B horizon or a weak iron-organic hardpan at depths generally greater than 2 m; banksia dominant.
	212Bs__B1a	Extremely low to very low relief dunes, undulating sandplain and discrete sand rises with deep bleached grey sands with an intensely coloured yellow B horizon occurring within 1 m of the surface; marri and jarrah dominant.
	212Bs__B2	Flat to very gently undulating sandplain with well to moderately well drained deep bleached grey sands with a pale yellow B horizon or a weak iron-organic hardpan 1-2 m.
	212Bs__B4	Broad poorly drained sandplain with deep grey siliceous sands or bleached sands, underlain at depths generally greater than 1.5 m by clay or less frequently a strong iron-organic hardpan.
	212Bs__B5	Shallowly incised stream channels of minor creeks and rivers with deep grey siliceous sands or bleached sands, underlain at depths generally greater than 1.5 m by clay or less frequently a strong iron-organic hardpan.
	212Bs__B6	Sandplain and broad extremely low rises with imperfectly drained deep or very deep grey siliceous sands.
213 Pinjarra	213Pj__P3	Flat to very gently undulating plain with deep, imperfect to poorly drained acidic gradational yellow or grey-brown earths and mottled yellow duplex soils, with loam to clay loam surface horizons.
	213Pj__P9	Shallowly incised stream channels of minor creeks and rivers with deep acidic mottled yellow duplex soils.
	213PjSWP6a	Very gently undulating alluvial terraces and low rises contiguous with the plain, with deep moderately well to well drained soils associated with major current river systems and larger streams. Acidic red and yellow duplex soils, less common.

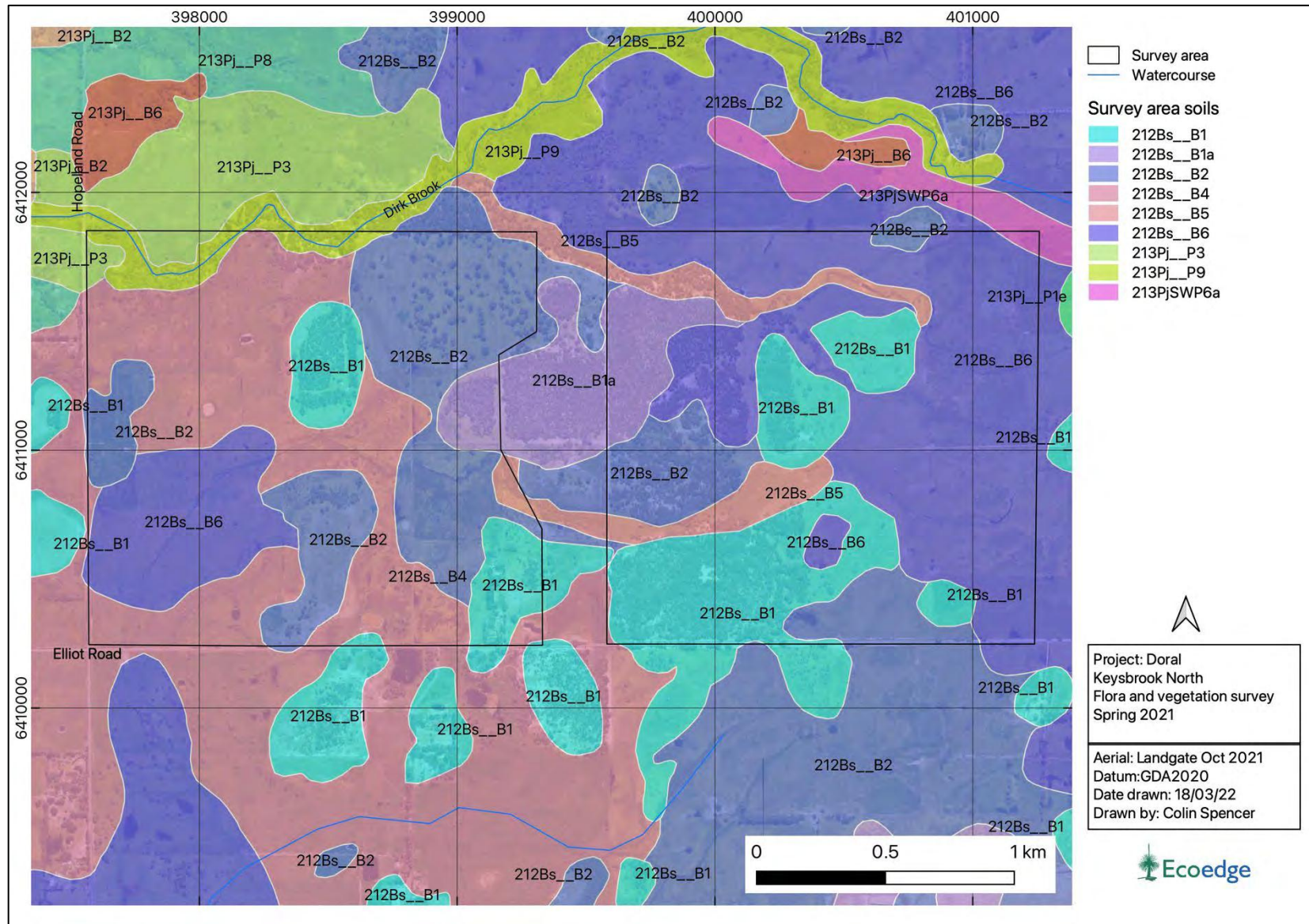


Figure 3. Soil units mapped in and nearby the survey area (van Gool 1990).

3.3 Vegetation description according to pre-European mapping datasets

3.3.1 Vegetation complexes

The comprehensive pre-1750 distribution of vegetation complexes³ across the south west of Western Australia is based on two main data sets, Heddle et al.'s 1980 1:250,000 scale vegetation complex mapping of the 'System 6' area comprising the greater Perth and Darling Range Region and Mattiske and Havel's 1998 1:50,000 scale mapping of forest vegetation covered by the Regional Forest Agreement 1999⁴ (Webb *et al.* 2016). Both data sets were prepared in order to inform the adequacy of biodiversity conservation through state managed reserves (EPA 1993, South West Regional Forest Agreement 1999). In 2016 these data sets were revised by DPaW (Webb et al. 2016) in order to fill data gaps and improve alignment and correlation between the data sets.

According to the vegetation complex mapping as updated by Webb et al. in 2016 three vegetation complexes, the Bassendean Complex – Central and South, the Guildford Complex and Southern River Complex are mapped across the survey area. These are described in **Table 3** and shown in **Figure 4**.

Table 3. Vegetation complexes mapped for the Survey Area (Webb et al. 2016).

Vegetation Complex	Description
Bassendean Complex – Central and South	Vegetation ranges from woodland of <i>Eucalyptus marginata</i> (Jarrah) - <i>Allocasuarina fraseriana</i> (Sheoak) - Banksia species to low woodland of Melaleuca species and sedge lands on the moister sites. This area includes the transition of <i>Eucalyptus marginata</i> (Jarrah) to <i>Eucalyptus todtiana</i> (Pricklybark) in the vicinity of Perth.
Guildford Complex	A mixture of open forest to tall open forest of <i>Corymbia calophylla</i> (Marri) - <i>Eucalyptus wandoo</i> (Wandoo) - <i>Eucalyptus marginata</i> (Jarrah) and woodland of <i>Eucalyptus wandoo</i> (Wandoo) (with rare occurrences of <i>Eucalyptus lane-poolei</i> (Salmon White Gum)). Minor components include <i>Eucalyptus rudis</i> (Flooded Gum) - <i>Melaleuca raphiophylla</i> (Swamp Paperbark).
Southern River Complex	Open woodland of <i>Corymbia</i> – (Marri) - <i>Eucalyptus marginata</i> – (Jarrah) - Banksia species with fringing woodland of <i>Eucalyptus rudis</i> (Flooded Gum) - <i>Melaleuca raphiophylla</i> (Swamp Paperbark) along creek beds.

³ Vegetation complex mapping is based on broadscale assessment of regional patterns of vegetation in relation to underlying landforms, soils and climatic trends.

⁴ Mattiske and Havel's (1998) mapping also included an assessment of an area of the very southern portion of the Swan Coastal Plain landform (Webb et al. 2016).

3.3.2 Vegetation associations

A systematic survey of native vegetation in Western Australia was undertaken by J. S. Beard (along with others) during the 1970s, which described vegetation systems in the southwest of Western Australia at a scale of 1:250,000. Beard's vegetation maps attempted to depict the vegetation as it might have been prior to European settlement in terms of type and extent (Beeston et al. 2001). The Beard Vegetation Association dataset, also referred to as the pre-European native vegetation extent dataset, was digitised by Shepherd et al. (2002).

Beard vegetation associations have been described to a minimum standard of Level 3 "Broad Floristic Formation" for the National Vegetation Inventory System (NVIS) (state-wide to regional scale)⁵ (NVIS 2017)

The survey area comprised only one Beard vegetation association: association 968 'Medium woodland; jarrah, marri & wandoo' shown in **Figure 4**.

⁵ Beard's vegetation mapping units are referred to as 'associations' however these do not correspond to the NVIS Level 5 'Associations'. The NVIS system was developed long after Beard's work was completed, and while both classification systems use the same term, NVIS 'Associations' describe vegetation in more detail than do Beard's.

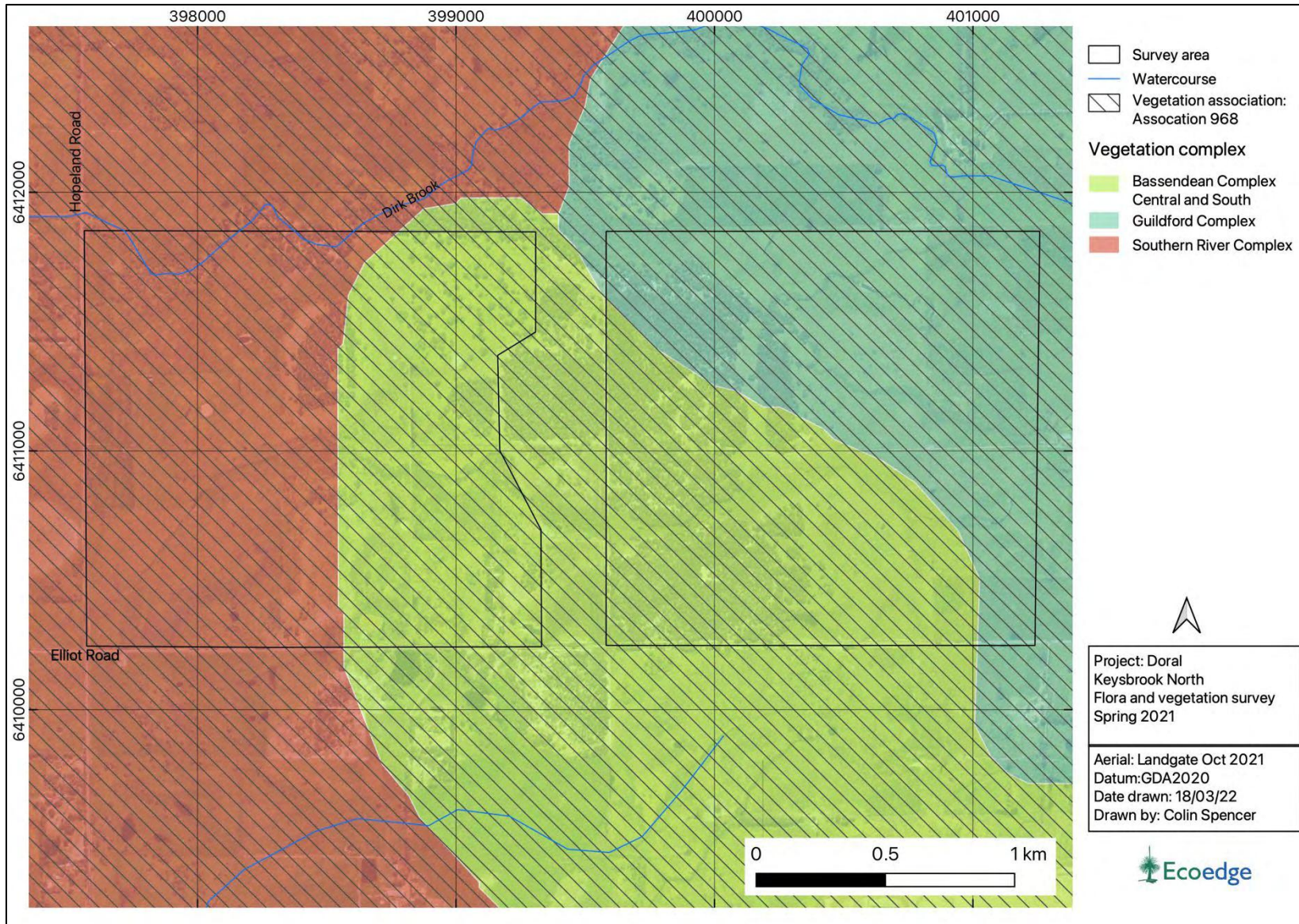


Figure 4. Vegetation complexes mapped in and nearby the survey area.

3.3.3 Assessment of remaining extent against pre-European extent

In 2001, the Commonwealth of Australia stated National Targets and Objectives for Biodiversity Conservation, which recognised that the retention of 30%, or more, of the pre-clearing extent of each ecological community was necessary if Australia's biological diversity was to be protected (Environment Australia 2001).

In its report on the Statewide Vegetation Statistics incorporating the Comprehensive, Adequate and Representative (CAR) Reserve Analysis, the Government of Western Australia (GoWA) provides information on the pre-European and current extent of the ecological communities of Western Australia and reports on the status of the CAR reserve system for WA (GoWA 2019a). This system is also based on the National retention targets of 30% overall. Only reserves managed by DBCA under the *Conservation and Land Management Act 1984* are considered for inclusion in the "CAR Reserve Analysis". In Western Australia these statistics have been based on Beard's vegetation associations and Webb et al.'s (2016) updated vegetation complexes.

The percentage remaining of the pre-European extent vegetation for the three complexes and one association described for the survey area are presented in **Table 4** and **Table 5** respectively. The percentage of current extent in DBCA managed land is also provided for vegetation associations at all levels, but this statistic is only provided at a state level for vegetation complexes. The red, orange and yellow shading in the tables indicates the status of the Commonwealth 30% retention target.

Status of the commonwealth retention target	>30%	<30%	<10%
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The extent remaining for all the complexes is below the 30% statewide retention target, but this is especially so for the Guildford complex which is below 10%. Beard's vegetation association 968 exceeds the 30% level at the state level but is less than 10% at the IBRA region and IBRA subregion levels.

Table 4. Vegetation complexes mapped within the survey area with regard to the Commonwealth retention targets (GoWA 2019b).

Region	Pre-European (ha)	Current Extent (ha)	% Remaining	*% Remaining in DBCA managed land
Bassendean Complex - Central and South				
Swan Coastal Plain	87,476.25	23,508.66	26.87	5.0
Shire of Serpentine-Jarrahdale	9,852.42	3,166.25	32.14	-
Guildford Complex				
Swan Coastal Plain	90,513.13	4,607.91	5.09	0.32
Shire of Serpentine-Jarrahdale	12,986.67	552.25	4.25	-
Southern River Complex				

Region	Pre-European (ha)	Current Extent (ha)	% Remaining	*% Remaining in DBCA managed land
Swan Coastal Plain	58,781.48	10,832.18	18.43	1.60
Shire of Serpentine-Jarrahdale	7,653.19	674.36	8.81	-

* Excludes Crown Freehold Department Interest Lands that are managed under Section 8(a) of the CALM Act.

Table 5. The vegetation association within the survey area with regards to the Commonwealth retention targets (GoWA 2019a).

Region	Pre-European (ha)	Current Extent (ha)	% Remaining	% remaining in DBCA Managed Land*
Association 968				
State-wide	296,877.84	95,048.82	32.02	18.45
IBRA region: Swan Coastal Plain (SWA)	136,188.20	9,017.32	6.62	1.43
IBRA sub-region Perth (SWA02)	136,188.20	9,017.32	6.62	1.43
Shire of Serpentine-Jarrahdale	24,351.49	1,121.13	4.60	0.57

* Excludes Crown Freehold Department Interest Lands that are managed under Section 8(a) of the CALM Act.

3.4 Threatened and Priority Ecological Communities

Ecological communities are defined by Western Australia's DBCA (previously DPaW and the Department of Environment and Conservation (DEC)) as "...naturally occurring biological assemblages that occur in a particular type of habitat. They are the sum of species within an ecosystem and, as a whole, they provide many of the processes which support specific ecosystems and provide ecological services." (DEC 2013).

Under Section 27 of the *Biodiversity Conservation Act 2016* (BC Act), the Western Australian Minister for Environment may list communities considered to be under significant threat as a Threatened ecological community (TEC). These TECs can be listed under one of three conservation categories: Critically Endangered (CR), Endangered (EN), Vulnerable (VU). The BC Act also provides for listing communities as collapsed ecological communities.

Possible TECs that do not meet survey criteria are added to the DBCA's Priority ecological community lists under Priorities 1, 2 or 3 (referred to as P1, P2, P3). Ecological communities that are adequately known, 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 (P4). These ecological communities require regular monitoring. Conservation Dependent ecological communities are placed in Priority 5 (P5) (DEC 2013).

The current listing of Threatened and Priority ecological communities is specified in DBCA (2018a, 2021b). The conservation categories for these Threatened and Priority ecological communities are defined in **Appendix 3**.

TECs can also be listed under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). There are three categories of TEC under the EPBC Act: Critically Endangered (CR), Endangered (EN) and Vulnerable (VU) (Department of Agriculture, Water and the Environment) (DAWE 2020a). These are defined in **Appendix 4**.

The desktop assessment found nine EPBC Act listed TECs and six BC Act listed TECs occurring within ten km of the survey area, based on results generated from an extract from the DBCA databases (DBCA 2021a) and a 10 km radius Protected Matters Search Tool (PMST) query (DAWE 2021). Four PECs were recorded in the search area. These communities are listed in **Table 6**.

Of these communities, only the Banksia Woodlands of the Swan Coastal Plain TEC PEC was predicted⁶ over the survey area **Figure 5** (DBCA 2021a).

Copies of the NatureMap and PMST data searches are provided in **Appendix 5**.

⁶ The Banksia woodland mapping is based on the predicted likely occurrence of the community (DoEE 2016).

Table 6. Threatened and Priority ecological communities occurring and possibly within 10 km of the Survey Area (DBCA 2021a, DAWE 20201).

Community Name	Status (WA)	Status (EPBC Act)
Claypans of the Swan Coastal Plain – comprising of four state-listed ecological communities, three of which were identified in the study area. <ul style="list-style-type: none"> Herb rich saline shrublands in clay pans (SCP07) – Vulnerable Herb rich shrublands in clay pans (SCP08) – Vulnerable Shrublands on dry clay flats. (SCP10a) – Endangered. 	VU VU EN	CR
<i>Corymbia calophylla</i> - <i>Kingia australis</i> woodlands on heavy soils of the Swan Coastal Plain (SCP 3a)	CR	EN
<i>Corymbia calophylla</i> - <i>Xanthorrhoea preissii</i> woodlands and shrublands of the Swan Coastal Plain (SCP 3c)	CR	EN
Tuart (<i>Eucalyptus gomphocephala</i>) Woodlands and Forests of the Swan Coastal Plain ecological community	P3	CR
‘Banksia Woodlands of the Swan Coastal Plain’ – a federally listed TEC consisting of numerous State-listed communities.	P3	EN
<i>Low lying Banksia attenuata</i> woodlands or shrublands (SCP21c)	P3	EN
<i>Banksia attenuata</i> and/or <i>Eucalyptus marginata</i> woodlands of the eastern side of the Swan Coastal Plain (SCP 20b)	P3	EN
Forests and woodlands of deep seasonal wetlands of the Swan Coastal Plain (SCP15)	VU	-

Note: This table only includes formally recognised TECs that are known of and mapped, and included in the DBCA’s database.

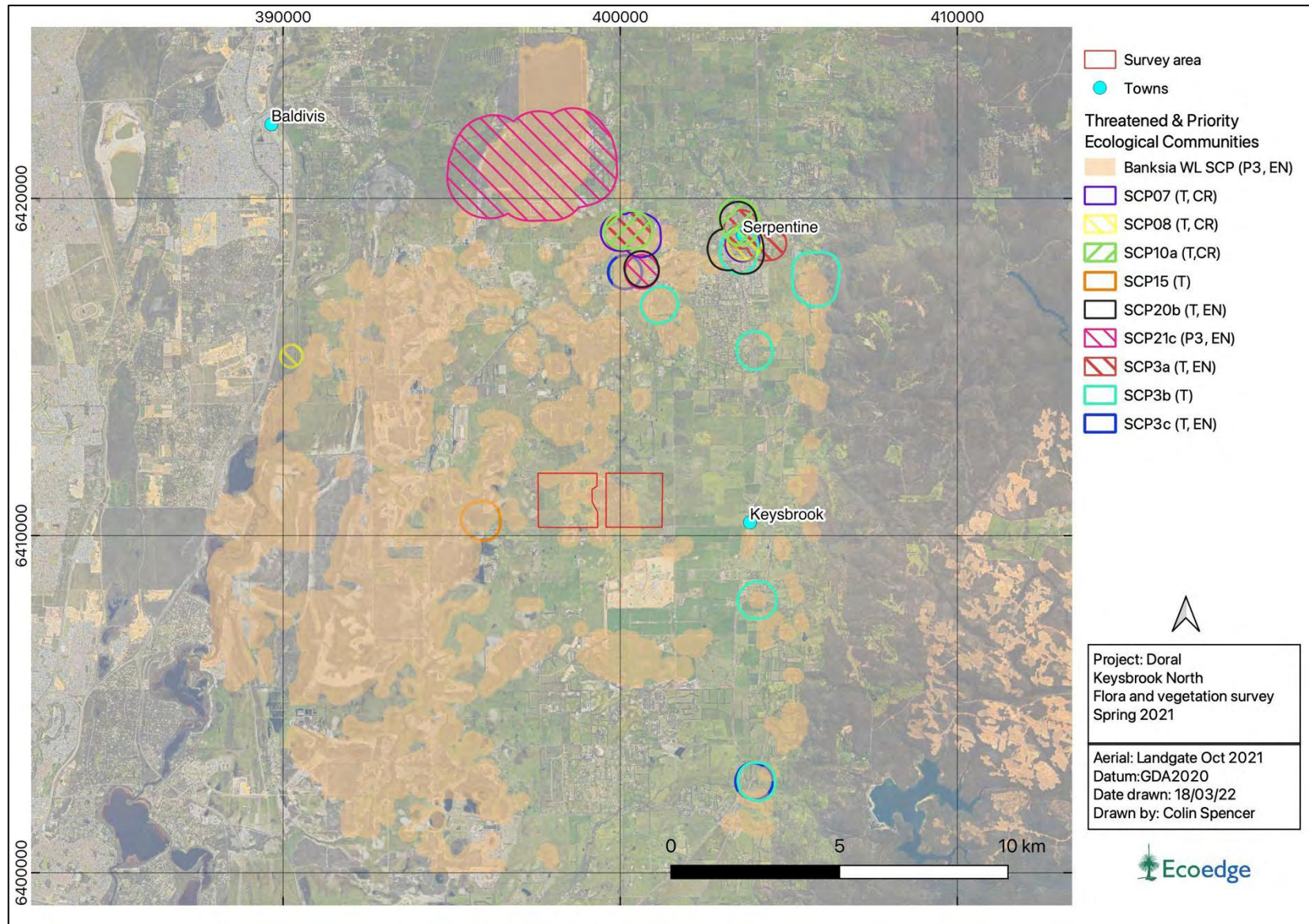


Figure 5. Location of TECs and PECs within a 10 km radius of the survey area (DBCA 2021a).

3.5 Threatened and Priority Flora

Species of flora and fauna are defined as having a Threatened or Priority conservation status where their extant populations are restricted geographically and/or under threat of possible extinction. The DBCA recognises these threats and consequently applies regulations towards population and species protection.

Threatened extant flora species are listed under Section 19 of the BC Act. They are ranked according to their level of threat using the International Union for Conservation of Nature (IUCN) Red List categories and criteria of Critically Endangered (CR), Endangered (EN), Vulnerable (VU). It is an offence to “take” or damage Threatened flora without Ministerial approval. Section 5 of the Act defines “to take” as “... to gather, pluck, cut, pull up, destroy, dig up, remove, harvest or damage flora by any means”.

Priority flora is under consideration for future declaration as “Threatened flora”, dependent on more information. Species classified as Priority One to Three (referred to as P1, P2 and P3) require further survey to determine their status. Priority Four (P4) species are adequately known rare or Threatened species that require regular monitoring.

Threatened flora lists are formally reviewed annually, whilst the Priority flora list is subject to a less formal ongoing review. The current listing of Threatened and Priority flora was updated on the 5th December 2018 (DBCA 2018b).

Categories of Threatened and Priority flora as defined by the BC Act are presented in **Appendix 6** (DBCA 2019).

Threatened flora may also be protected under the Commonwealth EPBC Act and be listed in one of six categories; the definitions of these categories are summarised in **Appendix 7** (DAWE 2020b).

Threatened or Priority flora occurring within 10 km of the survey area generated from a NatureMap search (DBCA 2021c) and a Protected Matters Search Tool query (DAWE 2021). DBCA and WA Herbarium Threatened and Priority flora data downloads (DBCA 2021d) are provided in **Appendix 5**.

Forty five significant species were identified within this search area. Of these, twenty species were considered possible to occur within the survey area and twenty five unlikely to occur. There were no species regarded as Likely to occur within the survey area and there were ⁷no species recorded within the survey area (DBCA 2021d). The DBCA mapped occurrences of these significant flora within the study area are shown in **Figure 6** (DBCA 2021d).

⁷ Note the occurrence of a Threatened taxa within the survey area is incorrect. This occurrence is located along the South Western Highway at least 16 km south of the survey area (DBCA 2021d).

A breakdown of the likelihood of occurrence of all potential species according to conservation status is provided in **Table 7**, with the complete likelihood of occurrence assessment provided in **Appendix 8**.

Table 7. Likelihood of occurrence according to conservation status.

Likelihood of occurrence	Total number	Priority 1	Priority 2	Priority 3	Priority 4	Threatened
Likely	-	-	-	-	-	-
Possible	20	3	1	5	4	7
Unlikely	25	2	1	7	5	10
Total	45	5	2	12	9	17

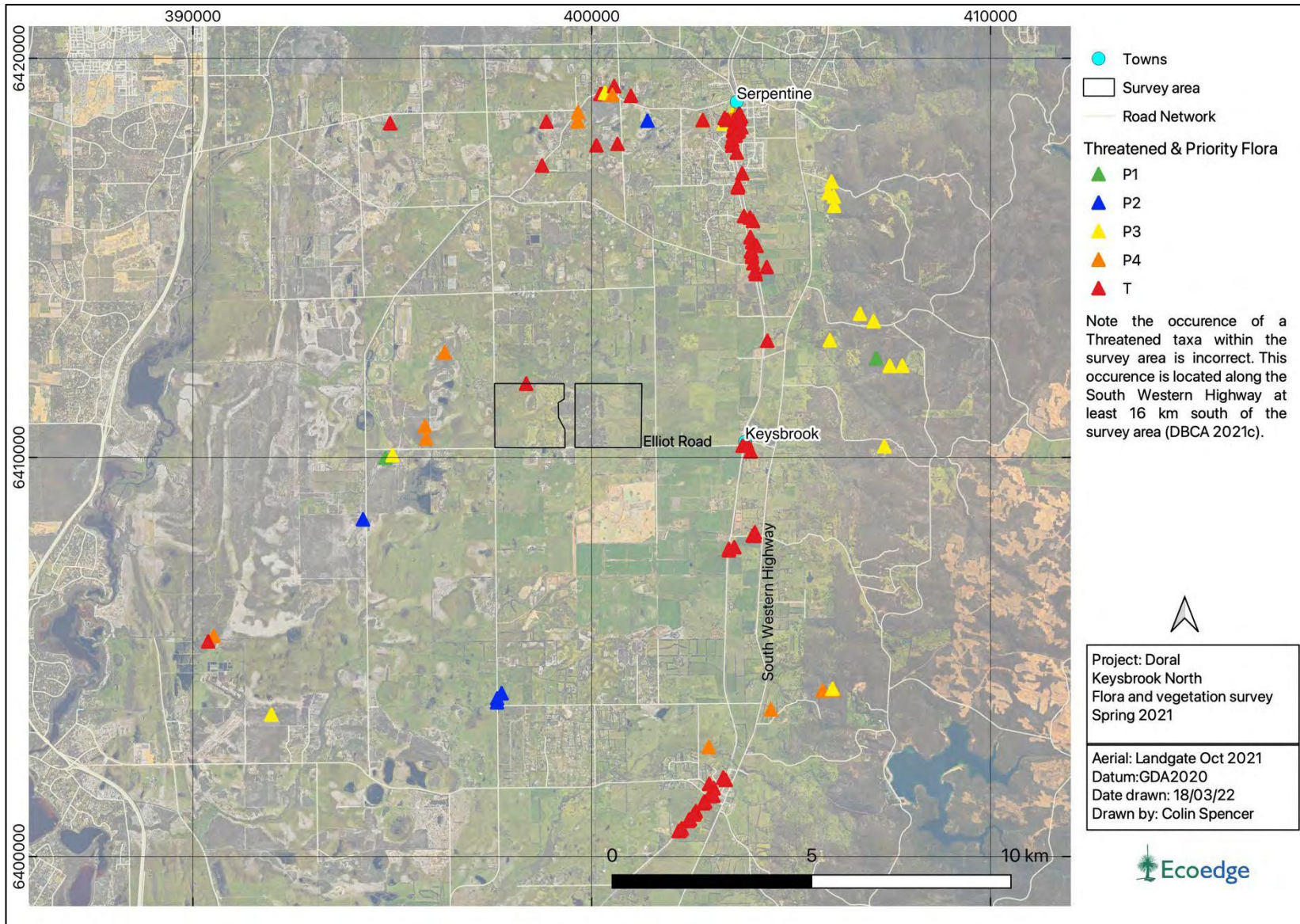


Figure 6. Location of Threatened and Priority flora within a 10 km radius of the survey area (DBCA 2021d).

3.6 Geomorphic wetlands

Wetlands on the Swan Coastal Plain have been classified into types using the geomorphic wetland classification system of Semeniuk & Semeniuk (1995), which is based on the characteristics of landform and water permanence, for example, lakes, palusplains and damplands. These are described in **Table 8**. The Swan Coastal Plain wetlands have also been evaluated and assigned an appropriate management category and corresponding category objective, providing guidance on the nature of the management and protection the wetland should be afforded. These categories are described in **Table 9**.

Table 8. Wetland types (adapted from Semeniuk & Semeniuk 1995).

Management Category	Basin	Flat	Channel	Slope	Highland
Permanently inundated	Lake		River		
Seasonally inundated	Sumpland	Floodplain	Creek/ Brook		
Intermittent inundation	Playa	Barlkarra	Wadi		
Seasonally waterlogged	Dampland	Palusplain	Trough	Paluslope	Palusmont

Table 9. Definitions of and objectives for the different wetland management categories (EPA 2008).

Management Category	Definition	Category Objective
Conservation	Wetlands with high conservation value for both natural or human use.	To preserve wetland (natural) attributes and functions.
Resource Enhancement	Wetlands with moderate natural and human use attributes that can be restored or enhanced.	To restore wetlands through maintenance and enhancement of wetland functions and attributes.
Multiple Use	Wetlands that score poorly on both natural and human use attributes.	To use, develop and manage wetlands in the context of water, town and environmental planning.

According to the latest SCP Geomorphic wetland data set (DBCA 2021e), three types of wetland occur over the survey area, palusplain wetlands, damplands and sumplands (**Figure 7**). The seasonally waterlogged palusplain comprise the greatest proportion of the wetlands followed by damplands and the sumplands.

There are two Conservation category wetlands (CCW) within the survey area. These are both dampland wetlands which occur in the north of the survey area and appear to be associated with an unnamed and unmapped tributary of the Dirkbrook. The remainder of dampland wetlands comprise mostly Resource Enhancement wetlands (REW).

Most of the palusplain wetlands in the survey appear to have been cleared for agriculture and have been classified as Multiple Use wetlands (MUW) with the exception of two area in the north western part of the survey area, near the Dirk Brook, which are REWs.

The seasonally inundated sumplands, which occupy a small part of the survey area, have been assigned both MUW and REW status (**Figure 8**).

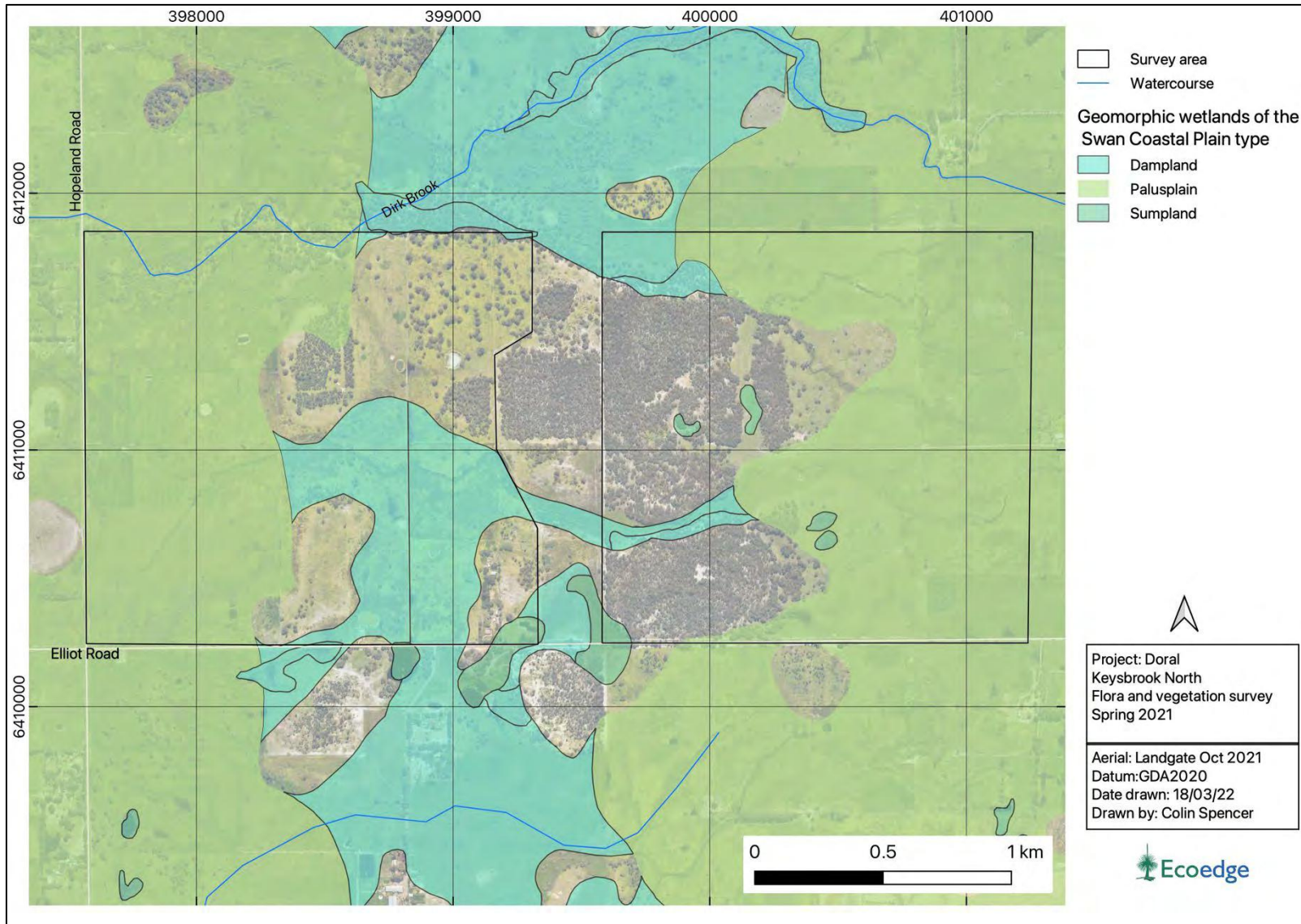


Figure 7. Geomorphic wetlands within and in proximity to the survey area (DBCA 2021e).

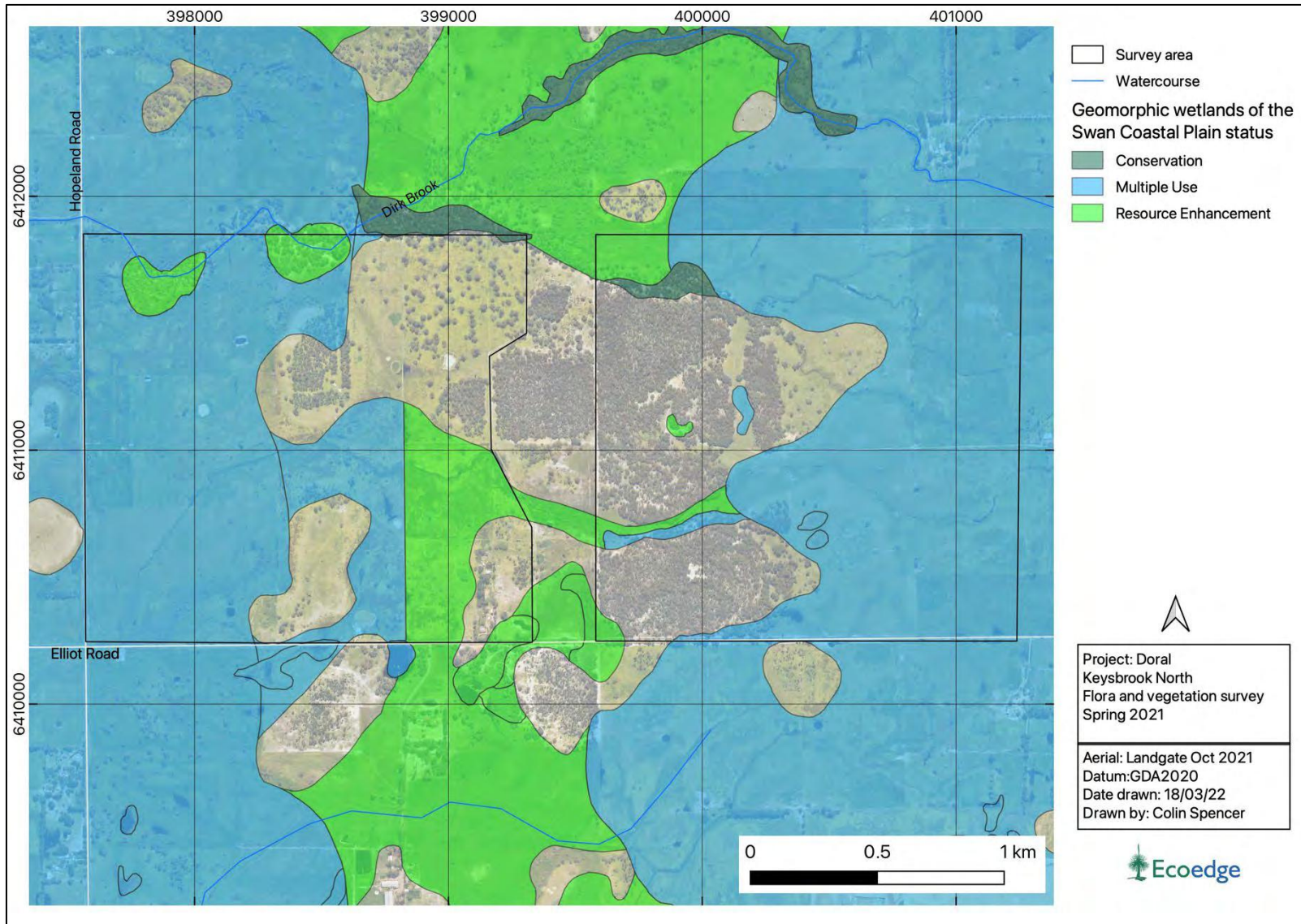


Figure 8. Geomorphic wetland status within and in proximity to the survey area (DBCA 2021e).

3.7 Ecological linkages and connectivity

A large extent of the survey area has been cleared of native vegetation with most of the remaining vegetation occurring in the western half of the east survey block. This vegetation is part of a parcel of vegetation which extends west and southwest beyond the survey area. This parcel of vegetation forms a 'vegetated island' within a predominantly cleared agricultural landscape. Aerial imagery shows that it is loosely connected to other fragmented parcels which occur north of the survey area via an unnamed ephemeral tributary of the Dirk Brook which occurs near the northern boundary of the survey area. There are no parcels of vegetation linked to the survey area vegetation in the west, south or east.

There are no formally mapped ecological linkages within the survey area. The Molloy et al. (2009) Regional Ecological Linkage mapping ceased approximately 3 km south of the survey area.

3.8 Environmentally sensitive areas

Environmentally Sensitive Areas (ESAs) are protected under the Environmental Protection (Clearing of Native Vegetation) Regulations 2004. They are selected for their environmental values at State or National levels (Government of Western Australia 2005). They include:

- Defined wetlands and riparian vegetation within 50 m
- Areas covered by Threatened ecological communities
- Area of vegetation within 50 m of Threatened flora
- Bush Forever sites
- Declared World Heritage property sites.

According to the latest ESA dataset there are two ESAs within the survey area (DWER 2020). These ESAs are associated with CCWs which occur near the northern boundary of the survey area (**Figure 9**). The ESA in the west extends beyond the boundary of the survey area. The nearest ESA outside of the survey area occurs approximately 350 m north of the northern boundary and is also associated with a CCW (**Figure 7**).

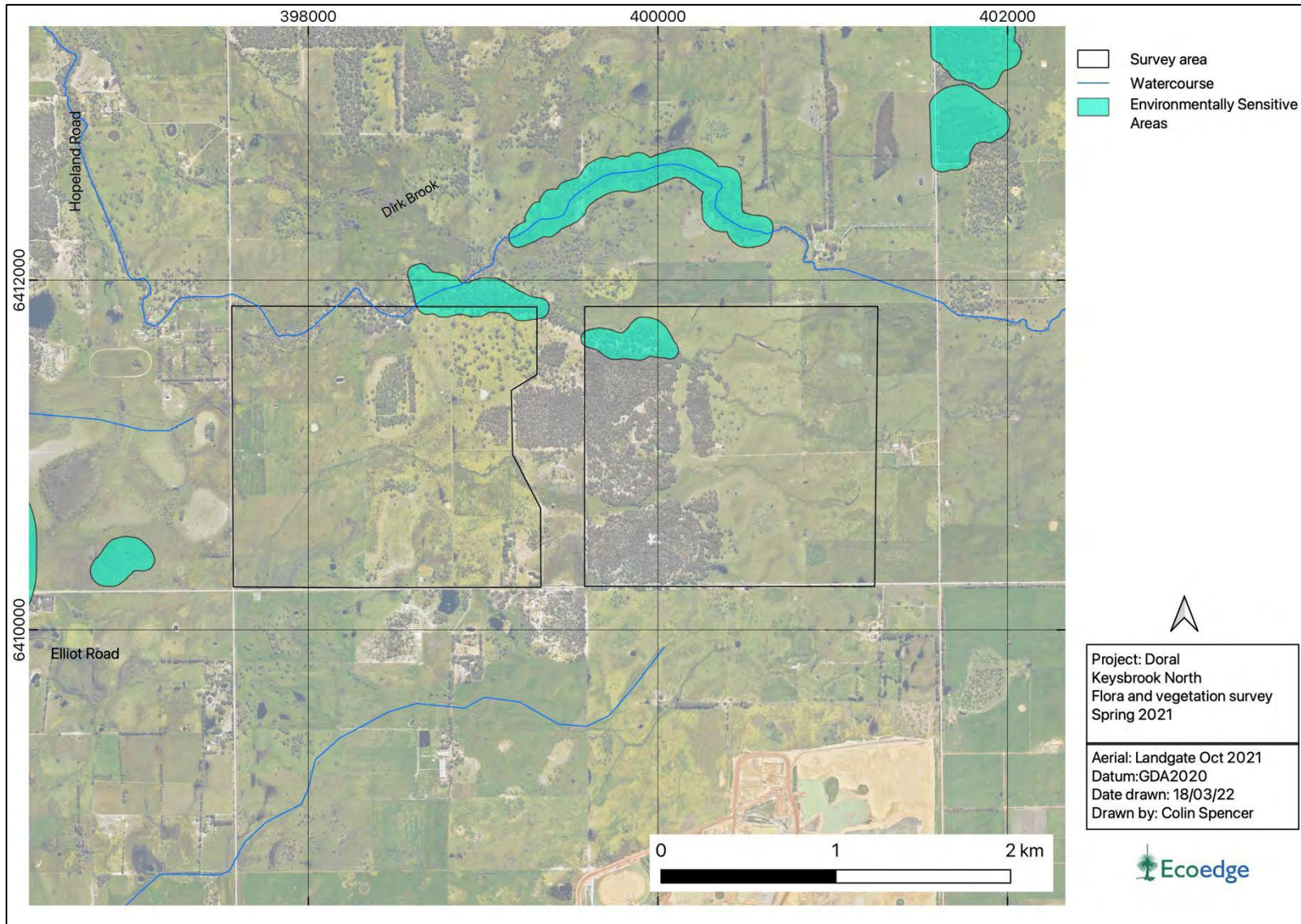


Figure 9. Environmentally sensitive areas in proximity to the survey area (DWER 2020).

3.9 Previous Surveys

Two previous flora and vegetation studies have been undertaken over the current survey area, these are:

1. MBS (2004) Vegetation and Fauna Assessment of Exploration Licence 70/2407 Keysbrook, Prepared for Olympia Resources Limited.
2. Bennett Environmental Consulting (BEC) (2004) Vegetation and Flora of Exploration Licence 70/2407 Keysbrook Western Australia, Prepared for MBS Environmental Pty Ltd.

Both of the 2004 surveys encompassed a larger area than the current 2021 survey area including vegetated portions adjacent to the survey area. The relevant portion for this survey covered the large eastern portion of the “Monstert” block. The indicative boundaries of the previous surveys where they intersect or are adjacent to the survey area are provided in **Figure 10**. The MBS survey area also included areas further south of the current survey area but these have not been included in the figure because of their separation from the survey area.

Two flora surveys have been undertaken of vegetation adjacent to the survey area these are:

1. Ecoedge (2021) Detailed, Reconnaissance and Targeted Flora and Vegetation Survey Lot 64 Elliot Road Keysbrook, Western Australia.
2. Onshore Environmental (2019), Field Assessment of Keysbrook Leucosene Conservation Areas & Revegetation Considerations.

The outcomes of these surveys are summarised below with the boundary of relevant portions of the surveys shown in **Figure 10**.

3.9.1 MBS (2004)

Level of survey – Preliminary field assessment ~ reconnaissance survey.

Time of survey: 19-20 May 2004.

Objectives: The objectives of the MBS (2004) survey were to: identify, assess and map vegetation types, identify habitats where significant flora may occur, and provide recommendations on further flora surveys if required.

Relevance to current survey: It covered all of the current survey area

Flora: No flora of conservation significance were recorded during the survey.

Vegetation: *Banksia attenuata* woodland interspersed with Jarrah Marri Woodland ranging from Degraded to Excellent condition. There were no TECs or PECs recognised in the survey area.

Recommendations: No specific recommendations were made with regards to potential occurrences of significant flora and the need or otherwise for further survey. However, four conservation significant flora species were recommended in the likelihood of occurrence table as having a moderate or higher chance of occurring within the Survey Area (**Table 10**).

Table 10. MBS (2004) conservation significant flora with a moderate or higher likelihood of occurrence rating.

Species	Status	Likelihood
<i>Anthotium juniforme</i>	P2	Moderate
<i>Aponogeton hexatepalus</i>	P4	Moderate
<i>Calothamnus graniticus</i>	P4	High
<i>Drakea elastica</i>	T	Moderate

3.9.2 Bennett Environmental Consulting (2004)

Level of survey: Detailed and targeted survey.

Time of survey: 27 – 28 October 2004.

Objectives: Map the vegetation and list the flora of the lease. Locate and record the presence of any Declared Rare and Priority Flora.

Relevance to current survey area: It covered all of the current survey area

Flora: No significant flora were recorded during the survey.

Vegetation: Seven vegetation units were described across the survey area. Two of these were recognised as potential TECs.

Vegetation unit CcXp was inferred to be the potential TEC, FCT 3c. However the report advised that these occurrences were degraded and of too small an area to be considered worthy of conservation.

Vegetation unit BaBm was identified to be either FCT21a or FCT21c which formed part of the Banksia woodlands of the SCP TEC, but at the the time of survey was not listed as either a State or Federally listed TEC.

Vegetation condition ranged from Completely Degraded to Very Good. Bennet (2004) ascribed a lower vegetation condition, than MBS 2004, to most of the survey area. Bennett suggest this difference was because the MBS survey was undertaken in autumn prior to onset of winter rains and germination of annual grasses.

3.9.3 Ecoedge 2021

Level of survey: Detailed and targeted survey.

Time of survey: October and November 2020 and August 2021.

Objective: to delineate all flora and vegetation components within the survey area, including TECs and PECs and threatened and priority flora.

Relevance to current survey area: The survey area is adjacent to the current survey area

Flora: No significant flora were recorded during the surveys

Vegetation: Three native vegetation units in mostly Degraded to Completely Degraded condition were identified within the survey area. None of these were regarded as occurrences of State of Federally listed TEC, nor where they regarded as occurrences of a State listed PEC.

3.9.4 Onshore Environmental

Level of survey: Detailed and targeted survey.

Time of survey: October and November 2020 and August 2021.

Objective: Describe and map vegetation types and condition; prepare a species list for each vegetation type; and outline potential restoration constraints; and develop a revegetation plan based on survey outcomes.

Relevance to current survey area: The survey area is adjacent to the current survey area

Flora: No significant flora were recorded during the surveys

Vegetation: Four native vegetation units ranging from Completely Degraded to Good condition were identified within the survey area adjacent to the current survey area. The conservation status of these communities was not determined.



Figure 10. The indicative location of previous survey areas in proximity to the survey area

4 Survey results

Tracklog and relevés were recorded, and locations are shown in **Appendix 9**. A list of species found during this survey is provided in **Appendix 10**.

4.1 Flora

One hundred and nineteen species of vascular flora were identified within the survey area, of which 25 (21%) were introduced non-native taxa. Families with the highest number of taxa were Asteraceae (ten species, five of them being introduced), Cyperaceae (nine taxa) and Orchidaceae (nine taxa). None of the introduced species was a Declared Pest plant or Weed of National Significance.

4.1.1 Threatened and Priority flora

There were no threatened or priority flora recorded within the survey area.

Several trees within vegetation adjacent to the creek that flows through the northern part of the survey area in Vegetation unit ErMrW appeared to be the Priority 4 *Eucalyptus rudis* subsp. *cratyantha*. However, upon further examination, were considered to representative of the intergrade between the common variety of flooded gum *E. rudis* subsp. *rudis* and *E. rudis* subsp. *cratyantha*. The intergrade variety is not recognised as a priority 4 taxon. French and Nicolle (2019) note that populations of *E. rudis* along parts of the Murray and Harvey Rivers, have fruits similar in shape to *E. rudis* subsp. *cratyantha* but are more variable in shape and mostly smaller than subspecies *cratyantha* and are regarded as intergrades between the subspecies.

DBCA records (DBCA 2022) show that *E. rudis* subsp. *cratyantha* is found from near Serpentine south to near Cape Naturaliste on the coastal plain, with outlying populations in the Collie basin. French and Nicole (2019) contend, however that this species is actually restricted to a small area at Cape Naturaliste.

4.2 Vegetation Units

Five vegetation units were identified and mapped in the survey area. These are described in **Table 11** and shown in **Figure 11** and **Figure 12**. Photographs of the vegetation units are provided in **Appendix 11**.

Unit EmCcBaBmOF is found on low sandy rises, unit CcEmAfOF is found on the transition between these rises and the surrounding loamy flats where units CcEmXpOF and CcOF are found. Unit ErMrOW occurs along the creekline in the north-west part of the survey area. Apart from these vegetation units there were areas of pasture with isolated trees, mainly *Corymbia calophylla*, but with *Melaleuca preissiana* and *M. raphiophylla* in swampy areas which were mapped as “cleared”.

Table 11. Description of vegetation units in the survey area.

Unit	Description
EmCcBaBmOF	<i>Eucalyptus marginata</i> , <i>Corymbia calophylla</i> , (<i>Allocasuarina fraseriana</i>) medium open forest over <i>Banksia attenuata</i> , <i>B. menziesii</i> , <i>Xylomelum occidentale</i> low woodland over <i>Xanthorrhoea brunonis</i> medium very open shrubland over <i>Dasyopogon bromeliifolius</i> , <i>Hibbertia hypericoides</i> low very open shrubland over <i>Caladenia flava</i> , <i>Dampiera linearis</i> , <i>Drosera erythrorhiza</i> , * <i>Hypochaeris glabra</i> , <i>Lagenophora huegelii</i> , <i>Lomandra</i> spp., * <i>Romulea rosea</i> , * <i>Ursinia anthemoides</i> open forbland, * <i>Briza maxima</i> , <i>Microlaena stipoides</i> scattered grasses and <i>Mesomelaena tetragona</i> scattered sedges on grey sand on low rises.
CcEmAfOF	<i>Corymbia calophylla</i> , <i>Eucalyptus marginata</i> , <i>Allocasuarina fraseriana</i> medium open forest over (<i>Banksia attenuata</i> , <i>B. menziesii</i>), <i>B. grandis</i> , <i>Xylomelum occidentale</i> low woodland over <i>Hibbertia hypericoides</i> , <i>Xanthorrhoea brunonis</i> medium open shrubland over * <i>Briza maxima</i> , <i>Microlaena stipoides</i> scattered grasses and <i>Drosera erythrorhiza</i> , * <i>Hypochaeris glabra</i> , <i>Lagenophora huegelii</i> , <i>Pyrorchis nigricans</i> , * <i>Ursinia anthemoides</i> very open forbland on grey sand/ sandy loam on lower slopes (transitional between EmCcBaBmOF and CcEmXpOF).
CcEmXpOF	<i>Corymbia calophylla</i> (<i>Eucalyptus marginata</i>) medium open forest over <i>Hibbertia hypericoides</i> , <i>Xanthorrhoea preissii</i> (<i>X. brunonis</i>) medium open shrubland over <i>Cyathochaeta avenacea</i> , <i>Mesomelaena stygia</i> , <i>M. tetragona</i> open sedgeland, <i>Conostylis aculeata</i> , <i>Desmocladus fasciculatus</i> , * <i>Hypochaeris glabra</i> , <i>Trachymene pilosa</i> very open forbland on grey-brown loamy sand.
CcOF	<i>Corymbia calophylla</i> (<i>Eucalyptus marginata</i>) medium open forest over <i>Xanthorrhoea brunonis</i> low shrubland over * <i>Briza maxima</i> , <i>Microlaena stipoides</i> scattered grasses and <i>Drosera erythrorhiza</i> , * <i>Hypochaeris glabra</i> , <i>Lagenophora huegelii</i> , <i>Pyrorchis nigricans</i> very open forbland on grey sandy loam to clay-loam on flats. (The small tree <i>Melaleuca preissiana</i> may occur in this community adjacent to the northern creekline)
ErMrW	<i>Eucalyptus rudis</i> medium woodland over <i>Melaleuca raphiophylla</i> low woodland over * <i>Arctotheca calendula</i> , * <i>Hypochaeris glabra</i> open forbland, * <i>Briza maxima</i> , * <i>Ehrharta longiflora</i> grassland and * <i>Juncus gregiflorus</i> , * <i>J. subsecundus</i> open rushland on grey-yellow sandy loam on alluvial flats

* Denotes introduced species.

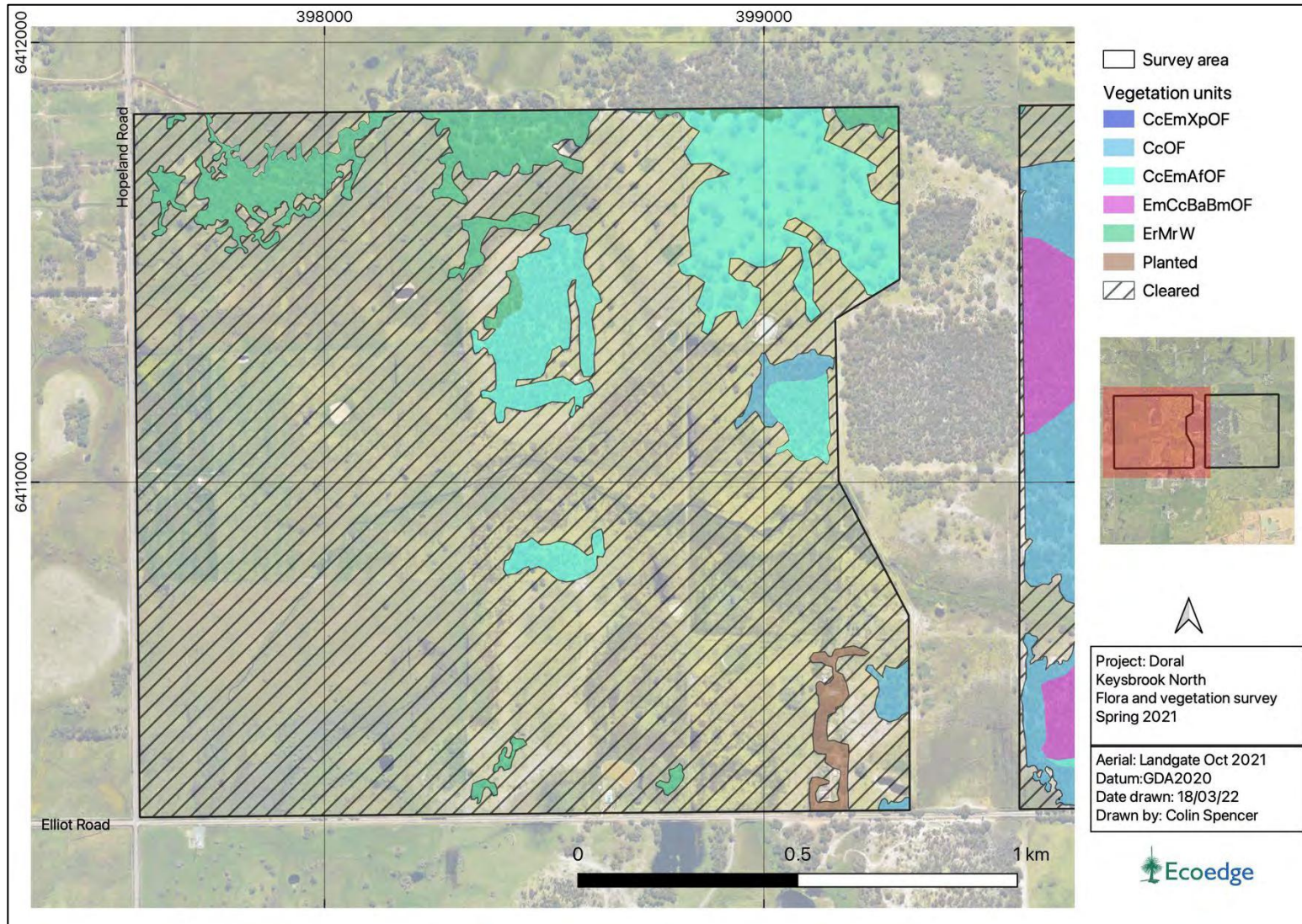


Figure 11. Vegetation units for the survey area.

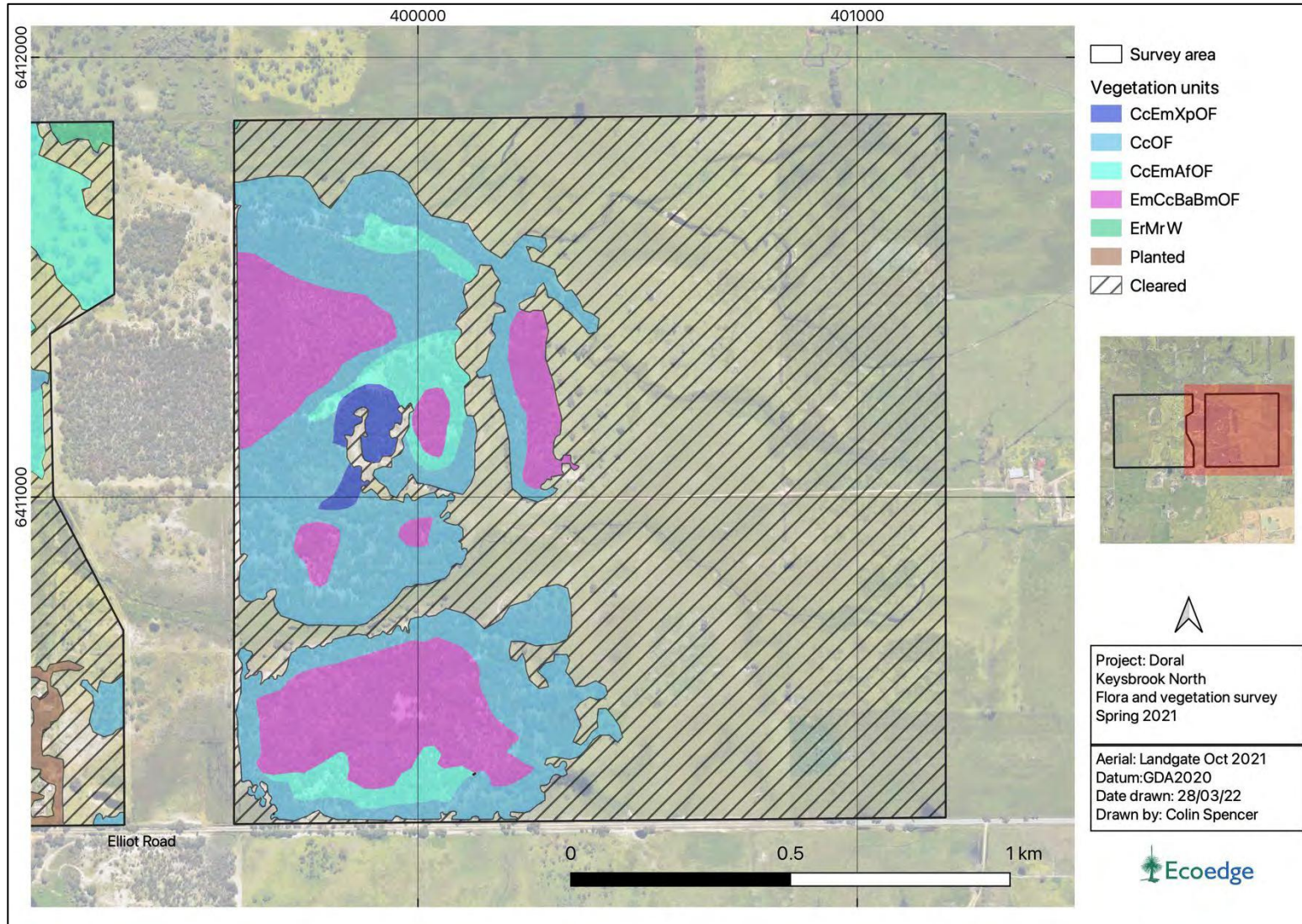


Figure 12. Vegetation units for the survey area.

4.3 Multivariate Analysis

4.3.1 Background and limitations

MVAs were conducted to assist in determining the relationship of the vegetation within the survey area with the floristic community types described in Keighery *et al.* (2012) (the SCP dataset) and therefore highlight which vegetation units may be a TEC or PEC.

All vegetation in the survey area has been degraded to some extent and although the quadrats were placed in the best condition vegetation the species richness of the quadrats (21-32 taxa/quadrat) was substantially lower than the typical number expected for quadrats in the relevant communities from the Swan Coastal Plain surveys (40-55 taxa/quadrat). In addition, the proportion of non-native species was higher than for comparable SCP survey quadrats. Experience has shown that these two factors (ie., lower species richness and higher proportion of weeds) are problematic when using the quadrats with a dataset where virtually all the comparison quadrats were placed in vegetation of at least Very Good and usually Excellent condition.

Another potentially confounding factor in assigning the vegetation to an appropriate FCT is that it appears that because of the relatively low relief of the survey area the transition from 'upland' vegetation on the low sandy rises to 'lowland' vegetation is very subtle, as recognised by Onshore Environmental (2019) in their survey of adjacent vegetation. Consequently, not only is it difficult to see and map boundaries in the field there is also some mixing of typical 'upland' species and 'lowland' taxa as is the case with unit CcEmAfOF.

Nevertheless, the two MVAs conducted to compare the Keysbrook quadrats with quadrats from the Swan Coastal Plain dataset provided valid determinations of the most likely floristic community types that can be applied to the vegetation in which the six quadrats were placed.

4.3.2 MVA results

In the first iteration of the MVA all six survey area quadrats were compared together with the reduced SCP dataset (see sub-section 2.3) and the part of the dendrogram from this analysis is shown in **Figure 13** below.

As can be seen in **Figure 13** the six Keysbrook quadrats (KEYN01 to KEYN06) cluster with each other and they form a larger grouping with five quadrats assigned to FCT SCP 3c (*Corymbia calophylla* - *Xanthorrhoea preissii* woodlands and shrublands of the Swan Coastal Plain) as well as quadrats from four other floristic community types (FCTs 6, 18, 24 and 25).⁸ Based on the results of this MVA the four Keysbrook quadrats on sandy-loam soils, usually with impeded

⁸ This is an example of the tendency of quadrats from within a relatively small sampling area to cluster together even though some should, based on their dominant species, instead cluster with quadrats from another location. This effect can be caused, for example, by a common suite of weed taxa.

drainage, and dominated by *Corymbia calophylla* with species such as *Kingia australis*, *Xanthorrhoea preissii*, *Cyathochaeta avenacea* and *Mesomelaena tetragona* in the understorey were assigned to FCT SCP 3c. These four quadrats represent Vegetation units CcEmAfOF, CcEmXpOF, and CcOF.

A second MVA was carried out with just the two Keysbrook quadrats which had *Banksia attenuata* or *B. menziesii* in them (KEYN02, KEYN06), and which were situated on low sandy rises, to see whether separating them from the *C. calophylla*-dominated quadrats would lead to them being grouped with quadrats from the full SCP dataset which had been assigned to Banksia-dominated FCTs. This MVA grouped them mainly with quadrats assigned to FCT 21a (Central *Banksia attenuata*-*Eucalyptus marginata* woodlands) and FCT 21c (Low lying *Banksia attenuata* woodlands and shrublands) (**Figure 14**).

Because they were grouped with approximately equal numbers of quadrats assigned to FCT 21a and FCT 21c it is not possible to assign them to one or the other. However, there is sufficient evidence from the results of the MVA to determine that vegetation unit 'EmCcBaBmOF' meets the floristic composition criteria of the Banksia Woodlands of the SCP TEC. A MVA by E.A. Griffin reported in Bennett (2004) that included two Banksia-dominated quadrats from the survey area also concluded that they were most similar to FCT 21a or 21c.

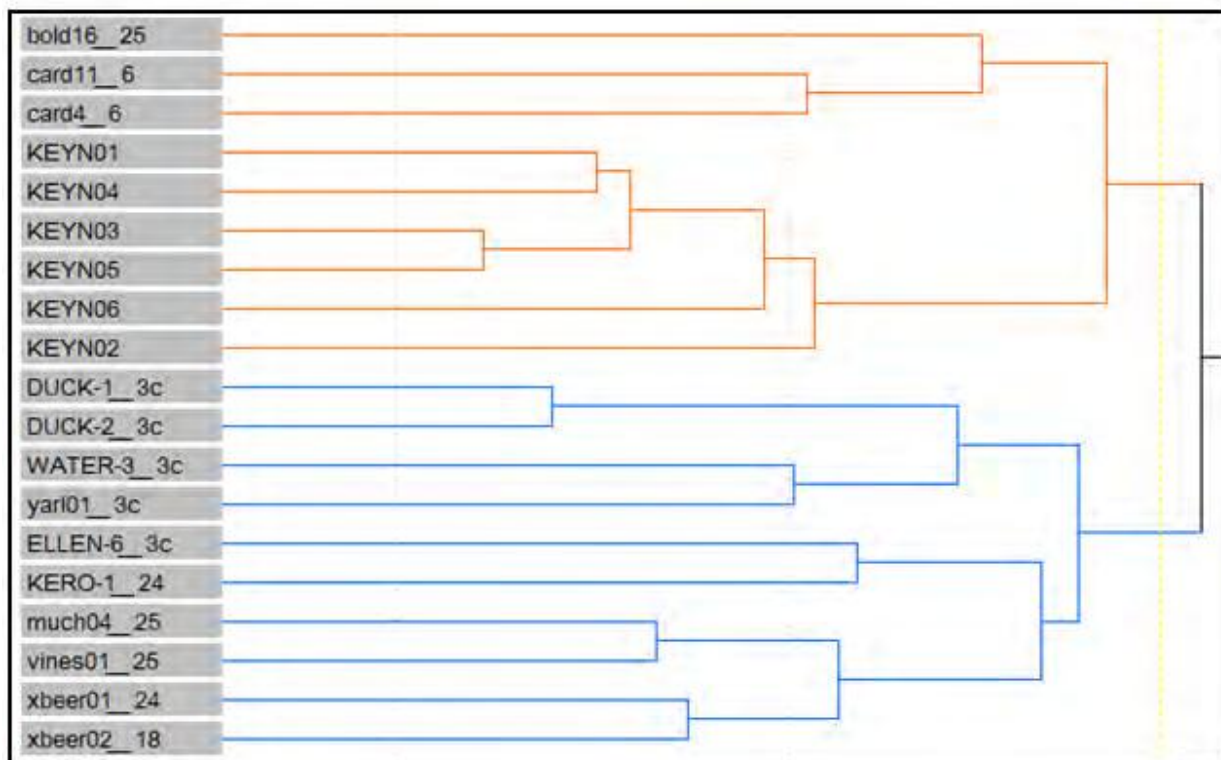


Figure 13. Grouping of the Keysbrook quadrats with quadrats from the SCP database quadrats.

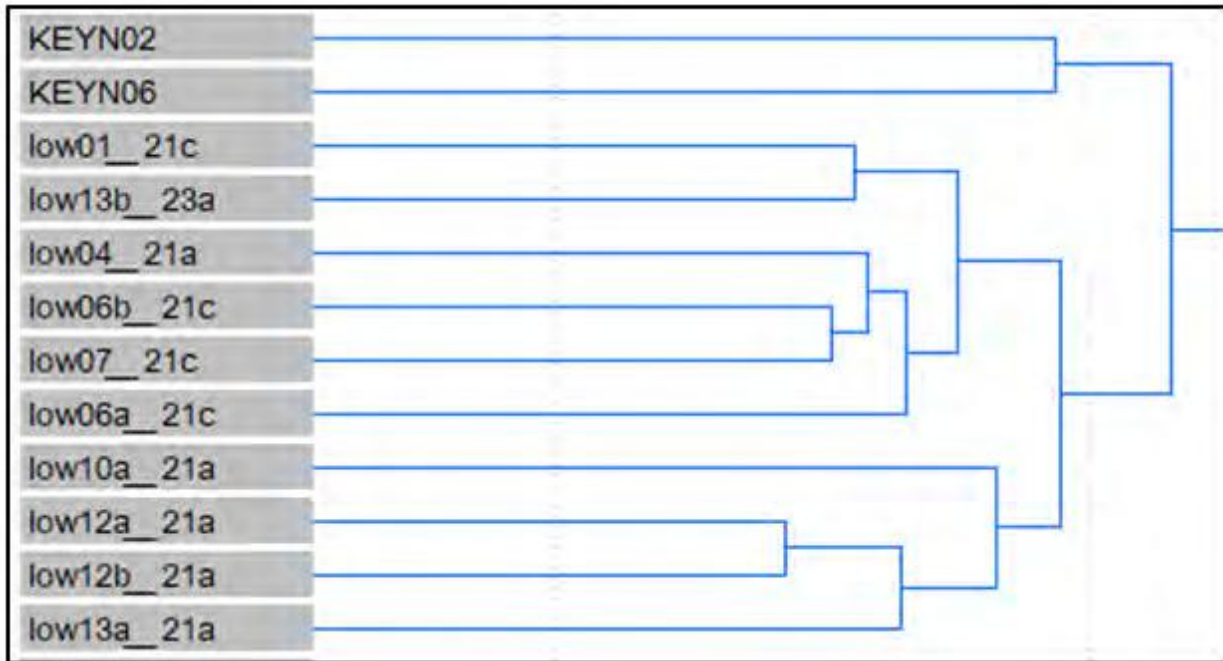


Figure 14. Dendrogram from a separate MVA showing two of the Keysbrook quadrats grouped with quadrats assigned to FCT 21a and FCT 21c, part of the Banksia Woodlands of the SCP TEC.

4.4 Vegetation condition

Most of the native vegetation was in Degraded or Completely Degraded condition, only about 10% was in Good condition. Livestock grazing over many years along with the effects of Phytophthora dieback, and subsequent weed invasion are apparently the main causes of degradation.

In general, vegetation condition has degraded in those parts of the survey area assessed by Bennett (2004), as would be expected from a further 17 years of grazing. Whereas they mapped most of the vegetation in the eastern section of the survey area as Very Good and Good none was mapped as Very Good during the present survey⁹.

A breakdown of the condition of the survey area vegetation is shown in **(Table 12)** and a breakdown of vegetation condition per unit is provided in **Table 13**. The distribution of vegetation condition in the survey area is mapped in **Figure 15** and **Figure 16**.

Table 12. Vegetation condition in the survey area.

Veg. Condition	Area (ha)	%
Good	9.81	7.54
Degraded	50.81	39.05
Completely Degraded	69.49	53.41
	130.11	100.00
Cleared	400.24	
Total	530.35	

⁹ Very small areas of Very Good too small to map separately were observed in the southern part of the survey area.

Table 13. Proportion of the vegetation units in the survey area in various condition classes.

Vegetation Unit	Condition	Area (ha)	%
CcEmXpOF	Good	2.22	93.91
	Completely Degraded	0.14	6.09
		2.37	100.00
CcOF	Good	3.08	6.23
	Degraded	23.81	48.22
	Completely Degraded	22.49	45.55
		49.37	100.00
CcEmAfOF	Good	2.39	6.93
	Degraded	2.90	8.44
	Completely Degraded	29.13	84.63
		34.42	100.00
EmCcBaBmOF	Good	2.13	7.40
	Degraded	23.41	81.36
	Completely Degraded	3.23	11.24
		28.77	100.00
ErMrW	Degraded	0.69	5.18
	Completely Degraded	12.69	94.82
		13.38	100.00
Planted	Completely Degraded	1.81	
Cleared		400.24	

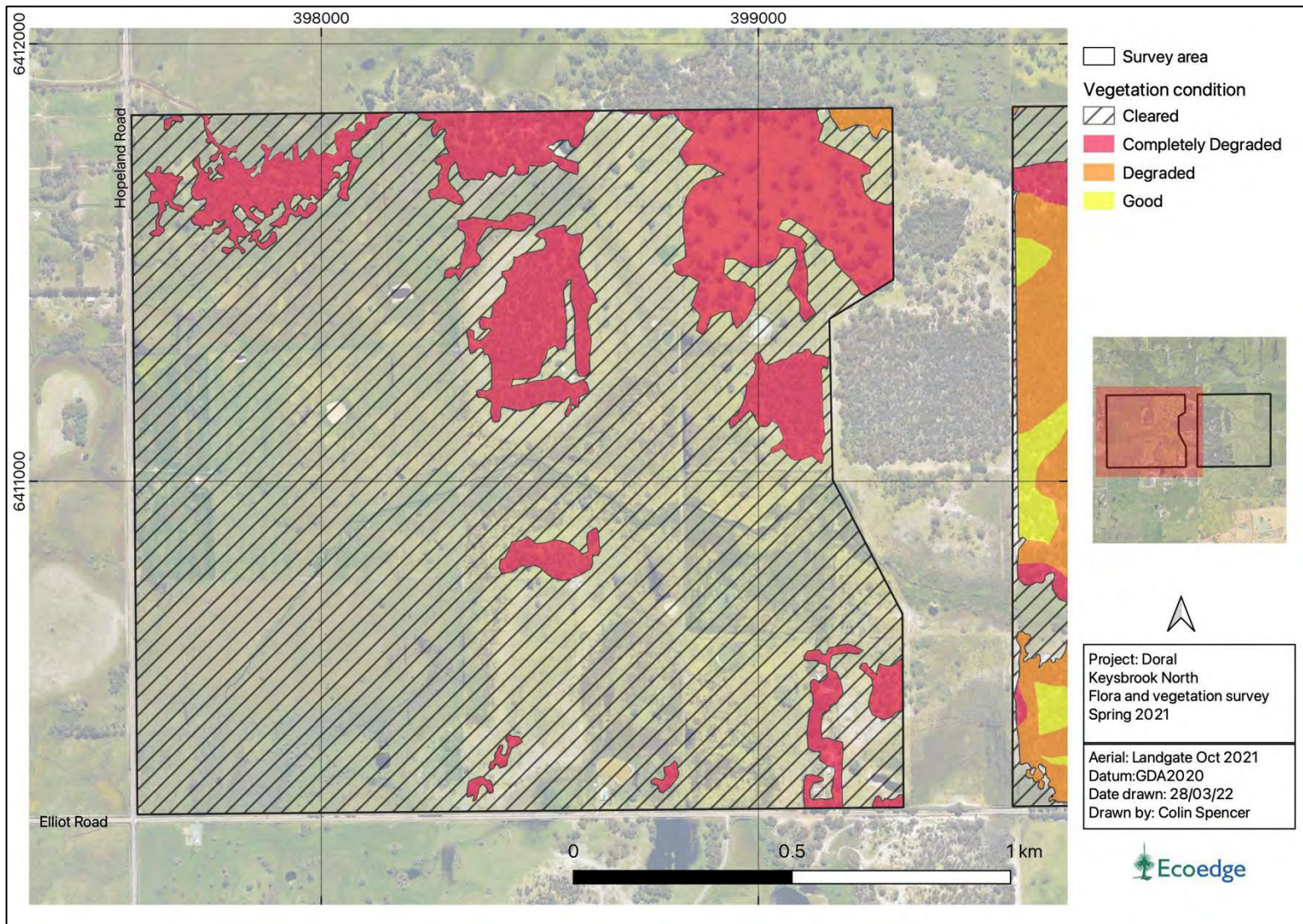


Figure 15. Vegetation condition of the survey area.

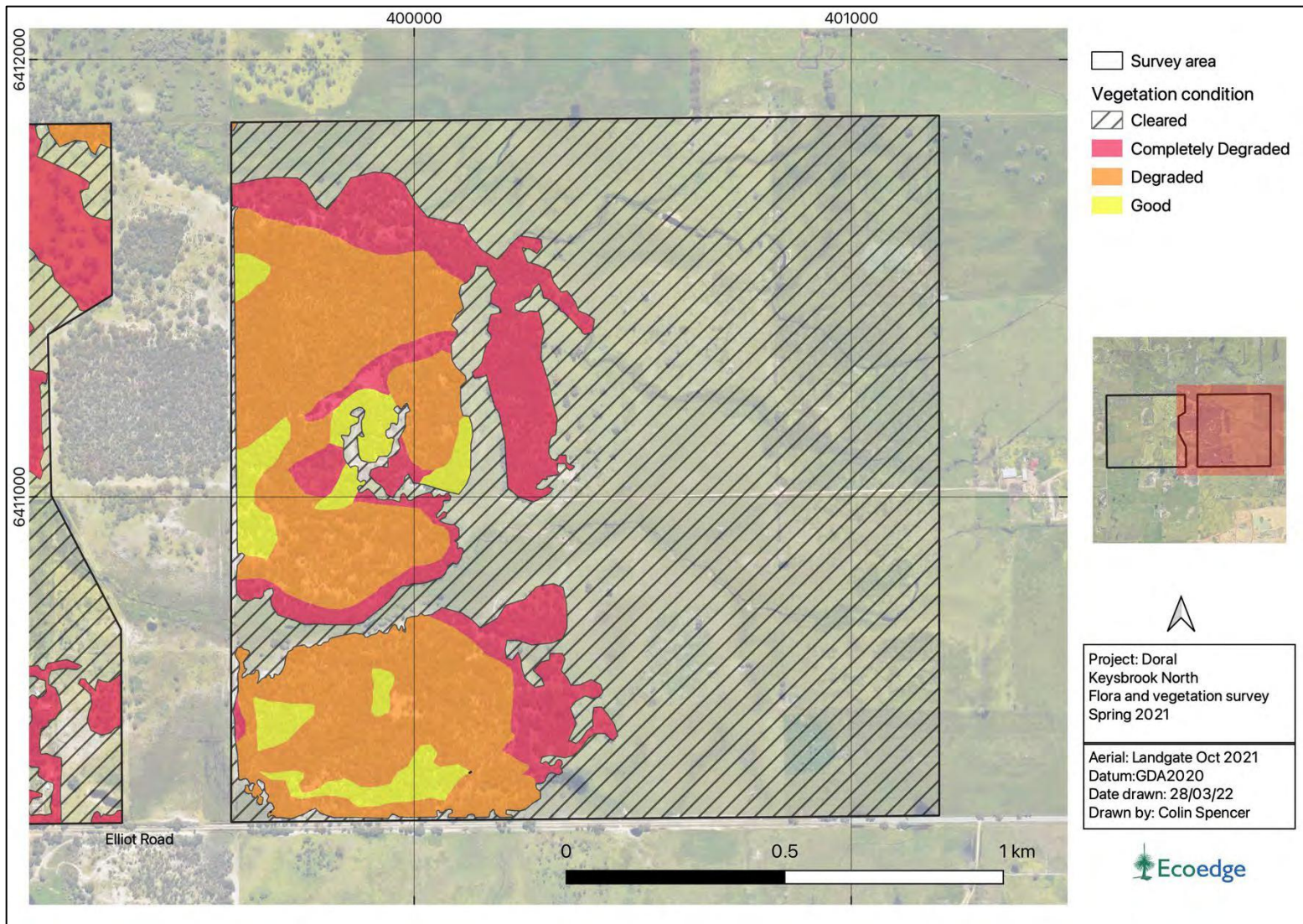


Figure 16. Vegetation condition of the survey area.

4.5 Threatened Ecological Communities

4.5.1 *Corymbia calophylla* - *Xanthorrhoea preissii* woodlands and shrublands of the SCP (SCP FCT 3c)

The MVA discussed in **sub-section 4.3.2** resulted in the assignment of the State and Federally listed SCP FCT3c to vegetation units CcEmAfOF, CcEmXpOF, and CcOF.

The DoEE (2017) approved conservation advice for FCT 3c states that ‘no condition thresholds have been applied to the nationally-listed ecological community and hence all areas meeting the description of the ecological community are habitat areas critical to its survival’. This means, that according to survey observations that those areas in the survey area in Completely Degraded condition should not be considered as part of the TEC, as they no longer have attributes representative of the community¹⁰.

A breakdown of the extent and condition of FCT 3c in the survey area is shown in **Table 14** and mapped in **Figure 17**. The DBCA reporting form is provided in **Appendix 12**.

Table 14. Area and condition details for SCP FCT 3c in the Keysbrook survey area.

Vegetation unit	Condition	Area (ha)
CcEmAfOF	Good	2.39
	Degraded	2.90
CcEmXpOF	Good	2.22
	Degraded	
CcOF	Good	3.08
	Degraded	23.81
Total		34.39

¹⁰ This observation is supported by the criteria in the DEC 2011 ‘Threatened and Priority Communities Report Form – Field Manual’ which only regards vegetation in Degraded or better condition to be representative of either a PEC or TEC.

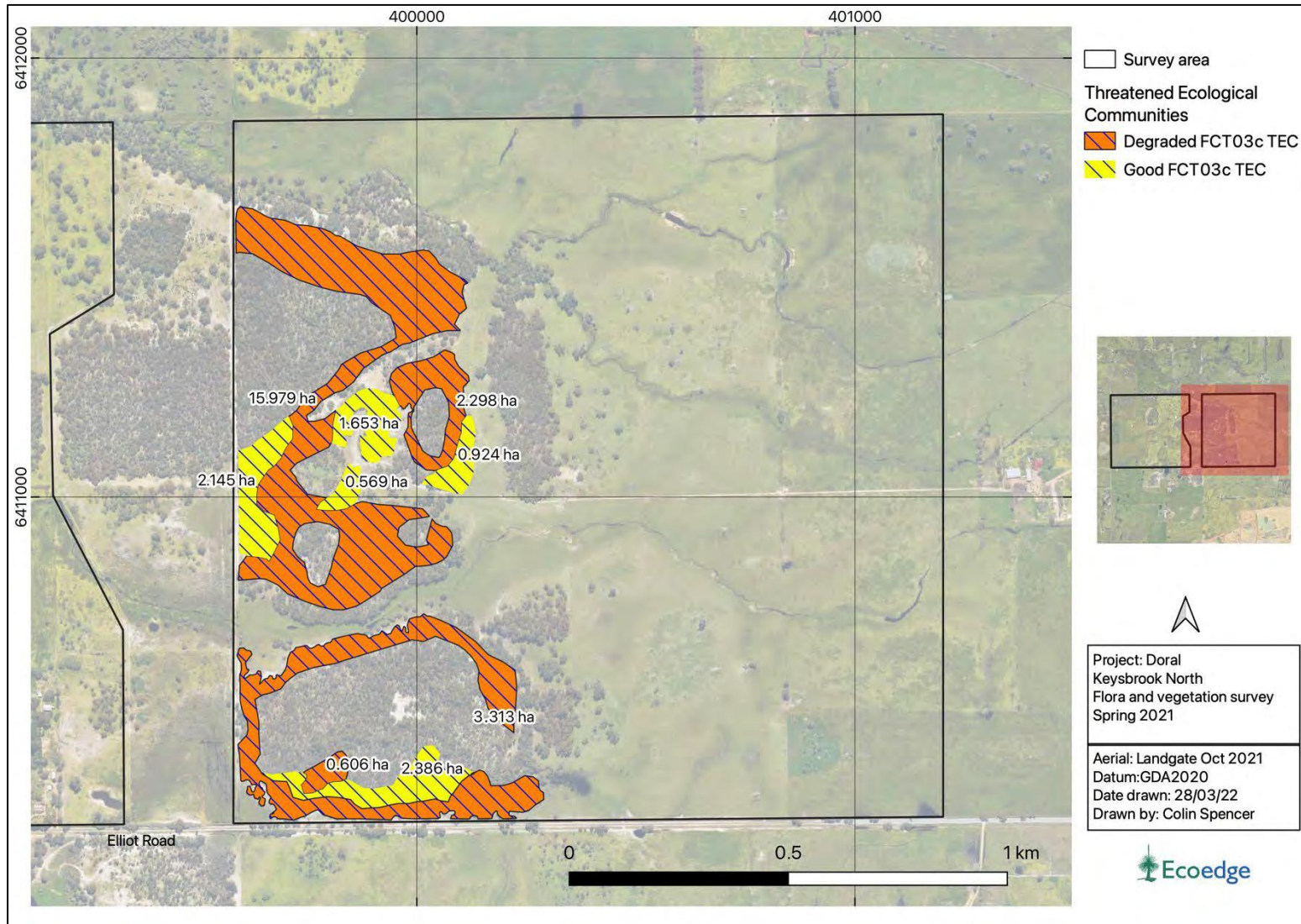


Figure 17. Vegetation condition the TEC FCT03c within the survey area.

4.5.2 Banksia Woodlands of the SCP TEC

The MVA discussed in sub-section 4.3.2 resulted in the assignment of either FCT SCP 21a and SCP 21c to vegetation unit EmCcBaBmOF. Both the FCTs are part of the federally listed Banksia Woodlands of the SCP TEC and State listed PEC of the same name, however patch condition and patch area thresholds apply for occurrences of this community type to be recognised as an occurrence of the Banksia woodlands of the SCP TEC (DotEE 2016, DBCA 2018a). These thresholds are shown in **Table 15**.

Of the six patches of vegetation unit EmCcBaBmOF shown in **Figure 18** only three patches were identified in Good condition, but none of these patches exceeded 2 ha and are therefore not be considered as an occurrence of the Federally listed TEC (DotEE 2016), or state listed PEC.

Table 15. Condition and minimum patch sizes for the “Banksia Woodlands of the Swan Coastal Plain” TEC (DotEE 2016) and PEC (2018b).

Condition Category	Minimum Patch Sizes	Criteria met
‘Pristine’	No minimum patch size applies	No
‘Excellent’	0.5 ha or 5,000 m ² (e.g. 50 m x 100 m)	No
‘Very Good’	1 ha or 10,000 m ² (e.g. 100 m x 100 m)	No
‘Good’	2 ha or 20,000 m ² (e.g. 200 m x 100 m)	No
To be considered as part of the EPBC Act ecological community a patch should meet at least the ‘Good’ condition category.		

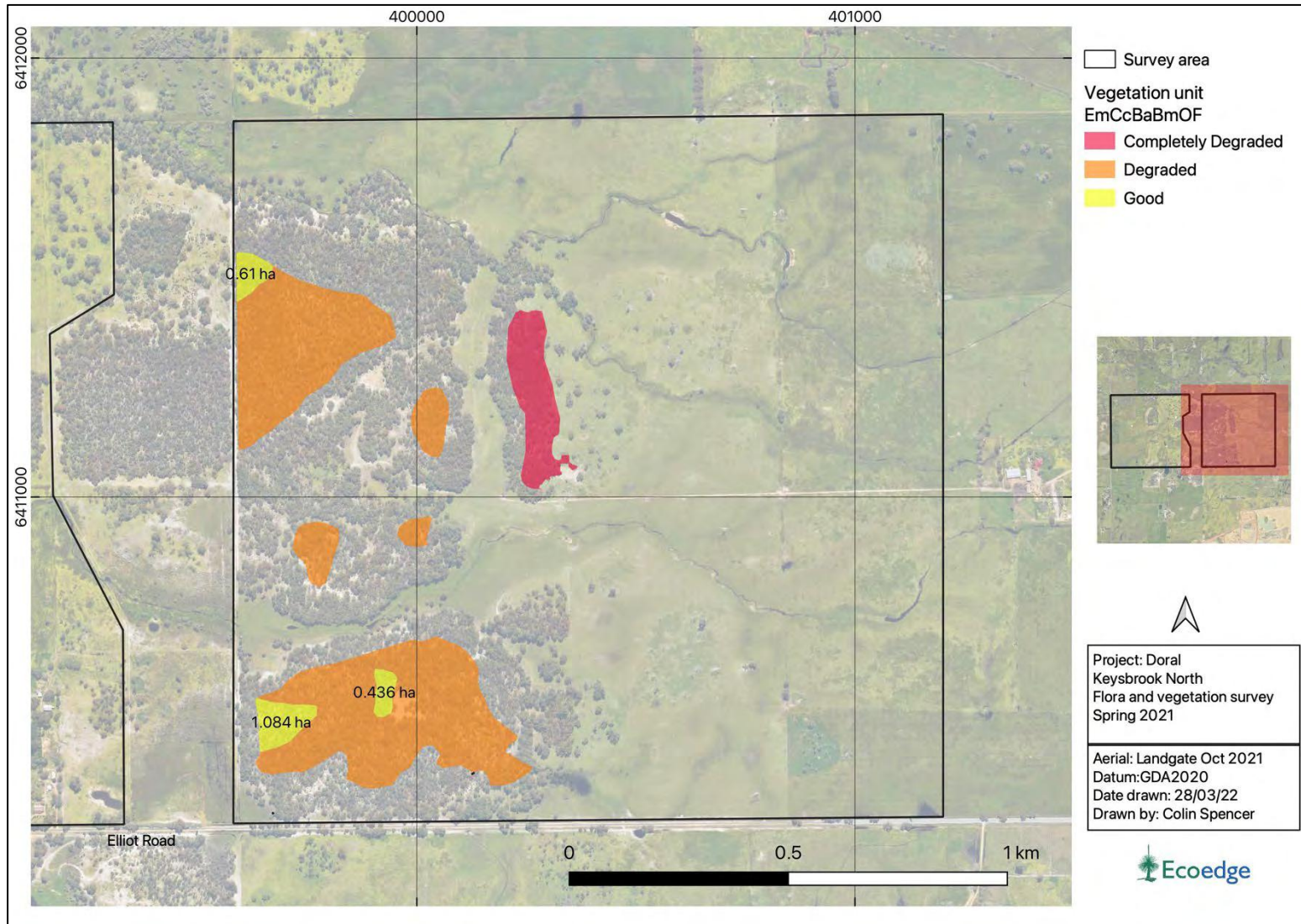


Figure 18. Vegetation condition of unit EmCcBaBmOf.

5 Wetlands and watercourses

The vegetation unit ErMrW is recognised as having habitat representative of a wetland or watercourse. This unit this occurs along much of the creekline in the northern part of the survey area and is mostly in a Completely Degraded condition with some small areas in a Degraded condition. *Melaleuca preissiana*, which is a typical small tree of wetlands may occur in areas mapped as CcOF where it abuts the creekline in the northern part of the survey area. However, unit CcOF is not considered to be wetland vegetation.

Portions of this vegetation unit occur within mapped occurrences of the CC and RE wetlands. The location of these CC and RE wetlands and there intersection with the mapped wetland habitat is shown in **Figure 19**. Noting that large portions of mapped RE and CC wetlands have not been attributed a vegetation unit being either Cleared or no longer representative of a wetland vegetation type.

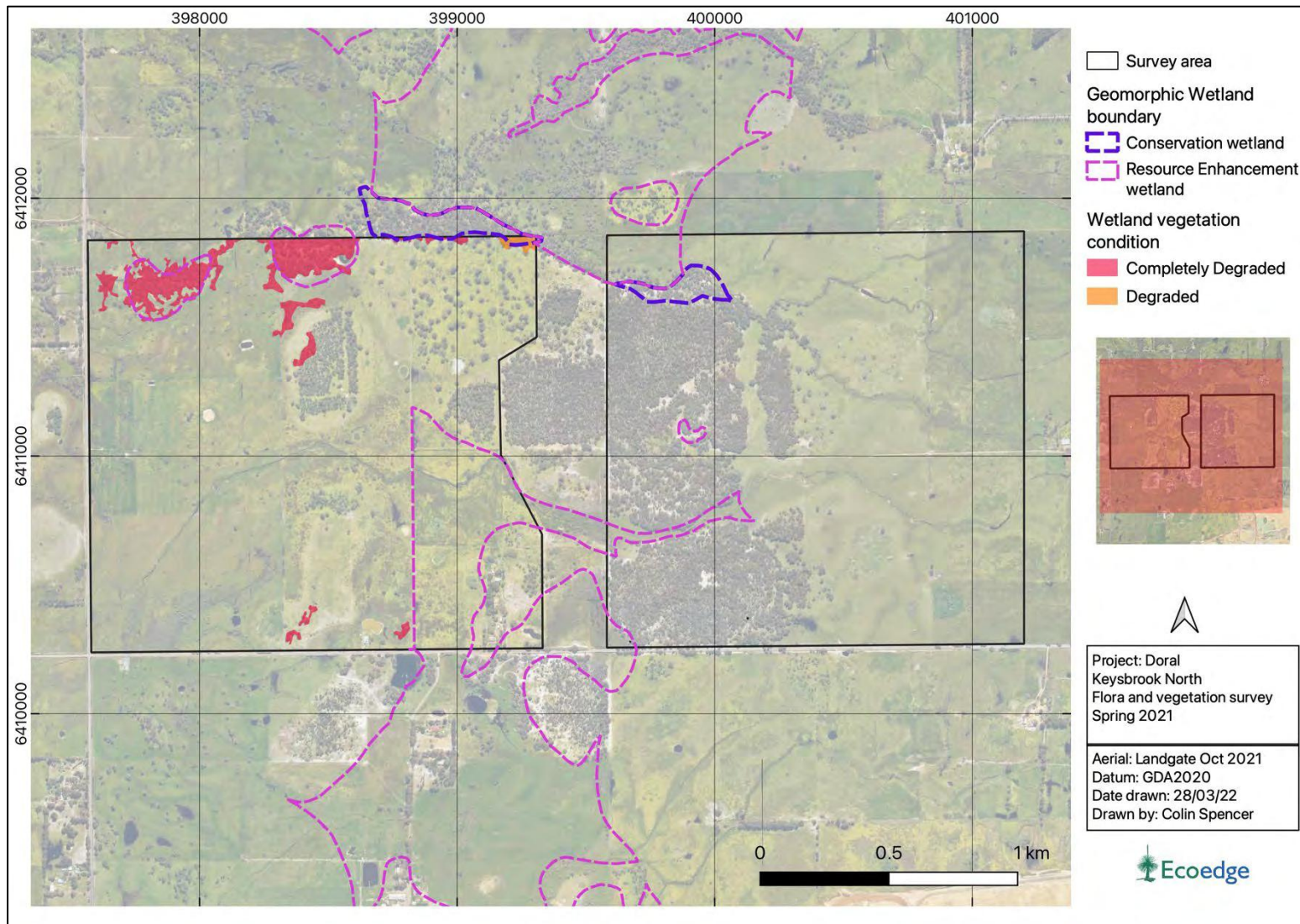


Figure 19. Vegetation condition of REW and CCW wetlands in the survey area.

6 Discussion and conclusions

6.1 Threatened and Priority Flora

There were no threatened or priority flora recorded within the survey area. Neither were there any Declared pest plants or Weeds of National Significance.

6.1.1 Post-survey Residual Likelihood of Threatened and Priority Flora

All the 45 taxa potentially occurring the survey area (**sub-section 3.5**) were considered to have residual likelihood post-survey of 'Unlikely' including the Threatened orchid, *Drakea elastica* which was searched for in late winter targeted survey.

The Unlikely rating means that, inspite of a thorough search at the optimum survey time the potentially occurring species were either not found; or suitable habitat was not present. It is notable that no Threatened or Priority flora were found by Bennett during a previous survey of the survey area 17 years previously Bennett (2004).

6.2 Threatened ecological communities

6.2.1 *Corymbia calophylla* – *Xanthorrhoea preissii* woodlands and shrublands FCT 3c

A total of 34.4 ha of vegetation in the survey area, comprised of units CcEmAfOF, CcEmXpOF and CcOF meets the criteria to be considered an occurrence of SCP FCT3c (*Corymbia calophylla* – *Xanthorrhoea preissii* woodlands and shrublands, Swan Coastal Plain ecological community. This community has been listed Endangered under the Commonwealth EPBC Act and Critically Endangered under the Western Australian BC Act.

As at April 2017, 29 occurrences of FCT03c totalling about 115 ha have been identified located between Bullsbrook and Capel (DoEE 2017). At the time of its assessment, it was listed because of its restricted distribution and extent, and the highly fragmented remaining patches being threatened by clearing, weed invasion, hydrological changes, and too frequent fire.

The area of FCT 3c in the Keysbrook survey area increases the known area of the TEC by about 30% and consequently it is a very important occurrence of this community.

6.2.2 Wetland and watercourse vegetation

Bennett (2004) identified three wetland vegetation units during their survey, these being:

1. Low open forest of *Melaleuca preissiana* over sedgeland (on a floodplain).
2. Low open woodland of *Corymbia calophylla* over tall shrubland of *Pericalymma ellipticum* over low shrubland of *Hypocalymma angustifolium* (palusplain).
3. Open heath of *Astartea affinis* over open sedgeland/grassland (palusplain).

Only one of these wetland units Low open forest of *Melaleuca preissiana* over sedgeland was mapped as a separate unit (ErMrW) during the current survey. This unit was predominantly in a Completely Degraded condition. Bennett's two other wetland units were no longer

recognisable in the field, presumably because of ongoing degradation and loss of species due to grazing.

The pattern of ongoing degradation of wetland habitat across the survey area is similar for CCW wetlands and REW mapped across the survey. These have been mostly been cleared, or are in a Degraded to Completely Degraded Condition. Consideration may, therefore, need to be given to revising the conservation status of the Cleared and Completely Degraded portions of the RE and CC wetlands as these areas would be regarded as scoring poorly on both natural and human use attributes.

6.2.3 Vegetation complexes and associations

Three vegetation complexes are mapped across the survey area: the Bassendean Complex – Central and South, the Guilford Complex and Southern River Complex. However the survey area vegetation is generally only representative of the Bassendean Complex – Central and South, and the Southern River Complex as much of the Guildford Complex mapped across the survey area has been cleared.

All of these of complexees, but particularly the Guildford Complex (5.09%) are below the desired 30% pre-European retention target.

There is only one of Beard's vegetation associations mapped within the survey area, association 968 'Medium woodland; marri & wandoo'. The survey area vegetation does not resemble the description of association 968 due mostly to the absence of Wandoo. This discrepancy may be due in part to the clearing of wandoo from this part of the landscape and to the large scale of Beard's mapping which was not designed to be used at the local scale. Wandoo is a dominant species of the Guildford complex which has been extensive cleared.

Association 968 exceeds the 30% retention target at a statewide level, but is significantly below this level at the IBRA region (6.62%), subregion (6.62%) and local government level (4.60%) where it is less than the 10% threshold. The discrepancy between the statewide and other levels is due to a large area of this association in a mostly uncleared state within the Darling Plateau.

6.3 Ecological Linkages and connectivity

The survey area vegetation occurs within a mostly discrete parcel of vegetation that extends beyond the survey area mostly towards the west and southwest. This parcel of vegetation has limited value as part of an ecological linkage. It occurs as a generally isolated parcel in a cleared agricultural context and is only loosely connected to other isolated parcels of vegetation via a scattered and generally narrow corridor of vegetation along the Dirk brook and its associated tributaries. These values may be further limited by the overall degraded condition of the vegetation.

There is no statutory basis for the protection of this vegetation as an ecological linkage. However, the importance of ecological linkages, in general, has been recognised as an

environmental policy consideration in EPA and Planning policy (EPA, 2008 and references therein).

6.4 Environmentally sensitive areas

There are two ESAs within the survey area (DWER 2020), both of which are associated with CC wetlands in Degraded to Completely Degraded condition which occur near the northern boundary of the survey area. The ESA in the west extends beyond the boundary of the survey area. The nearest ESA outside of the survey area occurs approximately 350 m north of the northern boundary and is also associated with a CC wetland.

Exemptions for the need to obtain a clearing permit under the Environmental Protection (Clearing of Native Vegetation) Regulation 2004 do not apply within the boundary of ESAs.

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Appendix 1. Threatened and Priority flora likelihood of occurrence assessment rationale.

Appendix 2. Vegetation condition scale (EPA, 2016).

Appendix 3. Categories of Threatened and Priority ecological communities.

Appendix 4. Categories of Threatened ecological communities under the EPBC Act.

Appendix 5. Protected Matters Search Tool and NatureMap reports.

Appendix 6. State Categories of Threatened and Priority list flora.

Appendix 7. Categories of Threatened species under the EPBC Act.

Appendix 8. Pre and post likelihood of occurrence.

Appendix 9. Track log and relevé points.

Appendix 10. List of vascular flora found within the survey area.

Appendix 11. Photographs of the vegetation units.

Appendix 12. DBCA TEC reporting form.

Appendix 1. Threatened and Priority flora Likelihood of occurrence assessment methodology.

Rating	Presurvey rationale	Post survey rationale
Recorded		Taxon was or has been recorded in the survey area.
Likely	Known to occur within one kilometre (km) of the survey area with suitable habitat known or predicted to occur within the survey area.	<p>The taxon is known to occur within one km of the survey area and very suitable habitat was present, but the taxon was not observed for one of the following reasons.</p> <ul style="list-style-type: none"> L1. The taxon was dormant at the time of survey and could therefore not be located. L2. The habitat was compromised, for example due to a recent fire. L3. The survey area is challenging to survey. The taxon is non- descript and difficult to find because, for example, it occurs in large areas of rocky granite outcrops, or within an expanse of open water.
Possible	Known to occur within a five-ten km of the survey area with suitable habitat known or predicted to occur within the survey area.	<p>The taxon is known from within a five to ten km radius of the survey area, and suitable habitat for the species was present, but despite a thorough search being carried out, the species was not observed. The taxon may however be present for any of the following reasons.</p> <ul style="list-style-type: none"> P1. The taxon was dormant at the time of survey and could therefore not be located. P2. The habitat was compromised, for example, due to a recent fire. P3. The survey area is challenging to survey. The taxon is non- descript and difficult to find because, for example, it occurs in large areas of rocky granite outcrops, or within an expanse of open water.
Unlikely	Known or predicted to occur within ten km, but no suitable habitat is known or predicted to occur within the survey area.	<p>The taxon was not found and is unlikely to be present for one or more of the following reasons:</p> <ul style="list-style-type: none"> U1. No suitable habitat was observed, and the taxon is known to be restricted to a narrow and clearly defined habitat type. U2. Suitable or potential habitat was present and appropriately searched, but the taxon was not observed. U3. Suitable habitat present, but these areas were too degraded for the taxon to occur, for example, due to weed invasion and/or clearing.

Example of application of pre and post-survey likelihood of occurrence

Taxon	Cons Status	Flowering	Description	Pre survey likelihood	Post Survey Likelihood
<i>Drakaea elastica</i>	T (EN)	Oct-Nov	Tuberous, perennial, herb, 0.12-0.3 m high. Fl. red, green, yellow. White or grey sand. Low-lying situations adjoining winter-wet swamps.	Likely	Unlikely (U3)

Appendix 3. Vegetation condition scale (EPA 2016).

Vegetation Condition	South West and Interzone Botanical Provinces
Pristine	Pristine or nearly so, no obvious signs of disturbance or damage caused by human activities since European settlement.
Excellent	Vegetation structure intact, disturbance affecting individual species and weeds are non-aggressive species. Damage to trees caused by fire, the presence of non-aggressive weeds and occasional vehicle tracks.
Very Good	Vegetation structure altered, obvious signs of disturbance. 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. Disturbance to vegetation structure caused by very frequent fires, the presence of very aggressive weeds, 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. Disturbance to vegetation structure caused by very frequent fires, the presence of very aggressive weeds at high density, 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 and shrubs.

Appendix 3. Categories of Threatened ecological communities under the EPBC Act.

Category	Definition
Critically endangered (CR)	If, at that time, an ecological community is facing an extremely high risk of extinction in the wild in the immediate future (indicative timeframe being the next 10 years).
Endangered (EN)	If, at that time, an ecological community is not critically endangered but is facing a very high risk of extinction in the wild in the near future (indicative timeframe being the next 20 years).
Vulnerable (VU)	If, at that time, an ecological, community is not critically endangered or endangered but is facing a high risk of extinction in the wild in the medium-term future (indicative timeframe being the next 50 years).

Appendix 4. Categories of threatened and priority ecological communities under the BC Act.

Conservation code	Category
(T) Threatened ecological community pursuant to Sect 27 of the <i>Biodiversity Conservation Act 2016</i> .	
T	<p>(T) CR – Critically endangered</p> <p>An ecological community that has been adequately surveyed and found to have been subject to a major contraction in area and/or that was originally of limited distribution and is facing severe modification or destruction throughout its range in the immediate future, or is already severely degraded throughout its range but capable of being substantially restored or rehabilitated.</p>
	<p>(T) EN - Endangered</p> <p>An ecological community that has been adequately surveyed and found to have been subject to a major contraction in area and/or was originally of limited distribution and is in danger of significant modification throughout its range or severe modification or destruction over most of its range in the near future.</p>
	<p>(T) VU - Vulnerable</p> <p>An ecological community that has been adequately surveyed and is found to be declining and/or has declined in distribution and/or condition and whose ultimate security has not yet been assured and/or a community that is still widespread but is believed likely to move into a category of higher threat in the near future if threatening processes continue or begin operating throughout its range.</p>
(P) Priority species – possible threatened communities.	
p1	<p>Poorly known communities</p> <p>Ecological communities that are known from very few occurrences with a very restricted distribution (generally ≤ 5 occurrences or a total area of ≤ 100ha). Occurrences are believed to be under threat either due to limited extent, or being on lands under immediate threat (e.g. within agricultural or pastoral lands, urban areas, active mineral leases) or for which current threats exist. May include communities with occurrences on protected lands. Communities may be included if they are comparatively well-known from one or more localities but do not meet adequacy of survey requirements, and/or are not well defined, and appear to be under immediate threat from known threatening processes across their range.</p>

Conservation code	Category
P2	<p>Poorly known communities</p> <p>Communities that are known from few occurrences with a restricted distribution (generally ≤ 10 occurrences or a total area of ≤ 200ha). At least some occurrences are not believed to be under immediate threat (within approximately 10 years) of destruction or degradation. Communities may be included if they are comparatively well known from one or more localities but do not meet adequacy of survey requirements, and/or are not well defined, and appear to be under threat from known threatening processes.</p>
P3	<p>Poorly known communities</p> <ul style="list-style-type: none"> a) 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: b) communities known from a few widespread occurrences, which are either large or with significant remaining areas of habitat in which other occurrences may occur, much of it not under imminent threat (within approximately 10 years), or; c) communities made up of large, and/or widespread occurrences, that may or may not be represented in the reserve system, but are under threat of modification across much of their range from processes such as grazing by domestic and/or feral stock, inappropriate fire regimes, clearing, hydrological change etc. <p>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.</p>
P4	<p>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.</p> <ul style="list-style-type: none"> a) Rare. Species that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection but could be if present circumstances change. These species are usually represented on conservation lands. b) Near Threatened. Species that are considered to have been adequately surveyed and that are close to qualifying for vulnerable but are not listed as Conservation Dependent. c) Species that have been removed from the list of threatened species during the past five years for reasons other than taxonomy.
P5	<p>Conservation dependent ecological communities</p> <p>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.</p>

Appendix 7. Protected Matters Search Tool and NatureMap reports

Keysbrook NatureMap Consig Flora Report 210921_10Km

Created By Guest user on 21/09/2021

Kingdom Plantae

Conservation Status Conservation Taxon (T, X, IA, S, P1-P5)

Current Names Only Yes

Core Datasets Only Yes

Method 'By Circle'

Centre 115° 55' 26" E, 32° 26' 51" S

Buffer 10km

Name ID	Species Name	Naturalised	Conservation Code	¹ Endemic To Query Area
1.	3237 <i>Acacia benthamii</i>		P2	
2.	3373 <i>Acacia horridula</i>		P3	
3.	14932 <i>Acacia lasiocarpa</i> var. <i>bracteolata long peduncle variant</i> (G.J. Keighery 5026)		P1	
4.	14131 <i>Acacia oncinophylla</i> subsp. <i>patulifolia</i>		P4	
5.	6946 <i>Anthocercis gracilis</i> (Slender Tailflower)		T	
6.	141 <i>Aponogeton hexatepalus</i> (Stalked Water Ribbons)		P4	
7.	11612 <i>Boronia capitata</i> subsp. <i>gracilis</i>		P3	
8.	4444 <i>Boronia tenuis</i> (Blue Boronia)		P4	
9.	1596 <i>Caladenia huegelii</i> (Grand Spider Orchid)		T	
10.	13862 <i>Caladenia speciosa</i>		P4	
11.	11333 <i>Calothamnus graniticus</i> subsp. <i>leptophyllus</i>		P4	
12.	1639 <i>Drakaea elastica</i> (Glossy-leaved Hammer Orchid)		T	
13.	41801 <i>Eryngium pinnatifidum</i> subsp. <i>Palustre</i> (G.J. Keighery 13459)		P3	
14.	6686 <i>Halgania corymbosa</i>		P3	
15.	29775 <i>Isopogon drummondii</i>		P3	
16.	19272 <i>Johnsonia pubescens</i> subsp. <i>cygnorum</i>		P2	
17.	45081 <i>Lasiopetalum glutinosum</i> subsp. <i>glutinosum</i>		P3	
18.	1086 <i>Lepyrodia heleocharoides</i>		P3	
19.	33638 <i>Meionectes tenuifolia</i>		P3	
20.	5260 <i>Pimelea rara</i> (Summer Pimelea)		P4	
21.	8212 <i>Senecio leucoglossus</i>		P4	
22.	20666 <i>Stachystemon</i> sp. <i>Keysbrook</i> (R. Archer 17/11/99)		P1	
23.	43540 <i>Stackhousia</i> sp. <i>Red-blotched corolla</i> (A. Markey 911)		P3	
24.	7756 <i>Stylidium longitubum</i> (Jumping Jacks)		P4	
25.	48297 <i>Styphelia filifolia</i>		P3	
26.	16865 <i>Synaphea odocoleops</i>		P1	
27.	18590 <i>Synaphea</i> sp. <i>Fairbridge Farm</i> (D. Papenfus 696)		T	
28.	19055 <i>Synaphea</i> sp. <i>Pinjarra</i> (R. Davis 6578)		T	
29.	30751 <i>Synaphea</i> sp. <i>Pinjarra Plain</i> (A.S. George 17182)		T	
30.	28354 <i>Synaphea</i> sp. <i>Serpentine</i> (G.R. Brand 103)		T	
31.	1033 <i>Tetralia australiensis</i>		T	
32.	1317 <i>Thysanotus anceps</i>		P3	
33.	14714 <i>Verticordia lindleyi</i> subsp. <i>lindleyi</i>		P4	
34.	12448 <i>Verticordia plumosa</i> var. <i>ananeotes</i>		T	

Conservation Codes

T - Rare or likely to become extinct
X - Presumed extinct
IA - Protected under international agreement
S - Other specially protected fauna
1 - Priority 1
2 - Priority 2
3 - Priority 3
4 - Priority 4
5 - Priority 5

¹ For NatureMap's purposes, species flagged as endemic are those whose records are wholly contained within the search area. Note that only those records complying with the search criterion are included in the calculation. For example, if you limit records to those from a specific datasource, only records from that datasource are used to determine if a species is restricted to the query area.

EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected.

Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

Information is available about [Environment Assessments](#) and the EPBC Act including significance guidelines, forms and application process details.

Report created: 21/09/21 23:11:19

[Summary](#)

[Details](#)

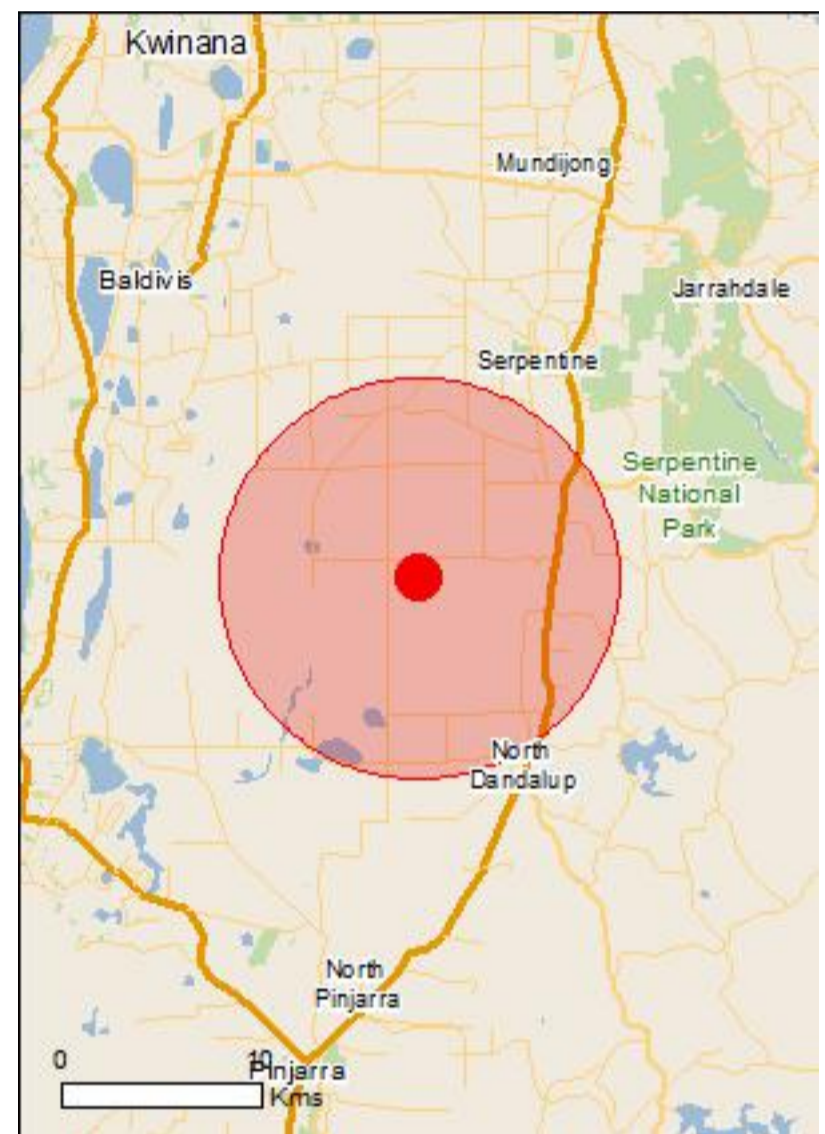
[Matters of NES](#)

[Other Matters Protected by the EPBC Act](#)

[Extra Information](#)

[Caveat](#)

[Acknowledgements](#)



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[Coordinates](#)

[Buffer: 10.0Km](#)



Summary

Matters of National Environmental Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the [Administrative Guidelines on Significance](#).

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance:	2
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	None
Listed Threatened Ecological Communities:	4
Listed Threatened Species:	34
Listed Migratory Species:	10

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at <http://www.environment.gov.au/heritage>

A [permit](#) may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Land:	1
Commonwealth Heritage Places:	None
Listed Marine Species:	15
Whales and Other Cetaceans:	None
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	None

Extra Information

This part of the report provides information that may also be relevant to the area you have nominated.

State and Territory Reserves:	4
Regional Forest Agreements:	1
Invasive Species:	39
Nationally Important Wetlands:	None
Key Ecological Features (Marine)	None

Details

Matters of National Environmental Significance

Wetlands of International Importance (Ramsar)	[Resource Information]
Name	Proximity
Becher point wetlands	Within 10km of Ramsar
Peel-yalgorup system	10 - 20km upstream

Listed Threatened Ecological Communities	[Resource Information]
For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.	

Name	Status	Type of Presence
Banksia Woodlands of the Swan Coastal Plain ecological community	Endangered	Community likely to occur within area
Clay Pans of the Swan Coastal Plain	Critically Endangered	Community likely to occur within area
Corymbia calophylla - Kingia australis woodlands on heavy soils of the Swan Coastal Plain	Endangered	Community known to occur within area
Tuart (Eucalyptus gomphocephala) Woodlands and Forests of the Swan Coastal Plain ecological community	Critically Endangered	Community likely to occur within area

Listed Threatened Species	[Resource Information]	
Name	Status	Type of Presence
Birds		
Botaurus poiciloptilus Australasian Bittern [1001]	Endangered	Species or species habitat likely to occur within area
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat may occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat likely to occur within area
Calyptorhynchus banksii naso Forest Red-tailed Black-Cockatoo, Karrak [67034]	Vulnerable	Species or species habitat known to occur within area
Calyptorhynchus baudinii Baudin's Cockatoo, Long-billed Black-Cockatoo [769]	Endangered	Roosting known to occur within area
Calyptorhynchus latirostris Carnaby's Cockatoo, Short-billed Black-Cockatoo [59523]	Endangered	Species or species habitat known to occur within area
Falco hypoleucos Grey Falcon [929]	Vulnerable	Species or species habitat may occur within area
Leipoa ocellata Malleefowl [934]	Vulnerable	Species or species habitat likely to occur within area

Name	Status	Type of Presence
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat likely to occur within area
Rostratula australis Australian Painted Snipe [77037]	Endangered	Species or species habitat likely to occur within area
Sternula nereis nereis Australian Fairy Tern [82950]	Vulnerable	Species or species habitat may occur within area
Mammals		
Dasyurus geoffroii Chuditch, Western Quoll [330]	Vulnerable	Species or species habitat likely to occur within area
Pseudocheirus occidentalis Western Ringtail Possum, Ngwayir, Womp, Woder, Ngoor, Ngoolangit [25911]	Critically Endangered	Species or species habitat likely to occur within area
Setonix brachyurus Quokka [229]	Vulnerable	Species or species habitat known to occur within area
Other		
Westralunio carteri Carter's Freshwater Mussel, Freshwater Mussel [86266]	Vulnerable	Species or species habitat known to occur within area
Plants		
Andersonia gracilis Slender Andersonia [14470]	Endangered	Species or species habitat likely to occur within area
Anthocercis gracilis Slender Tailflower [11103]	Vulnerable	Species or species habitat likely to occur within area
Caladenia huegelii King Spider-orchid, Grand Spider-orchid, Rusty Spider-orchid [7309]	Endangered	Species or species habitat known to occur within area
Diuris drummondii Tall Donkey Orchid [4365]	Vulnerable	Species or species habitat likely to occur within area
Diuris micrantha Dwarf Bee-orchid [55082]	Vulnerable	Species or species habitat likely to occur within area
Diuris purdiei Purdie's Donkey-orchid [12950]	Endangered	Species or species habitat likely to occur within area
Drakaea elastica Glossy-leaved Hammer Orchid, Glossy-leaved Hammer Orchid, Warty Hammer Orchid [16753]	Endangered	Species or species habitat known to occur within area
Drakaea micrantha Dwarf Hammer-orchid [56755]	Vulnerable	Species or species habitat likely to occur within area
Eleocharis keigheryi Keighery's Eleocharis [64893]	Vulnerable	Species or species habitat may occur within area
Eucalyptus x balanites Cadda Road Mallee, Cadda Mallee [87816]	Endangered	Species or species habitat may occur within area
Lasiopetalum pterocarpum Wing-fruited Lasiopetalum [64922]	Endangered	Species or species

Name	Status	Type of Presence
Synaphea sp. Fairbridge Farm (D. Papenfus 696) Selena's Synaphea [82881]	Critically Endangered	habitat likely to occur within area Species or species habitat known to occur within area
Synaphea sp. Pinjarra (R. Davis 6578) Club-leafed Synaphea [82880]	Critically Endangered	Species or species habitat known to occur within area
Synaphea sp. Pinjarra Plain (A.S. George 17182) [86878]	Endangered	Species or species habitat known to occur within area
Synaphea sp. Serpentine (G.R. Brand 103) [86879]	Critically Endangered	Species or species habitat known to occur within area
Synaphea stenoloba Dwellingup Synaphea [66311]	Endangered	Species or species habitat likely to occur within area
Tetraria australiensis Southern Tetraria [10137]	Vulnerable	Species or species habitat likely to occur within area
Thelymitra stellata Star Sun-orchid [7060]	Endangered	Species or species habitat may occur within area
Verticordia plumosa var. ananeotes Tufted Plumed Featherflower [23871]	Endangered	Species or species habitat may occur within area

Listed Migratory Species

[[Resource Information](#)]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Migratory Marine Birds		
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Migratory Terrestrial Species		
Motacilla cinerea Grey Wagtail [642]		Species or species habitat may occur within area
Migratory Wetlands Species		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat known to occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat likely to occur within area
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat may occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat likely to occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat likely to occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat likely to occur within area

Name	Threatened	Type of Presence
Pandion haliaetus Osprey [952]		Species or species habitat likely to occur within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat likely to occur within area

Other Matters Protected by the EPBC Act

Commonwealth Land [\[Resource Information \]](#)

The Commonwealth area listed below may indicate the presence of Commonwealth land in this vicinity. Due to the unreliability of the data source, all proposals should be checked as to whether it impacts on a Commonwealth area, before making a definitive decision. Contact the State or Territory government land department for further information.

Name
Commonwealth Land -

Listed Marine Species [\[Resource Information \]](#)

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Birds		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat known to occur within area
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardea ibis Cattle Egret [59542]		Species or species habitat may occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat likely to occur within area
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat may occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat likely to occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat likely to occur within area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat likely to occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within

Name	Threatened	Type of Presence area
Motacilla cinerea Grey Wagtail [642]		Species or species habitat may occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat likely to occur within area
Pandion haliaetus Osprey [952]		Species or species habitat likely to occur within area
Rostratula benghalensis (sensu lato) Painted Snipe [889]	Endangered*	Species or species habitat likely to occur within area
Thinornis rubricollis Hooded Plover [59510]		Species or species habitat may occur within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat likely to occur within area

Extra Information

State and Territory Reserves	[Resource Information]
Name	State
NTWA Bushland covenant (0077)	WA
NTWA Bushland covenant (0086)	WA
NTWA Bushland covenant (0089)	WA
North Dandalup	WA

Regional Forest Agreements	[Resource Information]
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Note that all areas with completed RFAs have been included.

Name	State
South West WA RFA	Western Australia

Invasive Species	[Resource Information]
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Weeds reported here are the 20 species of national significance (WoNS), along with other introduced plants that are considered by the States and Territories to pose a particularly significant threat to biodiversity. The following feral animals are reported: Goat, Red Fox, Cat, Rabbit, Pig, Water Buffalo and Cane Toad. Maps from Landscape Health Project, National Land and Water Resources Audit, 2001.

Name	Status	Type of Presence
Birds		
Acridotheres tristis Common Myna, Indian Myna [387]		Species or species habitat likely to occur within area
Anas platyrhynchos Mallard [974]		Species or species habitat likely to occur within area
Carduelis carduelis European Goldfinch [403]		Species or species habitat likely to occur within area
Columba livia Rock Pigeon, Rock Dove, Domestic Pigeon [803]		Species or species

Name	Status	Type of Presence
Passer domesticus House Sparrow [405]		habitat likely to occur within area Species or species habitat likely to occur within area
Passer montanus Eurasian Tree Sparrow [406]		Species or species habitat likely to occur within area
Streptopelia chinensis Spotted Turtle-Dove [780]		Species or species habitat likely to occur within area
Streptopelia senegalensis Laughing Turtle-dove, Laughing Dove [781]		Species or species habitat likely to occur within area
Sturnus vulgaris Common Starling [389]		Species or species habitat likely to occur within area
Turdus merula Common Blackbird, Eurasian Blackbird [596]		Species or species habitat likely to occur within area
Mammals		
Bos taurus Domestic Cattle [16]		Species or species habitat likely to occur within area
Canis lupus familiaris Domestic Dog [82654]		Species or species habitat likely to occur within area
Capra hircus Goat [2]		Species or species habitat likely to occur within area
Felis catus Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
Feral deer Feral deer species in Australia [85733]		Species or species habitat likely to occur within area
Funambulus pennantii Northern Palm Squirrel, Five-striped Palm Squirrel [129]		Species or species habitat likely to occur within area
Mus musculus House Mouse [120]		Species or species habitat likely to occur within area
Oryctolagus cuniculus Rabbit, European Rabbit [128]		Species or species habitat likely to occur within area
Rattus norvegicus Brown Rat, Norway Rat [83]		Species or species habitat likely to occur within area
Rattus rattus Black Rat, Ship Rat [84]		Species or species habitat likely to occur within area
Sus scrofa Pig [6]		Species or species habitat likely to occur within area
Vulpes vulpes Red Fox, Fox [18]		Species or species

Name	Status	Type of Presence
habitat likely to occur within area		
Plants		
Asparagus asparagoides Bridal Creeper, Bridal Veil Creeper, Smilax, Florist's Smilax, Smilax Asparagus [22473]		Species or species habitat likely to occur within area
Brachiaria mutica Para Grass [5879]		Species or species habitat may occur within area
Cenchrus ciliaris Buffel-grass, Black Buffel-grass [20213]		Species or species habitat may occur within area
Chrysanthemoides monilifera Bitou Bush, Boneseed [18983]		Species or species habitat may occur within area
Chrysanthemoides monilifera subsp. monilifera Boneseed [16905]		Species or species habitat likely to occur within area
Eichhornia crassipes Water Hyacinth, Water Orchid, Nile Lily [13466]		Species or species habitat likely to occur within area
Genista sp. X Genista monspessulana Broom [67538]		Species or species habitat may occur within area
Lantana camara Lantana, Common Lantana, Kamara Lantana, Large-leaf Lantana, Pink Flowered Lantana, Red Flowered Lantana, Red-Flowered Sage, White Sage, Wild Sage [10892]		Species or species habitat likely to occur within area
Lycium ferocissimum African Boxthorn, Boxthorn [19235]		Species or species habitat likely to occur within area
Olea europaea Olive, Common Olive [9160]		Species or species habitat may occur within area
Pinus radiata Radiata Pine Monterey Pine, Insignis Pine, Wilding Pine [20780]		Species or species habitat may occur within area
Rubus fruticosus aggregate Blackberry, European Blackberry [68406]		Species or species habitat likely to occur within area
Salix spp. except S.babylonica, S.x calodendron & S.x reichardtii Willows except Weeping Willow, Pussy Willow and Sterile Pussy Willow [68497]		Species or species habitat likely to occur within area
Salvinia molesta Salvinia, Giant Salvinia, Aquarium Watermoss, Kariba Weed [13665]		Species or species habitat likely to occur within area
Solanum elaeagnifolium Silver Nightshade, Silver-leaved Nightshade, White Horse Nettle, Silver-leaf Nightshade, Tomato Weed, White Nightshade, Bull-nettle, Prairie-berry, Satansbos, Silver-leaf Bitter-apple, Silverleaf-nettle, Trompillo [12323]		Species or species habitat likely to occur within area
Tamarix aphylla Athel Pine, Athel Tree, Tamarisk, Athel Tamarisk, Athel Tamarix, Desert Tamarisk, Flowering Cypress, Salt Cedar [16018]		Species or species habitat likely to occur within area
Reptiles		
Hemidactylus frenatus Asian House Gecko [1708]		Species or species

Name	Status	Type of Presence
		habitat likely to occur within area

Caveat

The information presented in this report has been provided by a range of data sources as acknowledged at the end of the report.

This report is designed to assist in identifying the locations of places which may be relevant in determining obligations under the Environment Protection and Biodiversity Conservation Act 1999. It holds mapped locations of World and National Heritage properties, Wetlands of International and National Importance, Commonwealth and State/Territory reserves, listed threatened, migratory and marine species and listed threatened ecological communities. Mapping of Commonwealth land is not complete at this stage. Maps have been collated from a range of sources at various resolutions.

Not all species listed under the EPBC Act have been mapped (see below) and therefore a report is a general guide only. Where available data supports mapping, the type of presence that can be determined from the data is indicated in general terms. People using this information in making a referral may need to consider the qualifications below and may need to seek and consider other information sources.

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Threatened, migratory and marine species distributions have been derived through a variety of methods. Where distributions are well known and if time permits, maps are derived using either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc) together with point locations and described habitat; or environmental modelling (MAXENT or BIOCLIM habitat modelling) using point locations and environmental data layers.

Where very little information is available for species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc). In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More reliable distribution mapping methods are used to update these distributions as time permits.

Only selected species covered by the following provisions of the EPBC Act have been mapped:

- migratory and
- marine

The following species and ecological communities have not been mapped and do not appear in reports produced from this database:

- threatened species listed as extinct or considered as vagrants
- some species and ecological communities that have only recently been listed
- some terrestrial species that overfly the Commonwealth marine area
- migratory species that are very widespread, vagrant, or only occur in small numbers

The following groups have been mapped, but may not cover the complete distribution of the species:

- non-threatened seabirds which have only been mapped for recorded breeding sites
- seals which have only been mapped for breeding sites near the Australian continent

Such breeding sites may be important for the protection of the Commonwealth Marine environment.

Coordinates

-32.44755 115.92397

Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

- [-Office of Environment and Heritage, New South Wales](#)
- [-Department of Environment and Primary Industries, Victoria](#)
- [-Department of Primary Industries, Parks, Water and Environment, Tasmania](#)
- [-Department of Environment, Water and Natural Resources, South Australia](#)
- [-Department of Land and Resource Management, Northern Territory](#)
- [-Department of Environmental and Heritage Protection, Queensland](#)
- [-Department of Parks and Wildlife, Western Australia](#)
- [-Environment and Planning Directorate, ACT](#)
- [-Birdlife Australia](#)
- [-Australian Bird and Bat Banding Scheme](#)
- [-Australian National Wildlife Collection](#)
- [-Natural history museums of Australia](#)
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- [-National Herbarium of NSW](#)
- [-Royal Botanic Gardens and National Herbarium of Victoria](#)
- [-Tasmanian Herbarium](#)
- [-State Herbarium of South Australia](#)
- [-Northern Territory Herbarium](#)
- [-Western Australian Herbarium](#)
- [-Australian National Herbarium, Canberra](#)
- [-University of New England](#)
- [-Ocean Biogeographic Information System](#)
- [-Australian Government, Department of Defence Forestry Corporation, NSW](#)
- [-Geoscience Australia](#)
- [-CSIRO](#)
- [-Australian Tropical Herbarium, Cairns](#)
- [-eBird Australia](#)
- [-Australian Government – Australian Antarctic Data Centre](#)
- [-Museum and Art Gallery of the Northern Territory](#)
- [-Australian Government National Environmental Science Program](#)
- [-Australian Institute of Marine Science](#)
- [-Reef Life Survey Australia](#)
- [-American Museum of Natural History](#)
- [-Queen Victoria Museum and Art Gallery, Inveresk, Tasmania](#)
- [-Tasmanian Museum and Art Gallery, Hobart, Tasmania](#)
- [-Other groups and individuals](#)

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the [Contact Us](#) page.

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Appendix 6. Definitions of conservation codes for Threatened and Priority flora.

Conservation code	Category
(T) Threatened species pursuant to Sect 19 of the BC Act 2016.	
T	<p>(T) CR – Critically endangered</p> <p>Threatened species considered to be <i>“facing an extremely high risk of extinction in the wild in the immediate future, as determined in accordance with criteria set out in the ministerial guidelines”</i>.</p>
	<p>(T) EN - Endangered</p> <p>Threatened species considered to be <i>“facing a very high risk of extinction in the wild in the near future, as determined in accordance with criteria set out in the ministerial guidelines”</i>.</p>
	<p>(T) VU - Vulnerable</p> <p>Threatened species considered to be <i>“facing a high risk of extinction in the wild in the medium-term future, as determined in accordance with criteria set out in the ministerial guidelines”</i>.</p>
(P) Priority species – possible Threatened species.	
P1	<p>Species that are known from one or a few locations (generally five or less) which are potentially at risk. All occurrences are either: very small; or on lands not managed for conservation, e.g. agricultural or pastoral lands, urban areas, road and rail reserves, gravel reserves and active mineral leases; or otherwise under threat of habitat destruction or degradation. Species may be included if they are comparatively well known from one or more locations but do not meet adequacy of survey requirements and appear to be under immediate threat from known threatening processes. Such species are in urgent need of further survey.</p>
P2	<p>Species that are known from one or a few locations (generally five or less), some of which are on lands managed primarily for nature conservation, e.g. national parks, conservation parks, nature reserves and other lands with secure tenure being managed for conservation. Species may be included if they are comparatively well known from one or more locations but do not meet adequacy of survey requirements and appear to be under threat from known threatening processes. Such species are in urgent need of further survey.</p>

Conservation code	Category
P3	<p>Species that are known from several locations, and the species does not appear to be under imminent threat, or from few but widespread locations with either large population size or significant remaining areas of apparently suitable habitat, much of it not under imminent threat. Species may be included if they are comparatively well known from several locations but do not meet adequacy of survey requirements and known threatening processes exist that could affect them. Such species are in need of further survey.</p>
P4	<p>(a) Rare. Species that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection but could be if present circumstances change. These species are usually represented on conservation lands.</p> <p>(b) Near Threatened. Species that are considered to have been adequately surveyed and that are close to qualifying for vulnerable but are not listed as Conservation Dependent.</p> <p>(c) Species that have been removed from the list of threatened species during the past five years for reasons other than taxonomy.</p>

Appendix 7. Categories of Threatened species under the EPBC Act.

Category	Definition
Extinct (Ex)	A native species is eligible to be included in the extinct category at a particular time if, at that time, there is no reasonable doubt that the last member of the species has died.
Extinct in the Wild (ExW)	A native species is eligible to be included in the extinct in the wild category at a particular time if, at that time (a) it is known only to survive in cultivation, in captivity or as a naturalised population well outside its past range; or (b) it has not been recorded in its known and/or expected habitat, at appropriate seasons, anywhere in its past range, despite exhaustive surveys over a time frame appropriate to its life cycle and form.
Critically Endangered (CE)	A native species is eligible to be included in the critically endangered category at a particular time if, at that time, it is facing an extremely high risk of extinction in the wild in the immediate future, as determined in accordance with the prescribed criteria.
Endangered (EN)	A native species is eligible to be included in the endangered category at a particular time if, at that time (a) it is not critically endangered; and (b) it is facing a very high risk of extinction in the wild in the near future, as determined in accordance with the prescribed criteria.
Vulnerable (VU)	A native species is eligible to be included in the vulnerable category at a particular time if, at that time (a) it is not critically endangered or endangered; and (b) it is facing a high risk of extinction in the wild in the medium term future, as determined in accordance with the prescribed criteria.
Conservation Dependent (CD)	A native species is eligible to be included in the conservation dependent category at a particular time if, at that time, the species is the focus of a specific conservation program, the cessation of which would result in the species becoming vulnerable, endangered or critically endangered within a period of 5 years.

Appendix 8. Pre and post likelihood of occurrence.

SPECIES	CATEGORY	FLOWERING	Likelihood	Post-Survey Likelihood
<i>Drosera occidentalis</i>	P1	Oct-Dec or Jan	Possible	Unlikely (U2)
<i>Stachystemon exilis</i>	P1		Possible	Unlikely (U2)
<i>Acacia lasiocarpa</i> var. <i>bracteolata</i> long peduncle variant (G.J. Keighery 5026)	P1	May or Aug	Possible	Unlikely (U2)
<i>Johnsonia pubescens</i> subsp. <i>cygnorum</i>	P2	Sep	Possible	Unlikely (U2)
<i>Boronia capitata</i> subsp. <i>gracilis</i>	P3	Jun-Nov	Possible	Unlikely (U2)
<i>Eryngium pinnatifidum</i> subsp. <i>palustre</i>	P3	Oct - Nov	Possible	Unlikely (U2)
<i>Lepyrodia heleocharoides</i>	P3	Dec	Possible	Unlikely (U2)
<i>Meionectes tenuifolia</i>	P3	Nov	Possible	Unlikely (U2)
<i>Styphelia filifolia</i>	P3	Mar - May	Possible	Unlikely (U2)
<i>Aponogeton hexatepalus</i>	P4	Jul-Oct	Possible	Unlikely (U2)
<i>Caladenia speciosa</i>	P4	Sep-Oct	Possible	Unlikely (U2)
<i>Stylidium longitubum</i>	P4	Oct-Dec	Possible	Unlikely (U2)
<i>Verticordia lindleyi</i> subsp. <i>lindleyi</i>	P4	May or Nov-Dec or Jan	Possible	Unlikely (U2)
<i>Tetraria australiensis</i>	T (VU)	Nov-Dec	Possible	Unlikely (U2)
<i>Caladenia huegelii</i>	T (EN)	Sep-Oct	Possible	Unlikely (U2)

<i>Drakaea elastica</i>	T (EN)	Oct-Nov	Possible	Unlikely (U2)
<i>Verticordia plumosa</i> var. <i>ananeotes</i>	T (EN)	Nov-Dec	Possible	Unlikely (U2)
<i>Diuris drummondii</i>	T (VU)	Nov-Jan	Possible	Unlikely (U2)
<i>Diuris micrantha</i>	T (VU)	Sep-Oct	Possible	Unlikely (U2)
<i>Drakaea micrantha</i>	T (VU)	Sep-Oct	Possible	Unlikely (U2)
<i>Thelymitra stellata</i>	T (EN)	Oct to Nov.	Unlikely	Unlikely (U2)
<i>Hibbertia acrotoma</i>	P1	Aug - ?	Unlikely	Unlikely (U2)
<i>Synaphea odocoileops</i>	P1	Aug-Oct	Unlikely	Unlikely (U2)
<i>Acacia benthamii</i>	P2	Aug-Sep	Unlikely	Unlikely (U2)
<i>Acacia horridula</i>	P3	May-Aug	Unlikely	Unlikely (U2)
<i>Acacia oncinophylla</i> subsp. <i>oncinophylla</i>	P3	Aug-Oct	Unlikely	Unlikely (U1)
<i>Halgania corymbosa</i>	P3	Aug to Nov	Unlikely	Unlikely (U1)
<i>Isopogon autumnalis</i>	P3	Feb to June	Unlikely	Unlikely (U1)
<i>Lasiopetalum glutinosum</i> subsp. <i>glutinosum</i>	P3	Sep	Unlikely	Unlikely (U2)
<i>Stackhousia</i> sp. Red-blotched corolla (A. Markey 911)	P3	Sep? to Nov	Unlikely	Unlikely (U2)
<i>Thysanotus anceps</i>	P3	Oct to Dec	Unlikely	Unlikely (U2)
<i>Acacia oncinophylla</i> subsp. <i>patulifolia</i>	P4	Aug-Nov or Nov-Dec	Unlikely	Unlikely (U1)
<i>Calothamnus graniticus</i> subsp. <i>leptophyllus</i>	P4	Jun-Aug	Unlikely	Unlikely (U2)
<i>Pimelea rara</i>	P4	Dec or Jan	Unlikely	Unlikely (U1)
<i>Senecio leucoglossus</i>	P4	Aug-Nov	Unlikely	Unlikely (U1)

<i>Synaphea</i> sp. Fairbridge Farm (D. Papenfus 696)	T (CR)	Oct	Unlikely	Unlikely (U2)
<i>Synaphea</i> sp. Pinjarra (R. Davis 6578)	T (CR)	Sep - Oct	Unlikely	Unlikely (U2)
<i>Synaphea</i> sp. Serpentine (G.R. Brand 103)	T (CR)	Sep-Oct	Unlikely	Unlikely (U2)
<i>Andersonia gracilis</i>	T (EN)	Sep-Nov	Unlikely	Unlikely (U2)
<i>Eucalyptus x balanites</i>	T (EN)	Oct to Dec or Jan to Feb	Unlikely	Unlikely (U1)
<i>Lasiopetalum pterocarpum</i>	T (EN)	Aug-Dec	Unlikely	Unlikely (U1)
<i>Synaphea</i> sp. Pinjarra Plain (A.S. George 17182)	T (EN)	Sep to Nov	Unlikely	Unlikely (U2)
<i>Synaphea stenoloba</i>	T (EN)	Aug-Oct	Unlikely	Unlikely (U2)
<i>Anthocercis gracilis</i>	T (VU)	Sep to Oct	Unlikely	Unlikely (U2)

Appendix 9. Survey area sample sites.

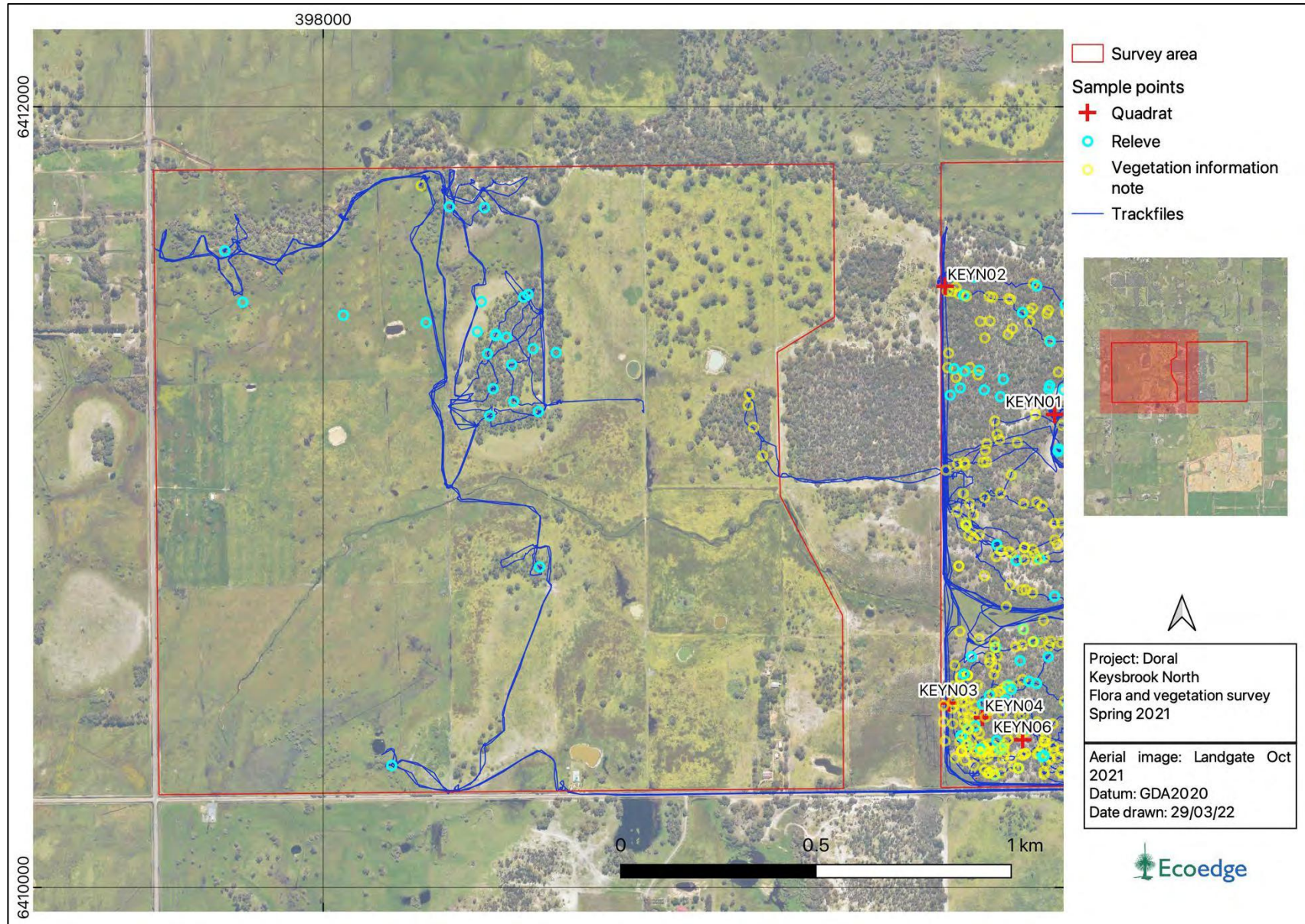


Figure A. Sample sites and tracklog location map.

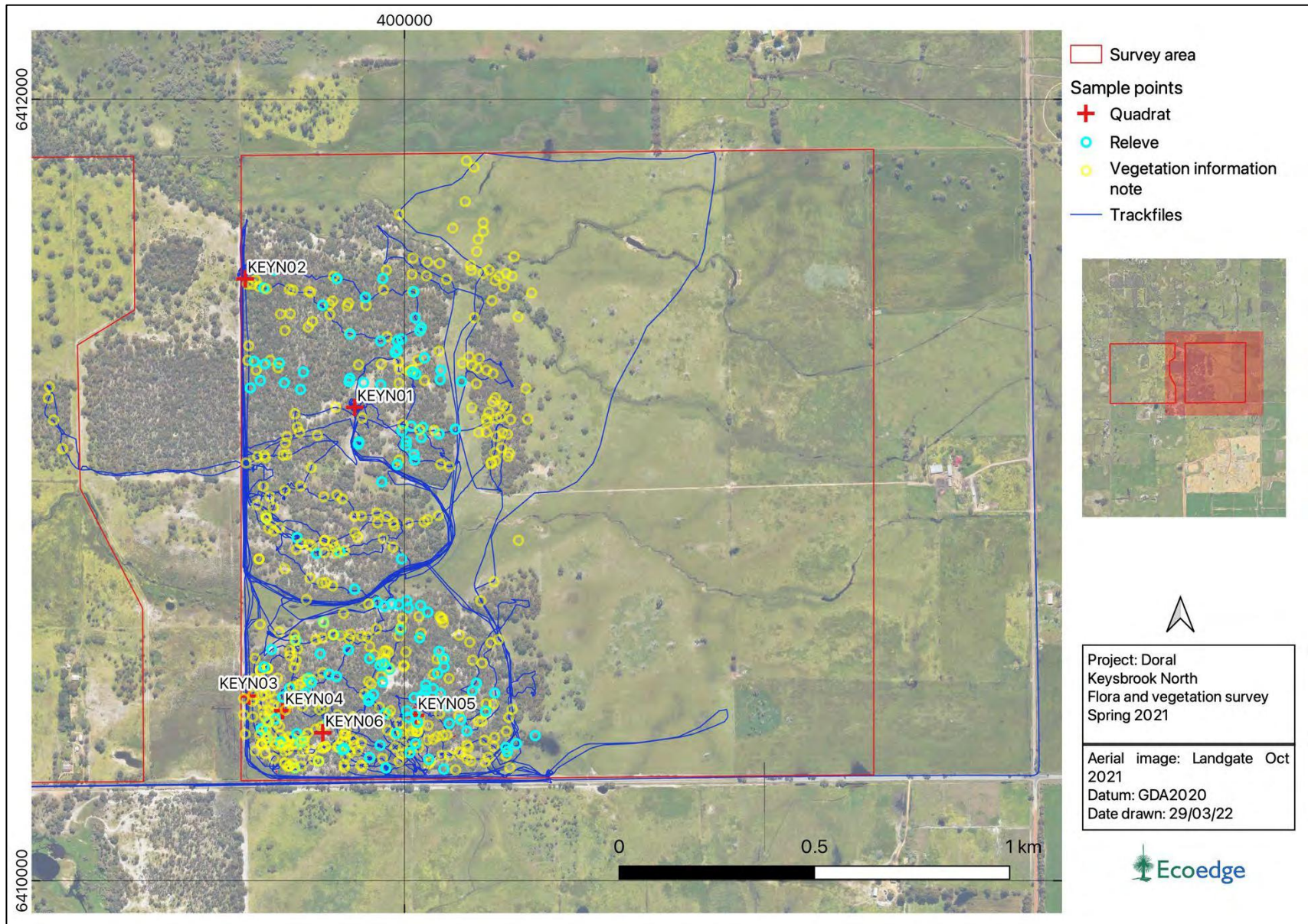


Figure B. Sample sites and tracklog location map.

Appendix 10. List of vascular flora found within the survey area.

#	FAMILY_NAME	SPECIES	NATURALISED	CONS. STATUS
1	Anarthriaceae	<i>Anarthria laevis</i>		
2	Anarthriaceae	<i>Lyginia barbata</i>		
3	Apiaceae	<i>Xanthosia huegelii</i>		
4	Araliaceae	<i>Trachymene pilosa</i>		
5	Asparagaceae	<i>Chamaescilla corymbosa</i>		
6	Asparagaceae	<i>Lomandra caespitosa</i>		
7	Asparagaceae	<i>Lomandra hermaphrodita</i>		
8	Asparagaceae	<i>Lomandra integra</i>		
9	Asparagaceae	<i>Lomandra micrantha</i>		
10	Asparagaceae	<i>Lomandra sericea</i>		
11	Asparagaceae	<i>Lomandra suaveolens</i>		
12	Asparagaceae	<i>Sowerbaea laxiflora</i>		
13	Asparagaceae	<i>Thysanotus arbuscula</i>		
14	Asteraceae	<i>Arctotheca calendula</i>	*	
15	Asteraceae	<i>Cotula coronopifolia</i>	*	
16	Asteraceae	<i>Erigeron bonariensis</i>	*	
17	Asteraceae	<i>Hypochaeris glabra</i>	*	
18	Asteraceae	<i>Ixiolaena viscosa</i>		
19	Asteraceae	<i>Lagenophora huegelii</i>		
20	Asteraceae	<i>Quinetia urvillei</i>		
21	Asteraceae	<i>Senecio hispidulus</i>		
22	Asteraceae	<i>Sonchus oleraceus</i>	*	
23	Asteraceae	<i>Ursinia anthemoides</i>	*	
24	Campanulaceae	<i>Wahlenbergia preissii</i>		
25	Casuarinaceae	<i>Allocasuarina fraseriana</i>		
26	Centrolepidaceae	<i>Aphelia cyperoides</i>		
27	Colchicaceae	<i>Burchardia congesta</i>		
28	Crassulaceae	<i>Crassula decumbens</i>		
29	Crassulaceae	<i>Crassula natans</i>	*	

#	FAMILY_NAME	SPECIES	NATURALISED	CONS. STATUS
30	Cucurbitaceae	<i>Cucumis myriocarpus</i>	*	
31	Cyperaceae	<i>Chaetospora curvifolia</i>		
32	Cyperaceae	<i>Cyathochaeta avenacea</i>		
33	Cyperaceae	<i>Isolepis marginata</i>		
34	Cyperaceae	<i>Lepidosperma longitudinale</i>		
35	Cyperaceae	<i>Lepidosperma pubisquameum</i>		
36	Cyperaceae	<i>Lepidosperma tenue</i>		
37	Cyperaceae	<i>Mesomelaena stygia</i>		
38	Cyperaceae	<i>Mesomelaena tetragona</i>		
39	Cyperaceae	<i>Tetraria octandra</i>		
40	Dasyogonaceae	<i>Dasyogon bromeliifolius</i>		
41	Dasyogonaceae	<i>Kingia australis</i>		
42	Dilleniaceae	<i>Hibbertia huegelii</i>		
43	Dilleniaceae	<i>Hibbertia hypericoides</i>		
44	Dilleniaceae	<i>Hibbertia vaginata</i>		
45	Droseraceae	<i>Drosera erythrorhiza</i>		
46	Droseraceae	<i>Drosera glanduligera</i>		
47	Droseraceae	<i>Drosera menziesii</i>		
48	Droseraceae	<i>Drosera porrecta</i>		
49	Droseraceae	<i>Drosera microphylla</i>		
50	Fabaceae	<i>Acacia applanata</i>		
51	Fabaceae	<i>Daviesia incrassata</i>		
52	Fabaceae	<i>Hovea trisperma</i>		
53	Fabaceae	<i>Jacksonia furcellata</i>		
54	Fabaceae	<i>Kennedia prostrata</i>		
55	Fabaceae	<i>Lupinus angustifolius</i>	*	
56	Fabaceae	<i>Ornithopus pinnatus</i>	*	
57	Goodeniaceae	<i>Dampiera linearis</i>		
58	Haemodoraceae	<i>Anigozanthos manglesii</i>		
59	Haemodoraceae	<i>Conostylis setigera</i>		
60	Haemodoraceae	<i>Conostylis aculeata</i> subsp. <i>aculeata</i>		

#	FAMILY_NAME	SPECIES	NATURALISED	CONS. STATUS
61	Haemodoraceae	<i>Haemodorum laxum</i>		
62	Hemerocallidaceae	<i>Caesia micrantha</i>		
63	Iridaceae	<i>Patersonia occidentalis</i>		
64	Iridaceae	<i>Romulea rosea</i>	*	
65	Juncaceae	<i>Juncus gregiflorus</i>		
66	Juncaceae	<i>Juncus subsecundus</i>		
67	Juncaceae	<i>Juncus subsecundus</i>	*	
68	Lauraceae	<i>Cassytha racemosa</i>		
69	Loganiaceae	<i>Phyllangium paradoxum</i>		
70	Lythraceae	<i>Lythrum hyssopifolia</i>	*	
71	Malvaceae	<i>Malva parviflora</i>	*	
72	Myrtaceae	<i>Astartea</i> sp.		
73	Myrtaceae	<i>Corymbia calophylla</i>		
74	Myrtaceae	<i>Eucalyptus marginata</i>		
75	Myrtaceae	<i>Eucalyptus rudis</i> subsp. <i>rudis</i>		
76	Myrtaceae	<i>Hypocalymma angustifolium</i>		
77	Myrtaceae	<i>Melaleuca preissiana</i>		
78	Myrtaceae	<i>Melaleuca raphiophylla</i>		
79	Myrtaceae	<i>Regelia ciliata</i>		
80	Orchidaceae	<i>Caladenia flava</i>		
81	Orchidaceae	<i>Diuris corymbosa</i>		
82	Orchidaceae	<i>Elythranthera brunonis</i>		
83	Orchidaceae	<i>Leporella fimbriata</i>		
84	Orchidaceae	<i>Microtis media</i>		
85	Orchidaceae	<i>Pterostylis sanguinea</i>		
86	Orchidaceae	<i>Pterostylis vittata</i>		
87	Orchidaceae	<i>Pterostylis erubescens</i>		
88	Orchidaceae	<i>Pterostylis</i> sp. Bloated snail orchid (W. Jackson BJ 486)		
89	Orchidaceae	<i>Pyrorchis nigricans</i>		
90	Oxalidaceae	<i>Oxalis glabra</i>	*	
91	Phyllanthaceae	<i>Poranthera microphylla</i>		

#	FAMILY_NAME	SPECIES	NATURALISED	CONS. STATUS
92	Poaceae	<i>Amphipogon turbinatus</i>		
93	Poaceae	<i>Briza maxima</i>	*	
94	Poaceae	<i>Briza minor</i>	*	
95	Poaceae	<i>Cynodon dactylon</i>	*	
96	Poaceae	<i>Ehrharta calycina</i>	*	
97	Poaceae	<i>Ehrharta longiflora</i>	*	
98	Poaceae	<i>Lolium perenne</i>	*	
99	Poaceae	<i>Microlaena stipoides</i>		
100	Poaceae	<i>Neurachne alopecuroides</i>		
101	Polygonaceae	<i>Rumex acetosella</i>	*	
102	Polygonaceae	<i>Rumex crispus</i>	*	
103	Polygonaceae	<i>Rumex pulcher</i>	*	
104	Proteaceae	<i>Banksia attenuata</i>		
105	Proteaceae	<i>Banksia grandis</i>		
106	Proteaceae	<i>Banksia menziesii</i>		
107	Proteaceae	<i>Hakea prostrata</i>		
108	Proteaceae	<i>Xylomelum occidentale</i>		
109	Restionaceae	<i>Desmocladius fasciculatus</i>		
110	Restionaceae	<i>Desmocladius flexuosus</i>		
111	Restionaceae	<i>Hypolaena exsulca</i>		
112	Rubiaceae	<i>Opercularia vaginata</i>		
113	Stylidiaceae	<i>Levenhookia pusilla</i>		
114	Stylidiaceae	<i>Stylidium diversifolium</i>		
115	Thymelaeaceae	<i>Pimelea lehmanniana</i>		
116	Verbenaceae	<i>Lantana camara</i>	*	
117	Violaceae	<i>Hybanthus calycinus</i>		
118	Xanthorrhoeaceae	<i>Xanthorrhoea brunonis</i>		
119	Xanthorrhoeaceae	<i>Xanthorrhoea preissii</i>		

Appendix 11. Photographs of the vegetation units.

Vegetation unit EmCcBaBmOF: *Eucalyptus marginata*, *Corymbia calophylla*, (*Allocasuarina fraseriana*) medium open forest over *Banksia attenuata*, *B. menziesii*, *Xylomelum occidentale* low woodland over *Xanthorrhoea brunonis* medium very open shrubland over *Dasypogon bromeliifolius*, *Hibbertia hypericoides* low very open shrubland over *Caladenia flava*, *Dampiera linearis*, *Drosera erythrorhiza*, **Hypochaeris glabra*, *Lagenophora huegelii*, *Lomandra* spp., **Romulea rosea*, **Ursinia anthemoides* open forbland, **Briza maxima*, *Microlaena stipoides* scattered grasses and *Mesomelaena tetragona* scattered sedges on grey sand on low rises.



Vegetation unit: CcEmAfOF: *Corymbia calophylla*, *Eucalyptus marginata*, *Allocasuarina fraseriana* medium open forest over (*Banksia attenuata*, *B. menziesii*), *B. grandis*, *Xylomelum occidentale* low woodland over *Hibbertia hypericoides*, *Xanthorrhoea brunonis* medium open shrubland over **Briza maxima*, *Microlaena stipoides* scattered grasses and *Drosera erythrorhiza*, **Hypochaeris glabra*, *Lagenophora huegelii*, *Pyrorchis nigricans*, **Ursinia anthemoides* very open forbland on grey sand/sandy loam on lower slopes (transitional between EmCcBaBmOF and CcEmXpOF).



Vegetation unit CcEmXpOF: *Corymbia calophylla* (*Eucalyptus marginata*) medium open forest over *Hibbertia hypericoides*, *Xanthorrhoea preissii* (*X. brunonis*) medium open shrubland over *Cyathochaeta avenacea*, *Mesomelaena stygia*, *M. tetragona* open sedgeland, *Conostylis aculeata*, *Desmodcladus fasciculatus*, **Hypochaeris glabra*, *Trachymene pilosa* very open forbland on grey-brown loamy sand.



Vegetation unit CcOF: *Corymbia calophylla* (*Eucalyptus marginata*) medium open forest over *Xanthorrhoea brunonis* low shrubland over **Briza maxima*, *Microlaena stipoides* scattered grasses and *Drosera erythrorhiza*, **Hypochaeris glabra*, *Lagenophora huegelii*, *Pyrorchis nigricans* very open forbland on grey sandy loam to clay-loam on flats. (The small tree *Melaleuca preissiana* may occur in this community adjacent to the northern creekline).



Vegetation unit: ErMrW: *Eucalyptus rudis* medium woodland over *Melaleuca raphiophylla* low woodland over **Arctotheca calendula*, **Hypochaeris glabra* open forbland, **Briza maxima*, **Ehrharta longiflora* grassland and **Juncus gregiflorus*, **J. subsecundus* open rushland on grey-yellow sandy loam on alluvial flats.



Appendix 12. PEC reporting form



Threatened and Priority Ecological Community (TEC/PEC) Occurrence Report Form

COMMUNITY:	Corymbia calophylla - Xanthorrhoea preissii woodlands and shrublands of the SCP (SCP FCT 3c)	OBSERVATION DATE:	25/03/2022
New occurrence <input checked="" type="checkbox"/>	Site ID: _____	CONS STATUS:	Threatened
OBSERVER/S:	Russell Smith & Colin Spencer	PHONE:	0447809124
ROLE:	botanists	ORGANISATION:	Ecoedge
EMAIL:	russell@ecoedge.com.au		

DESCRIPTION OF LOCATION (Provide at least nearest town/named locality, and the distance and direction to that place):
Lot 507, 508, 201 Elliot Road, Keysbrook

Reserve No: _____

DISTRICT: _____ **LGA:** _____ Land manager present:

DATUM:	COORDINATES: (If UTM coords provided, Zone is also required)	METHOD USED:
GDA94 / MGA94 <input checked="" type="checkbox"/>	DecDegrees <input type="checkbox"/> DegMinSec <input type="checkbox"/> UTM <input checked="" type="checkbox"/>	GPS <input checked="" type="checkbox"/> Differential GPS <input type="checkbox"/> Map <input type="checkbox"/>
AGD84 / AMG84 <input type="checkbox"/>	Lat / Northing: 6410771	No. satellites: _____ Map used: _____
WGS84 <input type="checkbox"/>	Long / Easting: 399889	Boundary polygon captured: <input type="checkbox"/> Map used: _____
Unknown <input type="checkbox"/>	Zone: 50	

LAND TENURE:

Nature reserve <input type="checkbox"/>	Timber reserve <input type="checkbox"/>	Private property <input checked="" type="checkbox"/>	Rail reserve <input type="checkbox"/>	Shire road reserve <input type="checkbox"/>
National park <input type="checkbox"/>	State forest <input type="checkbox"/>	Pastoral lease <input type="checkbox"/>	MRWA road reserve <input type="checkbox"/>	Other Crown reserve <input type="checkbox"/>
Conservation park <input type="checkbox"/>	Water reserve <input type="checkbox"/>	UCL <input type="checkbox"/>	SLK/Pole _____ to _____	Specify other: _____

AREA ASSESSMENT: Edge survey Partial survey Full survey Area observed (m²): _____

EFFORT: Time spent surveying (minutes): _____ No. of minutes spent / 100 m²: _____

THREATS - type, and supporting information: e.g. clearing, too frequent fire, weed, disease. Refer to field manual for list of threats & agents.	Cause/Agent: e.g. weed type, grazing species, recreation type	Area affected	Current impact (N-E)	Potential Impact (L-E)	Potential Threat Onset (S-L)
• Mining for mineral sands		%			
•		%			
•		%			
•		%			
•		%			
•		%			
•		%			
•		%			
•		%			

*Rate current and potential threat impact: N=Nil, L=Low, M=Medium, H=High, E=Extreme

*Estimate time to potential impact: S=Short (<12mths), M=Medium (<5yrs), L=Long (5yrs+)

CONDITION OF OCCURRENCE: (Bush Forever Scale) (estimate % of area in each)

Pristine _____% Very Good _____% Degraded 78%

Please return form to:

communities.data@dpaw.wa.gov.au

or Species and Communities Branch, Department of Parks and Wildlife, Locked Bag 104, Bentley Delivery Centre WA 6983

Record entered by: _____ Date entered: _____ Database no: _____



Threatened and Priority Ecological Community (TEC/PEC) Occurrence Report Form

Excellent ____%

Good 22%

Completely Degraded ____%

RECOMMENDED MANAGEMENT ACTIONS: e.g. roadside markers, weed control, etc.

ACTIONS IMPLEMENTED (include date):

HABITAT INFORMATION: (Check more than one box for combinations or where necessary)

LANDFORM:	ROCK TYPE:	LOOSE ROCK:	SOIL TYPE:	SOIL COLOUR:	DRAINAGE:
Crest <input type="checkbox"/> Hill <input type="checkbox"/> Ridge <input type="checkbox"/> Outcrop <input type="checkbox"/> Slope <input type="checkbox"/> Flat <input checked="" type="checkbox"/> Open depression <input type="checkbox"/> Drainage line <input type="checkbox"/> Closed depression <input type="checkbox"/> Wetland <input type="checkbox"/>	Granite <input type="checkbox"/> Dolerite <input type="checkbox"/> Laterite <input type="checkbox"/> Ironstone <input type="checkbox"/> Limestone <input type="checkbox"/> Quartz <input type="checkbox"/> Specify other:	(on soil surface; e.g. gravel, quartz fields) 0-10% <input type="checkbox"/> 10-30% <input type="checkbox"/> 30-50% <input type="checkbox"/> 50-100% <input type="checkbox"/>	Sand <input type="checkbox"/> Sandy loam <input checked="" type="checkbox"/> Loam <input type="checkbox"/> Clay loam <input type="checkbox"/> Light clay <input type="checkbox"/> Peat <input type="checkbox"/> Specify other:	Red <input type="checkbox"/> Brown <input checked="" type="checkbox"/> Yellow <input type="checkbox"/> White <input type="checkbox"/> Grey <input checked="" type="checkbox"/> Black <input type="checkbox"/> Specify other:	Well drained <input checked="" type="checkbox"/> Seasonally inundated <input type="checkbox"/> Permanently inundated <input type="checkbox"/> Tidal <input type="checkbox"/> Specify other:

Specific Landform Element: (Refer to field manual for additional values)

CONDITION OF SOIL:

Dry Moist Waterlogged Inundated Cracked Saline Other:

VEGETATION CLASSIFICATION:

1. Woodland
2. Open shrubland
3. Open sedgeland
4. Open herbland

FIRE HISTORY:

Last Fire: Season/Month: Year: **Fire Intensity:** High Medium Low No evidence of fire

Please return form to:

communities.data@dpaw.wa.gov.au

or Species and Communities Branch, Department of Parks and Wildlife, Locked Bag 104, Bentley Delivery Centre WA 6983

Record entered by: _____ Date entered: _____ Database no: _____



Threatened and Priority Ecological Community (TEC/PEC) Occurrence Report Form

Actual Occurrence Landuse:	Farming
Adjacent Landuse:	Farming

Associated Flora Species:	
	Corymbia calophylla (Eucalyptus marginata) medium open forest over Hibbertia hypericoides, Xanthorrhoea preissii (X. brunonis) medium open shrubland over Cyathochaeta avenacea, Mesomelaena stygia, M. tetragona open sedgeland, Conostylis aculeata, Desmodcladus fasciculatus, *Hypochaeris glabra, Trachymene pilosa very open forbland on grey-brown loamy sand.

Associated Fauna Species:	

OTHER COMMENTS:	

ATTACHED:	Map <input type="checkbox"/>	Mudmap <input type="checkbox"/>	Photo <input type="checkbox"/>	GIS data <input type="checkbox"/>	Field notes <input type="checkbox"/>
Other:					
COPY SENT TO:	Regional Office <input type="checkbox"/>	District Office <input type="checkbox"/>	Other:		

Please return form to:
communities.data@dpaw.wa.gov.au
 or Species and Communities Branch, Department of Parks and Wildlife, Locked Bag 104, Bentley Delivery Centre WA 6983

Record entered by: _____ Date entered: _____ Database no: _____



Threatened and Priority Ecological Community (TEC/PEC) Occurrence Report Form

Submitter of record:	<u>Russell Smith</u>	Role:	<u>botanist</u>
Signature:	<u>Russell Smith</u>	Date submitted:	<u>29/03/2022</u>

Please return form to:

communities.data@dpaw.wa.gov.au

or Species and Communities Branch, Department of Parks and Wildlife, Locked Bag 104, Bentley Delivery Centre WA 6983

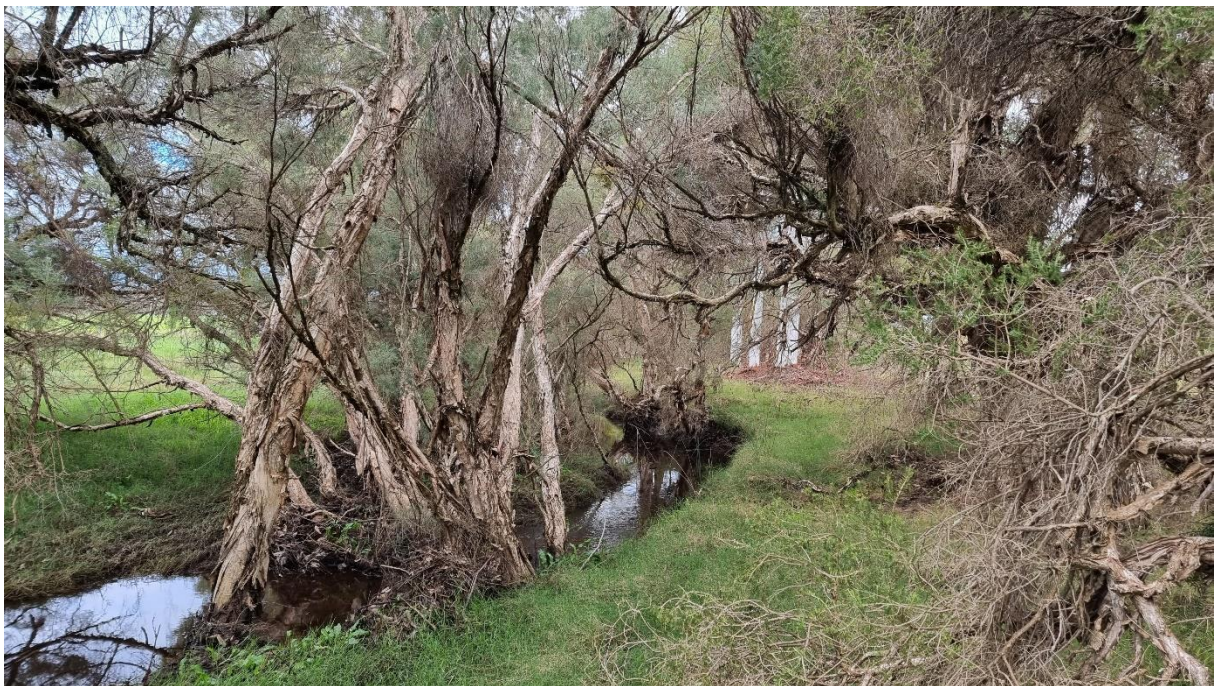
Record entered by: _____ Date entered: _____ Database no: _____

APPENDIX 5C: FLORA AND VEGETATION SURVEY LOTS 20, 62, 63 AND 211

Reconnaissance and Targeted Flora and Vegetation Survey

Western Extension

Keysbrook, Western Australia



Prepared for Doral Mineral Sands
February 2023



PO Box 9179, Picton WA 6229
0484 771 825 | enquiries@ecoedge.com.au

Version	Origin	Review	Review date	Release approval	Issue date
V1	E. Hutt	R. Smith	15/2/2023		
V2	R. Smith	C. Spencer	21/2/2023		
Final draft	D. Brace	Ecoedge		Ecoedge	22/2/2023
Final		Doral		Ecoedge	23/2/2023

Executive Summary

Ecoedge Environmental Services was engaged by Doral Mineral Sands in May 2022 to undertake a Targeted and Reconnaissance Flora and Vegetation Survey of part of Lots 20, 62, 63 and 211 located in Keysbrook, Western Australia (hereafter referred to as the survey area). The survey area occurs in two local government areas - the Shire of Serpentine-Jarrahdale and the Shire of Murray. The survey area is approximately 604.75 ha in size and is predominantly cleared agricultural land.

Doral are planning to extend their current Keysbrook mining operations and required the survey as part of their investigations into future mining opportunities across the landholding and to support environmental planning approval processes.

The survey was carried out on 12 and 13 July, 18 August, 16 September and 10 November 2022 in accordance with the EPA (2016) Technical Guidance: Flora and Vegetation Surveys for Environmental Impact Assessment.

Forty-nine species of vascular flora were identified within the survey area, of which 27 (55%) were introduced non-native taxa. There were another six taxa that were amenity plantings.

No Threatened or Priority flora or other flora of conservation significance were found.

One of the introduced species, Cape tulip (*Moraea flaccida*) is a Declared Pest plant in Western Australia under the *Biosecurity and Agriculture Management Act 2007*.

Seven vegetation mapping subunits were recognized and mapped for the survey area:

- Marri, and Jarrah-Sheoak open forest or woodland, subunits A1 and A2
- Low woodland of *Melaleuca preissiana* or *M. raphiophylla*, subunits B1 and B2
- *Sedgeland* of *Juncus pallidus*, unit C.

None of the vegetation units on site were regarded as occurrences of Threatened Ecological Communities under either the EPBC Act or BC Act. Nor were any of the units regarded as occurrences of a State listed Priority Ecological Community.

Most of the native vegetation was in Completely Degraded (92%) condition due to long-term grazing impacts. Phytophthora dieback disease also has played a part of degradation of the native vegetation in the past.

Three vegetation complexes are mapped for the survey area: the Bassendean Complex – Central and South (26.87%), the Guildford Complex (5.09%) and the Southern River Complex (18.53%). Each of these complexes are below the desired Commonwealth 30% pre-European retention target.

The single Conservation category wetland (0.775 ha) within the boundary of the survey area is in Completely Degraded condition. Almost all vegetation within the Resource Enhancement wetlands was also classed as Completely Degraded vegetation condition.

Parcels of vegetation within the south-eastern part of survey area have been assigned 1a ecological linkage values (1a). This are due to their close proximity to the regional ecological axis line located to the south-east of the survey area. These areas, however, have limited linkage values due to the overall Degraded condition of the vegetation and separation from other parcels of vegetation by expanses of pasture.

There are no Perth Metropolitan Regional Ecological Linkages within the survey area. The closest is located approximately 3km to the north of the survey area and are associated with the Bush Forever site BF77 Yangedi swamp link.

There is one mapped ESA in the north western portion of the survey area. This ESA is associated with the Conservation Category wetland UFI 14870. Another ESA intersects with the survey area boundary in the south eastern corner and is associated with the Conservation Category wetland UFI 14465.

There are no Bush Forever sites within the survey area. The closest Bush Forever site is approximately 2.5km away and is associated with BF77 Yangedi Swamp.

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Statement of limitations

Reliance on data

In the preparation of this report, Ecoedge Environmental Services has relied on data, surveys, analyses, designs, plans and other information provided by the Client and other individuals and organisations, most of which are referred to in the report. Unless stated otherwise in the report, Ecoedge has not verified the accuracy or completeness of the data. To the extent that the statements, opinions, facts, information, conclusions and/or recommendations in the report are based in whole or in part on the data, those conclusions are contingent upon the accuracy and completeness of the data. Ecoedge will not be liable in relation to incorrect conclusions should any data, information or condition be incorrect or have been concealed, withheld, unavailable, misrepresented or otherwise not fully disclosed to Ecoedge.

Report for the benefit of the Client

The report has been prepared for the benefit of the Client and no other party. Ecoedge assumes no responsibility and will not be liable to any other person or organisation for or in relation to any matter dealt with or conclusions expressed in the report or for any loss or damage suffered by any other person or organisation arising from matters dealt with or conclusions expressed in the report (including, without limitation, matters arising from any negligent act or omission of Ecoedge or for any loss or damage suffered by any other party relying on the matters dealt with or conclusions expressed in the report). Other parties should not rely upon the report or the accuracy or completeness of any conclusions and should make their own enquiries and obtain independent advice in relation to such matters.

1 Introduction

Ecoedge Environmental Services (Ecoedge) was engaged by Doral Mineral Sands (Doral) in May 2022 to undertake a Reconnaissance and Targeted Flora and Vegetation survey of part of Lots 20, 62, 63 and 211 located in Keysbrook, Western Australia (hereafter referred to as the survey area) **Figure 1**. The survey area is approximately 604.75 ha in size and contains approximately 38 ha of native vegetation **Figure 2**.

The survey area transverses the border of two local government areas - the Shire of Serpentine-Jarrahdale and the Shire of Murray. The town of Keysbrook is situated approximately 4.6 km to the northeast of the survey area with Hopeland Road running along the western boundary of the survey area and the South Western Highway approximately 4.7 km to the east. The surrounding area is predominantly used for agricultural purposes.

Doral are planning to extend their current Keysbrook mining operations and required the flora and vegetation survey as part of their investigations into future mining opportunities across the landholding and to support environmental planning approval processes. This survey area is referred to as the Keysbrook Western Extension.

The flora and vegetation survey was undertaken in spring 2022, in accordance with the Environmental Protection Authority (EPA) *Technical Guidance - Flora and Vegetation Surveys for Environmental Impact Assessment* (EPA 2016).

This report compiles the findings of the survey.

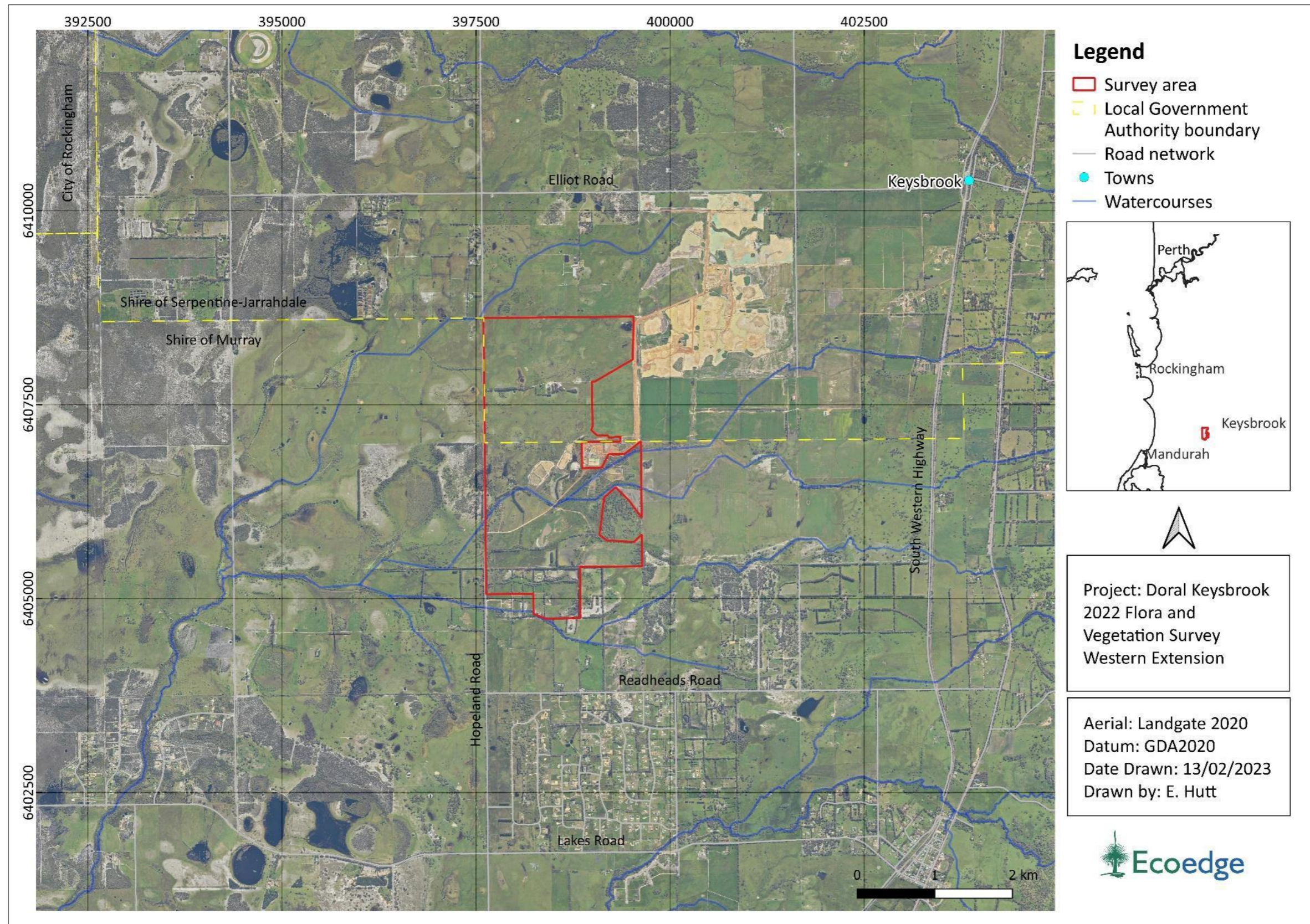


Figure 1. Aerial photograph showing the regional location of the survey area.

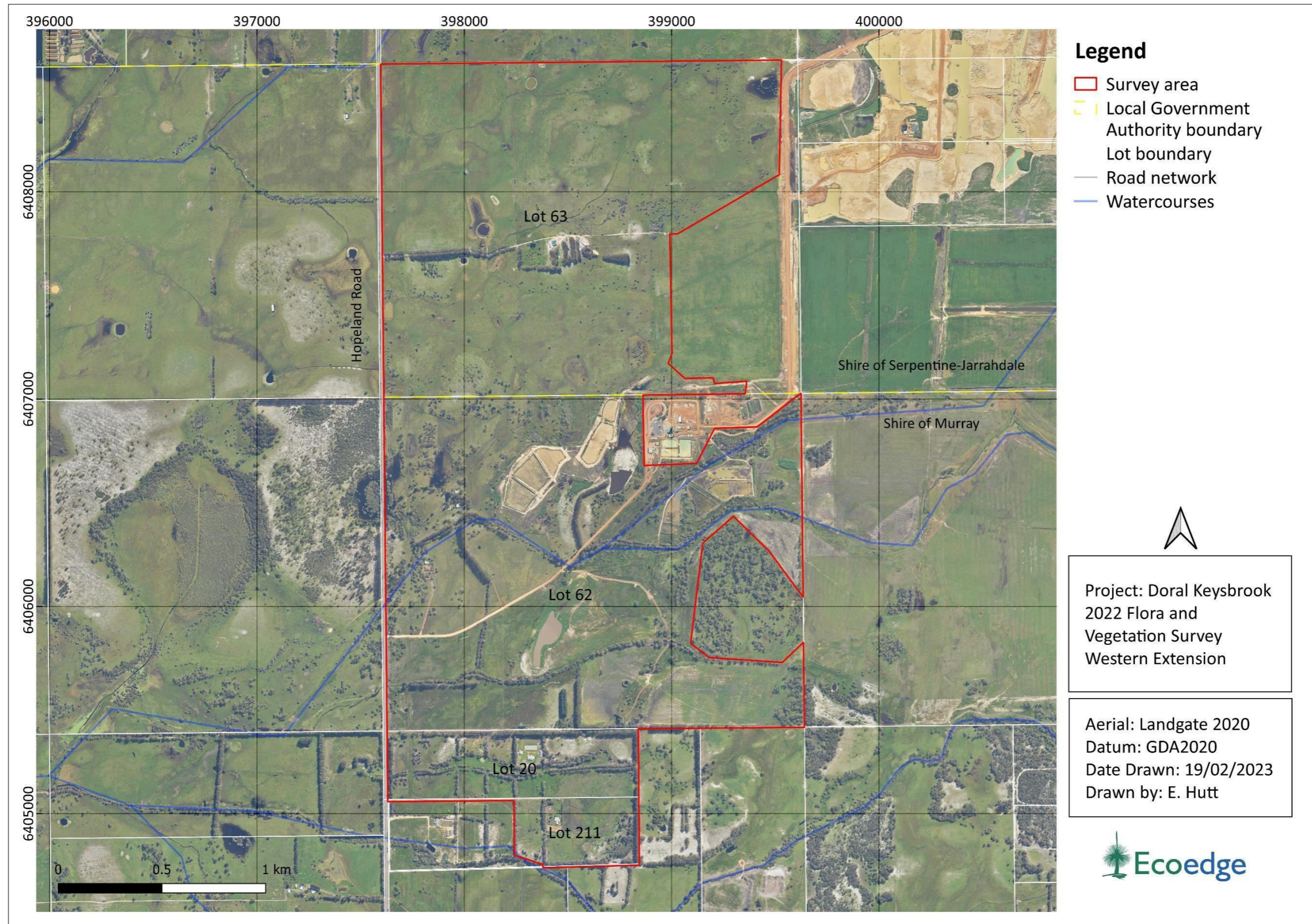


Figure 2. Aerial photograph showing the survey area.

2 Scope

The scope of the survey comprised two main parts, a desktop study and a field survey.

2.1 Desktop study

A desktop study over a 10 km radius of the survey areas was required prior to the field survey work to identify key features and constraints, which were in, or nearby the survey area, such as significant flora, significant vegetation/ecological communities, unusual or rare soil/landscape systems, surface water values, conservation estate, poorly represented vegetation associations and or vegetation complexes and environmentally sensitive areas (ESA).

2.2 Field survey

The reconnaissance and targeted field survey was required to ground-truth outcomes of the desktop assessment, with a focus on the delineation of all significant flora and significant vegetation, vegetation condition, mapping of weeds of national significance (WONS), declared pest plants listed under the *Biosecurity and Agriculture Management Act 2007* (BAM Act) and mapping of riparian vegetation.

The survey and report were required to be undertaken in accordance with the Environmental Protection Authority (EPA) Technical Guidance - Flora and Vegetation Surveys for Environmental Impact Assessment (EPA 2016) and other State and Commonwealth guidelines for threatened species and communities, such as approved conservation advice for *Environmental Protection and Biodiversity Act 1999* (EPBC Act) threatened species and communities.

3 Methods

3.1 Desktop assessment

Prior to the field survey, a desktop assessment within a 10 km buffer of the survey area was undertaken to provide contextual information on the flora and vegetation within the survey area. The desktop studies included a review of the following information.

- Regional geology and soil mapping (van Gool 1990, DPIRD 2017).
- Vegetation complex mapping of the South West Forest Region of Western Australia (Mattiske and Havel 1998) as updated by Webb et al. (2016).
- Beard's Pre-European Vegetation Association mapping dataset (DPIRD-006) (Beard et al. 2013, DPIRD 2019).
- WA Threatened and Priority Ecological Communities DBCA database extracts (DBCA 2021b) and TEC and PEC listings (DBCA 2018, DBCA 2021a, DBCA 2022b).
- Federal Protected Matters Search Tool results (DCCEEW 2022a).
- NatureMap search results (DBCA 2021c).
- Extract from the Department's Threatened Flora database and the WA Herbarium database (DBCA 2021d).
- Geomorphic Wetlands, Swan Coastal Plain dataset DBCA-019 (DBCA 2022a).
- Environmentally sensitive areas distribution maps and data (DWER 2021).
- Surface Hydrology Lines (National) (Crossman & Li 2015).
- Regional Ecological Linkages (Molloy et al. 2009).
- DBCA legislated lands and waters data set DBCA-11 (DBCA 2017).
- DBCA Bush Forever Area dataset DPLH-019 (DBCA 2019a).

The assessment also included a review of the following surveys.

- Ecoedge (2022). Detailed, Reconnaissance and Targeted Flora and Vegetation Survey Lot 507, 508, 201 Elliot Road and Part Lot 56 Wescott Road Keysbrook, Western Australia
- Ecoedge (2021). Detailed, Reconnaissance and Targeted Flora and Vegetation Survey, Lot 64 Elliot Road Keysbrook, Western Australia
- Onshore Environmental (2019). Field Assessment of Keysbrook Leucosene Conservation Areas & Revegetation Considerations, prepared for Keysbrook Leucosene Pty Ltd.
- Rockwater Hydrogeological and Environmental Consultants (2018). Keysbrook Project Wetland Vegetation Monitoring. Report prepared for MZI Resources Ltd.
- MBS (2004). Vegetation and Fauna Assessment of Exploration Licence 70/2407 Keysbrook, Prepared for Olympia Resources Limited.
- Bennett Environmental Consulting (BEC) (2004). Vegetation and Flora of Exploration Licence 70/2407 Keysbrook Western Australia, Prepared for MBS Environmental Pty Ltd.

3.2 Significant flora likelihood of occurrence

Prior to undertaking the survey, an assessment of the likelihood of occurrence of Threatened and Priority flora taxa identified from the desktop assessment was undertaken. The rationale for determining the pre- and post-likelihood of occurrence is provided in **Appendix 1**.

3.3 Field survey

The survey was carried out on 12 and 13 July, 18 August, 16 September and 10 November 2022 by Russell Smith (flora permit FB62000500) and Ben Eckermann (flora permit FB62000262) in accordance with the Environmental Protection Authority (EPA) Technical Guidance - Flora and Vegetation Surveys for Environmental Impact Assessment (EPA 2016). The earlier visit included a targeted survey for *Drakaea elastica* and *D. micrantha*.

A list of all vascular flora encountered during the survey was compiled, either in the field or from photographs and notes taken to enable later identification. Taxonomy and conservation status were checked against the latest WA Herbarium census download (DBCA 2021f).

Plant communities were described using data collected at 61 vegetation mapping note points and 155 vegetation condition points. This information as well as recent aerial photography was used to map vegetation unit and condition within the survey area.

Location of data collection points (vegetation mapping note points and vegetation condition points) and survey track files was recorded on a handheld global position system (GPS).

Vegetation condition was assessed using the method of the EPA (2016). (**Appendix 2**).

4 Survey limitations

Potential limitations with regard to the assessment are addressed in **Table 1**.

Table 1. Limitations of the field survey with regard to assessment adequacy and accuracy.

Aspect	Constraint	Comment
Scope	Not a constraint	The survey scope was prepared in consultation with the client and was designed to comply with EPA requirements.
Proportion of flora identified	Not a constraint	The survey was carried out over several months to include peak flowering seasons for the southern Swan Coastal Plain.
Climatic and seasonal effects	Minimal	Rainfall for the year till the end of October 2022 was 81% of average for the Serpentine weather station. However, the drier than average season did not appear to have affected growth and flowering of native species.
Availability of contextual information	Not a constraint	Comprehensive regional surveys of remnant vegetation, as well as more localised surveys, have been carried out on the southern Swan Coastal Plain.
Completeness of the survey	Not a constraint	The whole search area was covered on foot. Flowering was good.
Skill and knowledge of the botanists	Not a constraint	The senior field botanist conducting the survey has had extensive experience in botanical surveys in south-west Australia over a period of 25 years.
Disturbance (fire, grazing, clearing etc.)	Moderate	The survey area has historically been grazed by livestock, and it is ongoing.

5 Results desktop assessment

5.1 Biogeographic region and location

The survey area is situated within the Swan Coastal Plain (SWA02) sub-region of the Swan Coastal Plain biogeographic region, as defined in the Interim Biogeographical Regionalisation for Australia (IBRA) (Commonwealth of Australia, 2016). The survey area comprises four parcels of land totalling approximately 604.75 ha and is situated approximately 4.6 kilometres east of the Keysbrook townsite. It occurs across two local government areas – the Shire of Serpentine-Jarrahdale and the Shire of Murray. The surrounding land has been predominantly cleared for agriculture (**Figure 1**).

5.2 Tenure DBCA managed land

The survey area is not, nor in proximity to areas designated as a Conservation reserve under the Conservation and Land Management Act 1984.

5.3 Landform and soils

The survey area occurs on the Swan Coastal Plain (SCP), which is bounded by the Darling Scarp to the east, Indian Ocean to the west, Moore River to the north and Dunsborough to the south. The SCP is built up of two belts of sediments that differ in origin: aeolian sediments in the west and alluvial sediments in the east. The aeolian sediments comprise three major dune systems: The Bassendean Dune System is the most easterly and oldest system; the Quindalup System is the most westerly and youngest system, with the Spearwood system located in between. These wind deposited dunes press up against the Pinjarra plain, which is built up of alluvium deposited by streams from the Darling Plateau. Its alluvial soils are predominantly clays and silts; in places, low dunes of aeolian sands from the west may overlay the alluvial soils (Seddon 1972).

The survey area is occurs across the Bassendean land system (212_Bs) and the Pinjarra land system (213_Pj). The Bassendean land system is comprised predominantly of sand dunes and sand plains of deep, pale grey, siliceous sand intervened with sandy and clayey swamps with some black, peaty soils (van Gool 1990). The Pinjarra land system is predominantly poorly drained coastal plain, characterised by semi-wet soils that can range from grey deep sandy duplexes to brown loamy earths, pale sands and clays (van Gool 1990). These systems have been divided into soil phases based on local soil conditions, with the soil phases found in the survey area described in **Table 2** and shown in **Figure 3**.

Table 2. Soil Mapping Units occurring within the survey area (van Gool 1990).

System	Subsystem	Description
Bassendean (212_Bs)	212Bs_B1	Extremely low to very low relief dunes, undulating sandplain, and discrete sand rises with deep bleached grey sands, sometimes with a pale yellow B horizon or a weak iron-organic hardpan at depths generally greater than 2 m; banksia dominant.
	212Bs_B2	Flat to very gently undulating well drained sandplain of the surface. Deep bleached grey sands with a pale yellow B horizon or a weak iron-organic hardpan 1-2 m.
	212Bs_B4	Broad poorly drained sandplain with deep grey siliceous sands or bleached sands, underlain at depths generally greater than 1.5 m by clay or less frequently a strong iron-organic hardpan.
	212Bs_B6	Imperfectly drained sandplain and broad extremely low rises. Deep or very deep grey siliceous sands.
Pinjarra (213_Pj)	213Pj_B2	Well to moderately well drained flat to very gently undulating sandplain. Deep bleached grey sands with a pale yellow B horizon or a weak iron-organic hardpan 1-2 m.
	213Pj_P11	Shallow brown loamy soils or less commonly, very shallow sands over ironstone pavement which is a clear barrier to drainage.
	213Pj_P1b	Flat to very gently undulating plain. Imperfectly drained and moderately susceptible to salinity in limited areas. Deep acidic mottled yellow duplex (or 'effective duplex') soils. Moderately deep pale sand to loamy sand over clay.
	213Pj_P2	Flat to very gently undulating plain. Poor to imperfectly drained. Deep alkaline mottled yellow duplex soils which generally consist of shallow pale sand to sandy loam over clay.
	213Pj_P7	Seasonally inundated swamps and depressions with very poorly drained variable acidic mottled yellow and gley duplex soils.
	213Pj_P8	Broad poorly drained flats and poorly defined stream channels. Moderately deep to deep sands over mottled clays. These may be acidic or less commonly alkaline gley and yellow duplex soils to uniform bleached or pale brown sands over clay.

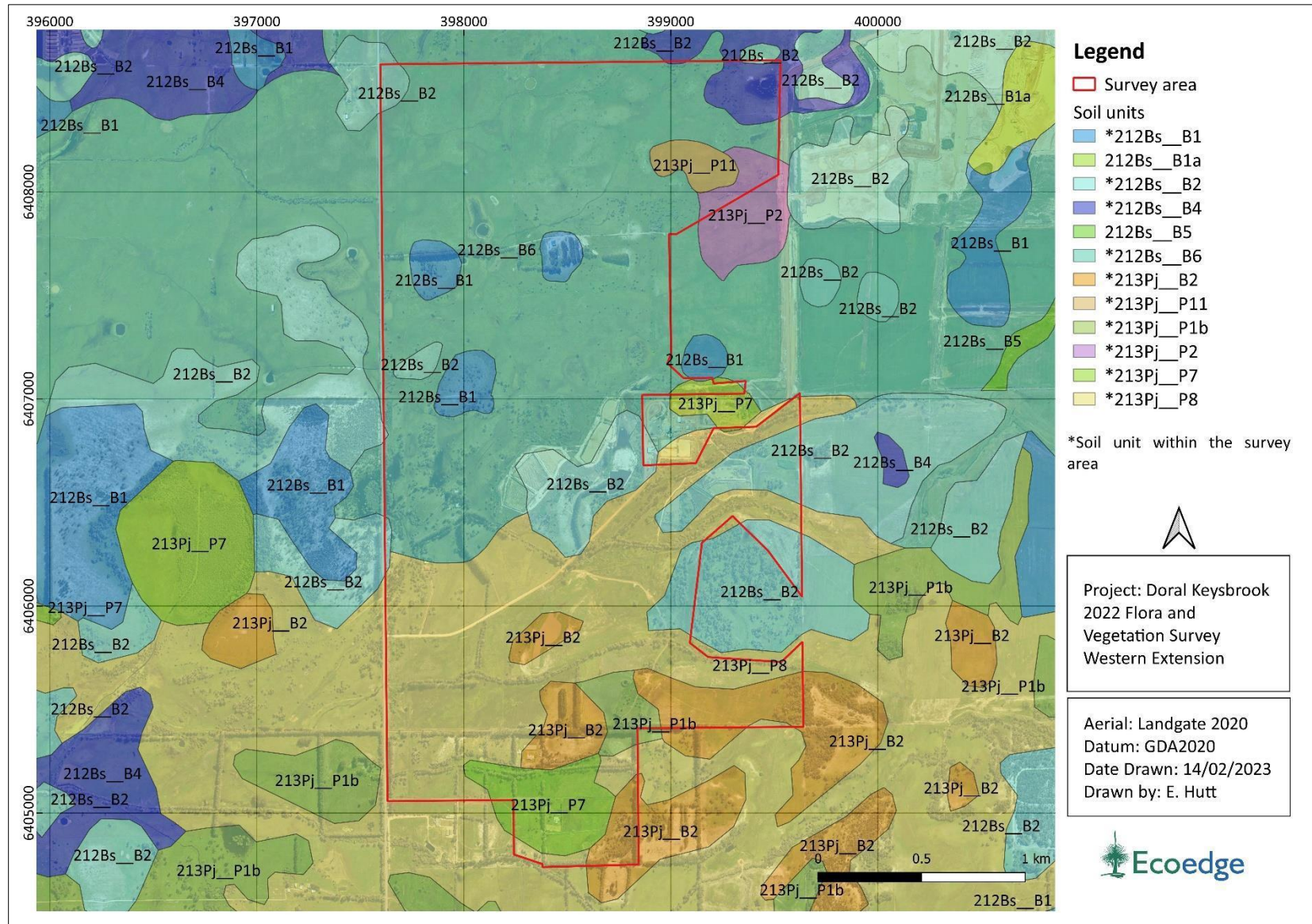


Figure 3. Soil subsystems mapped in and nearby the survey area (DPIRD 2017).

5.4 Vegetation description according to pre-European mapping datasets

5.4.1 Vegetation complexes

Three vegetation complexes occur within the survey area, according to the 1:50,000 mapping of South West Forest Region of Western Australia (Mattiske & Havel 1998) and the 1:250,000 mapping of vegetation complexes on the SCP (Hedde et al. 1980) as updated by Webb et al. (2016). These are described in **Table 3** and shown in **Figure 4**.

Table 3. Vegetation complexes mapped for the survey area (Webb et al. 2016).

Vegetation Complex	Description
Bassendean Complex – Central and South (44)	Vegetation ranges from woodland of <i>Eucalyptus marginata</i> (Jarrah) - <i>Allocasuarina fraseriana</i> (Sheoak) - Banksia species to low woodland of Melaleuca species and sedge lands on the moister sites. This area includes the transition of <i>Eucalyptus marginata</i> (Jarrah) to <i>Eucalyptus todtiana</i> (Pricklybark) in the vicinity of Perth.
Guildford Complex (32)	A mixture of open forest to tall open forest of <i>Corymbia calophylla</i> (Marri) - <i>Eucalyptus wandoo</i> (Wandoo) - <i>Eucalyptus marginata</i> (Jarrah) and woodland of <i>Eucalyptus wandoo</i> (Wandoo) (with rare occurrences of <i>Eucalyptus lane-poolei</i> (Salmon White Gum)). Minor components include <i>Eucalyptus rudis</i> (Flooded Gum) - <i>Melaleuca raphiophylla</i> (Swamp Paperbark).
Southern River Complex (42)	Open woodland of <i>Corymbia calophylla</i> (Marri) - <i>Eucalyptus marginata</i> (Jarrah) - Banksia species with fringing woodland of <i>Eucalyptus rudis</i> (Flooded Gum) - <i>Melaleuca raphiophylla</i> (Swamp Paperbark) along creek beds.

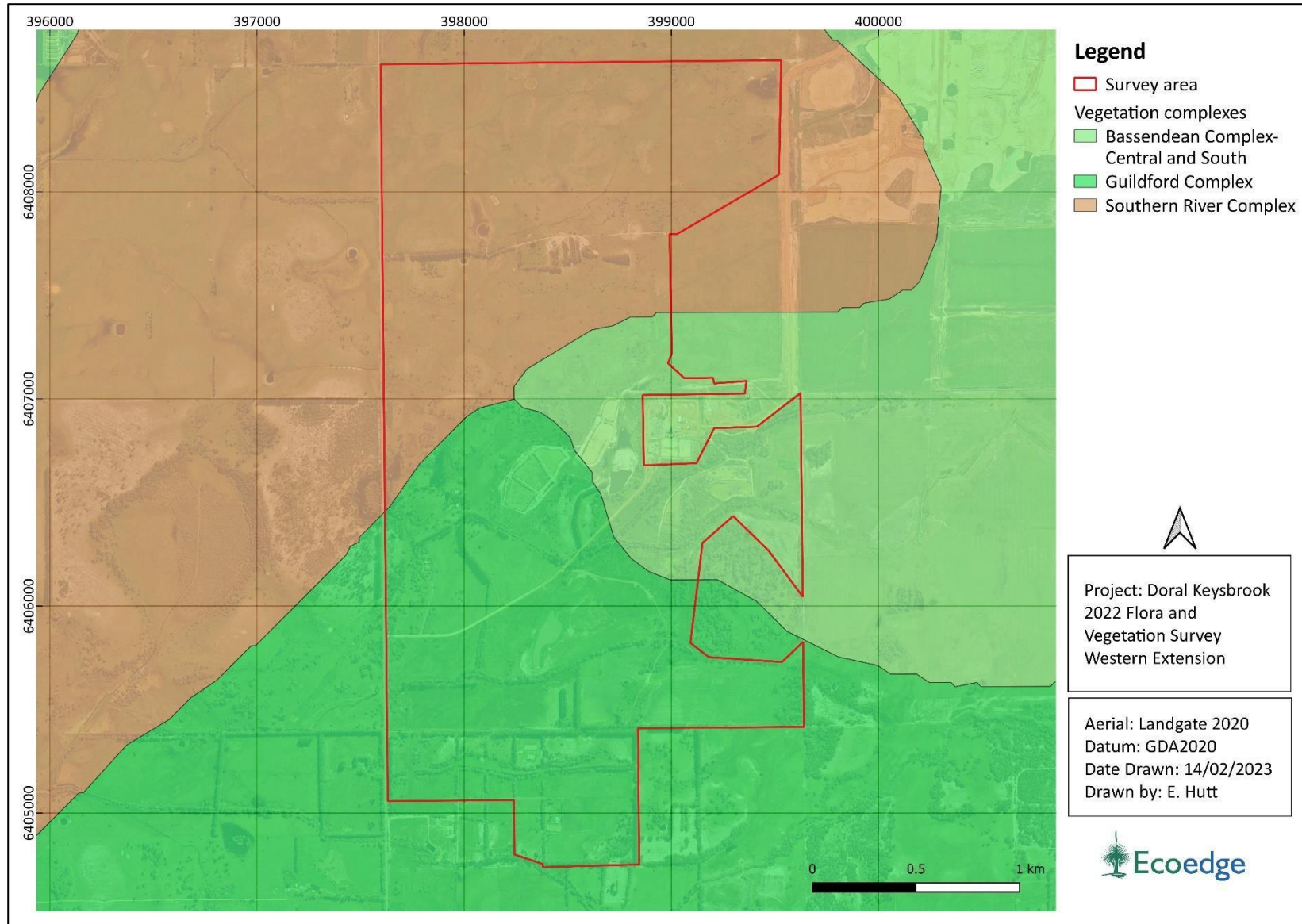


Figure 4. Vegetation complexes mapped in and nearby the survey area (Webb et al. 2016, DPaW 2018).

5.4.2 Vegetation associations

A systematic survey of native vegetation in Western Australia was undertaken by J. S. Beard (along with others) during the 1970s, which described vegetation systems in the southwest of WA at a scale of 1:250,000. Beard's vegetation mapping attempted to depict the vegetation as it might have been prior to European settlement in terms of type and extent (Beeston et al. 2001). The Beard Vegetation Association dataset, also referred to as the pre-European native vegetation extent dataset, was digitised by Shepherd et al. (2002).

Beard Vegetation Associations have been described to a minimum standard of Level 3 'Broad Floristic Formation' for the National Vegetation Inventory System (NVIS) (state-wide to regional scale)¹.

The survey area comprised only one Beard Vegetation Association: Association 968 'Medium woodland; jarrah, marri wandoo' (**Figure 5**).

¹ Beard's vegetation mapping units are referred to as 'associations' however these do not correspond to the NVIS Level 5 'Associations'. The NVIS system was developed long after Beard's work was completed, and while both classification systems use the same term, NVIS 'Associations' describe vegetation in greater detail.

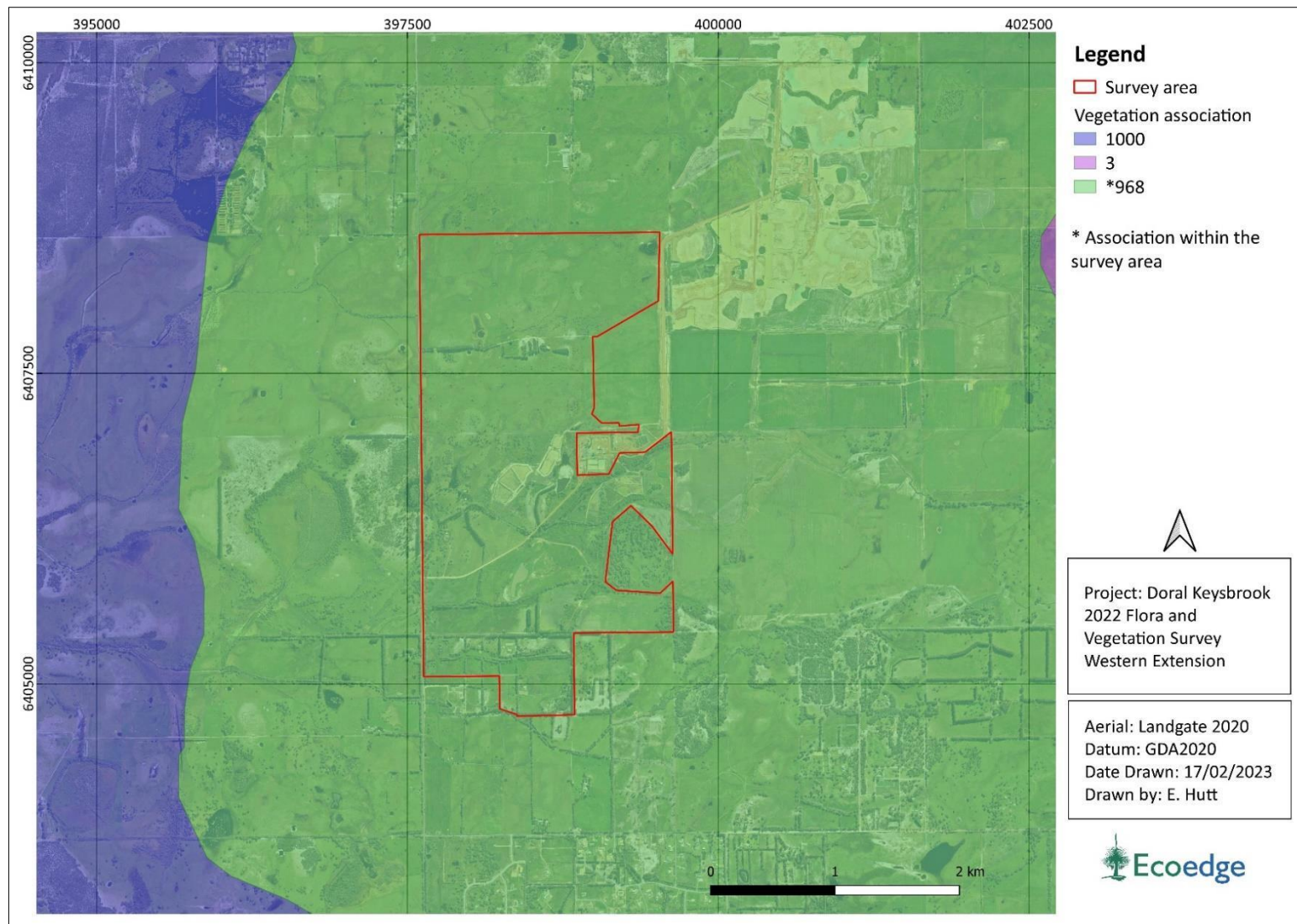


Figure 5. Vegetation associations mapped within and adjacent to the survey area (Beard et al. 2013).

5.4.3 Assessment of remaining extent against pre-European extent

In 2001, the Commonwealth of Australia stated National Targets and Objectives for Biodiversity Conservation, which recognised that the retention of 30%, or more, of the pre-clearing extent of each ecological community was necessary if Australia's biological diversity was to be protected (Environment Australia 2001).

In its report on the Statewide Vegetation Statistics incorporating the Comprehensive, Adequate and Representative (CAR) Reserve Analysis, the Government of Western Australia provides information on the pre-European and current extent of the ecological communities of Western Australia and reports on the status of the CAR reserve system for WA (Government of Western Australia, 2019a). This system is also based on the National retention targets of 30% overall. Only reserves managed by DBCA under the *Conservation and Land Management Act 1984* are considered for inclusion in the “CAR Reserve Analysis”.

An assessment of the three vegetation complexes found within the survey area against the *Statewide Vegetation Statistics* (Government of Western Australia 2019) is presented in **Table 4**. The extent remaining of all three complexes falls below the 30% state-wide retention target at a state wide and local government level, with the exception of the Bassendean Complex – Central and South in the Shire of Serpentine-Jarrahdale, which exceeded the retention target with 32.14%.

Table 5 presents the same statistics for the one Beard Vegetation Association mapped across the survey area: Association 968. While at a state wide level, the extent remaining of this association exceeds the retention target at 32.02%, the association is poorly represented at IBRA and local government area levels, falling below 10% extent remaining.

The red, orange and yellow shading in the tables indicates the status of the Commonwealth 30% retention target.

Status of the Commonwealth retention target	>30%	<30%	<10%
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Table 4. Vegetation complexes mapped within the survey area with regard to the Commonwealth retention targets (Government of Western Australia, 2019).

Vegetation Complex	Pre-European (ha)	Current Extent (ha)	% Remaining	% Remaining in DBCA Reserves
Bassendean Complex - Central and South (44)				
Swan Coastal Plain	87,476.25	23,508.66	26.87	5.0
Shire of Murray	13,703.04	3,314.45	24.19	-
Shire of Serpentine-Jarrahdale	9,852.42	3,166.25	32.14	-
Guildford Complex (32)				
Swan Coastal Plain	90,513.13	4,607.91	5.09	0.32
Shire of Murray	28,559.76	1,530.61	5.36	-
Shire of Serpentine-Jarrahdale	12,986.67	552.25	4.25	-
Southern River Complex (42)				
Swan Coastal Plain	58,781.48	10,832.18	18.43	1.60
Shire of Murray	6,556.41	1,459.96	22.27	-
Shire of Serpentine-Jarrahdale	7,653.19	674.36	8.81	-

* Excludes Crown Freehold Department Interest Lands that are managed under Section 8(a) of the CALM Act.

Table 5. The vegetation association within the survey area with regards to the Commonwealth retention targets (GoWA 2019a).

Beard Vegetation Association	Pre-European (ha)	Current Extent (ha)	% Remaining	% remaining in DBCA Managed Land*
Association 968				
State-wide	296,877.84	95,048.82	32.02	18.45
IBRA region: Swan Coastal Plain (SWA)	136,188.20	9,017.32	6.62	1.43

Beard Vegetation Association	Pre-European (ha)	Current Extent (ha)	% Remaining	% remaining in DBCA Managed Land*
IBRA sub-region Perth (SWA02)	136,188.20	9,017.32	6.62	1.43
Shire of Murray	47,585.28	4,135.26	8.69	2.41
Shire of Serpentine-Jarrahdale	24,351.49	1,121.13	4.60	0.57

* Excludes Crown Freehold Department Interest Lands that are managed under Section 8(a) of the CALM Act.

5.5 Conservation areas

The DWER offset calculator requires information on the following areas.

- Crown reserve established under the CALM Act 1984 or Land Administration Act 1997 for the purpose of conservation (**section 5.2**),
- Bush Forever Area (**section 5.11**),
- Conservation covenant, (**section 5.2**),
- Other conservation area.

The survey area does not contain any of these conservation areas.

5.6 Threatened and Priority ecological communities

Ecological communities are defined by Western Australia's DBCA (previously DPaW and the Department of Environment and Conservation (DEC)) as "...naturally occurring biological assemblages that occur in a particular type of habitat. They are the sum of species within an ecosystem and, as a whole, they provide many of the processes which support specific ecosystems and provide ecological services." (DEC, 2013).

Under Section 27 of the *Biodiversity Conservation Act 2016* (BC Act), the Western Australian Minister for Environment may list communities considered to be under significant threat as a Threatened ecological community (TEC). These TECs can be listed under one of three conservation categories: Critically Endangered (CR), Endangered (EN), Vulnerable (VU). The BC Act also provides for listing communities as collapsed ecological communities.

Possible TECs that do not meet survey criteria are added to the DBCA's Priority ecological community lists under Priorities 1, 2 or 3 (referred to as P1, P2, P3). Ecological communities that are adequately known, 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 (P4). These ecological communities require regular monitoring. Conservation Dependent ecological communities are placed in Priority 5 (P5) (DEC 2013).

The current listing of Threatened and Priority ecological communities is specified in DBCA (2018, 2021). The conservation categories for these Threatened and Priority ecological communities are defined in **Appendix 3**.

TECs can also be listed under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). There are three categories of TEC under the EPBC Act: Critically Endangered (CR), Endangered (EN) and Vulnerable (VU) (Department of Climate Change, Energy, the Environment and Water) (DCCEEW 2022b). These are defined in **Appendix 4**.

Under both the State BC Act and the Federal EPBC Act, ministerial authorisation is required where significant permanent modification to a TEC will occur.

Noting that if an occurrence of a TEC is found during a survey conducted under the auspices of the *Environmental Protection Act 1986* (EP Act), it must be mandatorily reported to the Chief Executive Officer of the DBCA under Section 49 of the BC Act.

The desktop assessment found four EPBC Act listed TEC and eight BC Act listed TEC occurring within 10 km of the survey area, based on results generated from an extract from the DBCA databases (DBCA 2021b) and a 10 km radius Protected Matters Search Tool (PMST) query (DCCEEW 2022b). Two PECs were recorded in the search area. These communities are listed in **Table 6**.

Of these communities, only the Banksia Woodlands of the Swan Coastal Plain TEC PEC have buffers mapped over the survey area **Figure 6** (DBCA 2021b).

Copies of the NatureMap (excel) and PMST data searches are provided in **Appendix 5**.

Table 6. Threatened and Priority ecological communities occurring and possibly within 10 km of the survey area (DBCA 2021b, DCCEEW 2022b).

Community Name	Status (WA)	Status (EPBC Act)
<i>Corymbia calophylla</i> - <i>Xanthorrhoea preissii</i> woodlands and shrublands of the Swan Coastal Plain (SCP3c)	T (CR)	EN
<i>Corymbia calophylla</i> - <i>Kingia australis</i> woodlands on heavy soils of the Swan Coastal Plain (SCP3a)	T (CR)	EN
Claypans of the Swan Coastal Plain – comprising of four state-listed ecological communities, three of which occur in the study area: <ul style="list-style-type: none"> • Herb rich saline shrublands in clay pans (SCP07) – Vulnerable • Herb rich shrublands in clay pans (SCP08) – Vulnerable • Shrubbylands on dry clay flats. (SCP10a) – Endangered. 	T (VU-EN)	CR
‘Banksia Woodlands of the Swan Coastal Plain’ – a federally listed TEC which can occur in a number of State-listed communities, two of which occur in the study area: <ul style="list-style-type: none"> • <i>Banksia attenuata</i> and/or <i>Eucalyptus marginata</i> woodlands of the eastern side of the Swan Coastal Plain (SCP20b) • Low lying <i>Banksia attenuata</i> woodlands or shrublands (SCP21c) 	P3	EN
Forests and woodlands of deep seasonal wetlands of the Swan Coastal Plain (SCP15)	T (VU)	-
<i>Corymbia calophylla</i> - <i>Eucalyptus marginata</i> woodlands on sandy clay soils of the southern Swan Coastal Plain (SCP3b)	T (VU)	-

Note: This table only includes formally recognised TECs that are known of and mapped, and included in the DBCA’s database.

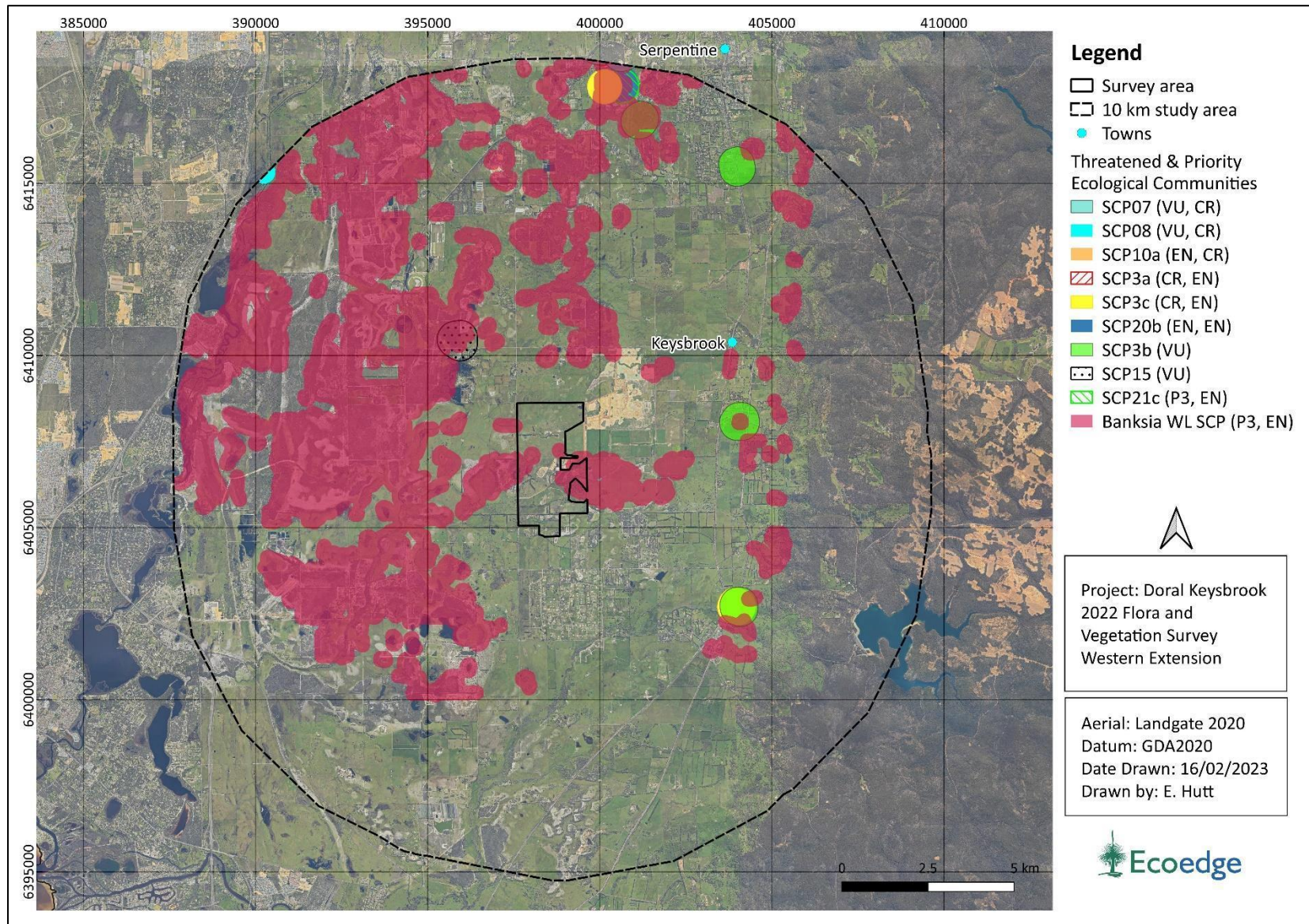


Figure 6. Location of TECs and PECs within a 10 km radius of the survey area (DBCA 2021b).

5.7 Threatened and Priority flora

Species of flora are defined as having a Threatened or Priority conservation status where their extant populations are restricted geographically and/or under threat of possible extinction. The DBCA recognises these threats and consequently applies regulations towards population and species protection.

Threatened extant flora species are listed under Section 19 of the BC Act. They are ranked according to their level of threat using the International Union for Conservation of Nature (IUCN) Red List categories and criteria of Critically Endangered (CR), Endangered (EN), Vulnerable (VU). It is an offence to “take” or damage Threatened flora without Ministerial approval. Section 5 of the Act defines “to take” as “... to gather, pluck, cut, pull up, destroy, dig up, remove, harvest or damage flora by any means”.

Priority flora is under consideration for future declaration as “Threatened flora”, dependent on more information. Species classified as Priority One to Three (referred to as P1, P2 and P3) require further survey to determine their status. Priority Four (P4) species are adequately known rare or Threatened species that require regular monitoring.

Threatened flora lists are formally reviewed annually, whilst the Priority flora list is subject to a less formal ongoing review. The current listing of Threatened and Priority flora was updated on the 6 October 2022 (DBCA, 2022b).

Categories of Threatened and Priority flora as defined by the BC Act are presented in **Appendix 6** (DBCA 2019b).

Threatened flora may also be protected under the Commonwealth EPBC Act and be listed in one of six categories; the definitions of these categories are summarised in **Appendix 7** (DCCEEW 2020).

Threatened or Priority flora occurring within 10 km of the project area generated from a NatureMap search, DBCA Threatened and Priority data search query and a Protected Matters Search Tool query, **Appendix 5** (DBCA 2021c, DBCA 2021d, DCCEEW 2022b). Full details are provided in a likelihood of occurrence table in **Appendix 8**. A number of the species listed in **Appendix 8** could potentially occur within the survey area, based on an assessment of their preferred habitats. There was one P3 species that has a pre-survey likelihood of occurring (**Table 7**). **Table 8** provides a summary of the pre survey likelihood of occurrence. Location of Threatened and Priority flora within a 10 km radius of the survey area (DBCA 2021d) are shown in **Figure 7**.

Table 7. Significant flora assessed as likely to occur within the survey area.

No.	Species	Conservation status
1	<i>Acacia benthamii</i>	P3

Table 8. Likelihood of occurrence according to conservation status.

Likelihood of occurrence	Total number	Priority 1	Priority 2	Priority 3	Priority 4	Threatened
Likely	1	-	1	-	-	-
Possible	8	1	1	1	2	3
Unlikely	40	4	1	12	8	15
Total	49	5	3	13	10	18

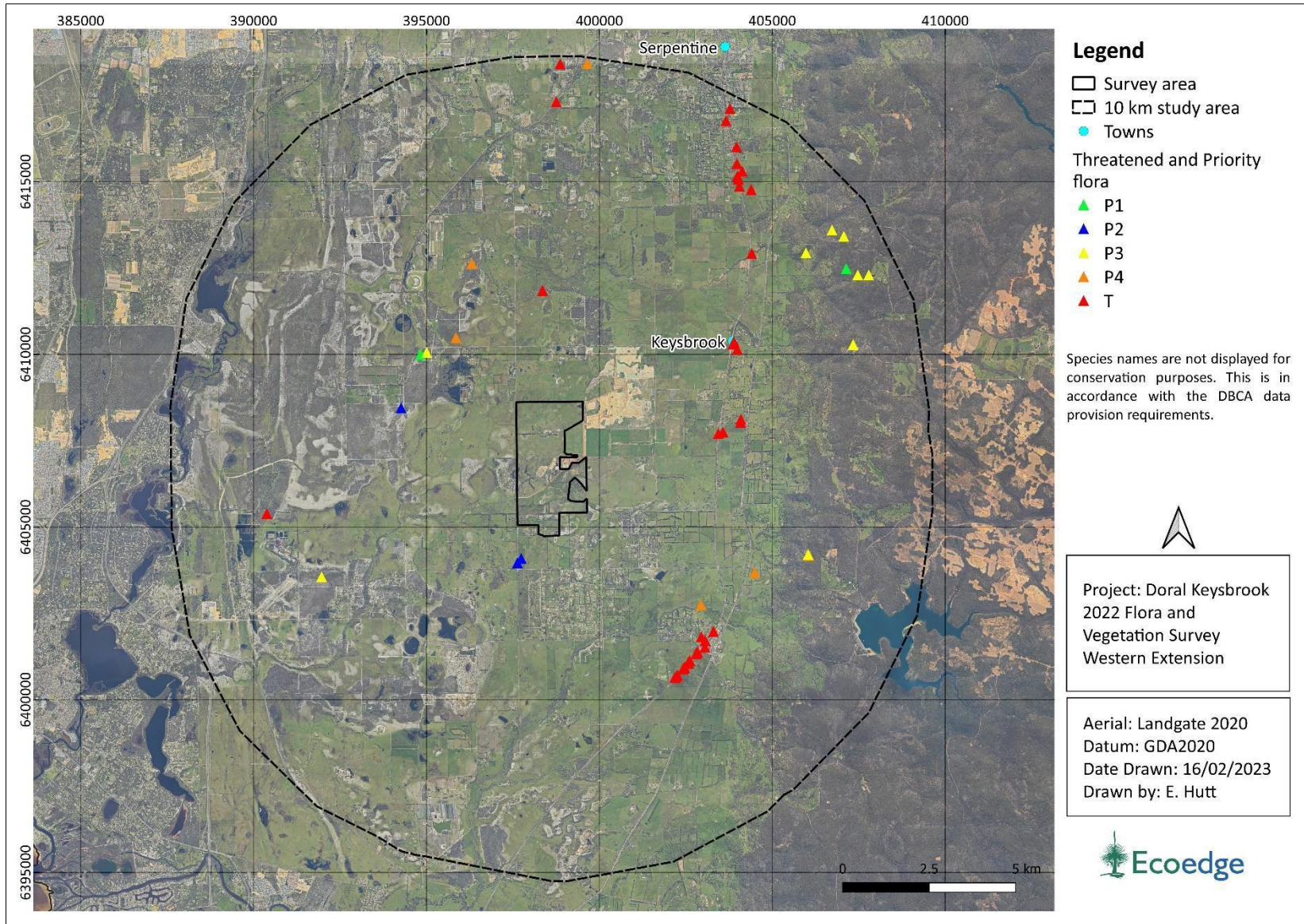


Figure 7. Location of Threatened and Priority flora occurring within a 10 km radius of the survey area (DBCA 2021d).

5.8 Wetlands and watercourses

Wetlands on the Swan Coastal Plain have been classified into types using the geomorphic wetland classification system of Semeniuk & Semeniuk (1995), which is based on the characteristics of landform and water permanence, for example, lakes, palusplains and damplands. These are described in **Table 9**. The Swan Coastal Plain wetlands have also been evaluated and assigned an appropriate management category and corresponding category objective, providing guidance on the nature of the management and protection the wetland should be afforded. These categories are described in **Table 10**.

Table 9. Wetland types (adapted from Semeniuk & Semeniuk, 1995).

Management Category	Basin	Flat	Channel	Slope	Highland
Permanently inundated	Lake		River		
Seasonally inundated	Sumpland	Floodplain	Creek		
Intermittent inundation	Playa	Barlkarra	Wadi		
Seasonally waterlogged	Dampland	Palusplain	Trough	Paluslope	Palusmont

Table 10. Definitions of and objectives for the different wetland management categories (EPA 2008).

Management Category	Definition	Category Objective
Conservation	Wetlands with high conservation value for both natural or human use.	To preserve wetland (natural) attributes and functions.
Resource Enhancement	Wetlands with moderate natural and human use attributes that can be restored or enhanced.	To restore wetlands through maintenance and enhancement of wetland functions and attributes.
Multiple Use	Wetlands that score poorly on both natural and human use attributes.	To use, develop and manage wetlands in the context of water, town and environmental planning.

A system of wetlands is mapped across the survey area, expressed as seasonally waterlogged palusplain covering most of the northern and western portions of the survey area, dipping down to areas of seasonally waterlogged damplands in the south-eastern corner (**Figure 8**). In the middle of the survey area, two unnamed drainage canal lines enter from the east of the survey area and merge before exiting on the western boundary (**Figure 8**).

Most of these wetlands have been categorised as Multiple Use with smaller areas scattered within the survey area categorised as Resource Enhancement (**Figure 9**). One Conservation Category wetland (UFI 14870), which is 0.775 ha in size, occurs in the northwest of the survey area (**Figure 9**).

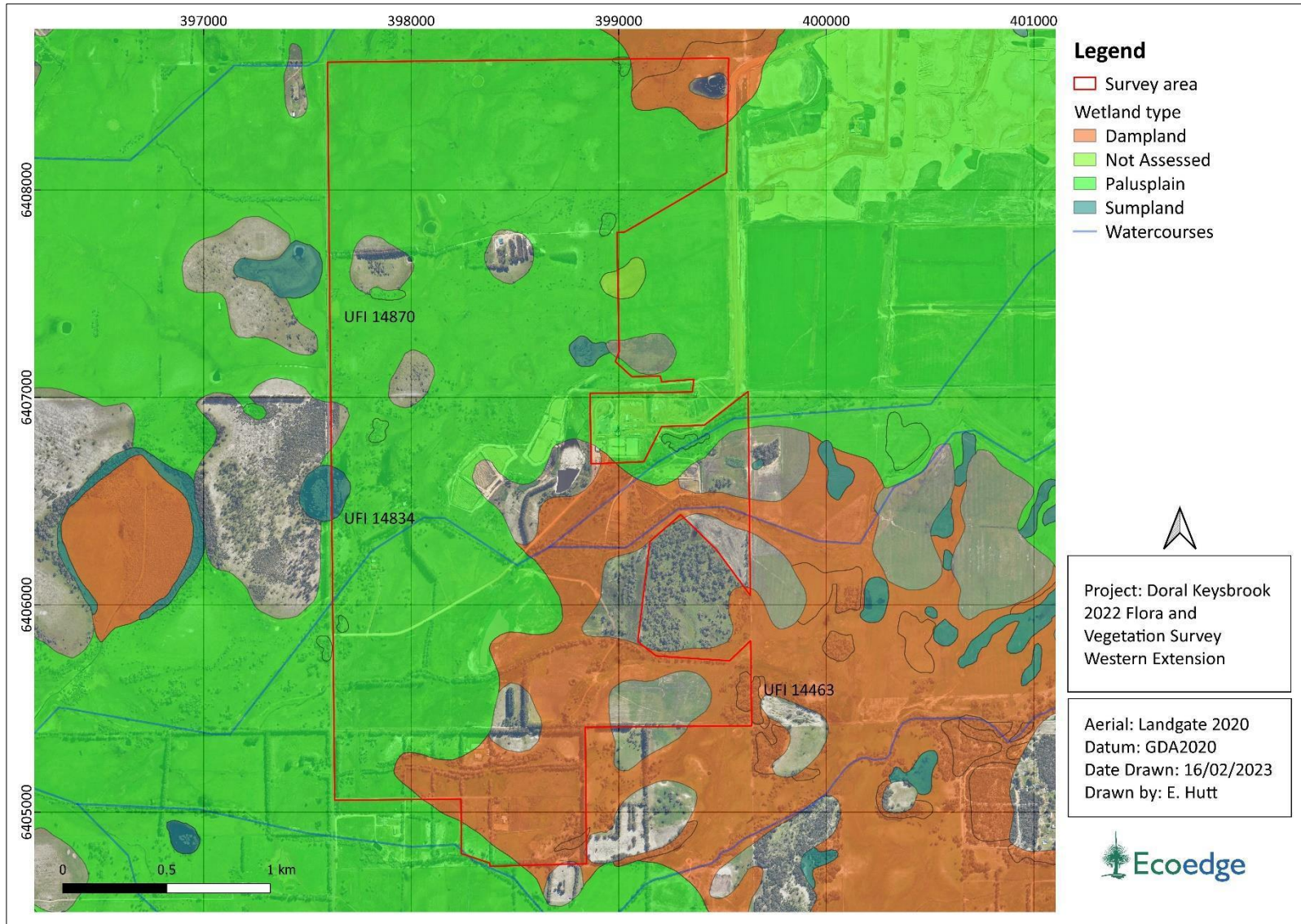


Figure 8. Geomorphic wetlands within and in proximity to the survey area (DBCA 2022a).

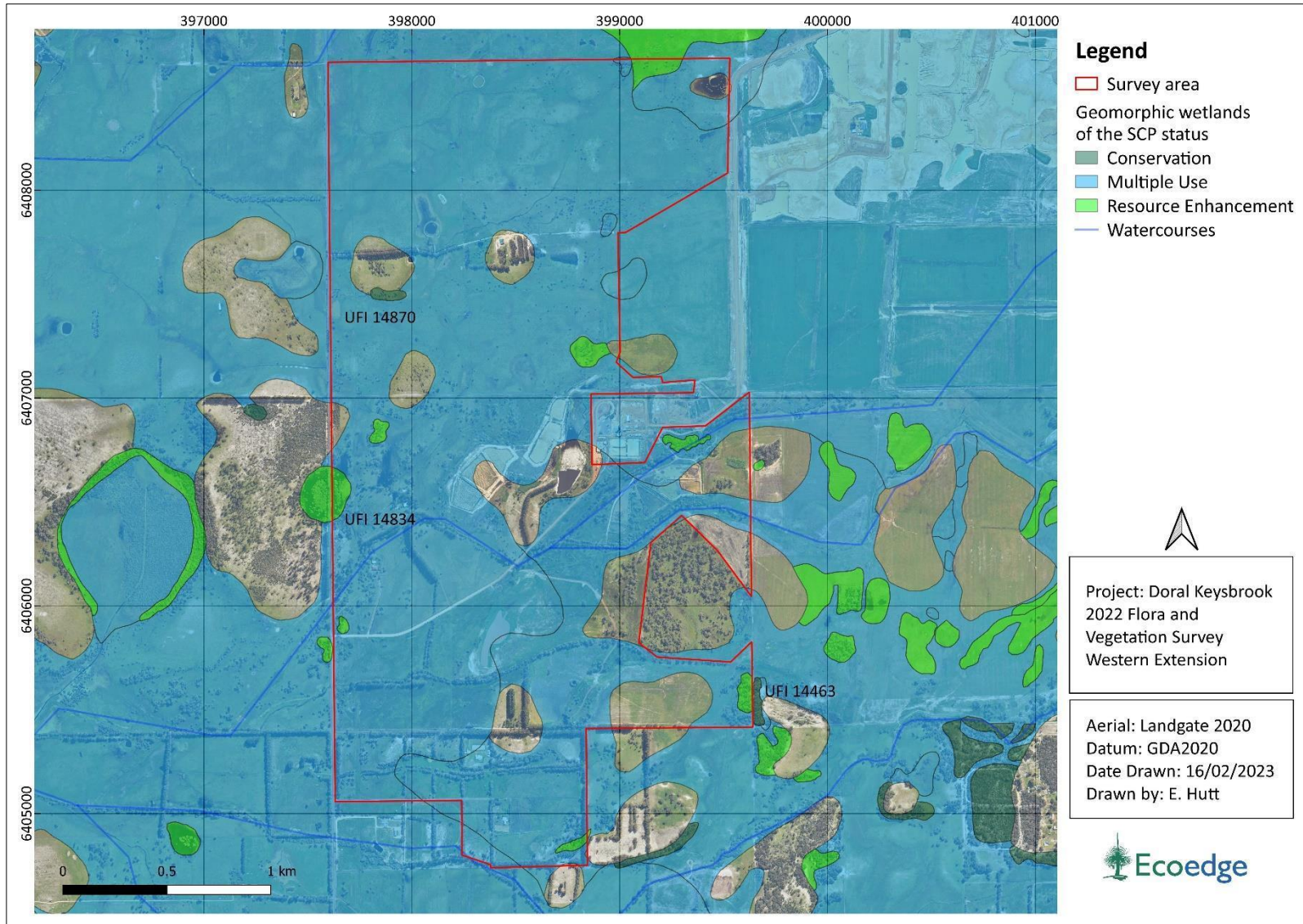


Figure 9. Geomorphic wetland status within and in proximity to the survey area (DBCA 2022a).

5.9 Regional ecological linkages

Regional ecological linkages “link protected patches of regional significance by retaining the best (condition) patches available as stepping stones for flora and fauna between regionally significant areas” (Molloy et al. 2009).

Regional ecological linkages have been mapped by Molloy et al. (2009) across the SW of WA in an area spanning between just north of Mandurah to Walpole in the southeast.

Molloy et al. (2009) assessed and assigned ‘proximity value’ (PV) ratings to all patches of remnant native vegetation as a way of indicating the value of their connectivity with regional ecological linkages. This was based on their distance from the nearest mapped regional ecological linkage axis line and connected parcels of remnant vegetation (**Table 11**).

Table 11. Linkage proximity values rating assigned to patches of remnant vegetation within a landscape by Molloy et al. (2009).

Proximity value	Description
1a	with an edge touching or < 100 m from a linkage
1b	with an edge touching or < 100 m from a natural area selected in 1a
1c	with an edge touching or < 100 m from a natural area selected in 1b
2a	with an edge touching or < 500 m from a linkage
2b	with an edge touching or < 500 m from a natural area selected in 2a
2c	with an edge touching or < 500 m from a natural area selected in 2b
3a	with an edge touching or < 1000 m from a linkage
3b	with an edge touching or < 1000 m from a natural area selected in 3a
3c	with an edge touching or < 1000 m from a natural area selected in 3b

Regional Ecological linkages have also been mapped for the Perth Metropolitan Region Scheme area. These linkages link patches of remnant vegetation judged to be of regional significance, such as Bush Forever Sites.

A regional ecological axis line mapped by Molloy et al. (2009) intersects with the survey area in the south-eastern corner. This axis line crosses into the survey area approximately 28 m at its deepest point and the length of its intersection is approximately 169 m. There are vegetation parcels linked to this axis line in the south-eastern corner with a linkage PV rating of 1a. On the eastern side of the survey area, further vegetation parcels are categorised as 1b, 1c and 2a PV ratings based on their levels of separation from the axis line and nearby canal lines.

There is a Perth Metropolitan Regional Ecological Link located approximately 3km to the north of the survey area and are associated with Bush forever site BF77 Yangedi swamp link (**Figure 10**).

5.10 Environmentally Sensitive Areas

Environmentally Sensitive Areas (ESAs) are protected under the Environmental Protection (Clearing of Native Vegetation) Regulations 2004. They are selected for their environmental values at State or National levels (Government of Western Australia, 2005). They include:

- Defined wetlands and riparian vegetation within 50 m,
- Areas covered by Threatened ecological communities,
- Area of vegetation within 50 m of Threatened flora,
- Bush Forever sites,
- Declared World Heritage property sites.

There is one mapped ESA in the north western portion of the survey area (**Figure 11**). This ESA is associated with the Conservation Category wetland UFI 14870. Another ESA intersects with the survey area boundary in the south eastern corner and is associated with the Conservation Category wetland UFI 14465 and the regional ecological axis line described in **subsection 5.9** and mapped in **Figure 10**. The wetlands were previously described in **subsection 5.8** and mapped in **Figure 9**.

5.11 Bush Forever sites

The Bush Forever program is a strategic plan implemented in 2000 by the State Government for the conservation of bushland within the Swan Coastal Plain portion of WA. A key objective of the program was to retain the Swan Coastal Plain's rich biodiversity by identifying and protecting the most significant and representative areas of the SCP's 26 naturally occurring vegetation complexes (Department of Environmental Protection 2000). The protection and management of these sites when considering land use planning processes is addressed by State Planning Policy 2.8 – Bushland policy for the Perth Metropolitan Region.

There is one Bush Forever site (BF77 Yangedi Swamp) in proximity to the survey area, however it is approximately 2.5 km to the north west and has no ecological or vegetation connections to the survey area (**Figure 10**).

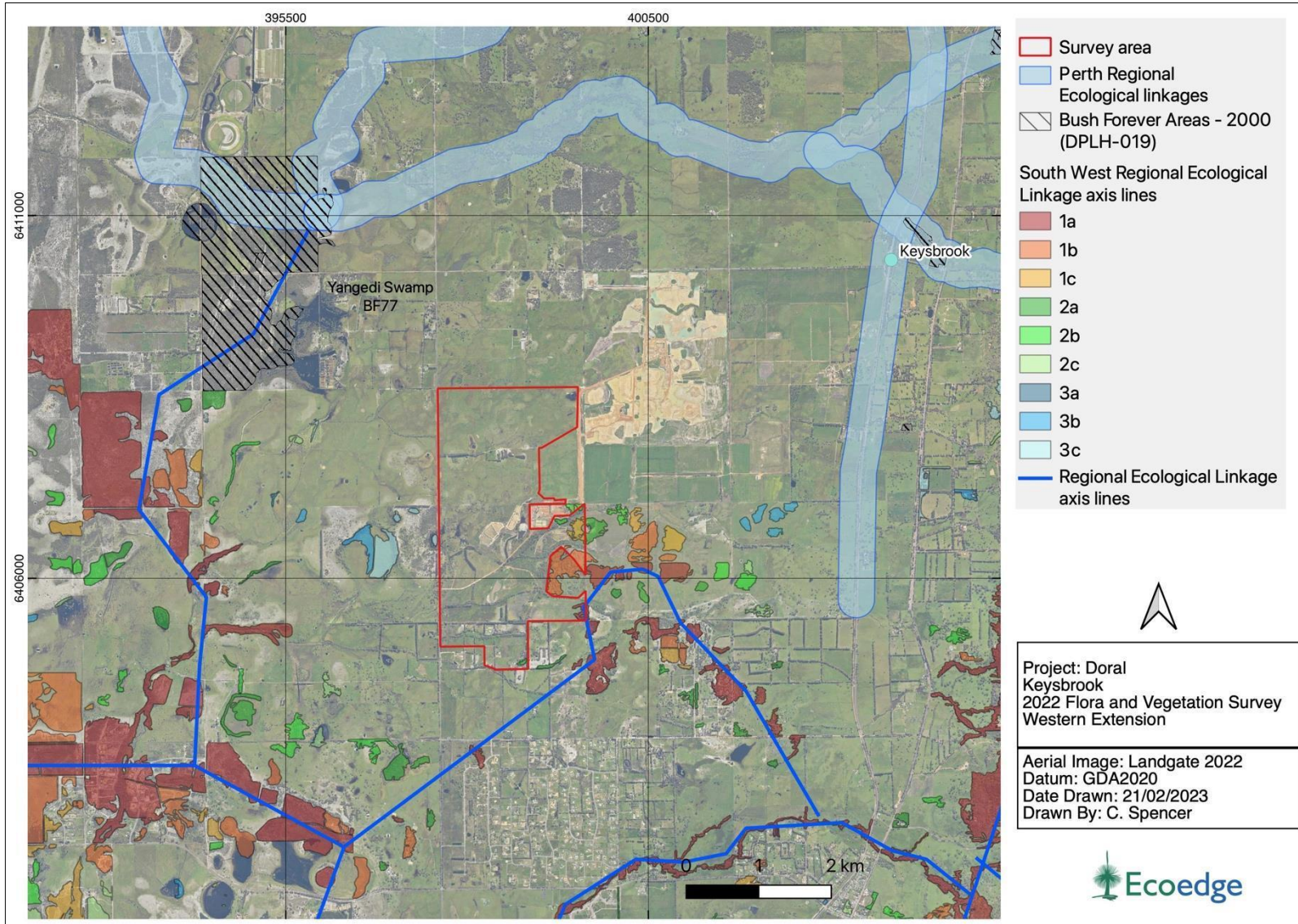


Figure 10. The survey area in relation to regional ecological linkages (Molloy et al. 2009) and Bush Forever Sites (DBCA 2019a).

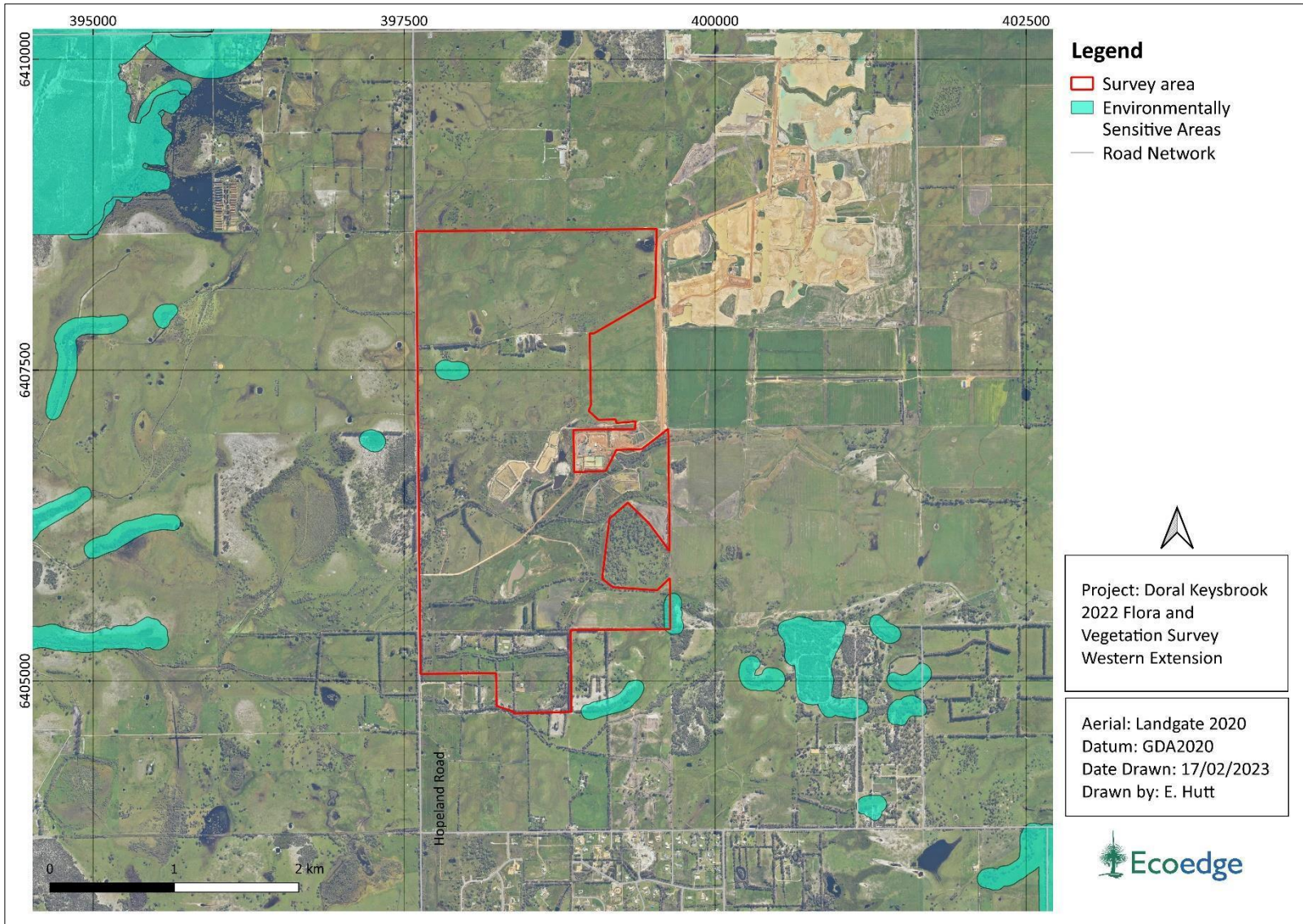


Figure 11. Environmental Sensitive Areas in proximity to the survey area (DWER 2021).

5.12 Other reports

A number of ecological reports, including flora and vegetation surveys, have been prepared over and surrounding the survey area. Summaries of six reports relevant to the current survey are provided below. These are relevant because they occur over or are directly adjacent to the survey area and present the most current assessment of the survey to date. They are presented in chronological order.

MBS Environmental (2004). Vegetation and fauna assessment of Exploration Licence 70/2407. Prepared for Olympia Resources Limited.

- Survey area focused on several free title farming properties (**Figure 12**).
- Preliminary field assessment and reconnaissance survey occurred over the period of 19-20 May 2004.
- Objectives were to identify, assess and map vegetation types, identify habitats where significant flora may occur, and provide recommendations on further flora surveys if required.
- ‘Open Marri woodland’ and ‘*Regelia ciliata*, *Hypocalymma augustifolium* dominated seasonal wetland’ vegetation types were found in the Linga East property and were recorded as being in Very Good condition.
- ‘*Kunzea glabrescens* thickets with patches of *Banksia ilicifolia*’ was recorded in the Linga West property and was in Good condition.
- The vegetation on the remaining properties were recorded as being in Degraded to Completely Degraded condition due to clearing, grazing and fire.
- No TEC or PECs or Threatened flora were recorded in the survey.

Bennett Environmental Consulting Pty Ltd (2004). Vegetation and flora of Exploration Licence 70/2407 Keysbrook Western Australia. Prepared for MBS Environmental.

- The survey area focused on the remnant vegetation found in MBS (2004) survey (**Figure 12**).
- A detailed and targeted survey was conducted over 27-28 October 2004.
- The objective of this survey was to map the vegetation and list flora and to record any Threatened and Priority flora occurring in the survey area.
- A total of 40 vascular plants, 119 genera and 169 species were recorded.
- Nine different vegetation units, representing six Floristic Community Types were recorded and ranged from Very Good to Completely Degraded in condition. All vegetation had been impacted by grazing or clearing.
- Potential TECs and PECs were either too small or too degraded to meet the threshold to be considered as a TEC or PEC.

- No Threatened flora was recorded during the survey.

Rockwater Hydrogeological and Environmental Consultants (2018). Keysbrook Project Wetland Vegetation Monitoring. Report prepared for MZI Resources Ltd.

- Part of the objective of this survey was to monitor vegetation health of Conservation Category wetlands in the vicinity of the Keysbrook Mineral Sands Project as part of its Water Management Plan (MBS 2013).
- Monitoring was undertaken in autumn of 2018 with a series of photo monitoring points recorded (**Figure 12**).
- Wetland 14463 (**Figure 9**) was recorded as having disturbed Low Forest of *Corymbia calophylla* and *Melaleuca preissiana* over Open Low Sedges (*Tetraria capillaris* and *Mesomelaena tetragona*). Vegetation of the site was not considered representative of wetland vegetation in the area and the mapping data for the site had been questioned.
- It was noted that multiple disturbances had impacted understory vegetation at all locations of wetland monitoring and the majority of the sites contain degraded, parkland-cleared vegetation.
- There was no change in vegetative health in the wetlands south of the approved mining boundary and the wetlands within the vicinity of the survey area ranged from Completely Degraded to Degraded.

Onshore Environmental (2019). Field Assessment of Keysbrook Leucoxene Conservation Areas & Revegetation Considerations. Prepared for Keysbrook Leucoxene Pty Ltd.

- Surveys were undertaken in the Northern Conservation Area (50 ha) and the Southern Conservation Area (27 ha) (**Figure 12**).
- The objective of this survey was to describe and map vegetation types and condition, compile a species list for each vegetation type and develop revegetation recommendations to address native revegetation compliance obligations.
- A total of 107 plant taxa from 40 families and 84 genera were recorded from the two survey areas.
- No Threatened flora was recorded during this survey.
- Four vegetation units (MICcEr, MIMp, SDCcXpKaXb and SDEmAf) were recorded in the survey areas.
- 5% (4 ha) of the vegetation was rated as being in Good condition, and the remainder of the vegetation was rated as either Degraded (37% or 28.6 ha) and Completely Degraded (21% or 16.2 ha).
- *Phytophthora cinnamoni* was mentioned in the report but not mapped.

Ecoedge (2021). Detailed and Targeted Flora and Vegetation Survey Keysbrook, Western Australia. Prepared for Doral Mineral Sands.

- A detailed and targeted flora survey was undertaken in October 2020 as part of investigations into future mining opportunities.
- The survey area covered 17.4 ha (**Figure 12**).

- Seventy three species of vascular plants were identified in the survey area, with 19 (26%) introduced taxa.
- No Threatened flora was recorded.
- No Declared Pest Plants or Weeds of National Significance were found.
- Three vegetation units (Jarrah-Banksia-Sheoak woodland subunits A1 and A2, Jarrah-Marri open forest unit B and *Melaleuca preissiana* dampland subunits C1 and C2) were identified in the survey area.
- None of the vegetation units were regarded as occurrences of a TEC or PEC.
- Most of the native vegetation was in Completely Degraded (55%) or Degraded (39%) condition due to grazing and potentially *Phytophthora* dieback.

Ecoedge (2022). Detailed, Reconnaissance and Targeted Flora and Vegetation Survey. Lot 507, 508, 201 Elliot Road and Part Lot 56 Wescott Road Keysbrook, Western Australia. Prepared for Doral Mineral Sands.

- A detailed and targeted flora survey was undertaken In June 2021 as part of investigations into future mining opportunities.
- The survey area covered 530 ha (**Figure 12**).
- One hundred and nineteen species of vascular flora were identified within the survey area, 25 (21%) of which were introduced taxa.
- No Threatened flora was found within the survey area.
- Five vegetation units (EmCcBaBmOF, CcEmAfOF, CcEmXpOF, CcOF, ErMrOW) were identified and mapped within the survey area.

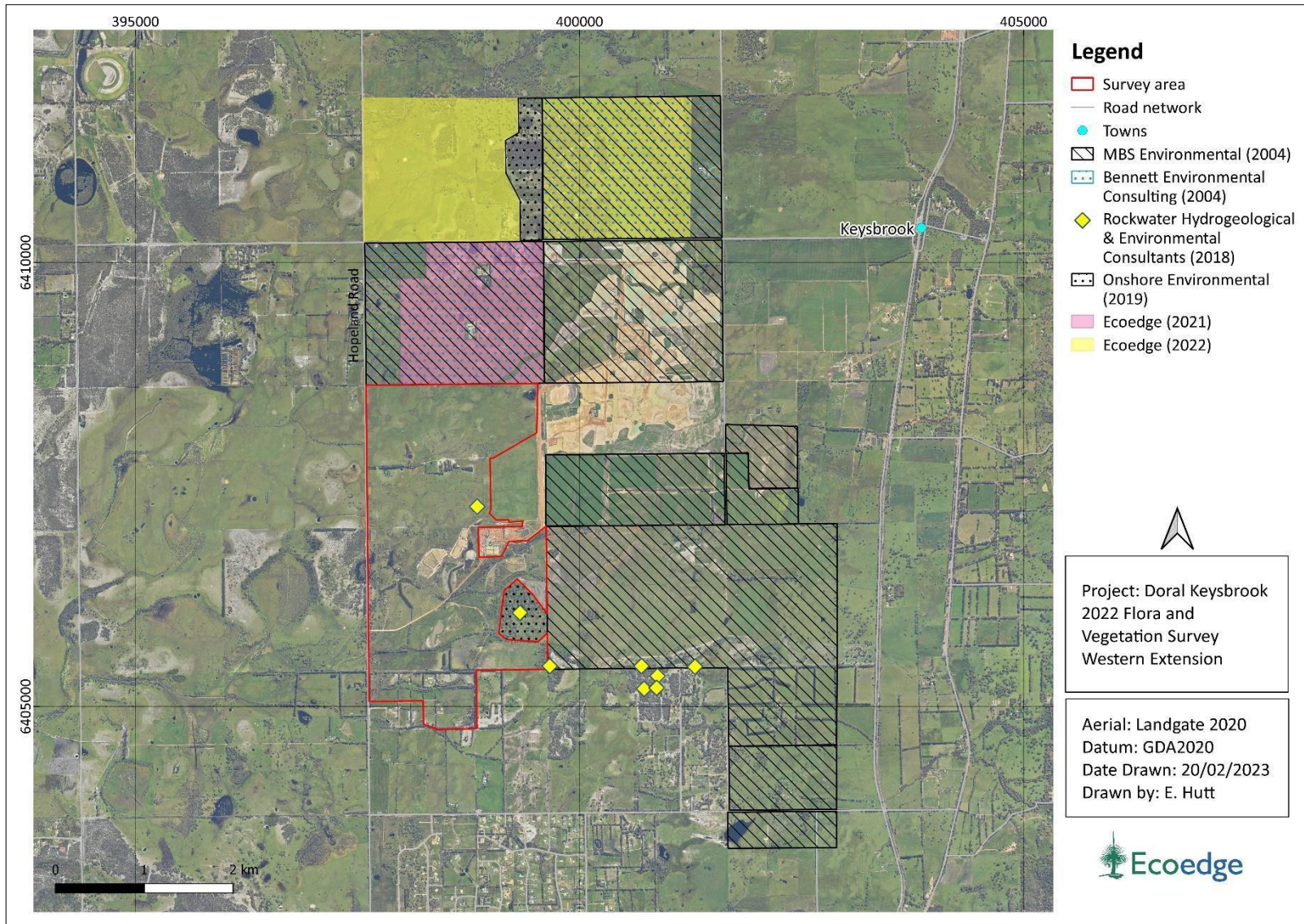


Figure 12. The location of the survey area in relation to other previous relevant flora and vegetation surveys.

6 Survey results

6.1 Flora

Forty-nine species of vascular flora were identified within the survey area, of which 27 (55%) were introduced non-native taxa. There were another six taxa that were amenity plantings. Families with the highest number of taxa were Myrtaceae (twelve species, four of them being plantings), and Poaceae (all introduced species).

Tracklog and vegetation condition notes were recorded, and locations are shown in **Appendix 9**. A list of species found during this survey is provided in **Appendix 10**.

6.2 Threatened and Priority flora

There were no threatened or priority flora or other species of conservation significance recorded within the survey area. Targeted surveys were carried out for the threatened orchids *Drakaea elastica* and *D. micrantha* on 18 August and 16 September.

6.3 Environmental weeds and Declared Pest plants

One of the introduced species, Cape tulip (**Moraea flaccida*) is a Declared Pest plant in Western Australia under the *Biosecurity and Agriculture Management Act 2007* (Department of Water Agriculture and the Environment, 2021²).

² Department of Water Agriculture and the Environment, 2021. Weeds of National Significance. <http://www.environment.gov.au/biodiversity/invasive/weeds/weeds/lists/wons.html>

7 Vegetation units

Seven vegetation mapping units or subunits were recognized and mapped for the survey area and are described in **Table 12**, below. The two dryland units, A1 and A2, were virtually all Completely Degraded, with almost no native taxa in the understorey. Two of the wetland or dampland units (B1, B2) were almost equally as degraded, while unit C, which consists of sedgeland was mainly classified as Degraded. Unit D, which covers only 0.4 ha, was classed as Good condition although it appears to mainly comprise plantings. Unit P was planted varieties of *Eucalyptus*. Photographs of each vegetation unit is provided in **Appendix 11**.

Because of their location on low sandy dunes units A1 and A2 may have contained *Banksia attenuata* or *B. menziesii* at one time, however through a combination of livestock grazing, intermittent frazing and the probable presence of *Phytophthora dieback* disease these species are no longer present.

None of the vegetation units resembles a TEC or PEC, because of their state of degradation.

Table 12. Description of vegetation units and subunits in the survey area.

Unit Code	Description
A1	Mid-height open forest or woodland of <i>Corymbia calophylla</i> (occasionally with <i>Allocasuarina fraseriana</i> , <i>Eucalyptus marginata</i> , <i>Melaleuca preissiana</i> or <i>Nuytsia floribunda</i>) over scattered <i>Kingia australis</i> tall shrubs over forbland including <i>*Arctotheca calendula</i> , <i>*Lolium</i> spp., <i>*Lotus subbiflorus</i> , <i>*Rumex</i> spp., <i>*Trifolium repens</i> on grey loamy sand.
A2	Mid-height open forest or woodland of <i>Eucalyptus marginata</i> and <i>Allocasuarina fraseriana</i> over scattered <i>Xylomelum occidentale</i> low trees over forbland including <i>*Arctotheca calendula</i> , <i>*Lolium</i> spp., <i>*Lotus subbiflorus</i> , <i>*Rumex</i> spp., <i>*Trifolium repens</i> on grey sand.
B1	Low woodland of <i>Melaleuca preissiana</i> or <i>M. raphiophylla</i> with isolated <i>Eucalyptus rudis</i> , <i>*Eucalyptus mannifera</i> medium trees over forbland of <i>*Arctotheca calendula</i> , <i>*Hypochaeris glabra</i> , <i>*Lotus subbiflorus</i> and <i>*Ursinia anthemoides</i> and grassland of <i>*Briza maxima</i> , <i>*B. minor</i> <i>*Ehrharta longiflora</i> , <i>*Lolium multiflorum</i> on grey-brown sandy loam.
B2	Low woodland of <i>Melaleuca preissiana</i> or <i>M. raphiophylla</i> over forbland of <i>*Arctotheca calendula</i> , <i>*Hypochaeris glabra</i> , <i>*Lotus subbiflorus</i> and grassland of <i>*Briza maxima</i> , <i>*B. minor</i> <i>*Lolium multiflorum</i> (and <i>*Cotula coronopifolia</i> in damper areas) on grey-brown loam.
C	Sedgeland of <i>Juncus pallidus</i> , with scattered emergent <i>*Eucalyptus globulus</i> or <i>Melaleuca preissiana</i> or <i>M. raphiophylla</i> low/medium trees over forbland of <i>*Arctotheca calendula</i> , <i>*Romulea rosea</i> , <i>*Rumex conglomeratus</i> and open grassland of <i>*Avena barbata</i> , <i>*Cenchrus clandestinus</i> , <i>*Eragrostis curvula</i> on grey sandy loam.
D	Tall shrubland of <i>Acacia saligna</i> , <i>Jacksonia sternbergiana</i> , <i>Kunzea glabrescens</i> and <i>Regelia ciliata</i> on grey sand. [Mainly plantings].
P	Amenity plantings of eucalyptus species, including <i>*Eucalyptus camaldulensis</i> , <i>*E. mannifera</i> .

8 Vegetation condition

As mentioned above, almost all vegetation in the survey area was in Completely Degraded condition (**Table 13**). The reasons for this are mainly due to physical disturbance (clearing) followed by a long period of livestock grazing. It is likely that Phytophthora dieback disease has played a role in vegetation degradation as well. There is only one small patch of vegetation, on the western boundary of the survey area, that was mapped as Good condition, and this is an area of revegetation.

Table 13. Vegetation condition in the Keysbrook survey area.

Condition	Area (ha)	%
Good	0.39	0.58
Degraded	5.18	7.75
Completely Degraded	61.29	91.67
Sub-total	66.86	100.00
Cleared	537.68	
Total	604.54	

Table 14. Proportion of vegetation units in vegetation condition classes.

Vegetation unit	Condition	Area (ha)	%
A1	Completely Degraded	15.3	95.4
	Degraded	0.7	4.6
	Sub-total	16.0	100.0
A2	Completely Degraded	3.9	100.0
	Sub-total	3.9	100.0
B1	Completely Degraded	9.1	95.4
	Degraded	0.4	4.6
	Sub-total	9.6	100.0
B2	Completely Degraded	4.4	76.9
	Degraded	1.3	23.1
	Sub-total	5.7	100.0
C	Completely Degraded	0.3	10.4
	Degraded	2.7	89.6
	Sub-total	3.0	100.0
D	Good	0.4	100.0
	Sub-total	0.4	100.0
Total Native Vegetation		38.5	

P (Planted)		28.3	
Total vegetated area		66.9	

9 Wetlands and watercourses

According to the geomorphic wetlands dataset Multiple Use wetland covers virtually the whole of the survey area, with five small areas of Resource Enhancement wetland also being present.

Three vegetation units (B1, B2 and C) comprise wetland vegetation and a fourth (D) consists of planted wetland taxa, such as *Acacia saligna* and *Regelia ciliata*.

One Conservation Category wetland (UFI 14870) occurs in the northwest of the survey area. The vegetation within this wetland (subunit B2) is Completely Degraded and therefore it doesn't warrant its status as CC. All vegetation in the Resource Enhancement wetland areas was in Completely Degraded condition, except for a small circular wetland on the western boundary (wetland UFI 14834) in Degraded condition, with 0.44 ha of vegetation unit B2.

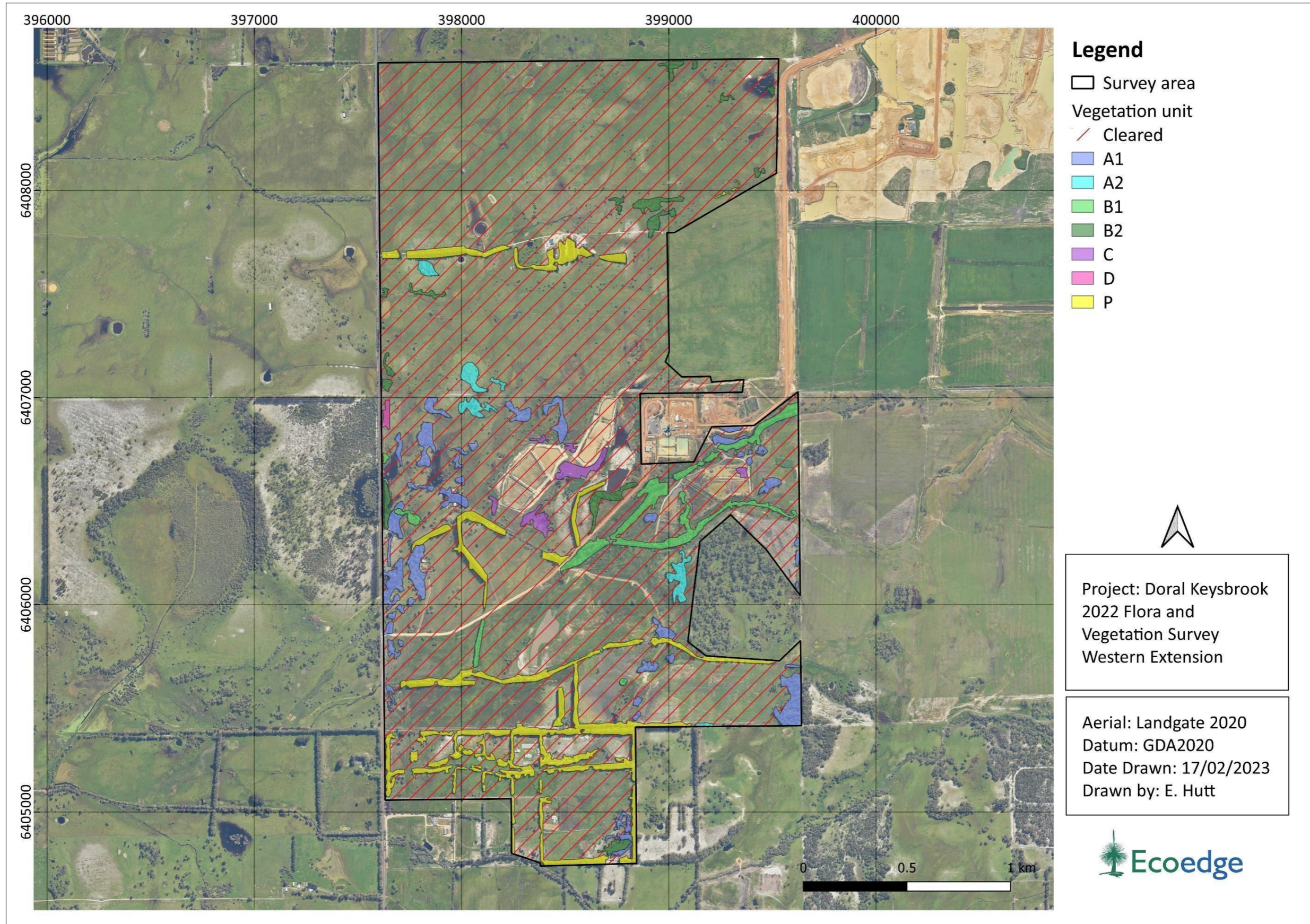


Figure 13. Vegetation units for the survey area.

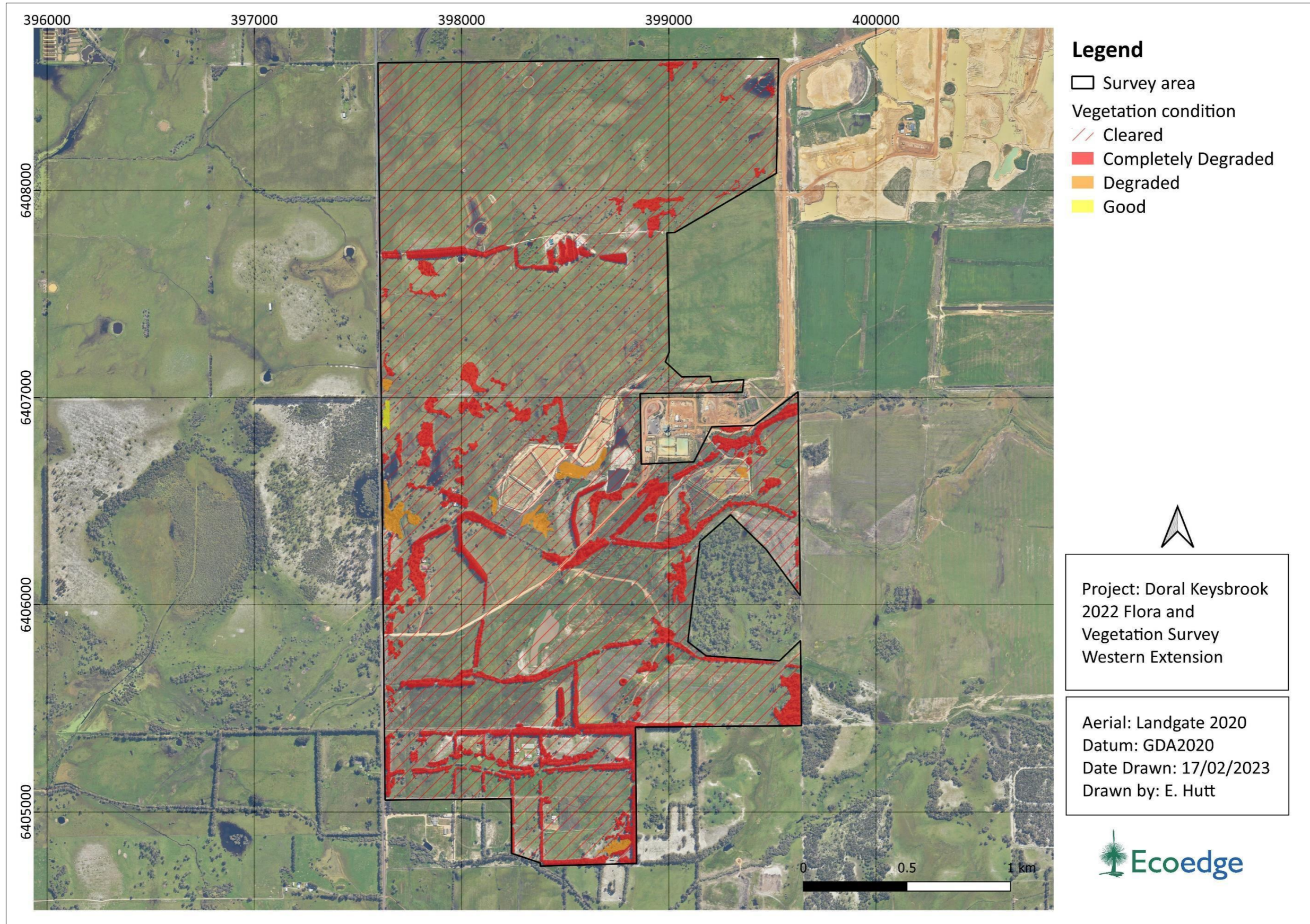


Figure 14. Vegetation condition for the survey area.

10 Discussions and conclusions

10.1 Significance of the flora

10.1.1 Threatened and Priority flora

There were no Threatened or Priority flora or other flora of conservation significance in the survey area. Hence the flora does not have particular conservation value.

10.1.2 Post-survey likelihood assessment

After completing the survey, an assessment was made of the residual likelihood of 49 Threatened and Priority List flora known or potentially occurring within 10 km of the survey area (**Appendix 8**). Of this flora, 17 were deemed to have an 'unlikely' residual likelihood of occurring within the survey area because there was no suitable habitat. The following rates for each species are provided in **Appendix 8**.

1. No suitable habitat was observed, and the taxon is known to be restricted to a narrow and clearly defined habitat type.
2. Suitable or potential habitat was present and appropriately searched, but the taxon was not observed.
3. Suitable habitat present, but these areas were too degraded for the taxon to occur, for example, due to weed invasion and/or clearing.

The other 32 taxa were deemed to have an 'unlikely' residual likelihood of occurring in the survey area because, although potential habitat was present, its condition was too degraded for them to occur there. That is, they were not found, suitable habitat may have been present in the past, but that habitat was now too degraded for them to occur there. Additionally, because these areas of previously suitable habitat were thoroughly searched at an appropriate time if they had been present, they would have been seen.

10.2 Significance of the vegetation

Because of its state of degradation very little of the vegetation has any particular conservation significance. None of the vegetation units can be inferred to be an occurrence of a TEC, because of the level of degradation. Vegetation units A1 and A2 may have originally had *Banksia attenuata* and *B. menziesii* and thus been part of the 'Banksia woodlands of the Swan Coastal Plain' TEC, but these species have disappeared, and the vegetation no longer resembles the threatened community.

Vegetation units B1 and B2 resemble the '*Melaleuca preissiana* damplands' community (SWAFCT04) of Gibson et al. (1994). This floristic community type is not a TEC or PEC. Vegetation unit C is so degraded that it is difficult to ascertain what the original community may have been, but it is likely also to have been the '*Melaleuca preissiana* damplands' community (SWAFCT04).

10.3 Wetland communities

There are five small areas of Resource Enhancement wetland within the survey area, which is otherwise virtually all classed as Multiple Use wetland. Most vegetation in the Resource Enhancement wetland areas was Completely Degraded. The only exception was a small circular wetland on the western boundary with 0.44 ha of vegetation in Degraded condition. None of the Multiple Use or Resource Enhancement wetlands warrant upgrading to Conservation category.

There is one mapped ESA in the north western portion of the survey area. This ESA is associated with the Conservation Category wetland UFI 14870. Another ESA intersects with the survey area boundary in the south eastern corner and is associated with the Conservation Category wetland UFI 14465.

There are no Bush Forever sites within the survey area. The closest Bush Forever site is approximately 2.5km away and is associated with BF77 Yangedi Swamp.

10.4 Regional ecological linkages

There are south-eastern parcels of vegetation within the survey area that have some limited ecological linkage values. These are due to the proximity to the regional ecological axis line located to the southeast of the survey area (**Figure 10**) and have limited linkage values due to the overall degraded condition of the vegetation and separation from other parcels of vegetation by expanses of pasture.

There is no statutory basis for the protection of this vegetation as an ecological linkage. However, the importance of ecological linkages, in general, has been recognised as an environmental policy consideration in EPA and Planning policy (EPA, 2008 and references therein).

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Appendix 1. Threatened and Priority flora likelihood of occurrence assessment rationale.

Appendix 2. Vegetation condition scale (EPA, 2016).

Appendix 3. Categories of Threatened and Priority ecological communities.

Appendix 4. Categories of Threatened ecological communities under the EPBC Act.

Appendix 5. Naturemap and Protected Matters Search Tool data search.

Appendix 6. State Categories of Threatened and Priority list flora.

Appendix 7. Categories of Threatened species under the EPBC Act.

Appendix 8. Pre and post likelihood of occurrence.

Appendix 9. Track log and vegetation condition records.

Appendix 10. List of vascular flora found within the survey area.

Appendix 11. Photographs and descriptions of each vegetation unit within the survey area.

Appendix 1 Threatened and Priority flora Likelihood of occurrence assessment methodology.

Rating	Presurvey rationale	Post survey rationale
Recorded		Taxon was or has been recorded in the survey area.
Likely	Known to occur within one kilometre (km) of the survey area with suitable habitat known or predicted to occur within the survey area.	<p>The taxon is known to occur within one km of the survey area and very suitable habitat was present, but the taxon was not observed for one of the following reasons.</p> <ul style="list-style-type: none"> L1. The taxon was dormant at the time of survey and could therefore not be located. L2. The habitat was compromised, for example due to a recent fire. L3. The survey area is challenging to survey. The taxon is non- descript and difficult to find because, for example, it occurs in large areas of rocky granite outcrops, or within an expanse of open water.
Possible	Known to occur within a five-ten km of the survey area with suitable habitat known or predicted to occur within the survey area.	<p>The taxon is known from within a five to ten km radius of the survey area, and suitable habitat for the species was present, but despite a thorough search being carried out, the species was not observed. The taxon may however be present for any of the following reasons.</p> <ul style="list-style-type: none"> P1. The taxon was dormant at the time of survey and could therefore not be located. P2. The habitat was compromised, for example, due to a recent fire. P3. The survey area is challenging to survey. The taxon is non- descript and difficult to find because, for example, it occurs in large areas of rocky granite outcrops, or within an expanse of open water.
Unlikely	Known or predicted to occur within ten km, but no suitable habitat is known or predicted to occur within the survey area.	<p>The taxon was not found and is unlikely to be present for one or more of the following reasons:</p> <ul style="list-style-type: none"> U1. No suitable habitat was observed, and the taxon is known to be restricted to a narrow and clearly defined habitat type. U2. Suitable or potential habitat was present and appropriately searched, but the taxon was not observed. U3. Suitable habitat present, but these areas were too degraded for the taxon to occur, for example, due to weed invasion and/or clearing.

Example of application of pre and post-survey likelihood of occurrence

Taxon	Cons Status	Flowering	Description	Pre survey likelihood	Post Survey Likelihood
<i>Drakaea elastica</i>	T (EN)	Aug -Oct	Tuberous, perennial, herb, 0.12-0.3 m high. Fl. red, green, yellow. White or grey sand. Low-lying situations adjoining winter-wet swamps.	Likely	Unlikely (U3)

Appendix 2. Vegetation condition scale (EPA 2016).

Vegetation Condition	South West and Interzone Botanical Provinces
Pristine	Pristine or nearly so, no obvious signs of disturbance or damage caused by human activities since European settlement.
Excellent	Vegetation structure intact, disturbance affecting individual species and weeds are non-aggressive species. Damage to trees caused by fire, the presence of non-aggressive weeds and occasional vehicle tracks.
Very Good	Vegetation structure altered, obvious signs of disturbance. 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. Disturbance to vegetation structure caused by very frequent fires, the presence of very aggressive weeds, 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. Disturbance to vegetation structure caused by very frequent fires, the presence of very aggressive weeds at high density, 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 and shrubs.

Appendix 3. Categories of Threatened ecological communities under the EPBC Act.

Category	Definition
Critically endangered (CR)	If, at that time, an ecological community is facing an extremely high risk of extinction in the wild in the immediate future (indicative timeframe being the next 10 years).
Endangered (EN)	If, at that time, an ecological community is not critically endangered but is facing a very high risk of extinction in the wild in the near future (indicative timeframe being the next 20 years).
Vulnerable (VU)	If, at that time, an ecological, community is not critically endangered or endangered but is facing a high risk of extinction in the wild in the medium-term future (indicative timeframe being the next 50 years).

Appendix 4. Categories of threatened and priority ecological communities under the BC Act.

Conservation code	Category
(T) Threatened ecological community pursuant to Sect 27 of the <i>Biodiversity Conservation Act 2016</i> .	
T	<p>(T) CR – Critically endangered</p> <p>An ecological community that has been adequately surveyed and found to have been subject to a major contraction in area and/or that was originally of limited distribution and is facing severe modification or destruction throughout its range in the immediate future, or is already severely degraded throughout its range but capable of being substantially restored or rehabilitated.</p>
	<p>(T) EN - Endangered</p> <p>An ecological community that has been adequately surveyed and found to have been subject to a major contraction in area and/or was originally of limited distribution and is in danger of significant modification throughout its range or severe modification or destruction over most of its range in the near future.</p>
	<p>(T) VU - Vulnerable</p> <p>An ecological community that has been adequately surveyed and is found to be declining and/or has declined in distribution and/or condition and whose ultimate security has not yet been assured and/or a community that is still widespread but is believed likely to move into a category of higher threat in the near future if threatening processes continue or begin operating throughout its range.</p>
(P) Priority species – possible threatened communities.	
p1	<p>Poorly known communities</p> <p>Ecological communities that are known from very few occurrences with a very restricted distribution (generally ≤ 5 occurrences or a total area of ≤ 100ha). Occurrences are believed to be under threat either due to limited extent, or being on lands under immediate threat (e.g. within agricultural or pastoral lands, urban areas, active mineral leases) or for which current threats exist. May include communities with occurrences on protected lands. Communities may be included if they are comparatively well-known from one or more localities but do not meet adequacy of survey requirements, and/or are not well defined, and appear to be under immediate threat from known threatening processes across their range.</p>

Conservation code	Category
P2	<p>Poorly known communities</p> <p>Communities that are known from few occurrences with a restricted distribution (generally ≤ 10 occurrences or a total area of ≤ 200ha). At least some occurrences are not believed to be under immediate threat (within approximately 10 years) of destruction or degradation. Communities may be included if they are comparatively well known from one or more localities but do not meet adequacy of survey requirements, and/or are not well defined, and appear to be under threat from known threatening processes.</p>
P3	<p>Poorly known communities</p> <ul style="list-style-type: none"> a) 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: b) communities known from a few widespread occurrences, which are either large or with significant remaining areas of habitat in which other occurrences may occur, much of it not under imminent threat (within approximately 10 years), or; c) communities made up of large, and/or widespread occurrences, that may or may not be represented in the reserve system, but are under threat of modification across much of their range from processes such as grazing by domestic and/or feral stock, inappropriate fire regimes, clearing, hydrological change etc. <p>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.</p>
P4	<p>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.</p> <ul style="list-style-type: none"> a) Rare. Species that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection but could be if present circumstances change. These species are usually represented on conservation lands. b) Near Threatened. Species that are considered to have been adequately surveyed and that are close to qualifying for vulnerable but are not listed as Conservation Dependent. c) Species that have been removed from the list of threatened species during the past five years for reasons other than taxonomy.
P5	<p>Conservation dependent ecological communities</p> <p>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.</p>

Appendix 5. NatureMap reports and Protected Matters Search Tool

Naturemap information from DBCA

Taxon	WA Cons	T Rank
<i>Hibbertia acrotoma</i>	1	
<i>Thysanotus anceps</i>	3	
<i>Morelotia australiensis</i>	T	
<i>Isopogon autumnalis</i>	3	
<i>Acacia benthamii</i>	2	
<i>Halgania corymbosa</i>	3	
<i>Acacia drummondii</i> subsp. <i>affinis</i>	3	
<i>Stachystemon exilis</i>	1	
<i>Styphelia filifolia</i>	3	
<i>Lasiopetalum glutinosum</i> subsp. <i>glutinosum</i>	3	
<i>Anthocercis gracilis</i>	T	
<i>Calectasia grandiflora</i>	2	
<i>Calothamnus graniticus</i> subsp. <i>leptophyllus</i>	4	
<i>Lepyrodia heleocharoides</i>	3	
<i>Aponogeton hexatepalus</i>	4	
<i>Acacia horridula</i>	3	
<i>Stylidium ireneae</i>	4	
<i>Senecio leucoglossus</i>	4	
<i>Verticordia lindleyi</i> subsp. <i>lindleyi</i>	4	
<i>Stylidium longitubum</i>	4	
<i>Drosera occidentalis</i>	4	
<i>Acacia oncinophylla</i> subsp. <i>oncinophylla</i>	3	
<i>Acacia oncinophylla</i> subsp. <i>patulifolia</i>	4	
<i>Grevillea pimeleoides</i>	4	
<i>Eryngium pinnatifidum</i> subsp. <i>Palustre</i> (G.J. Keighery 13459)	3	
<i>Verticordia plumosa</i> var. <i>aneoteles</i>	T	
<i>Lasiopetalum pterocarpum</i>	T	
<i>Johnsonia pubescens</i> subsp. <i>cygnorum</i>	2	
<i>Pimelea rara</i>	4	
<i>Synaphea</i> sp. Fairbridge Farm (D. Papenfus 696)	T	
<i>Synaphea</i> sp. Pinjarra Plain (A.S. George 17182)	T	
<i>Synaphea</i> sp. Pinjarra (R. Davis 6578)	T	
<i>Stackhousia</i> sp. Red-blotched corolla (A. Markey 911)	3	
<i>Synaphea</i> sp. <i>Serpentine</i> (G.R. Brand 103)	T	
<i>Meionectes tenuifolia</i>	3	
<i>Cyanothamnus tenuis</i>	4	
<i>Cyathochaeta teretifolia</i>	3	
<i>Caladenia huegelii</i>	T	CR
<i>Synaphea odocoileops</i>	1	



Australian Government

Department of Climate Change, Energy,
the Environment and Water

EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected. Please see the caveat for interpretation of information provided here.

Report created: 31-Oct-2022

[Summary](#)

[Details](#)

[Matters of NES](#)

[Other Matters Protected by the EPBC Act](#)

[Extra Information](#)

[Caveat](#)

[Acknowledgements](#)

Summary

Matters of National Environment Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the [Administrative Guidelines on Significance](#).

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance (Ramsar)	1
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	None
Listed Threatened Ecological Communities:	5
Listed Threatened Species:	34
Listed Migratory Species:	10

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at <https://www.dcceew.gov.au/parks-heritage/heritage>

A [permit](#) may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Lands:	6
Commonwealth Heritage Places:	None
Listed Marine Species:	15
Whales and Other Cetaceans:	None
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	None
Habitat Critical to the Survival of Marine Turtles:	None

Extra Information

This part of the report provides information that may also be relevant to the area you have

State and Territory Reserves:	10
Regional Forest Agreements:	1
Nationally Important Wetlands:	None
EPBC Act Referrals:	12
Key Ecological Features (Marine):	None
Biologically Important Areas:	None
Bioregional Assessments:	None
Geological and Bioregional Assessments:	None

Details

Matters of National Environmental Significance

Wetlands of International Importance (Ramsar Wetlands) [\[Resource Information \]](#)

Ramsar Site Name	Proximity	Buffer Status
Peel-yalgorup system	10 - 20km upstream from Ramsar site	In feature area

Listed Threatened Ecological Communities [\[Resource Information \]](#)

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Status of Vulnerable, Disallowed and Ineligible are not MNES under the EPBC Act.

Community Name	Threatened Category	Presence Text	Buffer Status
Banksia Woodlands of the Swan Coastal Plain ecological community	Endangered	Community likely to occur within area	In feature area
Clay Pans of the Swan Coastal Plain	Critically Endangered	Community likely to occur within area	In buffer area only
Corymbia calophylla - Kingia australis woodlands on heavy soils of the Swan Coastal Plain	Endangered	Community known to occur within area	In buffer area only
Corymbia calophylla - Xanthorrhoea preissii woodlands and shrublands of the Swan Coastal Plain	Endangered	Community known to occur within area	In buffer area only
Tuart (Eucalyptus gomphocephala) Woodlands and Forests of the Swan Coastal Plain ecological community	Critically Endangered	Community may occur within area	In feature area

Listed Threatened Species [\[Resource Information \]](#)

Status of Conservation Dependent and Extinct are not MNES under the EPBC Act.

Number is the current name ID.

Scientific Name	Threatened Category	Presence Text	Buffer Status
BIRD			
Botaurus poiciloptilus Australasian Bittern [1001]	Endangered	Species or species habitat likely to occur within area	In feature area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat likely to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Calyptorhynchus banksii naso Forest Red-tailed Black-Cockatoo, Karrak [67034]	Vulnerable	Species or species habitat known to occur within area	In feature area
Charadrius leschenaultii Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Species or species habitat may occur within area	In buffer area only
Falco hypoleucos Grey Falcon [929]	Vulnerable	Species or species habitat may occur within area	In feature area
Leipoa ocellata Malleefowl [934]	Vulnerable	Species or species habitat likely to occur within area	In feature area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area	In feature area
Rostratula australis Australian Painted Snipe [77037]	Endangered	Species or species habitat likely to occur within area	In feature area
Zanda baudinii listed as Calyptorhynchus baudinii Baudin's Black-Cockatoo, Long-billed Black-cockatoo [87736]	Endangered	Roosting known to occur within area	In feature area
Zanda latirostris listed as Calyptorhynchus latirostris Carnaby's Black Cockatoo, Short-billed Black-cockatoo [87737]	Endangered	Breeding known to occur within area	In feature area
MAMMAL			
Bettongia penicillata ogilbyi Woylie [66844]	Endangered	Species or species habitat may occur within area	In buffer area only
Dasyurus geoffroii Chuditch, Western Quoll [330]	Vulnerable	Species or species habitat known to occur within area	In feature area
Pseudocheirus occidentalis Western Ringtail Possum, Ngwayir, Womp, Woder, Ngoor, Ngoolangit [25911]	Critically Endangered	Species or species habitat likely to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Setonix brachyurus Quokka [229]	Vulnerable	Species or species habitat known to occur within area	In feature area
OTHER			
Westralunio carteri Carter's Freshwater Mussel, Freshwater Mussel [86266]	Vulnerable	Species or species habitat known to occur within area	In buffer area only
PLANT			
Andersonia gracilis Slender Andersonia [14470]	Endangered	Species or species habitat may occur within area	In buffer area only
Anthocercis gracilis Slender Tailflower [11103]	Vulnerable	Species or species habitat known to occur within area	In buffer area only
Caladenia huegelii King Spider-orchid, Grand Spider-orchid, Rusty Spider-orchid [7309]	Endangered	Species or species habitat known to occur within area	In buffer area only
Diuris drummondii Tall Donkey Orchid [4365]	Vulnerable	Species or species habitat likely to occur within area	In buffer area only
Diuris micrantha Dwarf Bee-orchid [55082]	Vulnerable	Species or species habitat likely to occur within area	In feature area
Diuris purdiei Purdie's Donkey-orchid [12950]	Endangered	Species or species habitat likely to occur within area	In feature area
Drakaea elastica Glossy-leafed Hammer Orchid, Glossy-leafed Hammer Orchid, Warty Hammer Orchid [16753]	Endangered	Species or species habitat likely to occur within area	In buffer area only
Drakaea micrantha Dwarf Hammer-orchid [56755]	Vulnerable	Species or species habitat likely to occur within area	In feature area
Eleocharis keigheryi Keighery's Eleocharis [64893]	Vulnerable	Species or species habitat may occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Eucalyptus x balanites Cadda Road Mallee, Cadda Mallee [87816]	Endangered	Species or species habitat may occur within area	In feature area
Lasiopetalum pterocarpum Wing-fruited Lasiopetalum [64922]	Endangered	Species or species habitat known to occur within area	In buffer area only
Synaphea sp. Fairbridge Farm (D. Papenfus 696) Selena's Synaphea [82881]	Critically Endangered	Species or species habitat known to occur within area	In feature area
Synaphea sp. Pinjarra (R. Davis 6578) Club-leafed Synaphea [82880]	Critically Endangered	Species or species habitat known to occur within area	In buffer area only
Synaphea sp. Pinjarra Plain (A.S. George 17182) [86878]	Endangered	Species or species habitat known to occur within area	In feature area
Synaphea sp. Serpentine (G.R. Brand 103) [86879]	Critically Endangered	Species or species habitat known to occur within area	In feature area
Synaphea stenoloba Dwellingup Synaphea [66311]	Endangered	Species or species habitat likely to occur within area	In buffer area only
Tetraria australiensis Southern Tetraria [10137]	Vulnerable	Species or species habitat likely to occur within area	In feature area
Thelymitra stellata Star Sun-orchid [7060]	Endangered	Species or species habitat may occur within area	In feature area
Verticordia plumosa var. ananeotes Tufted Plumed Featherflower [23871]	Endangered	Species or species habitat may occur within area	In buffer area only

Listed Migratory Species	[Resource Information]		
Scientific Name	Threatened Category	Presence Text	Buffer Status
Migratory Marine Birds			

Scientific Name	Threatened Category	Presence Text	Buffer Status
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area	In feature area
Migratory Terrestrial Species			
Motacilla cinerea Grey Wagtail [642]		Species or species habitat may occur within area	In feature area
Migratory Wetlands Species			
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat known to occur within area	In feature area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat likely to occur within area	In feature area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat likely to occur within area	In feature area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat likely to occur within area	In feature area
Charadrius leschenaultii Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Species or species habitat may occur within area	In buffer area only
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area	In feature area
Pandion haliaetus Osprey [952]		Species or species habitat likely to occur within area	In buffer area only
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat likely to occur within area	In buffer area only

Other Matters Protected by the EPBC Act

Commonwealth Lands

[[Resource Information](#)]

The Commonwealth area listed below may indicate the presence of Commonwealth land in this vicinity. Due to the unreliability of the data source, all proposals should be checked as to whether it impacts on a Commonwealth area, before making a definitive decision. Contact the State or Territory government land department for further information.

Commonwealth Land Name	State	Buffer Status
Unknown		
Commonwealth Land - [50852]	WA	In buffer area only
Commonwealth Land - [50855]	WA	In buffer area only
Commonwealth Land - [50854]	WA	In buffer area only
Commonwealth Land - [51239]	WA	In buffer area only
Commonwealth Land - [51240]	WA	In buffer area only
Commonwealth Land - [51919]	WA	In buffer area only

Listed Marine Species

[[Resource Information](#)]

Scientific Name	Threatened Category	Presence Text	Buffer Status
Bird			
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat known to occur within area	In feature area
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area overfly marine area	In feature area
Bubulcus ibis as Ardea ibis Cattle Egret [66521]		Species or species habitat may occur within area overfly marine area	In feature area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat likely to occur within area	In feature area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat likely to occur within area overfly marine area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat likely to occur within area overfly marine area	In feature area
Charadrius leschenaultii Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Species or species habitat may occur within area	In buffer area only
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat likely to occur within area	In feature area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area overfly marine area	In feature area
Motacilla cinerea Grey Wagtail [642]		Species or species habitat may occur within area overfly marine area	In feature area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area	In feature area
Pandion haliaetus Osprey [952]		Species or species habitat likely to occur within area	In buffer area only
Rostratula australis as Rostratula benghalensis (sensu lato) Australian Painted Snipe [77037]	Endangered	Species or species habitat likely to occur within area overfly marine area	In feature area
Thinornis cucullatus as Thinornis rubricollis Hooded Plover, Hooded Dotterel [87735]		Species or species habitat may occur within area overfly marine area	In buffer area only
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat likely to occur within area overfly marine area	In buffer area only

Extra Information

State and Territory Reserves			[Resource Information]
Protected Area Name	Reserve Type	State	Buffer Status
Karnet	Nature Reserve	WA	In buffer area only
Lambkin	Nature Reserve	WA	In buffer area only
North Dandalup	Nature Reserve	WA	In buffer area only
NTWA Bushland covenant (0076)	Conservation Covenant	WA	In buffer area only
NTWA Bushland covenant (0077)	Conservation Covenant	WA	In buffer area only
NTWA Bushland covenant (0086)	Conservation Covenant	WA	In buffer area only
NTWA Bushland covenant (0089)	Conservation Covenant	WA	In buffer area only
Serpentine	National Park	WA	In buffer area only
Unnamed WA46587	Nature Reserve	WA	In buffer area only
Unnamed WA50643	5(1)(h) Reserve	WA	In buffer area only

Regional Forest Agreements [Resource Information]

Note that all areas with completed RFAs have been included.

RFA Name	State	Buffer Status
South West WA RFA	Western Australia	In buffer area only

EPBC Act Referrals [Resource Information]

Title of referral	Reference	Referral Outcome	Assessment Status	Buffer Status
Huntly Bauxite Mine Transition	2022/09204		Assessment	In buffer area only

Controlled action				
Alcoa Pinjarra Refinery Production Increase and Bauxite Export	2020/8743	Controlled Action	Completed	In buffer area only
Clearing, mining and rehabilitation Scrivener Road	2015/7577	Controlled Action	Further Information	In buffer area only

Title of referral	Reference	Referral Outcome	Assessment Status	Buffer Status
Controlled action				
Gravel reserves			Request	
Construction of Road and Extension of Utilities on Turner Street, Serpentine	2008/4670	Controlled Action	Post-Approval	In buffer area only
Mineral Sands Mine	2005/2163	Controlled Action	Post-Approval	In buffer area only
Natural Gas Pipeline Expansion	2006/2813	Controlled Action	Post-Approval	In buffer area only
Not controlled action				
'Looping 10' gas transmission pipeline from Kwinana to Hopelands	2005/2212	Not Controlled Action	Completed	In buffer area only
Development of a wholesale nursery	2012/6622	Not Controlled Action	Completed	In buffer area only
Improving rabbit biocontrol: releasing another strain of RHDV, sthrn two thirds of Australia	2015/7522	Not Controlled Action	Completed	In feature area
INDIGO Central Submarine Telecommunications Cable	2017/8127	Not Controlled Action	Completed	In feature area
Serpentine Sports Reserve, Protection of Dieback Free Area	2008/4337	Not Controlled Action	Completed	In buffer area only
Not controlled action (particular manner)				
INDIGO Marine Cable Route Survey (INDIGO)	2017/7996	Not Controlled Action (Particular Manner)	Post-Approval	In feature area

Caveat

1 PURPOSE

This report is designed to assist in identifying the location of matters of national environmental significance (MNES) and other matters protected by the Environment Protection and Biodiversity Conservation Act 1999 (Cth) (EPBC Act) which may be relevant in determining obligations and requirements under the EPBC Act.

The report contains the mapped locations of:

- World and National Heritage properties;
- Wetlands of International and National Importance;
- Commonwealth and State/Territory reserves;
- distribution of listed threatened, migratory and marine species;
- listed threatened ecological communities; and
- other information that may be useful as an indicator of potential habitat value.

2 DISCLAIMER

This report is not intended to be exhaustive and should only be relied upon as a general guide as mapped data is not available for all species or ecological communities listed under the EPBC Act (see below). Persons seeking to use the information contained in this report to inform the referral of a proposed action under the EPBC Act should consider the limitations noted below and whether additional information is required to determine the existence and location of MNES and other protected matters.

Where data are available to inform the mapping of protected species, the presence type (e.g. known, likely or may occur) that can be determined from the data is indicated in general terms. It is the responsibility of any person using or relying on the information in this report to ensure that it is suitable for the circumstances of any proposed use. The Commonwealth cannot accept responsibility for the consequences of any use of the report or any part thereof. To the maximum extent allowed under governing law, the Commonwealth will not be liable for any loss or damage that may be occasioned directly or indirectly through the use of, or reliance

3 DATA SOURCES

Threatened ecological communities

For threatened ecological communities where the distribution is well known, maps are generated based on information contained in recovery plans, State vegetation maps and remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Threatened, migratory and marine species

Threatened, migratory and marine species distributions have been discerned through a variety of methods. Where distributions are well known and if time permits, distributions are inferred from either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc.) together with point locations and described habitat; or modelled (MAXENT or BIOCLIM habitat modelling) using

Where little information is available for a species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc.).

In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More detailed distribution mapping methods are used to update these distributions

4 LIMITATIONS

The following species and ecological communities have not been mapped and do not appear in this report:

- threatened species listed as extinct or considered vagrants;
- some recently listed species and ecological communities;
- some listed migratory and listed marine species, which are not listed as threatened species; and
- migratory species that are very widespread, vagrant, or only occur in Australia in small numbers.

The following groups have been mapped, but may not cover the complete distribution of the species:

- listed migratory and/or listed marine seabirds, which are not listed as threatened, have only been mapped for recorded
- seals which have only been mapped for breeding sites near the Australian continent

The breeding sites may be important for the protection of the Commonwealth Marine environment.

Refer to the metadata for the feature group (using the Resource Information link) for the currency of the information.

Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

- [-Office of Environment and Heritage, New South Wales](#)
- [-Department of Environment and Primary Industries, Victoria](#)
- [-Department of Primary Industries, Parks, Water and Environment, Tasmania](#)
- [-Department of Environment, Water and Natural Resources, South Australia](#)
- [-Department of Land and Resource Management, Northern Territory](#)
- [-Department of Environmental and Heritage Protection, Queensland](#)
- [-Department of Parks and Wildlife, Western Australia](#)
- [-Environment and Planning Directorate, ACT](#)
- [-Birdlife Australia](#)
- [-Australian Bird and Bat Banding Scheme](#)
- [-Australian National Wildlife Collection](#)
- Natural history museums of Australia
- [-Museum Victoria](#)
- [-Australian Museum](#)
- [-South Australian Museum](#)
- [-Queensland Museum](#)
- [-Online Zoological Collections of Australian Museums](#)
- [-Queensland Herbarium](#)
- [-National Herbarium of NSW](#)
- [-Royal Botanic Gardens and National Herbarium of Victoria](#)
- [-Tasmanian Herbarium](#)
- [-State Herbarium of South Australia](#)
- [-Northern Territory Herbarium](#)
- [-Western Australian Herbarium](#)
- [-Australian National Herbarium, Canberra](#)
- [-University of New England](#)
- [-Ocean Biogeographic Information System](#)
- [-Australian Government, Department of Defence](#)
- [Forestry Corporation, NSW](#)
- [-Geoscience Australia](#)
- [-CSIRO](#)
- [-Australian Tropical Herbarium, Cairns](#)
- [-eBird Australia](#)
- [-Australian Government – Australian Antarctic Data Centre](#)
- [-Museum and Art Gallery of the Northern Territory](#)
- [-Australian Government National Environmental Science Program](#)
- [-Australian Institute of Marine Science](#)
- [-Reef Life Survey Australia](#)
- [-American Museum of Natural History](#)
- [-Queen Victoria Museum and Art Gallery, Inveresk, Tasmania](#)
- [-Tasmanian Museum and Art Gallery, Hobart, Tasmania](#)
- Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the [Contact us](#) page.

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Appendix 6. Definitions of conservation codes for Threatened and Priority flora.

Conservation code	Category
(T) Threatened species pursuant to Sect 19 of the BC Act 2016.	
T	<p>(T) CR – Critically endangered</p> <p>Threatened species considered to be <i>“facing an extremely high risk of extinction in the wild in the immediate future, as determined in accordance with criteria set out in the ministerial guidelines”</i>.</p>
	<p>(T) EN - Endangered</p> <p>Threatened species considered to be <i>“facing a very high risk of extinction in the wild in the near future, as determined in accordance with criteria set out in the ministerial guidelines”</i>.</p>
	<p>(T) VU - Vulnerable</p> <p>Threatened species considered to be <i>“facing a high risk of extinction in the wild in the medium-term future, as determined in accordance with criteria set out in the ministerial guidelines”</i>.</p>
(P) Priority species – possible Threatened species.	
P1	<p>Species that are known from one or a few locations (generally five or less) which are potentially at risk. All occurrences are either: very small; or on lands not managed for conservation, e.g. agricultural or pastoral lands, urban areas, road and rail reserves, gravel reserves and active mineral leases; or otherwise under threat of habitat destruction or degradation. Species may be included if they are comparatively well known from one or more locations but do not meet adequacy of survey requirements and appear to be under immediate threat from known threatening processes. Such species are in urgent need of further survey.</p>
P2	<p>Species that are known from one or a few locations (generally five or less), some of which are on lands managed primarily for nature conservation, e.g. national parks, conservation parks, nature reserves and other lands with secure tenure being managed for conservation. Species may be included if they are comparatively well known from one or more locations but do not meet adequacy of survey requirements and appear to be under threat from known threatening processes. Such species are in urgent need of further survey.</p>

Conservation code	Category
P3	<p>Species that are known from several locations, and the species does not appear to be under imminent threat, or from few but widespread locations with either large population size or significant remaining areas of apparently suitable habitat, much of it not under imminent threat. Species may be included if they are comparatively well known from several locations but do not meet adequacy of survey requirements and known threatening processes exist that could affect them. Such species are in need of further survey.</p>
P4	<p>(a) Rare. Species that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection but could be if present circumstances change. These species are usually represented on conservation lands.</p> <p>(b) Near Threatened. Species that are considered to have been adequately surveyed and that are close to qualifying for vulnerable but are not listed as Conservation Dependent.</p> <p>(c) Species that have been removed from the list of threatened species during the past five years for reasons other than taxonomy.</p>

Appendix 7. Categories of Threatened species under the EPBC Act.

Category	Definition
Extinct (Ex)	A native species is eligible to be included in the extinct category at a particular time if, at that time, there is no reasonable doubt that the last member of the species has died.
Extinct in the Wild (ExW)	A native species is eligible to be included in the extinct in the wild category at a particular time if, at that time (a) it is known only to survive in cultivation, in captivity or as a naturalised population well outside its past range; or (b) it has not been recorded in its known and/or expected habitat, at appropriate seasons, anywhere in its past range, despite exhaustive surveys over a time frame appropriate to its life cycle and form.
Critically Endangered (CR)	A native species is eligible to be included in the critically endangered category at a particular time if, at that time, it is facing an extremely high risk of extinction in the wild in the immediate future, as determined in accordance with the prescribed criteria.
Endangered (EN)	A native species is eligible to be included in the endangered category at a particular time if, at that time (a) it is not critically endangered; and (b) it is facing a very high risk of extinction in the wild in the near future, as determined in accordance with the prescribed criteria.
Vulnerable (VU)	A native species is eligible to be included in the vulnerable category at a particular time if, at that time (a) it is not critically endangered or endangered; and (b) it is facing a high risk of extinction in the wild in the medium term future, as determined in accordance with the prescribed criteria.
Conservation Dependent (CD)	A native species is eligible to be included in the conservation dependent category at a particular time if, at that time, the species is the focus of a specific conservation program, the cessation of which would result in the species becoming vulnerable, endangered or critically endangered within a period of 5 years.

Appendix 8. Pre and post survey likelihood of occurrence table.

Pre and post survey likelihood of threatened and priority flora occurring within the survey area, based on a comparison of known (DBCA 2022d) and potential species (DCCEEW 2022a) within the 10 km radius study area.¹

Species	Cons Status*	Flowering	Description and Habitat	**Likelihood	***Post Survey Likelihood
<i>Thelymitra stellata</i>	T	Oct to Nov.	Tuberous, perennial, herb, 0.15-0.25 m high. Fl. yellow & brown. Sand, gravel, lateritic loam.	Unlikely	Unlikely (U1) - no suitable habitat
<i>Synaphea</i> sp. Fairbridge Farm (D. Papenfus 696)	T (CR)	Oct	Dense, clumped shrub, to 0.3 m high, to 0.4 m wide. Fl. Yellow. Sandy with lateritic pebbles. Near winter-wet flats, in low woodland with weedy grasses.	Possible	Unlikely (U3) – suitable habitat but too degraded
<i>Synaphea</i> sp. Pinjarra (R. Davis 6578)	T (CR)	Sep - Oct	Compact shrub, to 0.5 m high, to 0.7 m wide. Leaves hairless, blue-green, 3 lobed to irregularly lobed. Spike extend beyond leaves, fairly crowded flowers Fl. yellow. Grey clayey sand. Swamp habitat.	Unlikely	Unlikely (U3) – suitable habitat but too degraded
<i>Synaphea</i> sp. Serpentine	T (CR)	Sep-Oct	Perennial, Plants clumped 0.6 m high to 0.5 m wide. Leaves 2-4 x tripartite, terminal lobes linear. Spikes long, undulating, infused with red. Fl. Yellow. Predominantly on flat terrain on grey-brown sandy loams to clay in seasonally wet areas.	Unlikely	Unlikely (U3) – suitable habitat but too degraded

¹ Note presurvey data downloads were conducted by Ecoedge (DBCA 2020c and DCCEEW 2022b) for a 10 km buffer. This data is included in the appendices.

Species	Cons Status*	Flowering	Description and Habitat	**Likelihood	***Post Survey Likelihood
<i>Andersonia gracilis</i>	T (EN)	Sep-Nov	Slender erect or open straggly shrub, 0.1-0.5(-1) m high. Fl. white-pink-purple. White/grey sand, sandy clay, gravelly loam. Winter-wet areas, near swamps.	Unlikely	Unlikely (U3) – suitable habitat but too degraded
<i>Caladenia huegelii</i>	T (EN)	Sep-Oct	Tuberous, perennial, herb, 0.25-0.6 m high. Fl. green, cream, red. Grey or brown sand, clay loam. (Jarrah banksia woodland usually associated with the Bassendean sand-dune system, rarely in the Spearwood system).	Possible	Unlikely (U3) – suitable habitat but too degraded
<i>Drakaea elastica</i>	T (EN)	Oct-Nov	Tuberous, perennial, herb, 0.12-0.3 m high. Fl. red, green, yellow. White or grey sand. Low-lying situations adjoining winter-wet swamps.	Possible	Unlikely (U3) – suitable habitat but too degraded
<i>Eucalyptus x balanites</i>	T (EN)	Oct to Dec or Jan to Feb	(Mallee), to 5 m high, bark rough, flaky. Fl. white. Sandy soils with lateritic gravel.	Unlikely	Unlikely (U1) - no suitable habitat
<i>Lasiopetalum pterocarpum</i>	T (EN)	Aug-Dec	Open, multi-stemmed shrub (with distinctly winged fruit), to 1.2 m high. Fl. pink. Dark red-brown loam or clayey sand over granite. On sloping banks near creeklines.	Unlikely	Unlikely (U1) - no suitable habitat
<i>Synaphea</i> sp. Pinjarra Plain (A.S. George 17182)	T (EN)	Sep to Nov	Erect, clumped shrub (sub-shrub), to 0.8 m high. Fl. yellow. Grey sandy loam or clay, grey-brown clayey sand, brown clayey loam, laterite. Flats, seasonally	Unlikely	Unlikely (U3) – suitable habitat but too degraded

Species	Cons Status*	Flowering	Description and Habitat	**Likelihood	***Post Survey Likelihood
			wet areas, railroad reserves often with wet depressions or drains.		
<i>Synaphea stenoloba</i>	T (EN)	Aug-Oct	Caespitose shrub, 0.3–0.45 m high. Fl. Yellow. Sandy or sandy clay soils. Winter-wet flats, granite. Shrublands and woodlands on loamy soils.	Unlikely	Unlikely (U3) – suitable habitat but too degraded
<i>Verticordia plumosa</i> var. <i>ananeotes</i>	T (EN)	Nov-Dec	Erect, sparsely branched shrub, 0.3-0.5 m high. Fl. pink-purple/white. Sandy loam. Seasonally inundated plains.	Unlikely	Unlikely (U3) – suitable habitat but too degraded
<i>Anthocercis gracilis</i>	T (VU)	Sep to Oct	Erect, spindly shrub, to 0.6(-1) m high. Fl. yellow-green. Sandy or loamy soils. Granite outcrops.	Unlikely	Unlikely (U1) - no suitable habitat
<i>Diuris drummondii</i>	T (VU)	Nov-Jan	Tuberous, perennial, herb, 0.5-1.05 m high. Fl. yellow. Low-lying depressions, swamps.	Unlikely	Unlikely (U3) – suitable habitat but too degraded
<i>Diuris micrantha</i>	T (VU)	Sep-Oct	Tuberous, perennial, herb, 0.3–0.6 m high. Fl. yellow, brown. Brown loamy clay. Winter-wet swamps, in shallow water.	Unlikely	Unlikely (U3) – suitable habitat but too degraded
<i>Drakaea micrantha</i>	T (VU)	Sep-Oct	Tuberous, perennial, dwarf hammer orchid, 0.15–0.3 m high. Fl. red, yellow. Small heart shaped leaf with green veins. White-grey infertile sand in <i>Eucalyptus marginata</i> , <i>Allocasuarina fraseriana</i> woodland or forest. Often under <i>Kunzea ericifolia</i> , <i>K. glabrescens</i> with <i>Paracaleana nigrita</i> and other <i>Drakaea</i> species.	Unlikely	Unlikely (U3) – suitable habitat but too degraded

Species	Cons Status*	Flowering	Description and Habitat	**Likelihood	***Post Survey Likelihood
<i>Eleocharis keigheryi</i>	T (VU)	Aug-Nov	Rhizomatous, clumped perennial, grass-like or herb (sedge), to 0.4 m high. Fl. green. Clay, sandy loam. Emergent in freshwater: creeks, claypans	Unlikely	Unlikely (U3) – suitable habitat but too degraded
<i>Morelotia australiensis</i>	T (VU)	Nov-Dec	Rhizomatous, tufted perennial, grass-like or herb (sedge), to 1 m high. Fl. brown. Sandy soils associated with heavy soils on the Pinjarra Plain.	Unlikely	Unlikely (U3) – suitable habitat but too degraded
<i>Drosera occidentalis</i>	P1	Oct-Dec or Jan	Fibrous-rooted, rosetted perennial, herb, to 0.025 m high. Fl. pink/white. Peaty sand, margins of swamps, winter wet depressions and watersheds in open areas.	Unlikely	Unlikely (U3) – suitable habitat but too degraded
<i>Drosera oreopodion</i>	P1	Oct - Nov	Pygmy. White flower. White sand over laterite rock.	Unlikely	Unlikely (U1) - no suitable habitat
<i>Hibbertia acrotoma</i>	P1	Aug - ?	Perennial, prostrate shrub. 0.2 - 0.30 m high to 0.30- 0.40 m wide. Fl. Yellow.	Unlikely	Unlikely (U3) – suitable habitat but too degraded
<i>Stachystemon exilis</i>	P1	Sep - Nov	Monoecious shrub/herb to 0.2 m high. Fl. Green yellow. Open, low-lying Banksia woodland in which <i>B. ilicifolia</i> is a significant component of the upper canopy. Other associated species are <i>Melaleuca preissiana</i> , <i>M. thymoides</i> , <i>Adenanthos meisneri</i> and <i>Hypocalymma angustifolium</i> .	Possible	Unlikely (U3) – suitable habitat but too degraded

Species	Cons Status*	Flowering	Description and Habitat	**Likelihood	***Post Survey Likelihood
<i>Synaphea odocoileops</i>	P1	Aug-Oct	Tufted, compact shrub, 0.2–0.5 m high. Fl. yellow. Brown-orange loam & sandy clay, granite. Swamps, winter-wet areas.	Unlikely	Unlikely (U3) – suitable habitat but too degraded
<i>Acacia benthamii</i>	P2	Aug-Sep	Shrub, ca 1 m high. Fl. Yellow. Sand. Typically on limestone breakaways also recorded in Open shrubland; <i>Melaleuca raphiophylla</i> , <i>Pericalymma ellipticum</i> , <i>Xanthorrhoea preissii</i> , <i>Hakea ceratophylla</i> , <i>Calothamnus lateralis</i> , <i>Hibbertia stellaris</i> .	Likely	Unlikely (U1) - no suitable habitat
<i>Calectasia grandiflora</i>	P2	Jun-Nov	Rhizomatous, perennial, herb (or undershrub), to 0.65 m high, without stilt roots. Fl. blue/purple. White, grey or yellow sand, sandy clay, gravel, laterite, granite. Swampy areas, rock outcrops, flats, slopes, ridges.	Unlikely	Unlikely (U3) – suitable habitat but too degraded
<i>Johnsonia pubescens</i> subsp. <i>cygnorum</i>	P2	Sep	Grey-white-yellow sands. Flats, seasonally-wet sites.	Possible	Unlikely (U3) – suitable habitat but too degraded
<i>Acacia drummondii</i> subsp. <i>affinis</i>	P3	Jul-Aug	Erect shrub, 0.3-1 m high. Fl. yellow. Lateritic gravelly soils.	Unlikely	Unlikely (U1) - no suitable habitat
<i>Acacia horridula</i>	P3	May-Aug	Harsh, slender, single-stemmed shrub, 0.3-0.6(-1) m high. Fl. yellow. Gravelly soils over granite, sand. Rocky hillsides.	Unlikely	Unlikely (U1) - no suitable habitat

Species	Cons Status*	Flowering	Description and Habitat	**Likelihood	***Post Survey Likelihood
<i>Acacia oncinophylla</i> subsp. <i>oncinophylla</i>	P3	Aug-Oct	Shrub, 0.9-2.5 m high, 'minni-ritchi' bark, phyllodes mostly 8-13 cm long, 1-2 mm wide. Fl. yellow. Granitic soils.	Unlikely	Unlikely (U1) - no suitable habitat
<i>Cyathochaeta teretifolia</i>	P3	Oct-Jan	Rhizomatous, clumped, robust perennial, grass-like or herb (sedge), to 2 m high, to 1.0 m wide. Fl. brown. Grey sand, sandy clay. Swamps, creek edges.	Unlikely	Unlikely (U3) – suitable habitat but too degraded
<i>Eryngium pinnatifidum</i> subsp. <i>palustre</i>	P3	Oct - Nov	Tuberous perennial herb 20-30 cm, leaves soft & tubular, flowers bluish.	Unlikely	Unlikely (U3) – suitable habitat but too degraded
<i>Halgania corymbosa</i>	P3	Aug to Nov	Erect shrub, 0.35-1 m high. Fl. blue-purple. Gravelly soils, soils over granite.	Unlikely	Unlikely (U1) - no suitable habitat
<i>Isopogon autumnalis</i>	P3	Feb to June	Shrub, 0.5-1m high. Fl. cream or yellow.	Unlikely	Unlikely (U3) – suitable habitat but too degraded
<i>Lasiopetalum glutinosum</i> subsp. <i>glutinosum</i>	P3	Sep	Perennial erect open shrub, 0.4-0.6 m high. 0.6 m wide. Fl. pink. Open, low scrub over heath, on steep slopes of lateritic gravel, clay or sandy loam near granite outcrops and creeklines.	Unlikely	Unlikely (U1) - no suitable habitat
<i>Lepyrodia heleocharoides</i>	P3	Dec	Rhizomatous, slender, tufted perennial, herb (sedge-like), 0.15–0.25 m high. Moist peaty sand. Dry or seasonally inundated heath or woodland, swamps.	Unlikely	Unlikely (U3) – suitable habitat but too degraded

Species	Cons Status*	Flowering	Description and Habitat	**Likelihood	***Post Survey Likelihood
<i>Meionectes tenuifolia</i>	P3	Nov	Suckering spreading decumbent shrub with cream-green flowers - red style. Height to ca 25 cm. Broadly distributed across the Swan Coastal Plain, northern and southern Jarrah forests associated with ephemeral wetlands.	Unlikely	Unlikely (U3) – suitable habitat but too degraded
<i>Stackhousia</i> sp. Red-blotched corolla (A. Markey 911)	P3	Sep? to Nov	Limited information: Erect perennial herb 20 cm high. Flowers bright yellow. Jarrah forest, Wandoo woodland - loamy laterite gravel?	Unlikely	Unlikely (U1) - no suitable habitat
<i>Styphelia filifolia</i>	P3	Mar - May	Erect shrubs to 0.9 m high, 0.7 m wide, Fl white - Occurs sporadically from north of Eneabba to the Harvey area. Geraldton Sandplains and Swan Coastal Plain bioregions. Sandy soils of the coastal plain (with one known occurrence from the northern Darling Scarp), usually in Banksia or Jarrah woodland and in low-lying situations.	Possible	Unlikely (U3) – suitable habitat but too degraded
<i>Thysanotus anceps</i>	P3	Oct to Dec	Rhizomatous, leafless perennial, herb, to 0.4 m high. Fl. purple. White or grey sand, lateritic gravel, laterite.	Unlikely	Unlikely (U1) - no suitable habitat
<i>Acacia oncinophylla</i> subsp. <i>patulifolia</i>	P4	Aug-Nov or Nov-Dec	Shrub, 0.5-2.5(-3) m high, 'minni-ritchi' bark, phyllodes 4-9 cm long, 3-6 mm wide. Fl. yellow. Granitic soils, occasionally on laterite.	Unlikely	Unlikely (U1) - no suitable habitat

Species	Cons Status*	Flowering	Description and Habitat	**Likelihood	***Post Survey Likelihood
<i>Aponogeton hexatepalus</i>	P4	Jul-Oct	Rhizomatous or cormous, aquatic perennial, herb, leaves floating. Fl. green, white. Mud. Freshwater: ponds, rivers, claypans.	Unlikely	Unlikely (U3) – suitable habitat but too degraded
<i>Calothamnus graniticus subsp. leptophyllus</i>	P4	Jun-Aug	Erect, multi-stemmed shrub, 1-2 m high. Fl. red. Clay over granite, lateritic soils. Hillsides.	Unlikely	Unlikely (U1) - no suitable habitat
<i>Cyanothamnus tenuis</i>	P4	Aug-Nov	Procumbent or erect & slender shrub, 0.1–0.5 m high. Fl. blue, pink, white. Laterite, stony soils, granite.	Unlikely	Unlikely (U1) - no suitable habitat
<i>Grevillea pimeleoides</i>	P4		Upright shrub, 50 cm high x 40 cm wide. Yellow orange flowers. Granite hills near drainage line. Sandy loam with laterite. Open, sunny, well- drained position above drainage lines or water courses.	Unlikely	Unlikely (U3) – suitable habitat but too degraded
<i>Pimelea rara</i>	P4	Dec or Jan	Shrub, 0.2-0.35 m high. Fl. white. Lateritic soils.	Unlikely	Unlikely (U3) – suitable habitat but too degraded
<i>Senecio leucoglossus</i>	P4	Aug-Nov	Erect annual, herb, to 1.3 m high. Fl. white. Gravelly lateritic or granitic soils. Granite outcrops, slopes.	Unlikely	Unlikely (U1) - no suitable habitat
<i>Stylidium ireneae</i>	P4	Oct to Dec	Erect perennial herb, forming a small compact bush up to 15 cm in diameter. Stems maroon coloured. Corolla pale-pink, lobes laterally paired. Sandy loam.	Unlikely	Unlikely (U3) – suitable habitat but too degraded

Species	Cons Status*	Flowering	Description and Habitat	**Likelihood	***Post Survey Likelihood
			Valleys near creek lines, woodland, often with Agonis.		
<i>Stylidium longitubum</i>	P4	Oct-Dec	Erect annual (ephemeral), herb, 0.05-0.12 m high. Fl. Pink. Sandy clay, clay. Seasonal wetlands.	Possible	Unlikely (U3) – suitable habitat but too degraded
<i>Verticordia lindleyi</i> <i>subsp. lindleyi</i>	P4	May or Nov-Dec or Jan	Erect shrub, 0.2-0.75 m high. Fl. pink. Sand, sandy clay. Winter-wet depressions.	Possible	Unlikely (U3) – suitable habitat but too degraded

*Note: The BC Act Conservation Status is shown, EPBC Act status, where relevant, is in brackets.

**

Possible – Suitable habitat within the survey area.

Unlikely – No suitable habitat existing within the survey area.

Unknown – Data deficient.

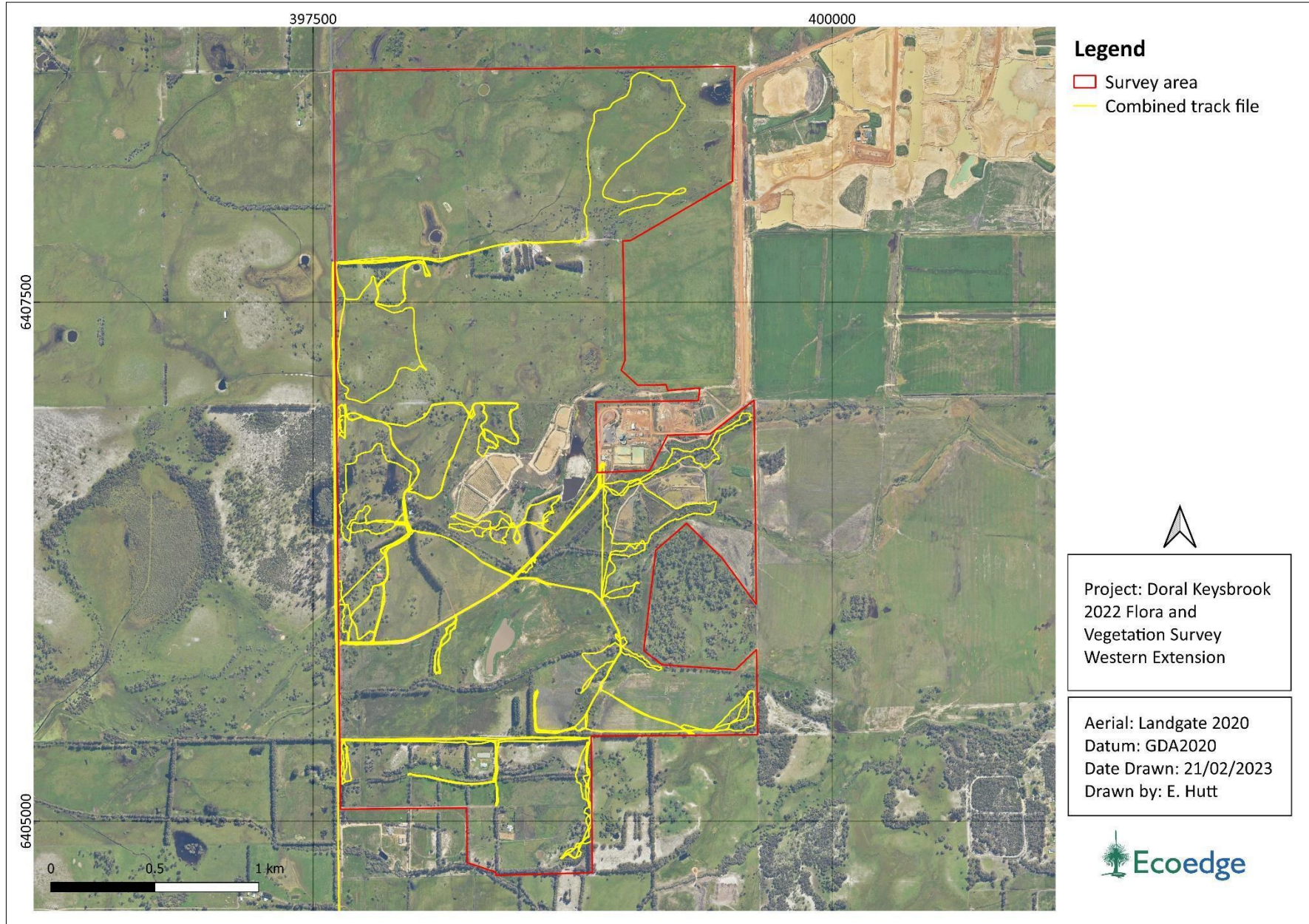
Observed - Taxon was positively identified on site during the survey.

Moderate - The taxon was not observed but suitable habitat was observed. The survey was conducted outside the recorded flowering season and it is difficult to distinguish or see in the absence of flowers.

Low – The taxon was not observed but suitable habitat was observed. The survey was conducted just outside the main flowering season or the taxon can be cryptic and difficult to find.

Very Low - The taxon was not observed but suitable habitat was observed. The survey was conducted within the main flowering season or the taxon can easily be identified even in the absence of flowers.

Appendix 9. Survey area sample sites



Appendix 10. List of vascular flora found within the survey area.

	FAMILY_NAME	LATIN NAME	NATURALISED	NOTE
1	Aizoaceae	<i>Carpobrotus edulis</i>	*	
2	Asteraceae	<i>Arctotheca calendula</i>	*	
3	Asteraceae	<i>Cotula coronopifolia</i>	*	
4	Asteraceae	<i>Cotula turbinata</i>	*	
5	Asteraceae	<i>Hypochaeris glabra</i>	*	
6	Asteraceae	<i>Ursinia anthemoides</i>	*	
7	Brassicaceae	<i>Raphanus raphanistrum</i>	*	
8	Casuarinaceae	<i>Allocasuarina fraseriana</i>		
9	Casuarinaceae	<i>Casuarina obesa</i>		Planted
10	Cyperaceae	<i>Cyperus eragrostis</i>	*	
11	Dasypogonaceae	<i>Kingia australis</i>		
12	Fabaceae	<i>Acacia saligna</i>		Planted
13	Fabaceae	<i>Jacksonia sternbergiana</i>		
14	Fabaceae	<i>Lotus subbiflorus</i>	*	
15	Fabaceae	<i>Ornithopus pinnatus</i>	*	
16	Fabaceae	<i>Trifolium repens</i>	*	
17	Iridaceae	<i>Moraea flaccida</i>	*	
18	Iridaceae	<i>Romulea rosea</i>	*	
19	Juncaceae	<i>Juncus pallidus</i>		
20	Lauraceae	<i>Cassytha racemosa</i>		
21	Loranthaceae	<i>Nuytsia floribunda</i>		
22	Myrtaceae	<i>Agonis flexuosa</i>		
23	Myrtaceae	<i>Astartea scoparia</i>		
24	Myrtaceae	<i>Callistemon glaucus</i>		Planted
25	Myrtaceae	<i>Corymbia calophylla</i>		
26	Myrtaceae	<i>Eucalyptus camaldulensis</i>		Planted
27	Myrtaceae	<i>Eucalyptus globulus</i>	*	
28	Myrtaceae	<i>Eucalyptus mannifera</i>	*	
29	Myrtaceae	<i>Eucalyptus rudis</i>		
30	Myrtaceae	<i>Hypocalymma angustifolium</i>		
31	Myrtaceae	<i>Kunzea glabrescens</i>		
32	Myrtaceae	<i>Kunzea recurva</i>		Planted
33	Myrtaceae	<i>Melaleuca preissiana</i>		
34	Myrtaceae	<i>Melaleuca raphiophylla</i>		
35	Myrtaceae	<i>Regelia ciliata</i>		Planted
36	Poaceae	<i>Avena barbata</i>	*	
37	Poaceae	<i>Briza maxima</i>	*	
38	Poaceae	<i>Briza minor</i>	*	
39	Poaceae	<i>Cenchrus clandestinus</i>	*	
40	Poaceae	<i>Cynodon dactylon</i>	*	
41	Poaceae	<i>Eragrostis curvula</i>	*	
42	Poaceae	<i>Lolium multiflorum</i>	*	
43	Poaceae	<i>Lolium perenne</i>	*	
44	Poaceae	<i>Lolium rigidum</i>	*	
45	Poaceae	<i>Vulpia bromoides</i>	*	
46	Polygonaceae	<i>Rumex acetosella</i>	*	
47	Polygonaceae	<i>Rumex conglomeratus</i>	*	
48	Proteaceae	<i>Banksia menziesii</i>		
49	Proteaceae	<i>Xylomelum occidentale</i>		

Appendix 11. Photographs and descriptions of each vegetation unit within the survey area.

Unit A1.

Mid-height open forest or woodland of *Corymbia calophylla* (occasionally with *Allocasuarina fraseriana*, *Eucalyptus marginata*, *Melaleuca preissiana* or *Nuytsia floribunda*) over scattered *Kingia australis* tall shrubs over forbland including **Arctotheca calendula*, **Lolium* spp., **Lotus subbiflorus*, **Rumex* spp., **Trifolium repens* on grey loamy sand.



Unit A2.

Mid-height open forest or woodland of *Eucalyptus marginata* and *Allocasuarina fraseriana* over scattered *Xylomelum occidentale* low trees over forbland including **Arctotheca calendula*, **Lolium* spp., **Lotus subbiflorus*, **Rumex* spp., **Trifolium repens* on grey sand.



Unit B1.

Low woodland of *Melaleuca preissiana* or *M. raphiophylla* with isolated *Eucalyptus rudis*, **Eucalyptus mannifera* medium trees over forbland of **Arctotheca calendula*, **Hypochaeris glabra*, **Lotus subbiflorus* and **Ursinia anthemoides* and grassland of **Briza maxima*, **B. minor* **Ehrharta longiflora*, **Lolium multiflorum* on grey-brown sandy loam.



Unit B2.

Low woodland of *Melaleuca preissiana* or *M. raphiophylla* over forbland of **Arctotheca calendula*, **Hypochaeris glabra*, **Lotus subbiflorus* and grassland of **Briza maxima*, **B. minor* **Lolium multiflorum* (and **Cotula coronopifolia* in damper areas) on grey-brown loam.



Unit C.

Sedgeland of *Juncus pallidus*, with scattered emergent **Eucalyptus globulus* or *Melaleuca preissiana* or *M. raphiophylla* low/medium trees over forbland of **Arctotheca calendula*, **Romulea rosea*, **Rumex conglomeratus* and open grassland of **Avena barbata*, **Cenchrus clandestinus*, **Eragrostis curvula* on grey sandy loam.



Unit D.

Tall shrubland of *Acacia saligna*, *Jacksonia sternbergiana*, *Kunzea glabrescens* and *Regelia ciliata* on grey sand. [Mainly plantings].



Unit P.

Amenity plantings of eucalyptus species, including **Eucalyptus camaldulensis*, **E. mannifera*.

