Appendix E

Detailed and Targeted Flora and Vegetation Survey

Detailed and Targeted Flora and Vegetation Survey

Collie River Road Bridge, Burekup

Shire of Harvey

Prepared for GHD
February 2025

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

Version	Origin	Review	Review date	Release approval	Issue date
V1	R. Smith	C. Spencer	30/01/2025		
Final Draft	R. Smith	Ecoedge	4/02/2025	Ecoedge	18/02/2025
Final	GHD	Ecoedge	2/10/2025	Ecoedge	2/10/2025

Executive Summary

Ecoedge Environmental Services (Ecoedge) was engaged by GHD in August 2024, to undertake a spring Detailed and Targeted flora and vegetation survey of a 4.67-hectare (ha) site for a proposed bridge construction project crossing the Collie River, on the Collie River Road, in the rural locality of Burekup.

The survey was required to inform project planning and environmental approvals for the proposed new bridge construction on behalf of the Shire of Harvey.

The survey was undertaken on 8 October and 15 November 2024 by senior botanist Russell Smith (flora permit FB62000500) in accordance with the Environmental Protection Authority (EPA) Technical Guidance - Flora and Vegetation Surveys for Environmental Impact Assessment (EPA 2016).

Eighty-four taxa were identified within the survey area with 50 (60%) being introduced species.

No Threatened flora listed under either the State *Biodiversity Conservation Act 2016* or Commonwealth *Environmental Protection Biodiversity Conservation Act 1999* were found nor were there any State listed Priority flora or flora of otherwise significance were found in the survey area.

All 57 Threatened or Priority taxa potentially occurring in the survey area were assigned a post-survey residual likelihood of "unlikely".

Four declared pest plants listed under the *Biosecurity and Agriculture Management Act 2007* were found within the survey area, **Asparagus asparagoides* (Bridal creeper), **Solanum linnaeanum* (Apple of Sodom), **Rubus laudatus* (Blackberry) and **Gomphocarpus fruticosus* (Narrowleaf cotton bush).

Two vegetation units are described and mapped for the survey area. Unit A comprised the riverine vegetation adjacent to the Collie River. It formed an open forest dominated by *Eucalyptus rudis* subsp. rudis (Flooded gum), *Corymbia calophylla* (Marri) and occasionally *Eucalyptus patens* (Blackbutt). Unit B is comprised of the open forest dominated mainly by *Corymbia calophylla* (Marri) which occurs on rocky clay-loam soils upslope of unit A.

A multivariate analysis which compared six floristic quadrats installed within the survey area with the data from the Swan Coastal Plain surveys showed that there was not a high correspondence with any of the Swan Coastal Plain floristic community types. Nevertheless, the most similar FCT was FCT 11 (Wet forests and woodlands), a relatively species-poor FCT often dominated by *Eucalyptus rudis*. FCT 11 is not a Threatened or Priority ecological community.

Most vegetation within the survey area was in Degraded (33%) or Completely Degraded (51%) condition. The main causes of degradation were partial clearing (in parts), livestock grazing and accompanying weed invasion. Whereas 90% of vegetation unit B was Degraded or Completely Degraded about 75% of unit A was in Good or Very Good condition.

The survey area vegetation is moderately well aligned with the description of the vegetation complex mapped across the survey area: the Lowden Complex and with the Beard vegetation association 1184 'Medium woodland-fringing; jarrah, marri, *Eucalyptus rudis* & *Agonis flexuosa*'. The Lowden Complex falls below the 30% Commonwealth retention target on the Darling Plateau whereas Association 1148 exceeds the 30% Commonwealth retention target at all levels.

The Collie River Ecological Linkage intersects the survey area, following the path of the river and providing a corridor of vegetation that has been assigned the highest tier of PV rating - 1a. This rating has been assigned because the vegetation is in proximity to the river linkage and its connectivity to Wellington National Park to the south and east of the survey area.

Vegetation unit A within the survey area meets the criteria to be considered distinctive wetland vegetation including as it does such groundwater dependant species as *Eucalyptus rudis*, *Astartea scoparia* and *Melaleuca viminea and Machaerina juncea.*

There are no ESAs mapped within or in proximity to the survey area.

Contents

Table of Tables

Table of Figures

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.

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 GHD in August 2024, to undertake a spring Detailed and Targeted flora and vegetation survey of a 4.67 hectare (ha) site for a proposed bridge construction project crossing the Collie River, on the Collie River Road in the rural locality of Burekup (the survey area) (**Figure 1** and **Figure 2**).

The survey area is located approximately 24.5 kilometres (km) east from the regional town of Bunbury in the southwest of Western Australia and occurs across the local government boundaries of the Shire of Harvey and the Shire of Dardanup.

GHD require the survey to inform project planning and environmental approvals for the proposed new bridge construction on behalf of the Shire of Harvey.

This report compiles the findings of the survey.

2 Scope and objectives

The scope 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 (ESAs). The desktop assessment area (study area) encompassed a five km buffer to the survey area.

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 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 1999) threatened species and communities.

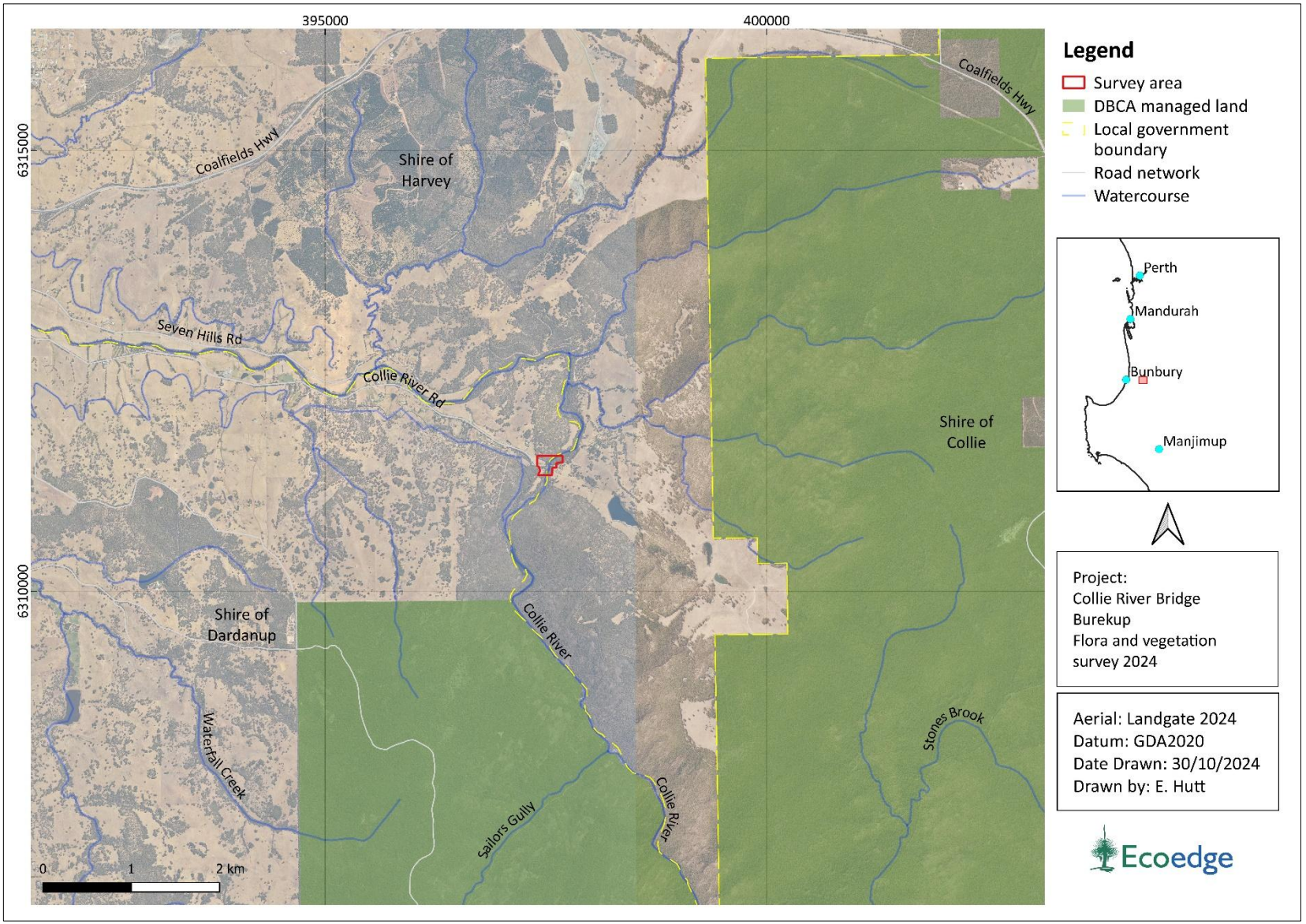


Figure 1. Aerial photograph showing the location of the survey area and surrounding area.

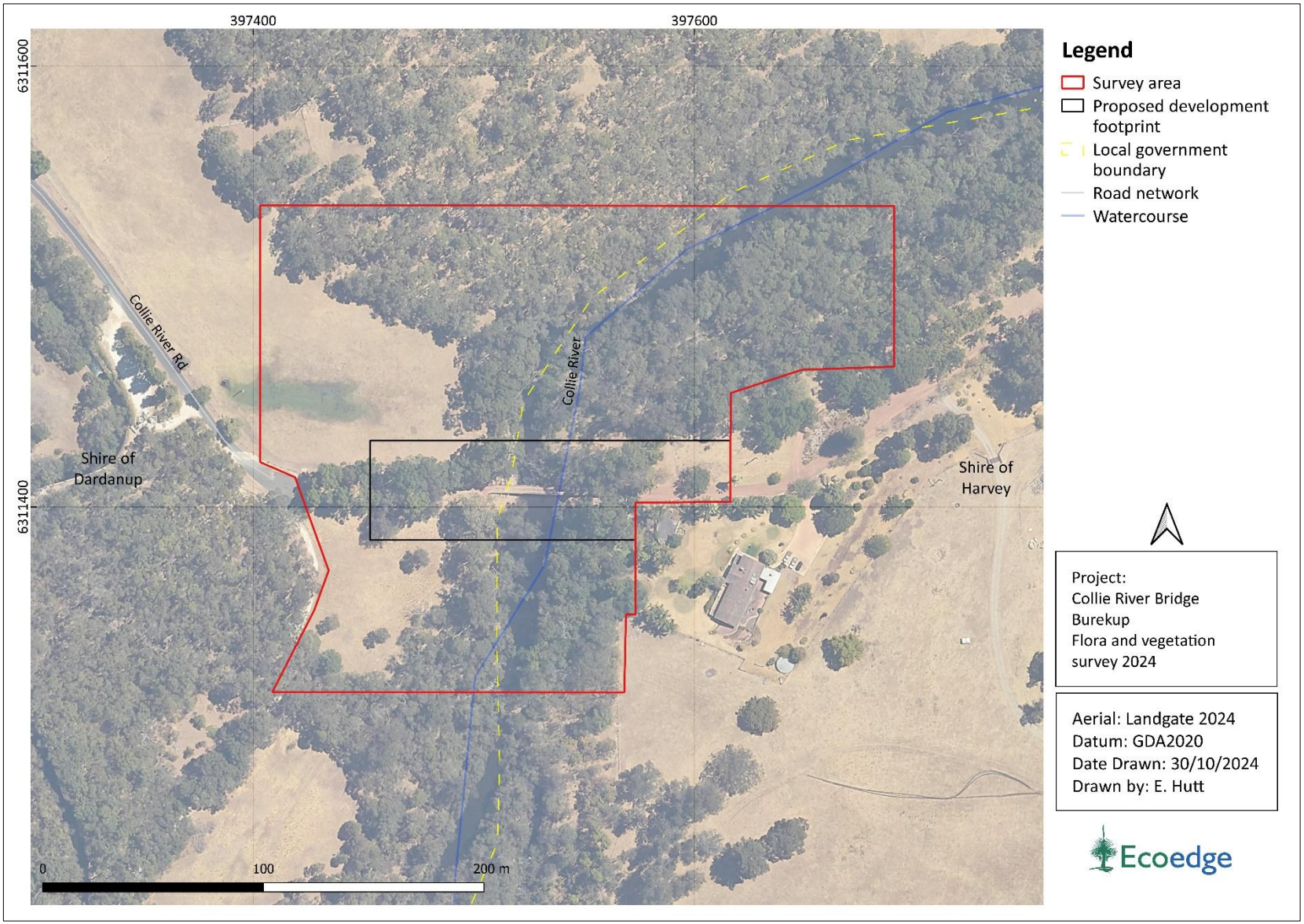


Figure 2. Survey area location.

3 Methods

3.1 Desktop assessment

Prior to the field survey, a desktop assessment 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 (Tille & Wilson 1996).
- Vegetation complex mapping of the SouthWest 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 DBCA database extracts from the Department of Biodiversity, Conservation and Attractions (DBCA 2024a) and TEC and PEC listings (DBCA 2023a, DBCA 2023b).
- Federal Protected Matters Search Tool results (DCCEEW 2024).
- Atlas of Living Australia 10 km area report (ALA 2024).
- Extract from the Department's Threatened Flora database and the Western Australian Herbarium database (DBCA 2024b).
- Geomorphic Wetlands, Swan Coastal Plain (SCP) dataset DBCA-019 (DBCA 2022).
- Environmentally sensitive areas distribution maps and dataset (DWER 2021).
- Surface Hydrology Lines (National) (Crossman & Li 2015).
- Regional Ecological Linkages (Molloy et al. 2009).

3.1.1 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. Fifty-seven Threatened and Priority flora taxa were assessed prior to the survey for likelihood of occurrence, of which nine were considered to possibly occur within the survey area (**Table 1**).

The rationale for determining this pre-survey (and post-survey) likelihood of occurrence is provided in **Appendix 1**.

Table 1. Threatened and Priority flora taxa assessed as possibly occurring in the survey area.

Taxon	Cons. code	Flowering
Aponogeton hexatepalus	P4	Jul-Oct
Bolboschoenus medianus	P1	Summer
Caladenia procera	T (CR)	Sep-Oct
Dillwynia dillwynioides	P3	Aug-Dec
Eleocharis keigheryi	T (VU)	Aug-Nov
Eucalyptus rudis subsp. *cratyantha*	P4	Jul-Sep
Gonocarpus keigheryi	P2	Dec -Feb
Grevillea ripicola	P4	Jan-Apr/Nov-Dec
Juncus meianthus	P2	Nov-Jan

3.2 Field survey

The flora and vegetation survey was undertaken on 8 October and 15 November 2024 by senior botanist Russell Smith (flora permit FB62000500) in accordance with the Environmental Protection Authority (EPA) Technical Guidance - Flora and Vegetation Surveys for Environmental Impact Assessment (EPA 2016).

The timing of the field visits was within the prima flowering time for flora within the high-rainfall south-west of Western Australia.

Flora species not identified in the field were either photographed or collected for later identification.

The dominant vegetation, species, and soil data was collected at 10 relevés across the survey area, and vegetation condition was recorded at 31 points. In addition, six 10 m x 10m floristic quadrats (CRBQ 01-06) were installed within the survey area.

The mapping notes and quadrat information was used to identify and describe vegetation units using the NVIS system (Level 5; NVIS 2017).

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

Quadrat details are shown in **Appendix 3**. The location of quadrats and trackfiles is shown in **Appendix 4**.

3.3 Multivariate analysis

The floristic data from the six quadrats was subjected to multivariate analysis (MVA) using the PATN statistical software package to determine the relationship of the vegetation unit to the floristic community types derived for the Swan Coastal Plain (SCP) by Gibson et al. (1994) and Keighery et al. (2012), in accordance with methods for survey and identification of Western Australian threatened ecological communities (DBCA 2023c). As recommended in DBCA (2024c) the analysis included the comparison of single quadrat against both of the reference data sets (referred to as single site insertion).

The Swan Coastal Plain datasets were used for comparison because there is no floristic quadrat dataset for the southern part of the Darling Scarp and associated Lowden valleys soil-landscape system. However, the SCP datasets are used for vegetation off the coastal plain to determine whether any quadrats match SCP claypan TECs which have some occurrences on the Darling Plateau.

Quadrats were only installed in Good-or-better condition vegetation to ensure, as best as practically possible, that the data was of similar quality, in terms of native species diversity and absence of weeds to the reference data sets. These areas were limited due to the highly degraded nature some of the survey area vegetation.

The Floristic Analysis (Multivariate) Methods are provided in **Appendix 5**.

3.4 Survey limitations

Limitations with regards to the assessment are addressed in **Table 2.**

Table 2. Limitations of the field survey with regard to assessment adequacy and accuracy.

Aspect	Constraint	Comment
Proportion of flora identified	Minor	Almost all flora observed within the survey area was identified.
Climatic and seasonal effects	Not a constraint	Rainfall till the end of October at Burekup, the nearest weather station, was 866 mm, which was just above the annual mean.
Availability of contextual information	Minor	Regional surveys (Gibson et al. (1994) and Keighery et al. (2012)) has been carried out of the vegetation of the southern Swan Coastal Plain. However, there have been no studies that have looked at the vegetation of the foothills and valleys of the southern Darling Scarp.
Completeness of the survey	Not a constraint	All parts of the survey area were accessible.
Skill and knowledge of the botanists (vascular flora)	Not a constraint	The botanist has 30 years of experience in flora surveys in the south-west of W.A.
Disturbance (fire, grazing, clearing etc.)	Minor	Some of the survey area has been cleared for agriculture, and livestock have been able to access almost all of it. Weed invasion is evident to a greater or lesser degree throughout.

4 Results desktop assessment

4.1 Biogeographic region and location

The survey area is situated within the Northern Jarrah Forest (JAF01) sub-region of the Jarrah Forest (JAF) biogeographic region as defined in the Interim Biogeographical Regionalisation for Australia (IBRA) (Commonwealth of Australia 2016).

4.2 Landform and soils

The survey area is located within the geomorphic region of the Darling Plateau, which occurs east of the Swan Coastal Plain. The Darling Plateau extends eastward from the Darling Scarp and is described as three geomorphologic zones - the Western Darling Range Zone (WDRZ; code 255), the Eastern Darling Range Zone (EDRZ; code 253) and the Southern Zone of Rejuvenated Drainage (SZRD; code 257), all located within the Avon Province as defined by Tille and Wilson (1996). The Darling Scarp forms the western margin of the WDRZ which is a deeply dissected lateritic plateau on granite, the EDRZ continues as lateritic plateau with eastward flowing streams in broad shallow valleys onto the SZRD's gently undulating rises to low hills, with continuous stream channels that flow most years (Tille and Wilson 1996).

Within each of these zones, finer scale soil landscape systems have been further identified and mapped to form a regional context in vegetation and landforms, which in turn have been divided up into soil phases based on local soil conditions. Soils across these zones can range from lateritic colluvium to granite weathered in-situ and gneiss (Tille and Wilson 1996). The survey area occurs on the WDRZ within the Lowden Valleys System (255Lv_). This system extends from Harvey to Bridgetown and consists of deeply incised valleys and colluvium over metasediments and granitic rocks (Tille et al. 1998). The system and soil phases found within the survey area and described in **Table 3** and shown in **Figure 3**.

Table 3. Soil Mapping Units occurring within the survey area (Tille & Wilson 1996).

System	Subsystem	Description
Lowden Valleys (255Lv_)	255LvBT5 Bridgetown steep slopes phase	Relief 100-180 m, slopes 15-50%, soils are loamy earths
	255LvBTf Bridgetown footslopes phase	Relief 10-40 m, slopes 3-15%, soils are loamy earths with some clays and gravels
	255LvBTr Bridgetown rocky slopes phase	Steep slopes (20-50%) with prominent areas of rock outcrop, soils are stony loamy earths and shallow loamy duplex soils

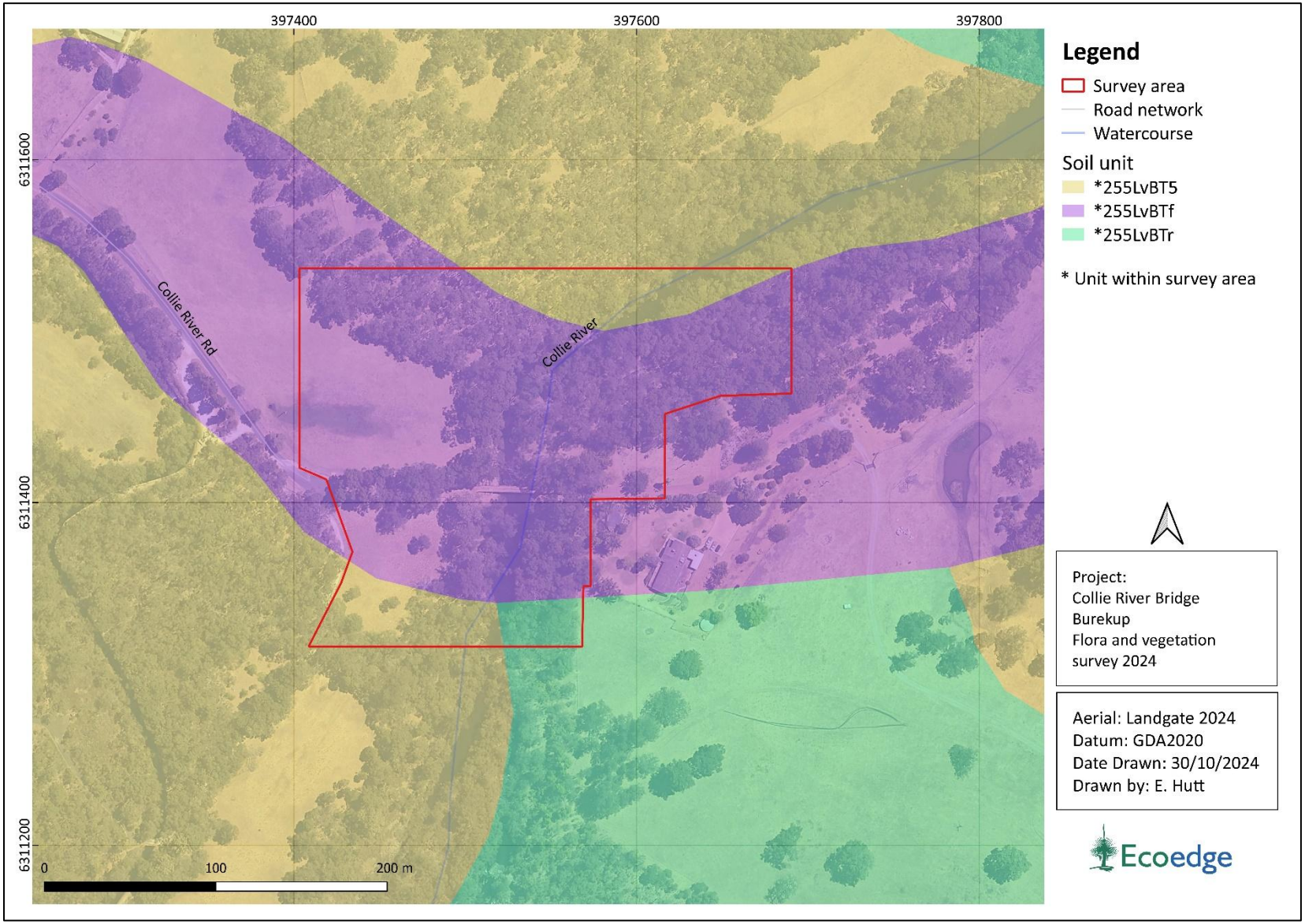


Figure 3. Land units mapped in and nearby the survey area (Tille & Wilson 1996).

4.3 Vegetation description according to pre-European mapping datasets

4.3.1 Vegetation complexes

The comprehensive pre-1750 distribution of vegetation complexes[1] across the southwest 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 of 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 1999[2] (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 the Department of Parks and Wildlife (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 one complex named the Lowden Complex is mapped across the survey area. This is described in **Table 4** and shown in **Figure 4**.

Table 4. Vegetation complex mapped for the survey area (Webb et al. 2016).

Vegetation Complex	Description
Lowden Complex (171)	Open forest of *Corymbia calophylla-Eucalyptus marginata* subsp. *marginata-Agonis flexuosa* with some *Eucalyptus wandoo* and occasional *Corymbia haematoxylon* on slopes, and woodland of *Eucalyptus rudis-Melaleuca rhaphiophylla* on valley floor in the humid zone.

4.3.2 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).

[1] Vegetation complex mapping is based on broadscale assessment of rregional patterns of vegetation in relation to underlying landforms, soils and climatic trends.

[2] 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).

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) [3] (NVIS 2017)

The survey area is comprised of one Beard vegetation association: association 1184 'Medium woodland-fringing; jarrah, marri, *Eucalyptus rudis* & *Agonis flexuosa*' (**Figure 5**).

[3] 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.

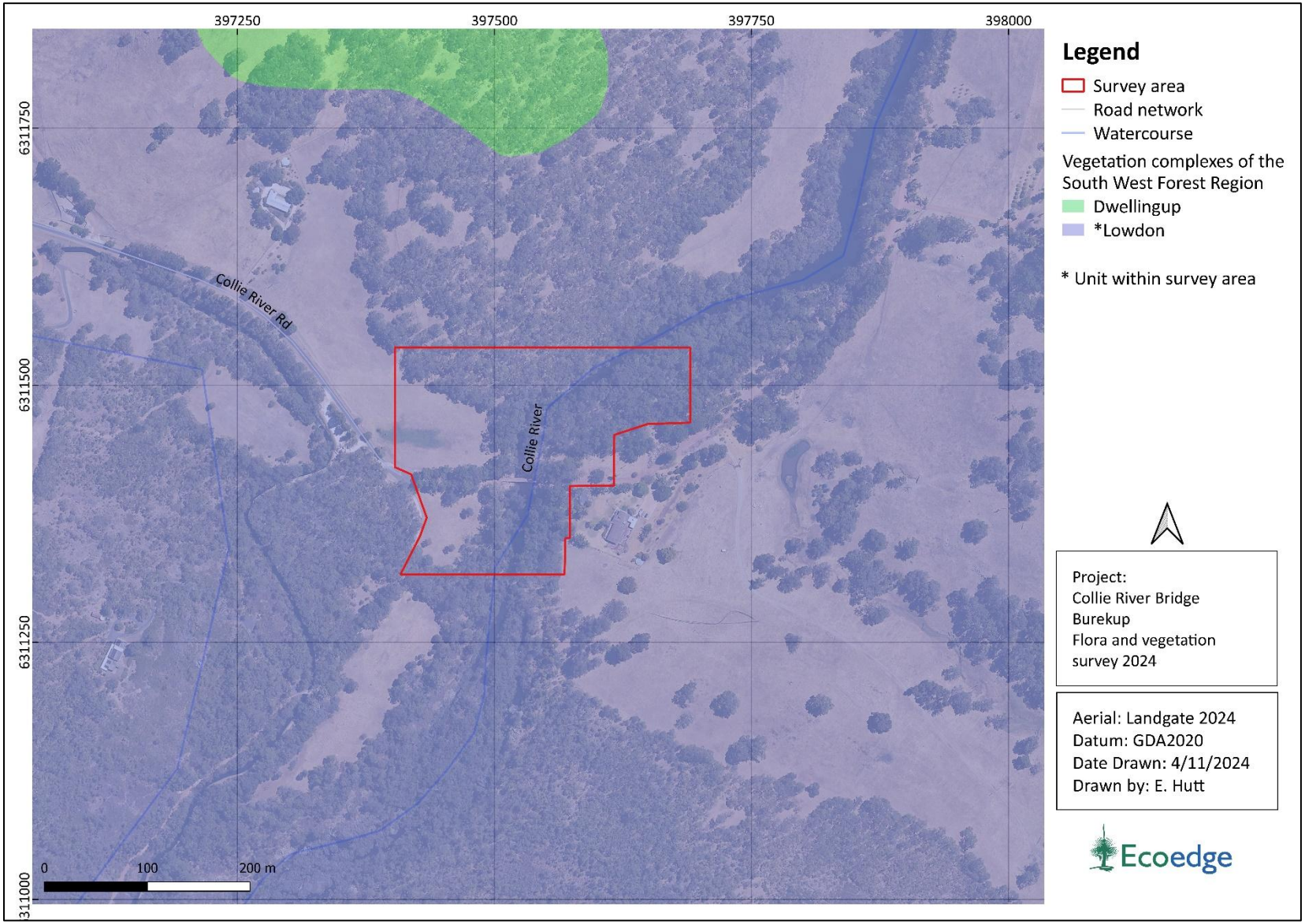


Figure 4. Vegetation complexes mapped in and nearby the survey area (Webb et al. 2016).

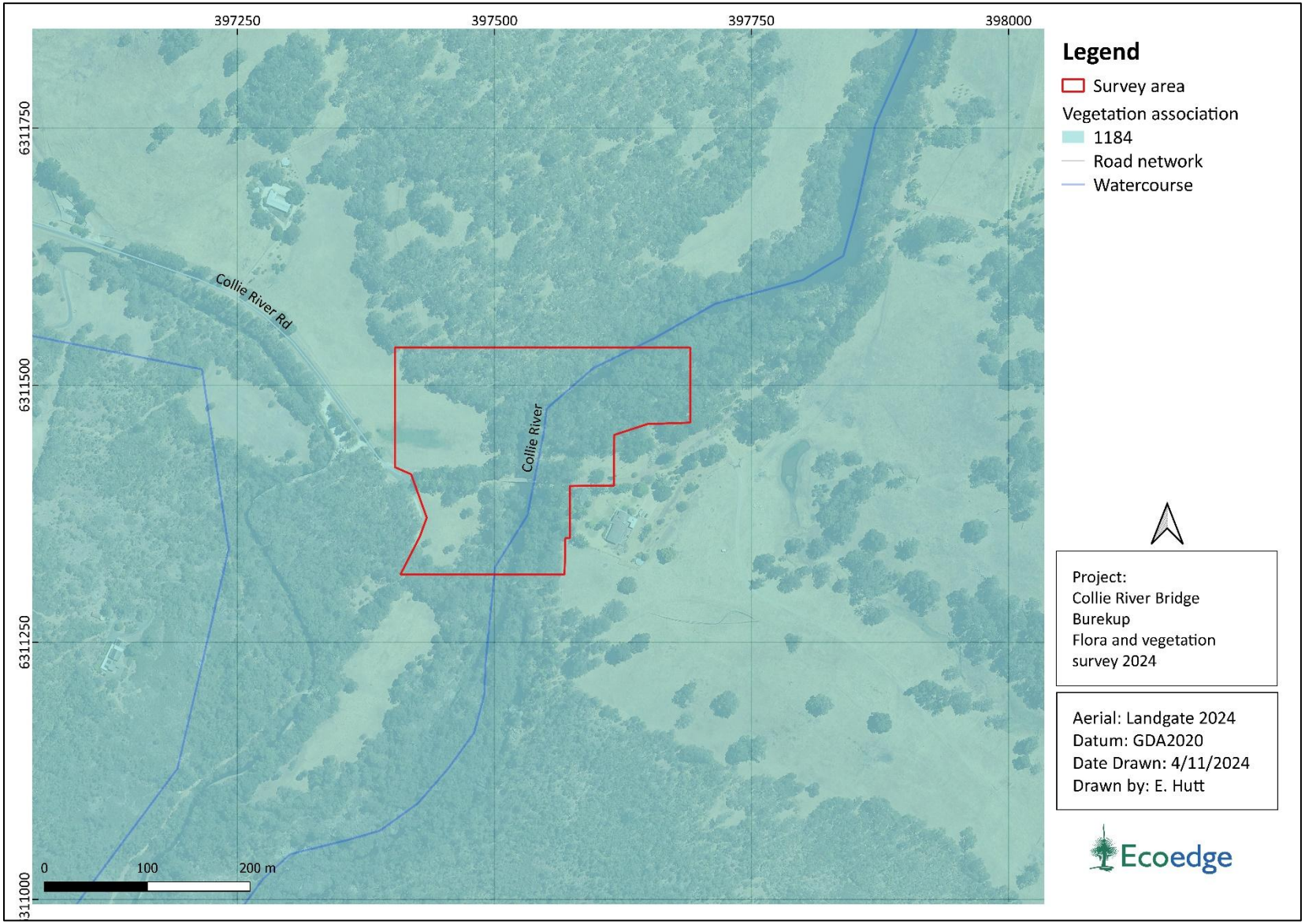


Figure 5. Vegetation associations mapped in and nearby the survey area (Webb et al. 2016).

4.3.3 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 and the percentage of current extent in DBCA managed land for the one complex and one association described for the survey area are presented in **Table 5** and **Table 6** respectively.

The Lowden Complex falls below the 30% Commonwealth retention target on the Darling Plateau with 11.84% of pre-European extent vegetation remaining. The complex is well represented in both local government areas with 36.80% of pre-European extent vegetation remaining in the Shire of Dardanup and 31.87% of pre-European extent vegetation remaining in the Shire of Harvey.

Association 1148 exceeds the 30% Commonwealth retention target at all levels, with 39.54% of State wide pre-European extent vegetation remaining, 39.54% remaining at IBRA region level and 38.47% remaining at IBRA subregion level. The Shire of Dardanup has 48.73% of extent vegetation remaining and the Shire of Harvey 32.20% 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%

Table 5. The vegetation complex mapped within the survey area with regards to the Commonwealth retention targets (GoWA 2019b).

Region	Pre-European (ha)	Current Extent (ha)	% Remaining	% Remaining in DBCA reserves[4]
Lowden Complex (171)				
Darling Plateau	17,287.73	6,334.80	11.84	15.74
Shire of Dardanup	5,791.29	2,131.10	36.80	n/a
Shire of Harvey	10,672.76	3,401.02	31.87	n/a

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

Table 6. 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 1184				
State-wide	63,562.26	25,132.43	39.54	22.87
IBRA region: Jarrah Forest (JAF)	63,562.26	25,132.43	39.54	22.87
IBRA sub-region: Northern Jarrah Forest (JAF01)	14,002.91	5,386.23	38.47	15.86
Shire of Dardanup	7,267.03	3,541.15	48.73	34.49
Shire of Harvey	11,909.14	3,835.11	32.20	9.57

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

[4] The % remaining in DBCA land is not calculated for the vegetation complex mapping data set.

4.4 Threatened and Priority ecological communities.

Ecological communities are defined by Western Australia's DBCA 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 under significant threat as a TEC. These TECs can be listed under one of three conservation categories. These categories are 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, that 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 (2023a, 2023b). The conservation categories for these Threatened and Priority ecological communities are defined in **Appendix 6**.

TECs can also be listed under the Commonwealth EPBC Act. There are three categories of TEC under the EPBC Act: Critically Endangered (CR), Endangered (EN) and Vulnerable (VU) (DCCEEW 2022). These are defined in **Appendix 7.**

The desktop assessment, which included a Protected Matters Search (DCCEEW 2024) and review of DBCA TEC and PEC database extracts (DBCA 2024a), found one EPBC Act and one State listed PEC within the 10 km study area.

Outcomes of these searches are presented in **Table 7.** The results of the DBCA records are shown in **Figure 6**.

Table 7. Threatened and Priority ecological communities occurring within 10 km study area (DCCEEW 2024, DBCA 2024a).

Community name and description	Status (WA)	Status (EPBC Act)
'Banksia Woodlands of the Swan Coastal Plain' - a federally listed TEC consisting of numerous State-listed communities	P3	T (EN)

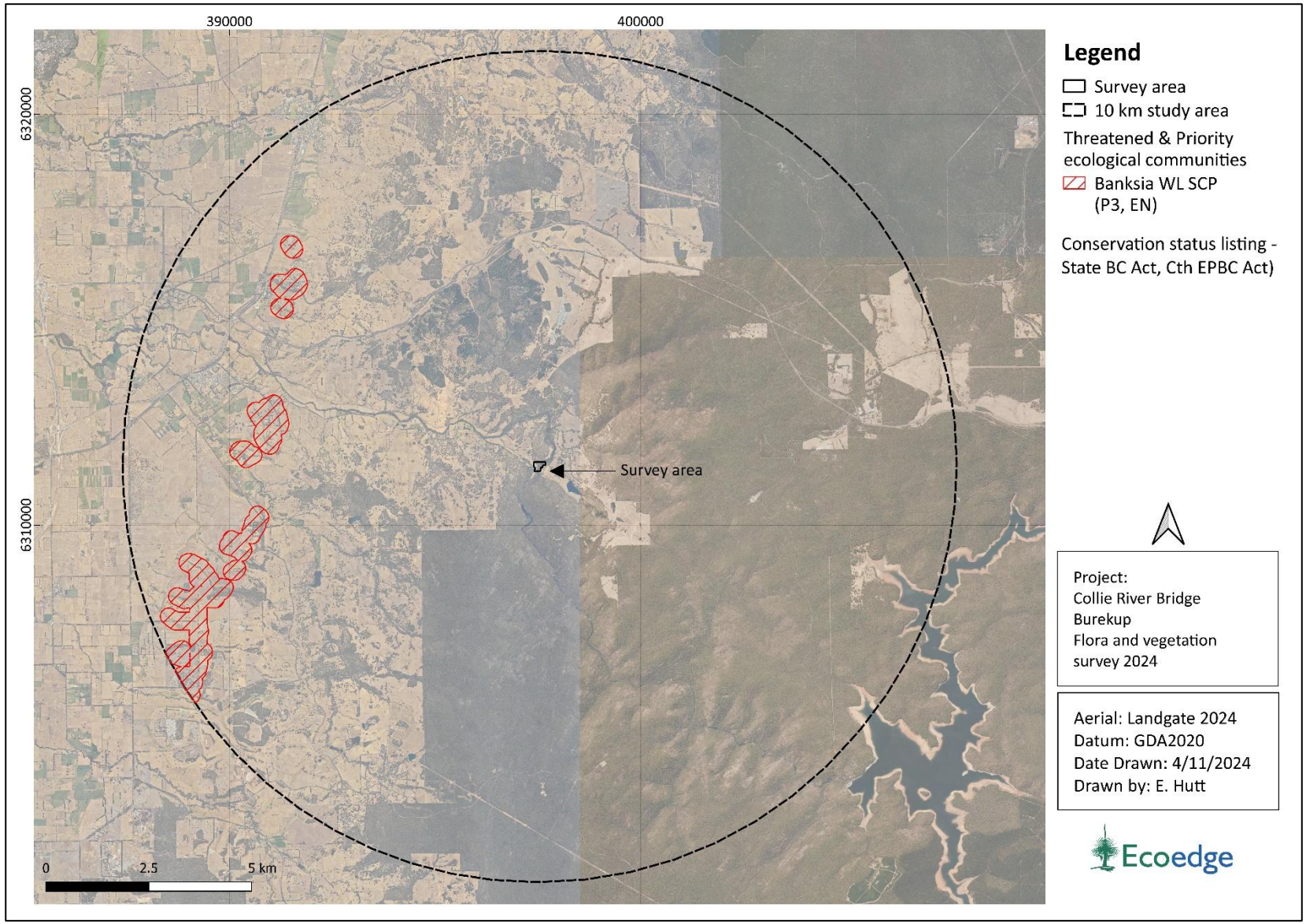


Figure 6. Threatened and Priority ecological communities within 10 km of the survey area (DBCA 2024a).

4.5 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. The categories are 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) are in need of further survey to determine their status, while Priority Four (P4) species are adequately known rare or Threatened species that require regular monitoring.

Threatened flora lists are formally reviewed annually with the current listing updated on 15 January 2025 (DBCA 2025). The Priority flora list is subject to ongoing review and update with updates regularly published on the Western Australian Herbarium FloraBase website.

Categories of Threatened and Priority flora as defined by the BC Act are presented in **Appendix 8** (DBCA 2019).

Threatened flora may also be protected under the Commonwealth EPBC Act and be listed in one of six categories. Definitions of these categories are summarised in **Appendix 9** (DCCEEW 2020).

Threatened or Priority flora occurring within 10 km of the survey area generated from an Atlas of Living Australia search (Atlas of Living Australia 2024) and a Protected Matters Search Tool query (DCCEEW 2024). DBCA and WA Herbarium Threatened and Priority flora data downloads (DBCA 2024b) are provided in **Appendix 10**.

Fifty-seven significant species were identified with the potential to occur within the search area. Of these, nine were given a pre-survey rating of "possible" and the remainder were considered to be "unlikely" to occur. The possibly occurring species within the survey area are listed in **Table 8.** The locations of these significant flora are shown in **Figure 7** (DBCA 2024a).

A breakdown of the likelihood of occurrence (possible and likely) of all potential species according to conservation status is provided in **Table 9,** with the complete likelihood of occurrence assessment provided in **Appendix 11**.

Table 8. Significant flora given a rating of “possible” to occur within the survey area.

Taxon	Cons code	Pre-survey likelihood
Aponogeton hexatepalus	P4	Possible
Bolboschoenus medianus	P1	Possible
Caladenia procera	T (CE)	Possible
Dillwynia dillwynioides	P3	Possible
Eleocharis keigheryi	T (VU)	Possible
Eucalyptus rudis subsp. *cratyantha*	P4	Possible
Gonocarpus keigheryi	P2	Possible
Grevillea ripicola	P4	Possible
Juncus meianthus	P2	Possible

Table 9. Likelihood of occurrence according to conservation status.

Likelihood of occurrence	Total number	Priority 1	Priority 2	Priority 3	Priority 4	Threatened
Likely	0	0	0	0	0	0
Possible	9	1	2	1	3	2
Unlikely	48	7	7	15	9	10
Total	**57**	**8**	**9**	**16**	**12**	**12**

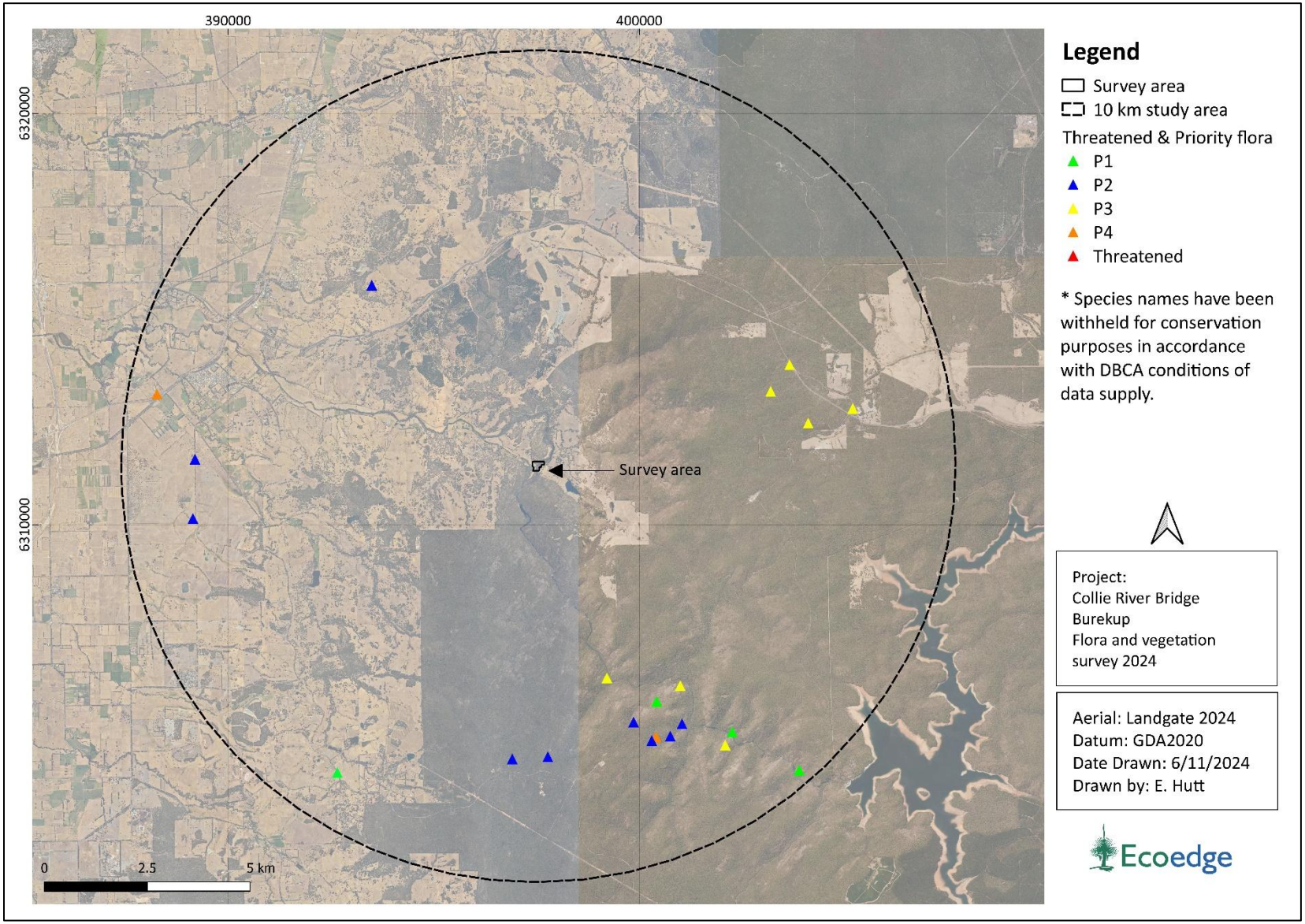


Figure 7. Threatened and Priority flora within the 10 km study area (DBCA 2024b).

4.6 Wetlands and water courses

4.6.1 Wetlands

Wetlands on the SCP 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 10.** The SCP 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 11.**

Table 10. 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 11. 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 (RE)	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 (MU)	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 wetland types mapped within the survey area; the closest wetland is a multiple use palusplain (UFI 2897) located approximately 805 m to the north west (**Figure 8**).

4.6.2 Watercourses

The Collie River, a perennial watercourse, intersects the survey area (Crossman & Li 2015) (**Figure 8**).

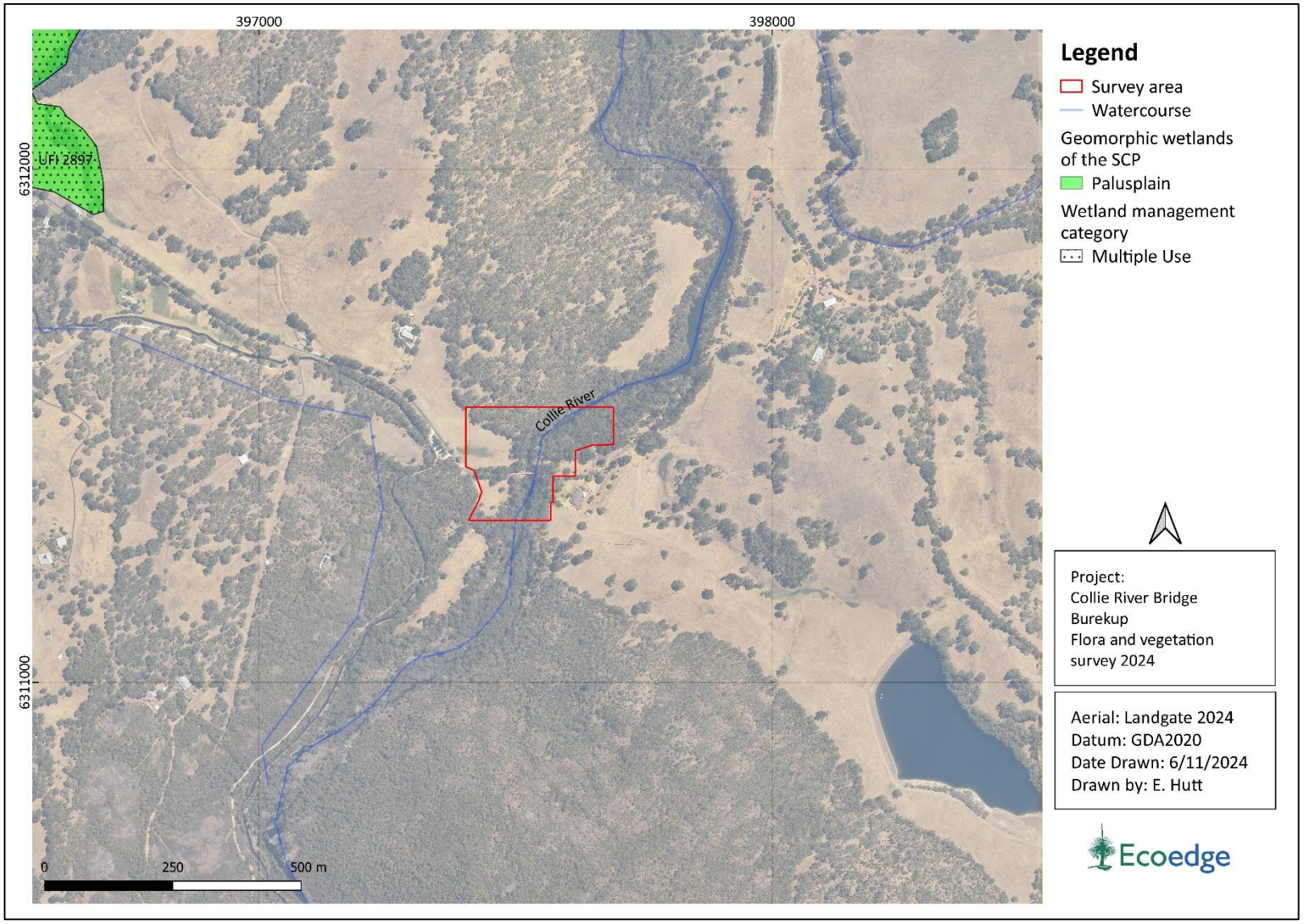


Figure 8. Geomorphic wetland type, associated management category and watercourses in proximity to the survey area (DBCA 2022).

4.7 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 south-west of Western Australia in an area spanning between just north of Mandurah to Walpole in the south-east.

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 12**).

Table 12. Linkage proximity values rating assigned to patches of remnant vegetation within a landscape from 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

The Collie River Ecological Linkage intersects the survey area (**Figure 9**), following the path of the river and providing a corridor of vegetation that has been assigned the highest tier of PV rating - 1a. The parcel of vegetation in which approximately 3.47 ha of the survey area occurs has been assigned this rating due to being contiguous or in close proximity with the river linkage and its connectivity to Wellington National Park to the south and east of the survey area.

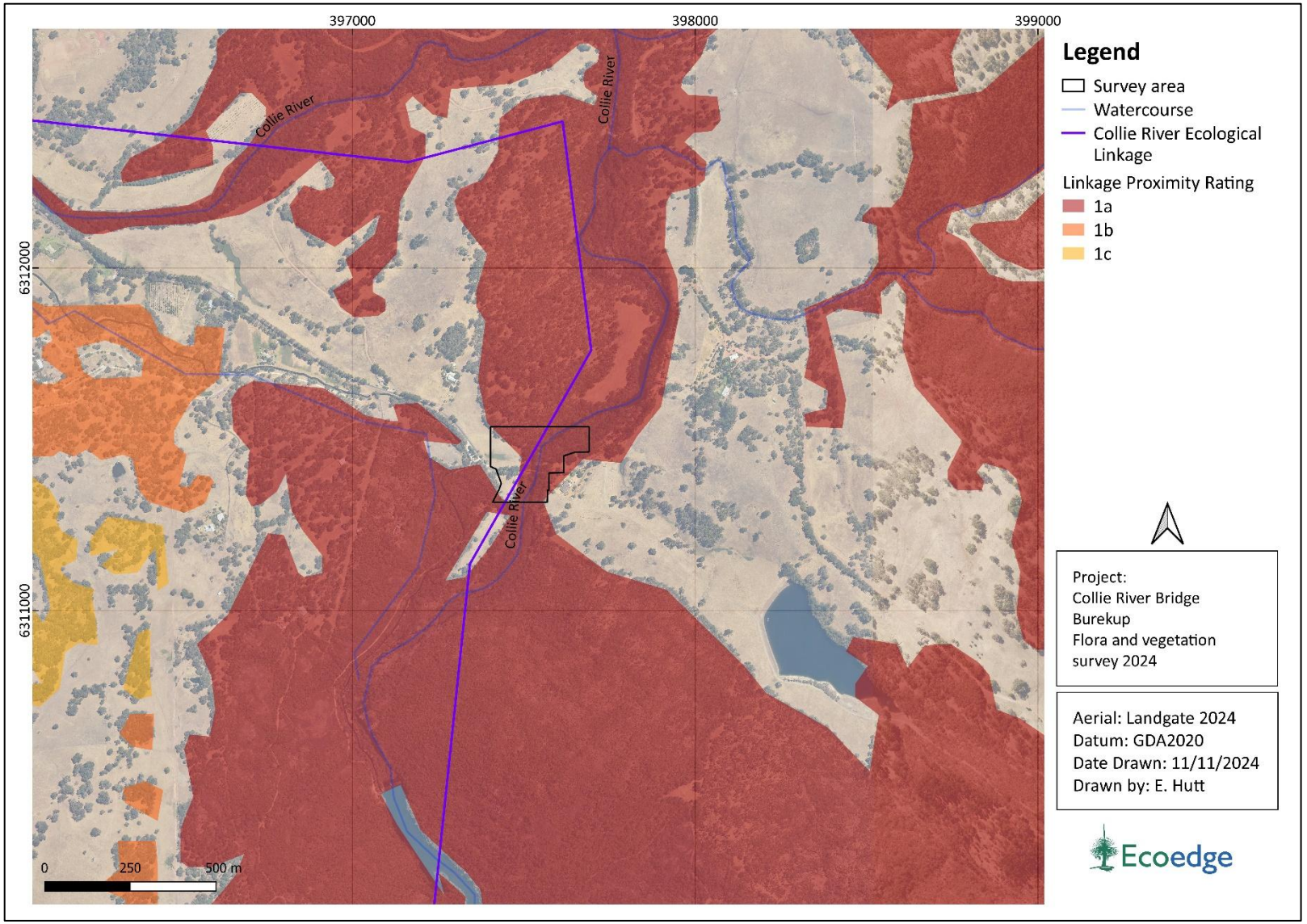


Figure 9. The survey area in relation to regional ecological linkages (Molloy et al. 2009).

4.8 Environmentally Sensitive Areas

Environmentally sensitive areas 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 are no ESAs mapped within or in proximity to the survey area. The closest ESA is located approximately 3.8 km to the east of the survey area which is associated with a Conservation category wetland (UFI 2900) (**Figure 10**).

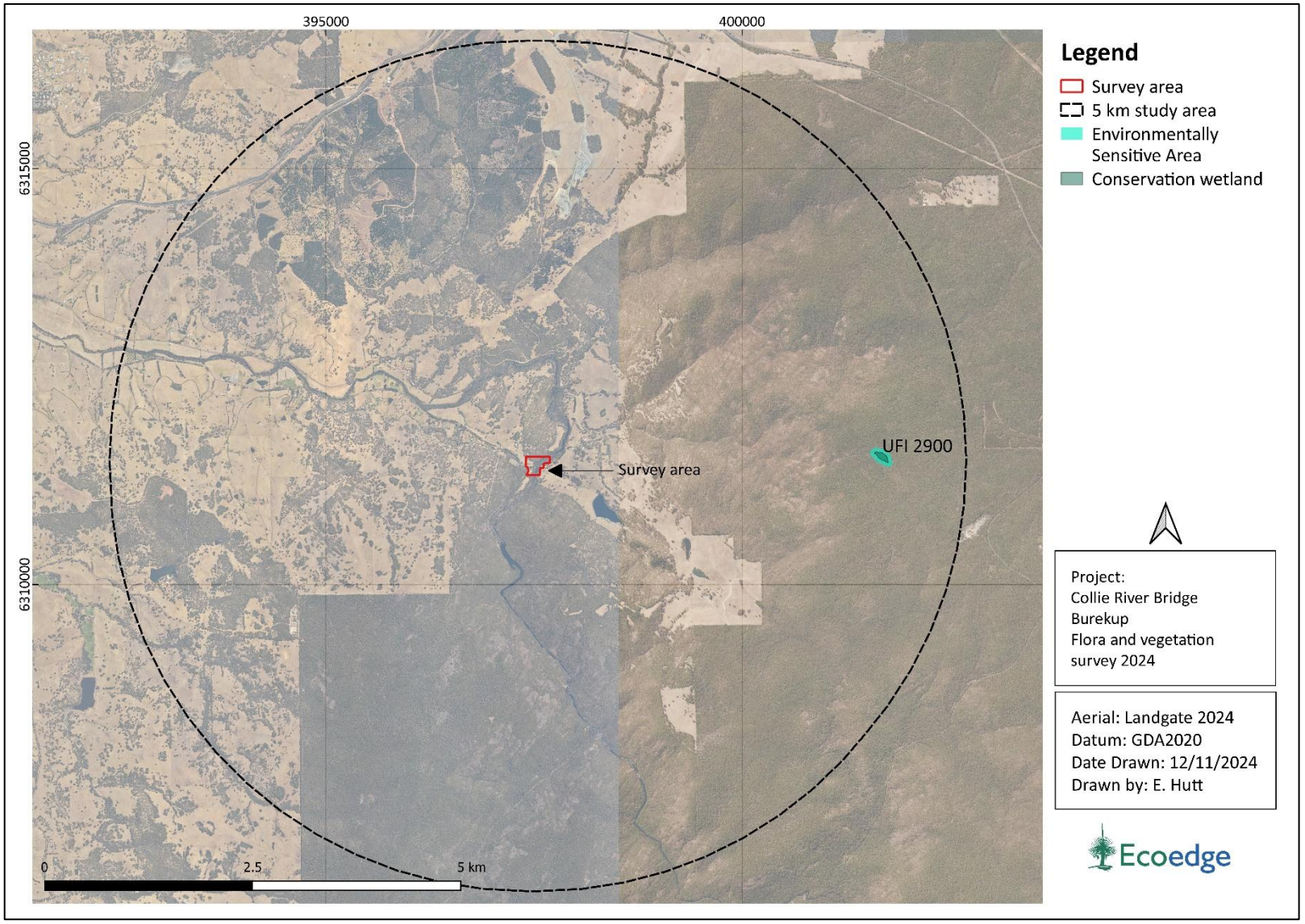


Figure 10. ESAs within study area (DWER 2021).

5 Survey results

5.1 Flora

Eighty-four taxa were identified within the survey area with 50 (60%) being introduced species. The most numerous families were the Myrtaceae family (13 species, two introduced) and Poaceae family (nine taxa, eight introduced species).

No Threatened flora listed under either the State BC Act or Commonwealth EPBC Act were found within the survey area. Neither was there any State listed Priority flora or flora of other significance found within the survey area.

A copy of the complete species list is provided in **Appendix 12.**

5.2 Post likelihood of occurrence

All 57 Threatened or Priority taxa potentially occurring in the survey area were assigned a post-survey residual likelihood of “unlikely”. These species are regarded “unlikely” to occur post-survey because either, although potentially suitable habitat was present, the areas were adequately surveyed and species not found to be present, or the habitat condition was in too degraded for the taxa to be present. For nine of the potential species inspection of the survey area demonstrated that suitable habitat was not present.

This includes the two Threatened taxa that were given a rating of “possible” pre-survey. Although potentially suitable habitat was present, the areas were adequately surveyed, and species were not found.

5.3 Declared pest plants and environmental weeds.

Five Declared pest plants listed under the *Biosecurity and Agriculture Management Act 2007* were found within the survey area, **Asparagus asparagoides* (Bridal creeper), **Galium spurium*, **Rubus laudatus* (Blackberry), **Solanum linnaeanum* (Apple of Sodom), and **Gomphocarpus fruticosus* (Narrowleaf cotton bush). **Asparagus asparagoides* is not assigned a control category under the act, whilst **G. fruticosus* and **R. laudatus* have a C3[5] control category. **Asparagus asparagoides and* **Rubus laudatus* are also recognised as Weeds of National Significance (WONS).

The locations of **Watsonia meriana*, which is not a DPP or WONS, but nevertheless is a serious environmental weed are also mapped.

The location of these plants is shown in **Figure 11**.

[5] C3 Management - Organisms that should have some form of management applied that will alleviate the harmful impact of the organism, reduce the numbers or distribution of the organism or prevent or contain the spread of the organism.

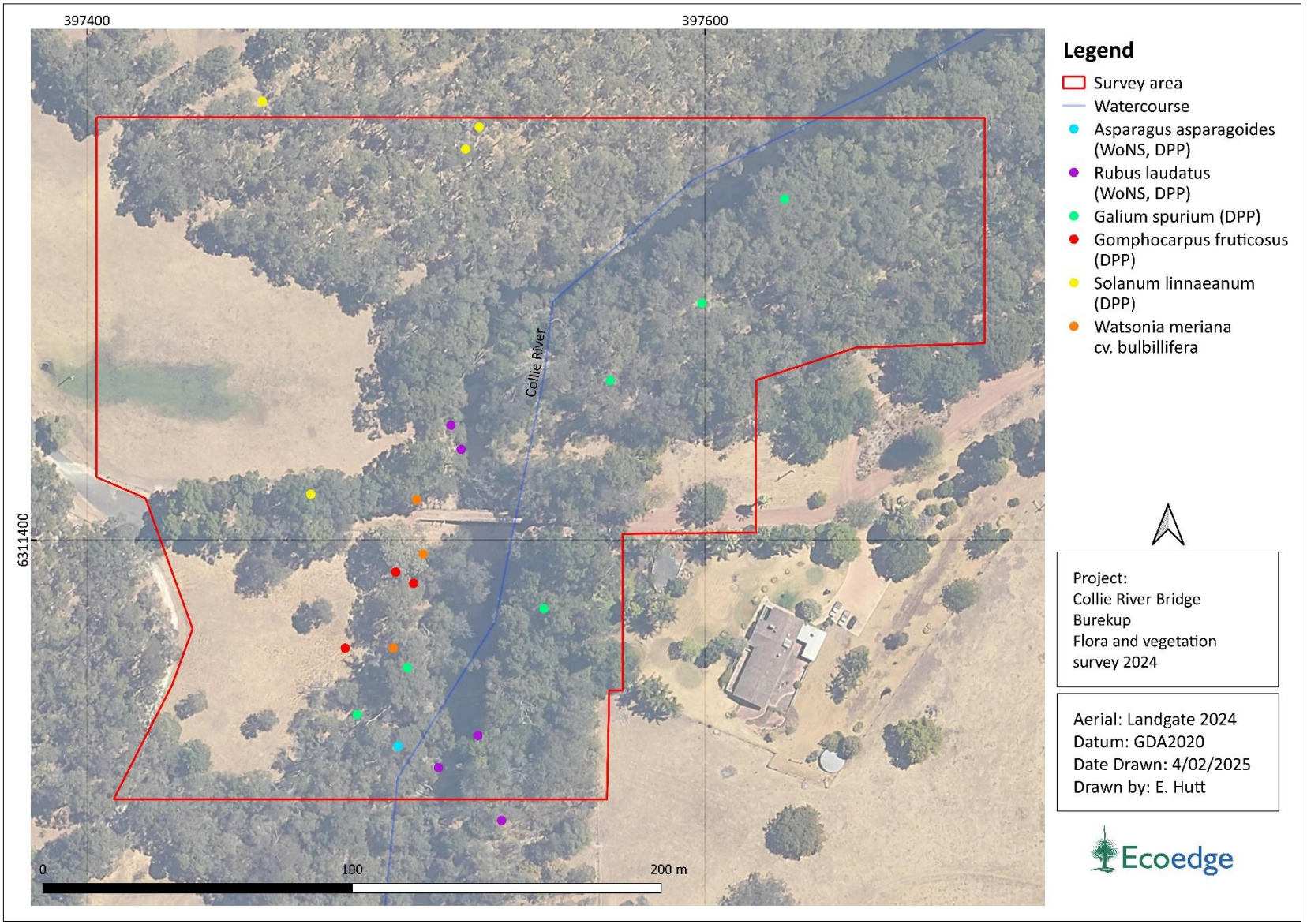


Figure 11. Location of Declared pest plants and environmental weeds within the survey area.

5.4 Vegetation units

Two vegetation units are described and mapped for the survey area. Unit A comprised the riverine vegetation adjacent to the Collie River. It formed an open forest dominated by *Eucalyptus rudis* subsp. rudis (Flooded gum), *Corymbia calophylla* (Marri) and occasionally *Eucalyptus patens* (Blackbutt). Three main variations occur within the unit which have a different understorey: the riverbank, channels where preferential flow of water takes place when the river overflows its banks and the sandy ridges between the river and the adjacent channels.

Vegetation unit B is comprised of the open forest dominated mainly by *Corymbia calophylla* (Marri) which occurs on rocky clay-loam soils upslope of unit A. This unit has been subject to heavy ongoing livestock grazing and most of the native understorey has disappeared.

A description of each of the units is provide in **Table 13**. Maps showing the occurrence of the units is shown in **Figure 12.**

The conservation status of the vegetation units is discussed in **Sub-section 6.1.2**.

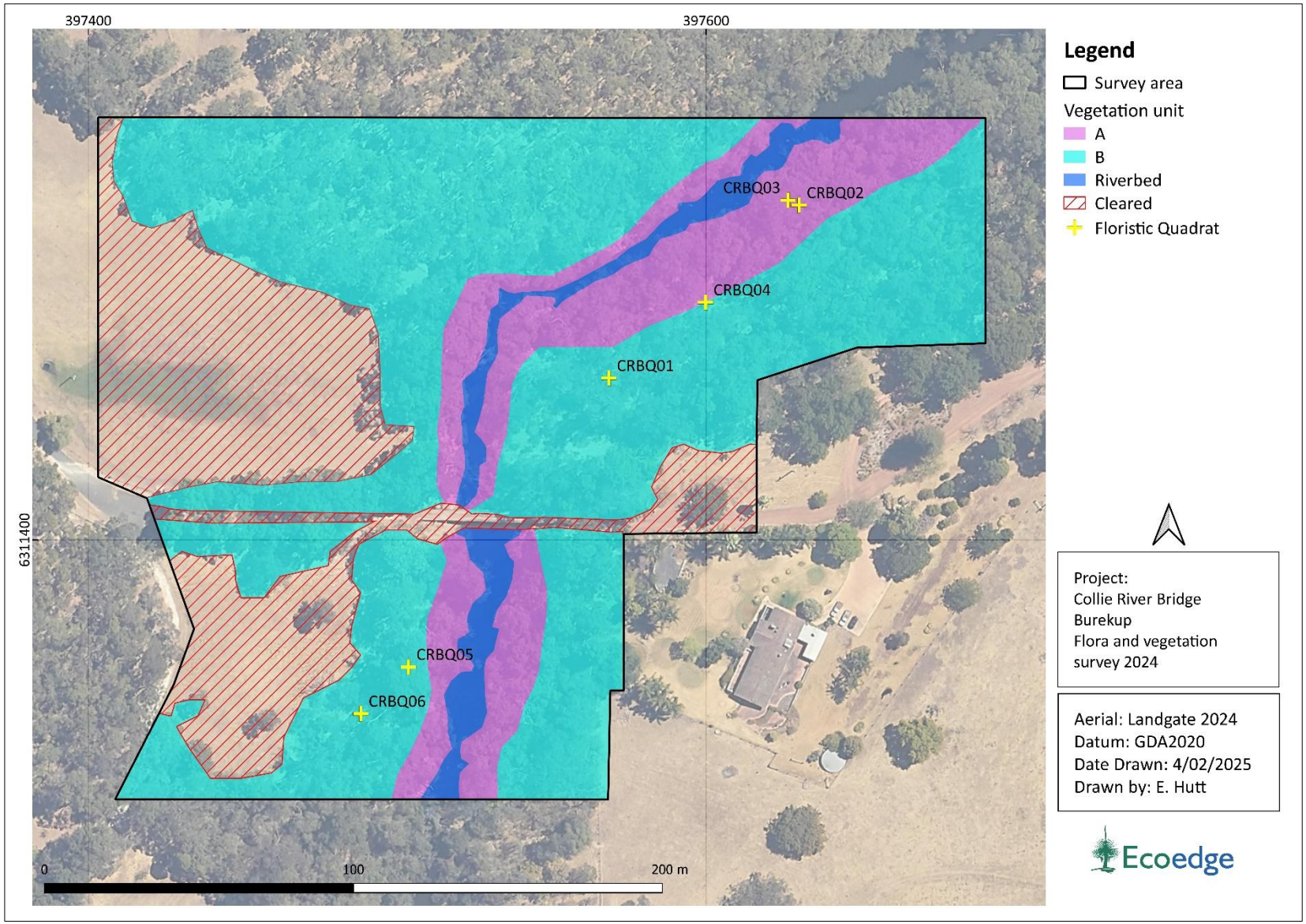


Figure 12. Vegetation within the survey area.

Table 13. Vegetation units within the survey area.

Veg. Unit	Photo	Description	Area (ha)
A		Open mid-height forest *of Eucalyptus rudis*, *Corymbia calophylla* and occasionally *Eucalyptus patens over low woodland of Agonis flexuosa* and *Trymalium odoratissimum* over open tall shrubland of *Acacia alata*, *Astartea scoparia*, *Calycopeplus oligandrus*, *Dodonaea viscosa* subsp. a*ngustissima* over very open low shrubland of *Clematis pubescens*, *Hibbertia sylvestris*, *Veronica plebeia* over open sedgeland of *Lepidosperma effusum*, *Machaerina juncea* with scattered forbs including *Pteridium esculentum*, *Patersonia occidentalis* and isolated *Microlaena stipoides* grass on grey-brown loam. (Along the edge of the river there is a narrow band of *Astartea scoparia* and *Melaleuca viminea*, with occasionally **Bambusa* sp., *Darwinia citriodora, *Ficus carica*, **Rubus laudatus,* and the tall sedge *Lepidosperma striatum*).	0.72
B		Open mid-height forest of *Corymbia calophylla* and occasionally *Eucalyptus marginata* over open low woodland of *Agonis flexuosa* over forbs including *Geranium dissectum*, **Medicago polymorphus* and grasses **Briza maxima*, **Ehrharta longiflora, *Lolium perenne*, on rocky or gravelly grey-brown clay-loam. (On the east side of the river planted and escaped exotic species such as **Eucalyptus citriodora*, **E. globulus*, **Acer negundo*, **Bougainvillea glabra*, **Washingtonia filifera,* and **Ficus macrophylla* are present in this unit).	2.58

5.5 Multivariate analysis

Five of the survey area quadrats were placed within vegetation unit A, with one (CRBQ01) situated within unit B. Only one quadrat was sited in unit B because most of the unit was too degraded. Unsurprisingly, because the survey area lies in the Lowden Valleys soil-landscape system and about 7 km east of the Swan Coastal Plain there was not a close match between the six quadrats installed within the survey area and any of the quadrats from the Swan Coastal Plain (SCP) survey (Gibson et al. 1994, Keighery et al 2012). The results of the comparisons with the two Swan Coastal Plain datasets are summarised in **Table 14**, below.

Coefficients of similarity between all of the six survey area quadrats and the most similar SCP quadrats was generally less than 0.25. Overall, the most similar SCP quadrats had been assigned to FCT 11 (Wet forests and woodlands), a relatively species-poor FCT often dominated by *Eucalyptus rudis*. FCT11 was chosen as the most likely community type because all of the survey area quadrat clustered most frequently with this FCT.

FCT 11 is not a Threatened or Priority ecological community.

Excerpts of the dendrogram are provided in **Appendix 13.**

Table 14. Summary of floristic analysis for quadrat by individual quadrat single site insertion – including weeds.

Survey Quadrat	Single site insertion - Gibson et al 1994				Single site insertion – Keighery et al 2012						Comparison of typical and other common species.	Recommended FCT
	Quadrat	FCT	Similarity	Dendrogram	Quadrat	FCT	Similarity	Dendrogram	Likely FCTs	Likely FCT Landform		
CRBQ01	low10b_11	11	0.24	Grouped with eight FCT11 and two FCT14 quadrats	Cavs07_S01	S01	0.26	Grouped with six FCT11 quadrats, three S07 quadrats, one FCT06 and one S17 quadrat	FCT11	255Lv	Shares *Eucalyptus rudis*, *Astartea* sp. *Hypochaeris glabra* and *Briza maxima* with FCT11	Poor match with any of the Swan Coastal Plain FCTs, but overall, the best match is with FCT11 (wet forests and woodlands).
	CARB-1_1b	1b	0.19		low10b_11	11	0.24					
	ELLEN-7_6	6	0.19		Sunday01_6	6	0.22					
	PAGA-2_13	13	0.18		raven02_S17	S17	0.22					
	NAVB-4_24	24	0.16		yuri05_S17	S17	0.20					
CRBQ02	CARB-1_1b	1b	0.28	Grouped with eight FCT11, two FCT14 quadrats and one FCT17 quadrats	CARB-1_1b	1b	0.28	Grouped with six FCT11 quadrats, three S07 quadrats, one FCT06 and one S17 quadrat	FCT11	255Lv	Shares *Eucalyptus rudis*, *Astartea* sp. *Hypochaeris glabra* and *Briza maxima* with FCT11	Poor match with any of the Swan Coastal Plain FCTs, but overall, the best match is with FCT11 (wet forests and woodlands).
	KERO-2_24	24	0.27		KERO-2_24	24	0.28					
	WOODP-2_30a2	30a	0.27		bold07_24	24	0.27					
	low10b_11	11	0.26		WOODP-2_30a2	30a	0.27					
	Possum5_17	17	0.25		PEPB-1_30b	30b	0.26					
CRBQ03	MILT-2_13	13	0.23	Grouped with eight FCT17 quadrats and one FCT13 quadrat	raven02_S17	S17	0.24	Grouped with six FCT11, three S07, two S17 and one FCT06 quadrat	FCT11	255Lv	Shares *Eucalyptus rudis*, *Astartea* sp. *Hypochaeris glabra* and *Briza maxima* with FCT11	Poor match with any of the Swan Coastal Plain FCTs, but overall, the best match is with FCT11 (wet forests and woodlands).
	hymus01_11	11	0.23		hymus01_11	11	0.23					
	Possum5_17	17	0.20		leda03_17	17	0.19					
	cool 08_24	24	0.19		Possum5_17	17	0.19					
	low10b_11	11	0.18		ELE09_S05	S05	0.18					
CRBQ04	hymus01_11	11	0.29	Grouped with eight FCT11, two FCT14 quadrats and one FCT13 quadrats	hymus01_11	11	0.29	Grouped with six FCT11, three S07, two S17 and one FCT06 quadrat	FCT11	255Lv	Shares *Eucalyptus rudis*, *Astartea* sp. *Hypochaeris glabra* and *Briza maxima* with FCT11	Poor match with any of the Swan Coastal Plain FCTs, but overall, the best match is with FCT11 (wet forests and woodlands).
	Possum5_17	17	0.28		Possum5_17	17	0.27					
	HARRY-6_11	11	0.21		ELE09_S05	S05	0.25					
	AUSTB-4_5	5	0.21		pinj13_S17	S17	0.22					
	YAN-21_14	14	0.19		yuri05_S17	S17	0.22					
CRBQ05	MILT-2_13	13	0.28	Grouped with eight FCT11, two FCT14 quadrats and one FCT17 quadrats	PEPB-1_30b	30b	0.25	Grouped with six FCT11, three S07, two S17 and one FCT06 quadrat	FCT11	255Lv	Shares *Eucalyptus rudis*, *Astartea* sp. *Hypochaeris glabra* and *Briza maxima* with FCT11	Poor match with any of the Swan Coastal Plain FCTs, but overall, the best match is with FCT11 (wet forests and woodlands).
	low10b_11	11	0.25		low10b_11	11	0.25					
	PEPB-1_30b	30b	0.25		ELLEN-7_6	6	0.24					
	ELLEN-7_6	6	0.24		hymus01_11	11	0.21					
	CARB-1_1b	1b	0.24		Cavs07_S01	S01	0.21					
CRBQ06	hymus01_11	11	0.26	Grouped with seven FCT11 and two FCT14 quadrats	hymus01_11	11	0.26	Grouped with six FCT11, three S07, two S17 and one FCT06 quadrat	FCT11	255Lv	Shares *Eucalyptus rudis*, *Astartea* sp. *Hypochaeris glabra* and *Briza maxima* with FCT11	Poor match with any of the Swan Coastal Plain FCTs, but overall, the best match is with FCT11 (wet forests and woodlands).
	rowe01_11	11	0.24		Cavs07_S01	S01	0.26					
	ELLEN-7_6	6	0.23		ELLEN-7_6	6	0.24					
	CARB-1_1b	1b	0.23		rowe01_11	11	0.23					
	PEPB-1_30b	30b	0.20		CARB-1_1b	1b	0.23					

5.6 Vegetation condition

Most vegetation within the survey area was in Degraded (33%) or Completely Degraded (51%) condition (**Table 15**). The main causes of degradation were partial clearing (in parts), livestock grazing and accompanying weed invasion. The weeds or non-native plants within the bushland were a combination of common agricultural weeds (such as **Briza* spp.), plantings (such as **Eucalyptus citriodora*) and apparent garden escapes (such as **Bougainvillea glabra* and **Fraxinus excelsior*).

Blackberry (**R. laudatus*) is common along the fringes of the river and has a significant affect on access.

Most of vegetation unit A (75%) was in Good or Very Good condition in contrast to unit B of which 90% was in Degraded or Completely Degraded condition. This reflects the pattern of clearing and grazing. Vegetation unit A, which is subject to flooding, and was consequently less subject to clearing and grazing.

A breakdown of vegetation condition per unit is provided in **Table 16.** The distribution of vegetation condition in the survey area is provided in **Figure 13.**

Table 15. Area and percentage of the survey area in vegetation condition classes.

Vegetation Condition	Area (ha)	%
Very Good	0.38	8.48
Good	0.32	7.14
Degraded	1.48	33.04
Completely Degraded	2.30	51.33
	4.48	100.00
Water	0.20	

Table 16. Area and condition classes for the various vegetation unit within the survey area.

Vegetation Mapping Unit	Condition	Area (ha)	%
A	Very Good	0.38	64.96
	Good	0.06	9.74
	Degraded	0.11	18.46
	Completely Degraded	0.04	6.84
		0.59	100.00
B	Good	0.26	10.17
	Degraded	1.23	47.70
	Completely Degraded	1.09	42.13
		2.59	100.00
Cleared	Completely Degraded	1.17	
Riverbed		0.20	
Total Survey Area		**4.54**	

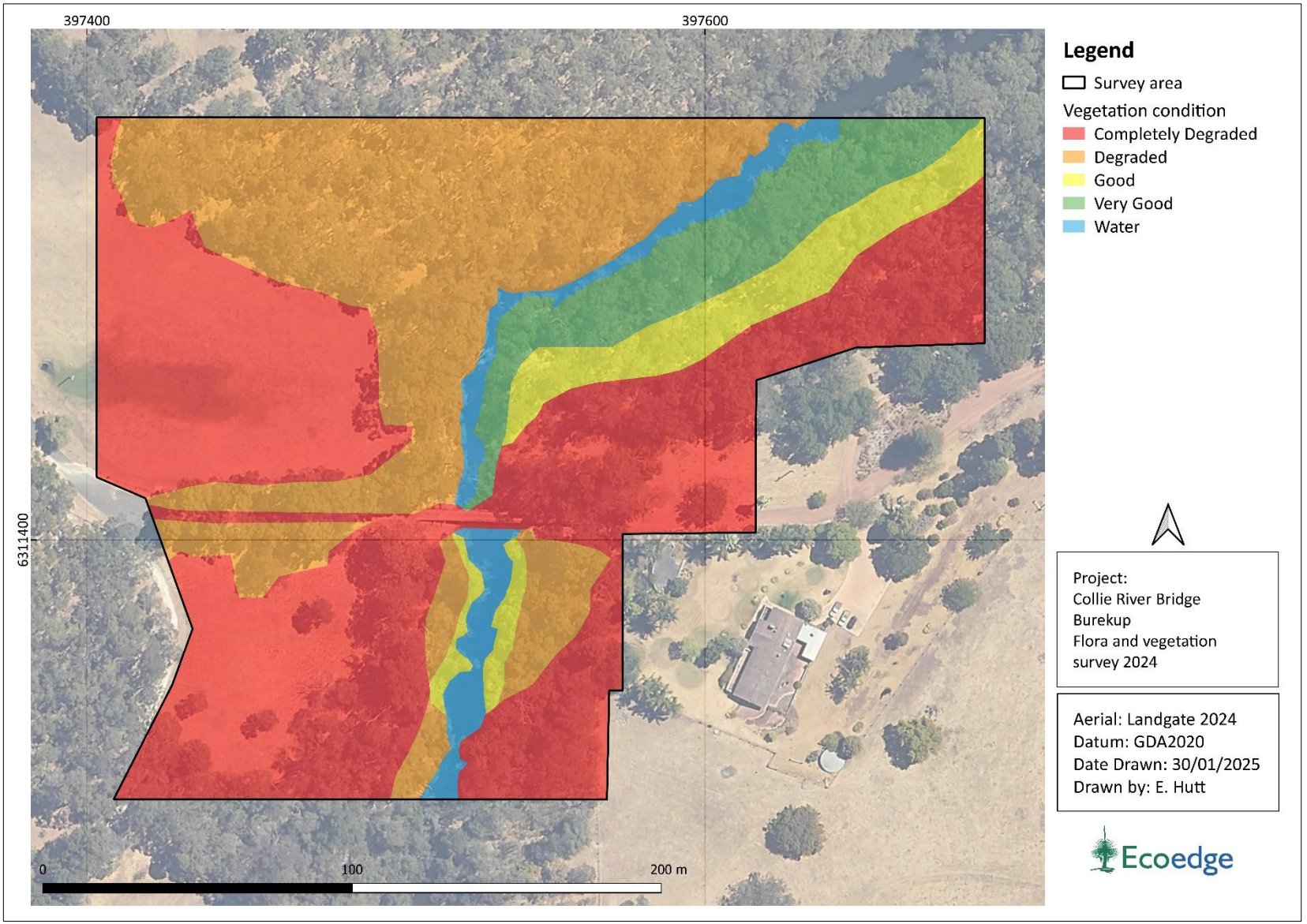


Figure 13. Vegetation condition within the survey area.

6 Discussion and conclusions

6.1 Significance of flora

There were no Threatened or Priority-listed flora, or other flora of conservation significance within the survey area.

6.1.1 Post-survey likelihood assessment

All 57 Threatened or Priority taxa potentially occurring in the survey area were assigned a post-survey residual likelihood of "Unlikely". These species are regarded Unlikely to occur post-survey because either, although potentially suitable habitat was present, the areas were adequately surveyed and species not found to be present, or the habitat condition was in too degraded for the taxa to be present. For nine of the potential species inspection of the survey area demonstrated that suitable habitat was not present.

6.1.2 Significance of vegetation

Neither of the vegetation units in the survey area is representative of a Threatened or Priority ecological community. However, unit A, being a riverine vegetation type, has particular conservation value for its role in protecting the riverbanks and because much of the riverine vegetation of the Collie River downstream of the survey area has been cleared or severely degraded (DoW 2011, pp. 10-11).

6.2 Vegetation complexes and associations

The survey area vegetation is moderately well aligned with the description of the vegetation complex mapped across the survey area: the Lowden Complex. With vegetation unit A fitting the "*Eucalyptus rudis-Melaleuca rhaphiophylla* on valley floors" part of the description and unit B aligning with the "open forest of *Corymbia calophylla-Eucalyptus marginata* subsp. *marginata-Agonis flexuosa*" part of the description. As mentioned in section 4.3 the Lowden Complex falls below the 30% Commonwealth retention target on the Darling Plateau with 11.84% of pre-European extent vegetation remaining, although it is above the minimum target level in the shire of Dardanup.

The survey area vegetation is also moderately well aligned with the Beard Vegetation Association mapped for the survey area: association 1184 'Medium woodland-fringing; jarrah, marri, *Eucalyptus rudis* & *Agonis flexuosa*'. Association 1148 exceeds the 30% Commonwealth retention target at all levels, with 39.54% of Statewide pre-European extent vegetation remaining.

6.3 Regional ecological linkages and Bush Forever Areas

The Collie River Ecological Linkage intersects the survey area, following the path of the river and providing a corridor of vegetation that has been assigned the highest tier of PV rating - 1a. This rating has been assigned because the vegetation is in proximity to the river linkage and its connectivity to Wellington National Park to the south and east of the survey area.

6.4 Waterways and wetlands

Vegetation unit A within the survey area meets the criteria to be considered distinctive wetland vegetation including as it does such groundwater dependant species as *Eucalyptus rudis*, *Astartea scoparia*, *Melaleuca viminea* and *Machaerina juncea.*

6.5 Environmentally sensitive areas

There are no ESAs mapped within or in proximity to the survey area. The closest ESA is located approximately 3.8 km to the east of the survey area which is associated with a Conservation category wetland.

References

Atlas of Living Australia. (2024). 10 km Area Report data set. Generated 4 September 2024. https://spatial.ala.org.au/

Beard, J. S., Beeston, G.R., Harvey, J.M., Hopkins, A. J. M. and Shepherd, D. P. (2013). The vegetation of Western Australia at the 1:3,000,000 scale. Explanatory memoir. Second edition. Conservation Science Western Australia 9: 1-152.

Beeston, G.R., Hopkins, A.J.M. and Shepherd, D.P. (eds) (2001). *Land-use and Vegetation, Western Australia*. Agriculture Western Australia, South Perth and National Land and Water Resources Audit, Canberra, from: https://library.dpird.wa.gov.au/rmtr/236/

Commonwealth of Australia and the State of Western Australia. (1999). Regional Forest Agreement for the South-West Forest Region of Western Australia.

Commonwealth of Australia (2016). *Interim Biogeographic Regionalisation for Australia (IBRA), Version 7 (Regions)*. Department of the Environment and Energy.

Crossman, S., Li, O. (2015). Surface Hydrology Lines (National). Geoscience Australia, Canberra. http://pid.geoscience.gov.au/dataset/ga/83130

Department of Biodiversity, Conservation and Attractions (DBCA). (2019). Conservation codes for Western Australian Flora and Fauna 3 January 2019.

Department of Biodiversity, Conservation and Attractions (DBCA). (2022). Geomorphic Wetlands, Swan Coastal Plain dataset DBCA-019, last updated 22 August 2022. https://catalogue.data.wa.gov.au/dataset/geomorphic-wetlands-swan-coastal-plain

Department of Biodiversity, Conservation and Attractions (DBCA). (2023a). Threatened ecological communities endorsed by the Minister for the Environment (23 November 2023).

Department of Biodiversity, Conservation and Attractions (DBCA). (2023b). Priority ecological communities for Western Australia, Version 35. Species and Communities Program, Department of Biodiversity, Conservation and Attractions 19 June 2023.

Department of Biodiversity, Conservation and Attractions (DBCA). (2024a). Extract from the Department's Threatened and Priority Ecological Community database, DBCA Species and Communities Branch, 24 September 2024, for GHD for the SoHarvey Collie River Rd Bridge flora and vegetation survey.

Department of Biodiversity, Conservation and Attractions (DBCA). (2024b). Extract from the Department's and Western Australian Herbarium Threatened and Priority Flora database, DBCA Species and Communities Branch, 18 September 2024, for GHD for the SoHarvey Collie River Rd Bridge flora and vegetation survey.

Department of Biodiversity, Conservation and Attractions (DBCA). (2024c). Methods for survey and identification of Western Australian threatened ecological communities. Version 4.3. Species and Communities Program. 23 January 2024.

Department of Biodiversity, Conservation and Attractions (DBCA), 2025. Threatened and Priority Flora list (15 January 2025). https://www.dbca.wa.gov.au/management/threatened-species-and-communities

Department of Climate Change, Energy, the Environment and Water (DCCEEW). (2020). Categories of Threatened species under the EPBC Act.

Department of Climate Change, Energy, the Environment and Water (DCCEEW). (2022). Categories of Threatened ecological communities under the EPBC Act.

Department of Climate Change, Energy, the Environment and Water (DCCEEW). (2024). Protected Matters Search Tool 10 km query for U125 GHD Collie River Rd Bridge. Generated 4 September 2024.

Department of Environment and Conservation (DEC). (2013). Definitions, categories and criteria for threatened and priority ecological communities.

Department of Water and Environmental Regulation (DWER). (2021). Clearing Regulations - Environmentally Sensitive Areas (DWER-046) dataset, last updated 9 November 2021. https://catalogue.data.wa.gov.au/dataset/clearing-regulations-environmentally-sensitive-areas-dwer-046.

Department of Water (DoW). (2011). Environmental flow regime for the lower Collie River, Shentons Elbow reach. Environmental water report series. Report No. 21. Government of Western Australia.

Environment Australia. (2001). National objectives and targets for biodiversity conservation 2001–2005.

Environmental Protection Authority (EPA). (1993). Red Book, Status report (1993) on the implementation of Conservation Reserves for Western Australia as recommended by the EPA (1976 – 1984), Report 15.

Environmental Protection Authority (EPA). (2008). Environmental Guidance for Planning and Development. Guidance Statement 33.

Environmental Protection Authority (EPA). (2016). Technical Guidance Flora and Vegetation Surveys for Environmental Impact.

Gibson, N., Keighery, B.J., Keighery, G.J., Burbridge, A.H., Lyons, M.N. (1994). A floristic survey of the southern Swan Coastal Plain: report to Heritage Council of W.A. and Australian Heritage Commission. Department of Conservation and Land Management, Western Australia.

Government of Western Australia (GoWA). (2005). Environmental Protection (Environmentally Sensitive Areas) Notice 2005 (Environmental Protection Act 1986) (No. No.55), Government Gazette.

Government of Western Australia (GoWA) (2019a). 2018 Statewide Vegetation Statistics incorporating the CAR Reserve Analysis (Full Report). Current as of March 2019. Department of Biodiversity, Conservation and Attractions, Perth, Western Australia. https://catalogue.data.wa.gov.au/dataset/dbca-statewide-vegetation-statistics

Government of Western Australia (GoWA). (2019b) 2018 South West Vegetation Complex Statistics. Current as of March 2019. Department of Biodiversity, Conservation and Attractions, Perth, Western Australia. https://catalogue.data.wa.gov.au/dataset/dbca.

Heddle, E.M., Loneragan, O.W., Havel, J.J. (1980). Vegetation of the Darling System. In: Atlas of Natural Resources, Darling System, Western Australia.

Keighery, B., Keighery, G., Longman, V.M., Clarke, K.A. (2012). Weed and native flora quadrat data compiled between 1990 – 1996 for the Swan Coastal Plain. Data compiled for the Departments of Environmental Protection and Conservation and Land Management.

Mattiske, E.M. & Havel, J.J. (1998). Vegetation Mapping in the South West of Western Australia and Regional Forest Agreement vegetation complexes. Map sheets for Pemberton, Collie, Pinjarra, Busselton-Margaret River, Mt Barker, and Perth, Western Australia. Scale 1:250,000.

Molloy, S., O'Connor, T., Wood, J., Wallrodt, S. (2009). South West Regional Ecological Linkages Technical Report. Western Australian Local Government Association (WALGA) and the Department of Environment and Conservation (DEC), West Perth.

NVIS Technical Working Group. (2017). Australian Vegetation Attribute Manual: National Vegetation Information System, Version 7.0.

Seddon, G. (1972). Sense of Place a response to an environment the swan coastal plain Western Australia. University of Western Australia Press, Perth, Western Australia.

Semeniuk, C.A. & Semeniuk, V. (1995). A Geomorphic Approach to Global Classification for Inland Wetlands. Vegetation 103–124.

Shepherd, D., Beeston, G., Hopkins, A. (2002). Native Vegetation in Western Australia – Extent, Type and Status.

State of Western Australia (2023). Biodiversity Conservation (Listing of Native Species) (Flora) Order 2023. Western Australian Government Gazette 2023 (135): 3391-3428. https://www.legislation.wa.gov.au/legislation/statutes.nsf/gazettes2023.html

Tille, P., Moore, G. and Griffin, T. (1998). Soils and landscapes of the south-western Australia. Chapter 2. Section 2.2. Soil Guide. Agriculture Western Australia, Bulletin 4343.

https://www.agric.wa.gov.au/sites/gateway/files/Soil%20Guide%20-%20a%20handbook.pdf

Tille, P.J. & Wilson, G. (1996). Wellington-Blackwood land resources survey. Department of Primary Industries and Regional Development, Western Australia, Perth. Report 14. https://library.dpird.wa.gov.au/land_res/14

Webb, A., Kinloch, J., Keighery, G., Pitt, G. (2016). The Extension of Vegetation Complex Mapping to Landform boundaries within the Swan Coastal Plain Landform and Forested Region of South West Western Australia.

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 two kilometres (km) of the survey area with suitable habitat known or predicted to occur within the survey area.	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. **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 taxon is non- descript and or very small and difficult to find because, for example, it occurs in large areas of rocky granite outcrops, or within an expanse of open water. **L4.** The taxon is non-descript and or very small and may be overlooked.
Possible	Known to occur within a two-ten km of the survey area with suitable habitat known or predicted to occur within the survey area.	The taxon is known from within a two to 10 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. **P1.** The taxon was dormant at the time of survey and could therefore not be located. **P2.** The taxon was not flowering at time of survey and could have been overlooked **P3.** The habitat was compromised, for example, due to a recent fire. **P4.** The taxon is non- descript and or very small and difficult to find because, for example, it occurs in large areas of rocky granite outcrops, or within an expanse of open water. **P5.** The taxon is non-descript and or very small and may have been overlooked. **P6.** Portions of the survey area with potential habitat could not be accessed, for example due to access restrictions.

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

Unlikely	Known or predicted to occur within ten km, but no suitable habitat is known or predicted to occur within the survey area.	The taxon was not found and is unlikely to be present for one or more of the following reasons: **U1.** A thorough search for the taxon was conducted and no suitable habitat was present given that the taxon is known to be generally restricted to a clearly defined habitat type. **U2.** Suitable or potential habitat was present and appropriately searched, but the taxon was not observed. **U3.** Suitable or potential habitat was 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
Drakaea elastica	T (EN)	Sep -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. Quadrat details

Quadrat: CRB01	Soil: Grey-brown clay-loam	Position: Valley floor
Date: October 8, 2024	Condition: Good	Moderate grazing (livestock)
Latitude	-33.3312399	
Longitude	115.8994541	

Taxon	Cover (%)	Height
Astartea scoparia	<10	>2 m
**Bromus diandrus*	<10	<1m
Calycopeplus oligandrus	10 to 30	>2 m
**Cenchrus clandestinus*	<10	<0.5 m
Darwinia citriodora	0 to 5	1 to 2 m
Dodonaea viscosa subsp. *angustissima*	<10	>2 m
**Ehrharta longiflora*	10 to 30	<1m
Eucalyptus rudis	30 to 70	>10 m
**Galium spurium*	10 to 30	<0.1 m
Juncus pallidus	0 to 5	1 to 2 m
Lepidosperma effusum	10 to 30	1 to 2 m
Lepidosperma striatum	0 to 5	1 to 2 m
Leptocarpus laxus	10 to 30	1 to 2 m
**Lysimachia arvensis*	<10	<0.1 m
Melaleuca rhaphiophylla	<10	>2 m
Microlaena stipoides	10 to 30	<0.5 m
**Ranunculus muricatus*	<10	<0.5 m
**Rumex pulcher*	Approx. 0	<0.1 m
**Sonchus asper*	0 to 5	<0.5 m

Quadrat: CRB02	Soil: Grey-brown loam	Position: Valley floor
Date: October 8, 2024	Condition: Very Good	
Latitude	-33.3307904	
Longitude	115.90006	

Taxon	Cover (%)	Height
Agonis flexuosa	70 to100	<10 m
**Briza maxima*	10 to 30	<0.5 m
**Cerastium glomeratum*	0 to 5	<0.1 m
Cheiranthera parviflora	Approx. 0	<1m
Clematis pubescens	0 to 5	1 to 2 m
**Ehrharta longiflora*	10 to 30	<1m
Eucalyptus rudis	0 to 5	>10 m
**Galium spurium*	0 to 5	<0.1 m
Hardenbergia comptoniana	Approx. 0	<0.1 m
Hibbertia commutata	30 to 70	<1m
**Lysimachia arvensis*	0 to 5	<0.1 m
Macrozamia riedlei	Approx. 0	<1m
Microlaena stipoides	10 to 30	<1m
Oxalis exilis	0 to 5	<0.1 m
Patersonia occidentalis	0 to 5	<0.5 m
Pteridium esculentum	0 to 5	1 to 2 m
**Sonchus oleraceus*	Approx. 0	<0.5 m

Quadrat: CRB03	Soil: Grey-brown loam	Position: Valley floor
Date: October 8, 2024	Condition: Very Good	
Latitude	-33.3307823	
Longitude	115.9000097	

Taxon	Cover (%)	Height
Eucalyptus rudis	10 to 30	>10 m
Eucalyptus patens	10 to 30	>10 m
Agonis flexuosa	30 to 70	<10 m
Pteridium esculentum	<10	1 to 2 m
Machaerina juncea	70 to100	<1m
**Galium spurium*	<10	<0.5 m
Veronica sp.	0 to 5	<0.5 m
Darwinia citriodora	0 to 5	<1m
Dodonaea viscosa subsp. *angustissima*	0 to 5	<1m
Microlaena stipoides	10 to 30	<0.5 m
**Sonchus oleraceus*	0 to 5	<0.5 m
**Lysimachia arvensis*	0 to 5	<0.5 m
Astartea sp.	0 to 5	1 to 2 m
Hibbertia commutata	0 to 5	<0.5 m
Billardiera sp. Narrow leaves	Approx. 0	<1m

Quadrat: CRB04	Soil: Grey-brown sandy loam	Position: Valley floor
Date: October 8, 2024	Condition: Very Good	
Latitude	-33.330985	
Longitude	115.8996581	

Taxon	Cover (%)	Height
Acacia alata	0 to 5	<1m
Agonis flexuosa	30 to 70	<10 m
Astartea scoparia	<10	>2 m
Dodonaea viscosa subsp. *angustissima*	<10	1 to 2 m
Empodisma gracillimum	<10	<1m
Eucalyptus rudis	10 to 30	>10 m
**Galium spurium*	0 to 5	<0.1 m
**Hypochaeris glabra*	0 to 5	<0.5 m
Lepidosperma effusum	10 to 30	1 to 2 m
**Lysimachia arvensis*	0 to 5	<0.1 m
Microlaena stipoides	10 to 30	<0.5 m
Pteridium esculentum	<10	1 to 2 m
**Sonchus oleraceus*	Approx. 0	<0.1 m
Veronica plebeia	0 to 5	<0.5 m

Quadrat: CRB05	Soil: Grey-brown sandy loam	Position: Valley floor
Date: October 8, 2024	Condition: Degraded to Good	Moderate grazing (livestock), Partial clearing
Latitude	-33.3320702	
Longitude	115.8988259	

Taxon	Cover (%)	Height
Agonis flexuosa	30 to 70	<10 m
**Asparagus asparagoides*	0 to 5	1 to 2 m
**Avena barbata*	<10	1 to 2 m
**Briza maxima*	10 to 30	<0.5 m
**Briza minor*	<10	<0.5 m
Dodonaea viscosa subsp. *angustissima*	0 to 5	1 to 2 m
Eucalyptus rudis	30 to 70	>10 m
**Galium spurium*	0 to 5	<0.5 m
Lepidosperma effusum	10 to 30	1 to 2 m
Machaerina juncea	<10	1 to 2 m
Microlaena stipoides	10 to 30	<1m
Pteridium esculentum	10 to 30	1 to 2 m
**Rubus laudatus*	<10	<1m
Rumex conglomeratus	Approx. 0	<1m
Sonchus oleraceus	0 to 5	<0.5 m
Taxandria linearifolia	<10	1 to 2 m
Thysanotus sp.	0 to 5	<1m
Trymalium odoratissimum	<10	>2 m

Quadrat: CRB06	Soil: Grey-brown sandy loam	Position: Creekline
Date: October 8, 2024	Condition: Degraded	
Latitude	-33.332193	
Longitude	115.8985504	

Taxon	Cover (%)	Height
Acacia alata	0 to 5	<1m
Agonis flexuosa	30 to 70	<10 m
**Asparagus asparagoides*	Approx. 0	<0.1 m
**Briza maxima*	30 to 70	<0.5 m
**Bromus diandrus*	<10	<0.5 m
Corymbia calophylla	10 to 30	>10 m
Dodonaea viscosa subsp. *angustissima*	0 to 5	1 to 2 m
Eucalyptus rudis	30 to 70	>10 m
**Galium spurium*	<10	<0.5 m
Microlaena stipoides	<10	<0.5 m
**Rumex pulcher*	Approx. 0	<0.5 m

Appendix 4. Sample sites and track logs.

397400

397600

6311400

CRBQ03

CRBQ02

CRBQ04

CRBQ01

CRBQ05

CRBQ06

0

100

200 m

Legend

- Survey area
- Trackfile
- Floristic Quadrat

Project:
Collie River Bridge
Burekup
Flora and vegetation survey 2024

Aerial: Landgate 2024
Datum: GDA2020
Date Drawn: 4/02/2025
Drawn by: E. Hutt

Ecoedge

Appendix 5. Floristic Analysis (Multivariate) Methods

The aim of the floristic analysis is to assign a Gibson et al. (1994) or Keighery et al. (2012) recognised floristic community type to quadrats/vegetation installed in survey area and thereby a FCT to vegetation representative of these quadrats.

Background

Sixty-six floristic community types (FCTs) have been recognised on the Swan Coastal Plain based on the outcome of two quadrat-based survey reports, Gibson et al. (1994) and Keighery et al. (2012).

The Gibson et al. (1994) survey report delimited 43 FCT's and the conservation status of these types across the southern half of the Swan Coastal Plain (SCP) between Seabird and Dunsborough. This report was based on a survey and statistical analysis of 509 quadrats located almost entirely on public lands. There were some limitations to the survey, in that it did not sample all geographical or geomorphological variations of this portion of the plain with the Quindalup dunes, foothills and Pinjarra plain being under sampled. This was because much of the vegetation on the foothills and plains has either been cleared or is not part of the public estate and there were few reserves within the Quindalup dunes (Gibson et al. 1994). The survey did not sample the Dandaragan Plateau subregion of the SCP.

The Keighery 2012 survey report, based on a survey of 613 quadrats, provided a context for many of the under sampled areas of the Gibson et al. (1994) report and identified a further 23 FCTs. It also included floristic variations on the sand plains to the north of Perth and the Dandaragan Plateau.

The Gibson et al. 1994 and the Keighery et al. 2012 survey data are collectively referred to as the reference data sets in this report.

Data was collected and analysed in accordance with methodology described in Gibson et al. 1994 and the DBCA (2023e) Methods for Survey and Identification of Western Australian TECs to avoid producing unreliable and potentially misleading results. The method is described as follows:

Data preparation

The survey quadrat data and the Gibson et al. 1994 and Keighery et al. (2012) data sets were reconciled with the current nomenclature of the WA Plant census using the latest data from the WA Herbarium. This step was necessary because of the ongoing changes in nomenclature as a result of continued research into the taxonomy of Western Australian plants and plants in general.

All singletons were removed from the datasets prior to analysis, as per Gibson et al. (1994). All unidentified taxa were removed from all data sets prior to analysis.

Quadrat data was reconciled with the reference data sets by, in some cases, differentiating species to infra-specific levels, for example by differentiating *Melaleuca viminea* to *Melaleuca viminea* subsp. *viminea*, or in other cases by reducing some infra-specific levels to their relevant species name for example from *Chamaescilla corymbosa* subsp. *corymbosa* to *Chamaescilla corymbosa*.

In other instances, taxa were reconciled by combining two very similar species 'as one' where confusion is known to have occurred in the field and identifications, such as for the

combination of *Thysanotus manglesianus* and *T. patersonii* to form the ˆ*Thysanotus manglesianus/patersonii*" complex. Species were also grouped as a collective where a taxon had not been identified to a sub species level at the time of the original survey, such as subsp. of *Acacia pulchella*. These are referred collectively as the *Acacia pulchella* group.

Data analysis

Following the data matching process, quadrat data was then combined with the complete reference data sets and subject to multivariate analysis (MVA) using Primer7 statistical software. Sites were classified according to similarities in species composition using the Bray-Curtis similarity measure with the resulting resemblance matrix then subject to a hierarchical group-average cluster analysis (Unweighted pair group method with arithmetic mean method UPGMA) to 'cluster' or group the quadrats with other similar reference site quadrats.

The initial grouped analysis resulted in the survey area quadrats clustering with themselves and then paired with a quadrat representative of FCT21a. This result was instructional, but further single site insertion analyses were undertaken to try to elucidate a match for each of the survey area quadrats with the reference set FCTs. In doing this data from individual quadrats was analysed individually to minimise disruption of the original data set. The resultant analysis dendrograms were then reviewed to determine the position of survey area quadrats in relation to SCP quadrats (Gibson et al., (1994) and Keighery et al. (2012)) and FCT relationships were inferred where possible.
The similarity scores of the five quadrats with closest affinity to the survey data produced in the Bray Curtis resemblance matrices were also identified and included to assist in elucidating a logical FCT assignment.
Consistent with DBCA (2023e), and in order to provide further confidence in alignments, the statistical results were also critically reviewed against other parameters, including:

- The typical and common[3] species lists for SCP FCTs, species richness, descriptions of FCTs and the species groupings tables presented in Gibson et al. (1994) and DBCA (2023e).
- Other information such as vegetation structure, soils, topography and geographical distribution data as presented in presented in Gibson et al. (1994).

Appendix 6. 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 7. Categories of threatened and priority ecological communities under the BC Act.

Conservation code	Category
(T) Threatened ecological community pursuant to Sect 27 of the *Biodiversity Conservation Act 2016.*	
T	(T) CR – Critically endangered 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.
	(T) EN - Endangered 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.
	(T) VU - Vulnerable 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) Priority species – possible threatened communities.	
P1	Poorly known communities Ecological communities that are known from very few occurrences with a very restricted distribution (generally ≤5 occurrences or a total area of ≤ 100ha). Occurrences are believed to be under threat either due to limited extent, or being on lands under immediate threat (e.g. within agricultural or pastoral lands, urban areas, active mineral leases) or for which current threats exist. May include communities with occurrences on protected lands. Communities may be included if they are comparatively well-known from one or more localities but do not meet adequacy of survey requirements, and/or are not well defined, and appear to be under immediate threat from known threatening processes across their range.

Conservation code	Category
P2	Poorly known communities Communities that are known from few occurrences with a restricted distribution (generally ≤10 occurrences or a total area of ≤200ha). At least some occurrences are not believed to be under immediate threat (within approximately 10 years) of destruction or degradation. Communities may be included if they are comparatively well known from one or more localities but do not meet adequacy of survey requirements, and/or are not well defined, and appear to be under threat from known threatening processes.
P3	Poorly known communities 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. Communities may be included if they are comparatively well known from several localities but do not meet adequacy of survey requirements and/or are not well defined, and known threatening processes exist that could affect them.
P4	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. 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	Conservation dependent ecological communities Ecological communities that are not threatened but are subject to a specific conservation program, the cessation of which would result in the community becoming threatened within five years.

Appendix 8. 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	(T) CR – Critically endangered Threatened species considered to be "*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*".
	(T) EN - Endangered Threatened species considered to be "*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*".
	(T) VU - Vulnerable Threatened species considered to be "*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*".
(P) Priority species – possible Threatened species.	
P1	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.
P2	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.

Conservation code	Category
P3	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.
P4	(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.

Appendix 9. 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 10. Online data searches.

Appendix 11. Pre and post survey likelihood of occurrence table.

TAXON	CONS. CODE	FLOWERING PERIOD	DESCRIPTION	PRE-SURVEY LIKELIHOOD	POST-SURVEY LIKELIHOOD
Morelotia australiensis	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 (1)
Caladenia procera	T (CE)	Sep-Oct	Tuberous, perennial, herb, 0.35-0.9 m high. Fl. yellow. Rich clay loam,. Alluvial loamy flats, jarrah/marri/peppermint woodland, dense heath, sedges.	Possible	Unlikely (2)
Caladenia huegelii	T (CR)	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).	Unlikely	Unlikely (1)
Synaphea 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	Unlikely (1)
Synaphea 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 (1)
Diuris drummondii	T (EN)	Nov-Jan	Tuberous, perennial, herb, 0.5-1.05 m high. Fl. yellow. Low-lying depressions, swamps.	Unlikely	Unlikely (1)
Diuris purdiei	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.	Unlikely	Unlikely (1)

TAXON	CONS. CODE	FLOWERING PERIOD	DESCRIPTION	PRE-SURVEY LIKELIHOOD	POST-SURVEY LIKELIHOOD
Drakaea micrantha	T (EN)	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 *Eucalyptus marginata, Allocasuarina fraseriana* woodland or forest. Often under *Kunzea ericifolia, K. glabrescens* with *Paracaleana nigrita* and other Drakaea species.	Unlikely	Unlikely (1)
Synaphea 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	Unlikely (1)
Synaphea stenoloba	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 (1)
Eleocharis keigheryi	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	Possible	Unlikely (2)
Diuris micrantha	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 (1)
Bolboschoenus medianus	P1	-	Rhizomatous, perennial, grass-like or herb (sedge). Fl. red-brown. Mud. In water and on river banks.	Possible	Unlikely (2)
Caladenia uliginosa subsp. *patulens*	P1	Sep-Oct	Tuberous, perennial, herb, 0.2-0.35 m high. Fl. green-cream. Clay loam and gravel. Well drained soils amongst dense shrubs.	Unlikely	Unlikely (1)
Carex tereticaulis	P1	Sep-Oct	Monoecious, rhizomatous, tufted perennial, grass-like or herb (sedge), 0.7 m high. Fl. brown. Black peaty sand.	Unlikely	Unlikely (1)

TAXON	CONS. CODE	FLOWERING PERIOD	DESCRIPTION	PRE-SURVEY LIKELIHOOD	POST-SURVEY LIKELIHOOD
Gastrolobium sp. Yoongarillup (S. Dilkes s.n. 1/9/1969	P1	Aug-Oct	Erect, perennial shrub; 0.5 m high, 1.0 m wide; flowers yellow/orange. Jarrah-Marri forest, white sand, gravel	Unlikely	Unlikely (1)
Orianthera wendyae	P1		Decumbent perennial subshrub, decumbent to 10 cm. Flowers white, foetid scent, in full flower. Brown sandy clay. Eucalyptus haematoxylon, E. marginata low woodland. locally common.	Unlikely	Unlikely (1)
Stylidium acuminatum (Carlquist) Wege subsp. *acuminatum*	P1	Oct-Dec/Jan	Rosetted perennial, herb, Leaves oblanceolate. Inflorescence racemose. Fl. yellow. Clayey sand over laterite. Hillslopes, ridges and valleys. Eucalypt forest, open woodland, Agonis shrubland.	Unlikely	Unlikely (1)
Stylidium perplexum	P1	Nov - Dec	Cushionlike plant to 20 cm tall with scapes extending higher, flowers white. Known from remnant bushland on the Whicher Scarp south-east of Dardanup where it grows in lateritic soils. It is apparently confined to, but common within, a narrow altitudinal gradient on an upper ridge slope bearing Eucalyptus marginata and Corymbia haematoxylon woodland over Banksia grandis and Xanthorrhoea.	Unlikely	Unlikely (1)
Synaphea odocoileops	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 (1)
Gonocarpus keigheryi M.L.Moody	P2		Erect, open shrub, 15 cm high x 15 cm wide. Flowers greenish. Watercourse. Seasonally moist. Littered, brown, clayey sand.	Possible	Unlikely (2)
Juncus meianthus	P2	Nov-Jan	Tufted perennial, herb, 0.05-0.2 m high, to 0.4 m wide. Fl. brown. Black sand, sandy clay. Creeks, seepage areas.	Possible	Unlikely (2)

TAXON	CONS. CODE	FLOWERING PERIOD	DESCRIPTION	PRE-SURVEY LIKELIHOOD	POST-SURVEY LIKELIHOOD
Caladenia swartsiorum	P2	Sep to Oct	Tuberous, perennial, herb, 0.3-0.35 m high. Fl. pale green to pale greenish yellow with red markings. Found between the Harvey Estuary and Lake Preston, growing amongst sedges in moist, sandy soils adjacent to seasonally wet flats and also in fewer numbers amongst native grasses in adjacent woodland habitat. Associated species include Agonis flexuosa, Banksia attenuata, Eucalyptus marginata, E. gomphocephala, Macrozamia riedlei and Xanthorrhoea preissii.	Unlikely	Unlikely (1)
Craspedia sp. Waterloo (G.J. Keighery 13724)	P2	Aug-Sep or Oct	Completely glabrous. Fl. Bright yellow. Growing in water on seasonally inundated heavy soils of the Pinjarra plain near Waterloo.	Unlikely	Unlikely (1)
Gastrolobium whicherense	P2	Oct	Slender, open shrub, to 1.6 m high. Fl. orange/yellow/red. Red-grey sandy clay over quartzite. Steep westerly slopes.	Unlikely	Unlikely (1)
Grevillea rosieri	P2	Jul-Sep	Shrubs, 0.5 m high. Flowers red or brown. Gravelly soil, or sand; sandplains; gravel pits.	Unlikely	Unlikely (1)
Pterostylis frenchii	P2	Nov-Dec	Tuberous, herb, to 0.35 m high, with rosette leaves. Fl. white. Calcareous sand with limestone, laterite. Flatlands and gentle slopes.	Unlikely	Unlikely (1)
Rytidosperma racemosum (R.Br.) Connor & Edgar *var. racemosum*	P2	Oct-Dec	Tufted perennial. Lateral lobes with setae.	Unlikely	Unlikely (1)
Thysanotus unicupensis	P2	Oct to Dec	Erect perennial dwarf shrub, height to 15 cm, width to 11 cm; flowers purple. Jarrah - Marri forest	Unlikely	Unlikely (1)
Dillwynia dillwynioides	P3	Aug-Dec	Decumbent or erect, slender shrub, 0.3–1.2 m high. Fl. red, yellow, orange,. Sandy soils. Winter-wet depressions, inundated flats generally alongside rivers or deeper swamps.	Possible	Unlikely (2)

TAXON	CONS. CODE	FLOWERING PERIOD	DESCRIPTION	PRE-SURVEY LIKELIHOOD	POST-SURVEY LIKELIHOOD
Acacia oncinophylla subsp. *oncinophylla*	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 (1)
Banksia mimica	P3	Dec-Feb	Prostrate, lignotuberous shrub, 0.15–0.4 m high. Fl. yellow, brown. White or grey sand over laterite, sandy loam.	Unlikely	Unlikely (1)
Caustis sp. Boyanup (G.S. McCutcheon 1706)	P3	Dec-Jan	Rhizomatous, clumped perennial, grass-like or herb (sedge), 0.7–1 m high. White or grey sand.	Unlikely	Unlikely (1)
Chamaescilla gibsonii	P3	Sep	Clumped tuberous, herb. Fl. blue. Clay to sandy clay. Winter-wet flats, shallow water-filled claypans.	Unlikely	Unlikely (1)
Hemiandra sp. Windy Harbour	P3			Unlikely	Unlikely (1)
Jacksonia gracillima	P3	Oct-Nov	Decumbent shrub - 20 cm high and 50 cm wide. Flowers standard orange-yellow; eye yellow with red halo; wings/keel red. Seasonally damp shrublands and woodlands, on sandy loams or clay loams	Unlikely	Unlikely (1)
Lasiopetalum laxiflorum	P3	Sep-Oct	Jarrah forest, lateritic soils. 2-3 ft high. Mauve flowers. Brown on underside of leaf.	Unlikely	Unlikely (1)
Lasiopetalum membranaceum	P3	Sep-Dec	Multi-stemmed shrub, 0.2-1 m high. Fl. pink, blue, purple. Sand over limestone.	Unlikely	Unlikely (1)
Lomandra whicherensis	P3	Nov-Dec	Tufted rhizomatous herb 20 cm high x 30 cm wide. Flowers yellow with purple stripe. Jarrah-marri forest, lateritic soils, sandy clay.	Unlikely	Unlikely (1)
Schoenus capillifolius	P3	Oct-Nov	Semi-aquatic tufted annual, grass-like or herb (sedge), 0.05 m high. Fl. green. Brown mud. Claypans.	Unlikely	Unlikely (1)

TAXON	CONS. CODE	FLOWERING PERIOD	DESCRIPTION	PRE-SURVEY LIKELIHOOD	POST-SURVEY LIKELIHOOD
Stylidium paludicola	P3	Oct-Dec	Reed-like perennial, herb, 0.35-1 m high, Leaves tufted, linear or subulate or narrowly oblanceolate, 0.5-4 cm long, 0.5-1.5 mm wide, apex acute, margin entire, glabrous. Scape mostly glabrous, inflorescence axis glandular. Inflorescence racemose. Fl. pink. Peaty sand over clay. Winter wet habitats. Marri and Melaleuca woodland, Melaleuca shrubland.	Unlikely	Unlikely (1)
Synaphea hians	P3	Jul-Nov	Prostrate or decumbent shrub, 0.15-0.6 m high, to 1 m wide. Fl. Yellow. Sandy soils. Rises.	Unlikely	Unlikely (1)
Synaphea polypodioides	P3	Sep-Oct	Clumped shrub (sunshrub), 0.35-0.4 m high. Light brown loam, red-brown sandy loam, gravelly, brown sandy clay over laterite. In undulating areas.	Unlikely	Unlikely (1)
Tetratheca parvifolia	P3	Oct	Small shrub, 0.2-0.3 m high. Fl. pink. Jarrah, woodland, wandoo woodland, gravelly soils.	Unlikely	Unlikely (1)
Verticordia attenuata	P3	Dec-May	Shrub, 0.4–1 m high. Fl. pink. White or grey sand. Winter-wet depressions	Unlikely	Unlikely (1)
Aponogeton hexatepalus	P4	Jul-Oct	Rhizomatous or cormous, aquatic perennial, herb, leaves floating. Fl. green, white. Mud. Freshwater: ponds, rivers, claypans.	Possible	Unlikely (2)
Eucalyptus rudis subsp. *cratyantha*	P4	Jul-Sep	Tree, 5-20 m high, bark rough, box-type. Fl. white. Loam. Flats, hillsides.	Possible	Unlikely (2)
Grevillea ripicola	P4	Jan-Apr/Nov-Dec	Spreading, much-branched, non-lignotuberous shrub, 0.6-2(-3) m high, to 4 m wide. Fl. red, orange. Sandy clay, clay or gravelly loam. Swampy flats, granite outcrops, along watercourses.	Possible	Unlikely (2)
Acacia flagelliformis	P4	May-Sep	Rush-like, erect or sprawling shrub, 0.3-0.75(-1.6) m high. Fl. yellow. Sandy soils. Winter-wet areas.	Unlikely	Unlikely (1)

TAXON	CONS. CODE	FLOWERING PERIOD	DESCRIPTION	PRE-SURVEY LIKELIHOOD	POST-SURVEY LIKELIHOOD
Acacia semitrullata	P4	May-Oct	Slender, erect, pungent shrub, (0.1-)0.2-0.7(-1.5) m high. Fl. cream, white. White/grey sand, sometimes over laterite, clay. Sandplains, swampy areas.	Unlikely	Unlikely (1)
Caladenia speciosa	P4	Sep-Oct	Tuberous, perennial, herb, 0.35-0.6 m high. Fl. white, pink. White, grey or black sand.	Unlikely	Unlikely (1)
Chamelaucium erythrochlorum (N.G.Marchant)	P4	Nov-Jan	Erect shrub, 0.6-1.5(-2) m high. Fl. pink-red. Gravelly lateritic soils, clay.	Unlikely	Unlikely (1)
Cyanothamnus tenuis	P4	Aug-Nov	Procumbent or erect & slender shrub, 0.1–0.5 m high. Fl. blue, pink, white. Laterite, stony soils, granite.	Unlikely	Unlikely (1)
Ornduffia submersa	P4	Sep-Oct	Tuberous emergent aquatic perennial dwarf shrub, height to 35 cm; flowers white; leaves floating on surface of water. Clay-based ponds and swamps (semi-aquatic)	Unlikely	Unlikely (1)
Pultenaea skinneri	P4	Jul-Sep	Slender shrub, 1-2 m high. Fl. yellow, orange, red. Sandy or clayey soils. Winter-wet depressions.	Unlikely	Unlikely (1)
Rumex drummondii	P4		Erect perennial, herb, 0.6-0.9 m high. Winter-wet disturbed areas.	Unlikely	Unlikely (1)
Senecio leucoglossus	P4	Aug-Nov	Erect annual, herb, to 1.3 m high. Fl. white. Gravelly lateritic or granitic soils. Granite outcrops, slopes.	Unlikely	Unlikely (1)

Appendix 12. List of vascular flora found within the survey area.

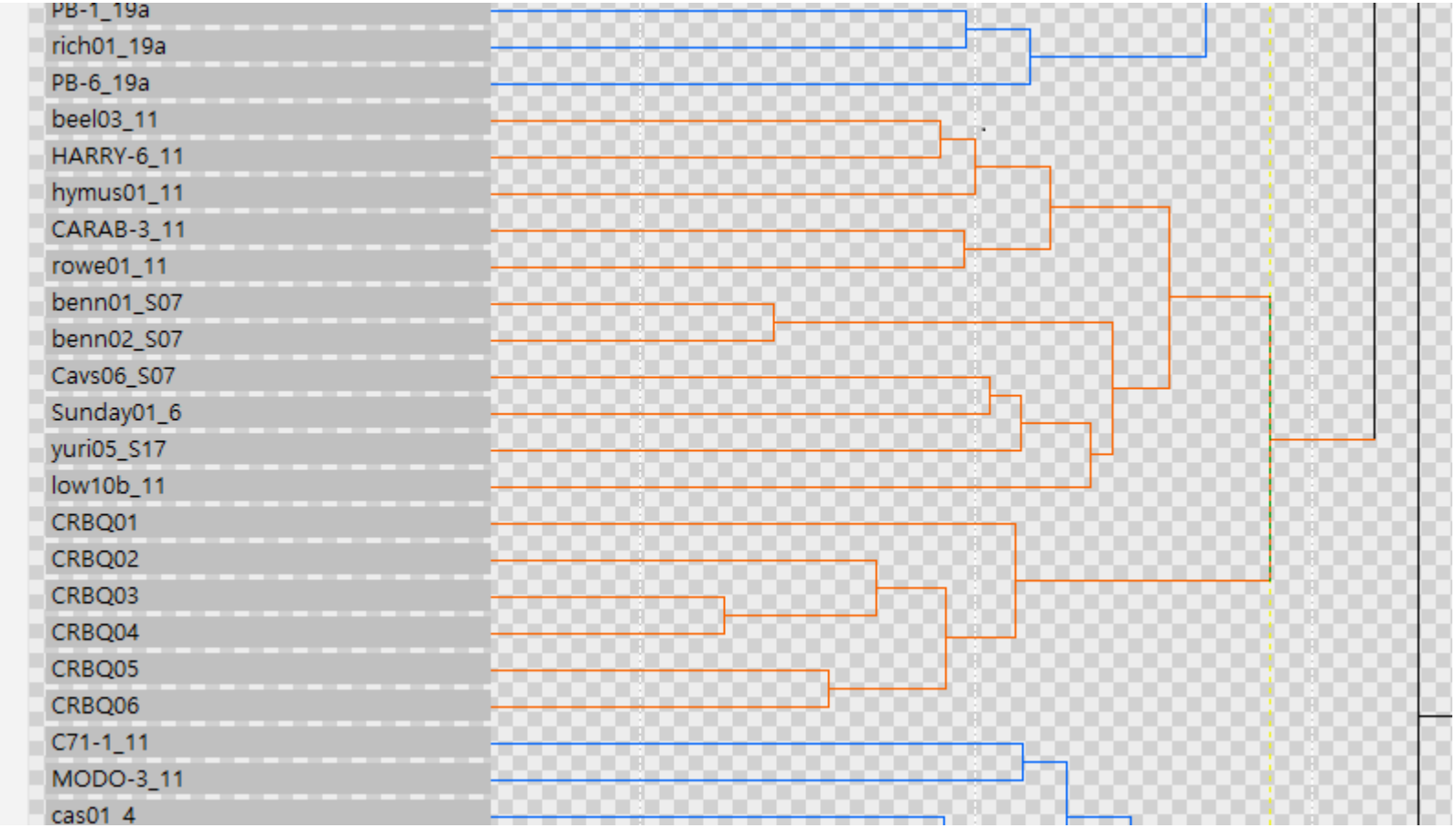
	FAMILY_NAME	SPECIES	VERNACULAR	NATURALISED	DPP	WONS
1	Apocynaceae	*Gomphocarpus fruticosus*	Narrowleaf Cottonbush	*	•	
2	Arecaceae	*Washingtonia filifera*	European fan palm	*		
3	Asparagaceae	*Asparagus asparagoides*	Bridal Creeper	*	•	•
4	Asparagaceae	*Thysanotus* sp.				
5	Asteraceae	*Arctotheca calendula*	Cape Weed	*		
6	Asteraceae	*Hypochaeris glabra*	Smooth Cats-ear	*		
7	Asteraceae	*Sonchus asper*	Rough Sowthistle	*		
8	Asteraceae	*Sonchus oleraceus*	Common Sowthistle	*		
9	Bignoniaceae	*Tecoma capensis*		*		
10	Caryophyllaceae	*Cerastium glomeratum*	Mouse Ear Chickweed	*		
11	Cyperaceae	*Cyperus congestus*	Dense Flat-sedge	*		
12	Cyperaceae	*Lepidosperma effusum*	Spreading Sword-sedge			
13	Cyperaceae	*Lepidosperma striatum*				
14	Cyperaceae	*Machaerina juncea*	Bare Twigrush			
15	Dennstaedtiaceae	*Pteridium esculentum*	Bracken			
16	Dilleniaceae	*Hibbertia silvestris*				
17	Euphorbiaceae	*Calycopeplus oligandrus*				
18	Euphorbiaceae	*Euphorbia peplus*	Petty Spurge	*		
19	Fabaceae	*Acacia alata*	Winged Wattle			
20	Fabaceae	*Hardenbergia comptoniana*	Native Wisteria			
21	Fabaceae	*Lotus angustissimus*	Narrowleaf Trefoil	*		
22	Fabaceae	*Medicago polymorpha*	Burr Medic	*		
23	Fabaceae	*Trifolium campestre*	Hop Clover	*		
24	Fabaceae	*Trifolium subterraneum*	Subterranean Clover	*		
25	Geraniaceae	*Erodium cicutarium*	Common Storksbill	*		
26	Geraniaceae	*Erodium moschatum*	Musky Crowfoot	*		
27	Geraniaceae	*Geranium dissectum*	Cutleaf Cranesbill	*		
28	Geraniaceae	*Geranium molle*	Dove's Foot Cranesbill	*		

	FAMILY_NAME	SPECIES	VERNACULAR	NATURALISED	DPP	WONS
29	Goodeniaceae	*Dampiera trigona*	Angled-stem Dampiera			
30	Iridaceae	*Gladiolus angustus*	Long Tubed Painted Lady	*		
31	Iridaceae	*Patersonia occidentalis*	Purple Flag			
32	Iridaceae	*Watsonia meriana* var. *bulbillifera*	Watsonia	*		
33	Juncaceae	*Juncus pallidus*	Pale Rush			
34	Moraceae	*Ficus carica*	Common Fig	*		
35	Moraceae	*Ficus macrophylla*	Moreton Bay fig	*		
36	Myrtaceae	*Agonis flexuosa*	Peppermint			
37	Myrtaceae	*Astartea scoparia*	Common Astartea			
38	Myrtaceae	*Corymbia calophylla*	Marri			
39	Myrtaceae	*Darwinia citriodora*	Lemon-scented Darwinia			
40	Myrtaceae	*Eucalyptus citriodora*	Lemon-scented Gum	*		
41	Myrtaceae	*Eucalyptus globulus*	Blue Gum	*		
42	Myrtaceae	*Eucalyptus marginata*	Jarrah			
43	Myrtaceae	*Eucalyptus patens*	Swan River Blackbutt			
44	Myrtaceae	*Eucalyptus rudis*	Flooded Gum			
45	Myrtaceae	*Melaleuca lateritia*	Robin Redbreast Bush			
46	Myrtaceae	*Melaleuca rhaphiophylla*	Swamp Paperbark			
47	Myrtaceae	*Melaleuca viminea*	Mohan			
48	Myrtaceae	*Taxandria linearifolia*				
49	Nyctaginaceae	*Bougainvillea glabra*	Lesser bougainvillea	*		
50	Oleaceae	*Fraxinus excelsior*	European Ash	*		
51	Oxalidaceae	*Oxalis exilis*				
52	Oxalidaceae	*Oxalis pes-caprae*	Soursob	*		
53	Oxalidaceae	*Oxalis purpurea*	Largeflower Wood Sorrel	*		
54	Phytolaccaceae	*Phytolacca octandra*	Red Ink Plant	*		
55	Pittosporaceae	*Cheiranthera parviflora*				
56	Plantaginaceae	*Veronica plebeia*	Creeping Speedwell			
57	Platanaceae	*Platanus ×hispanica*		*		
58	Poaceae	*Avena barbata*	Bearded Oat	*		
59	Poaceae	*Bambusa sp.*	Bamboo	*		

	FAMILY_NAME	SPECIES	VERNACULAR	NATURALISED	DPP	WONS
60	Poaceae	*Briza maxima*	Blowfly Grass	*		
61	Poaceae	*Briza minor*	Shivery Grass	*		
62	Poaceae	*Bromus diandrus*	Great Brome	*		
63	Poaceae	*Cenchrus clandestinus*	Kikuyu Grass	*		
64	Poaceae	*Ehrharta longiflora*	Annual Veldt Grass	*		
65	Poaceae	*Lolium perenne*	Perennial Ryegrass	*		
66	Poaceae	*Microlaena stipoides*	Weeping Grass			
67	Polygonaceae	*Rumex brownii*	Swamp Dock	*		
68	Polygonaceae	*Rumex conglomeratus*	Clustered Dock	*		
69	Polygonaceae	*Rumex pulcher*	Fiddle Dock	*		
70	Primulaceae	*Lysimachia arvensis*	Pimpernel	*		
71	Pteridaceae	*Adiantum aethiopicum*	Common Maidenhair			
72	Ranunculaceae	*Clematis pubescens*	Common Clematis			
73	Ranunculaceae	*Ranunculus muricatus*	Sharp Buttercup	*		
74	Restionaceae	*Empodisma gracillimum*				
75	Restionaceae	*Leptocarpus laxus*				
76	Rhamnaceae	*Trymalium odoratissimum*				
77	Rosaceae	*Rubus laudatus*		*	•	•
78	Rubiaceae	*Galium spurium*	False Cleavers	*	•	
79	Sapindaceae	*Acer negundo*	Boxelder Maple	*		•
80	Sapindaceae	*Dodonaea viscosa* subsp. *angustissima*	Hopbush			
81	Solanaceae	*Solanum linnaeanum*		*		
82	Violaceae	*Viola odorata*	Common Violet	*		
83	Zamiaceae	*Macrozamia riedlei*	Zamia			

Appendix 13. Dendrogram extracts.

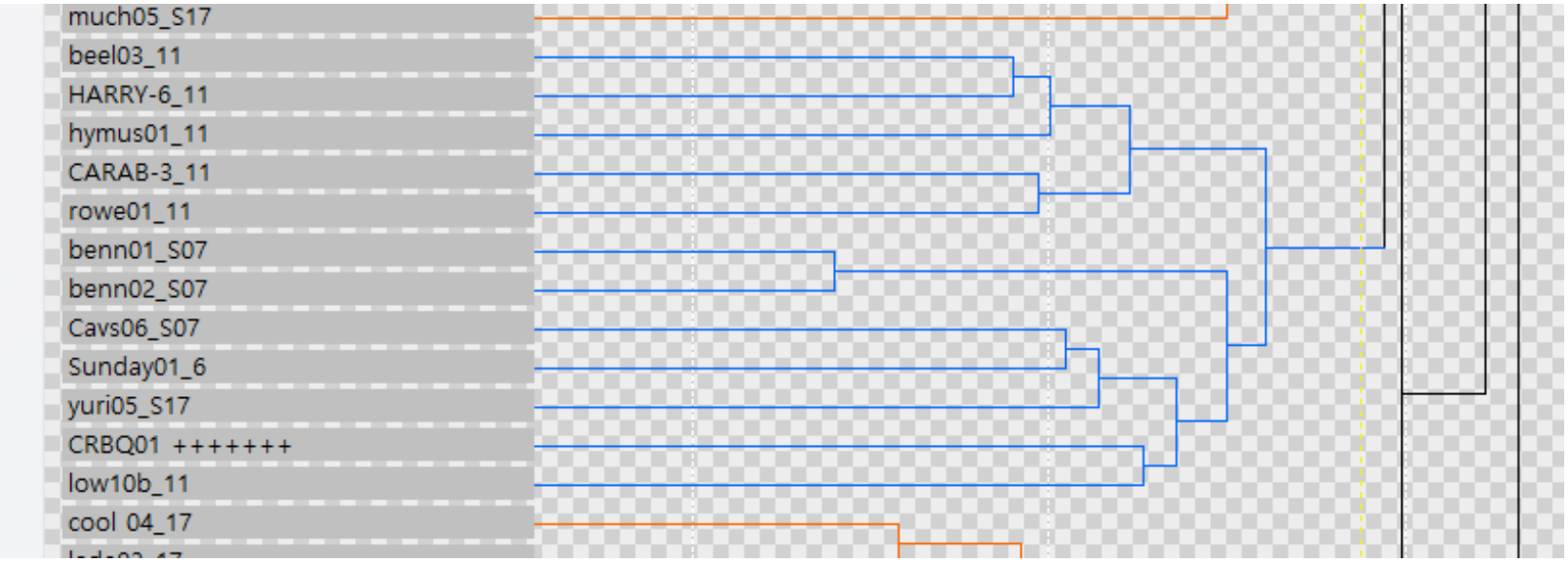
All quadrats



CRBQ01

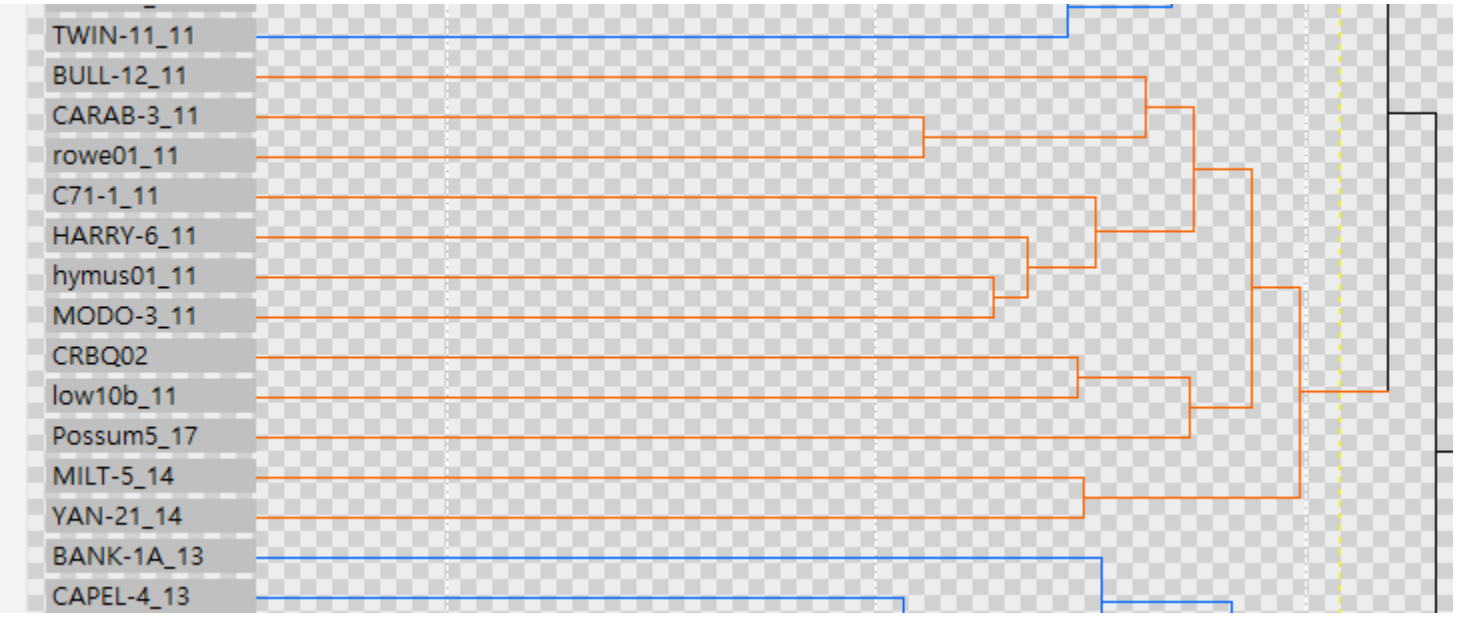
Single site insertion - Gibson et al 1994

Single site insertion – Keighery et al 2012

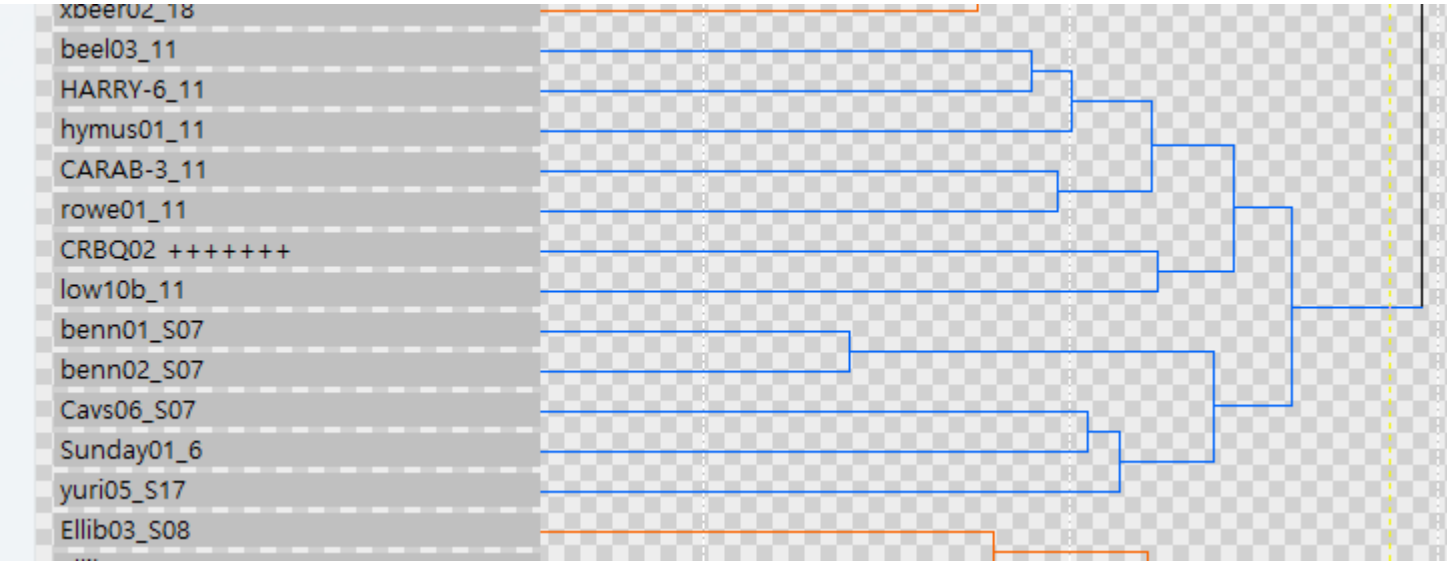


CRBQ02

Single site insertion - Gibson et al 1994

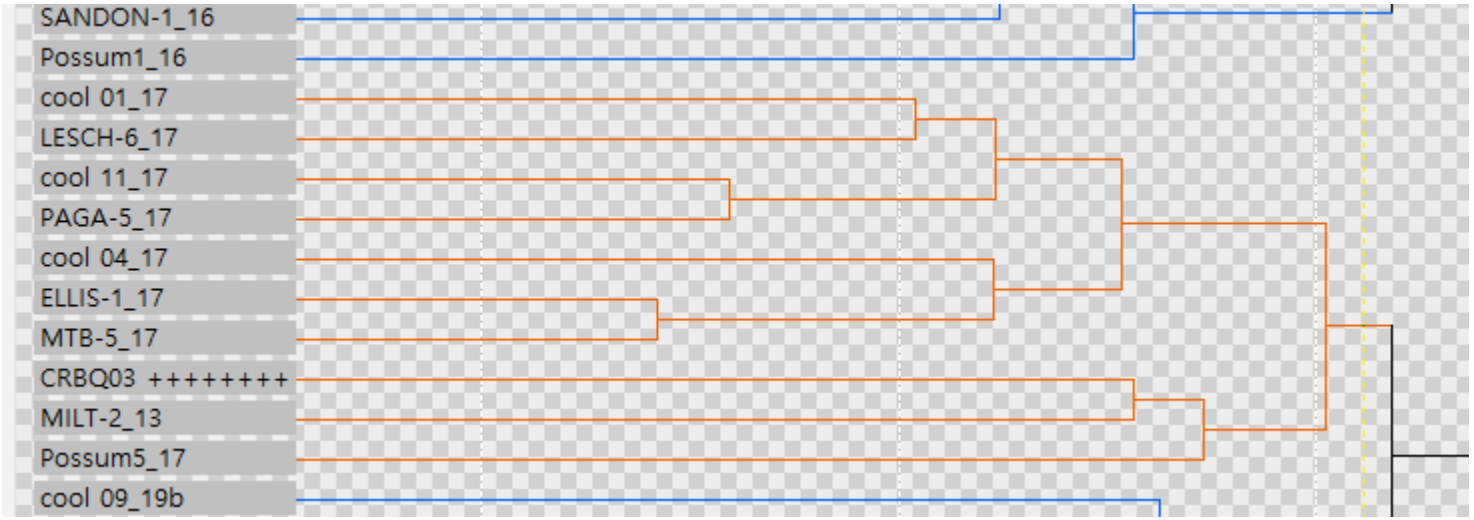


Single site insertion – Keighery et al 2012

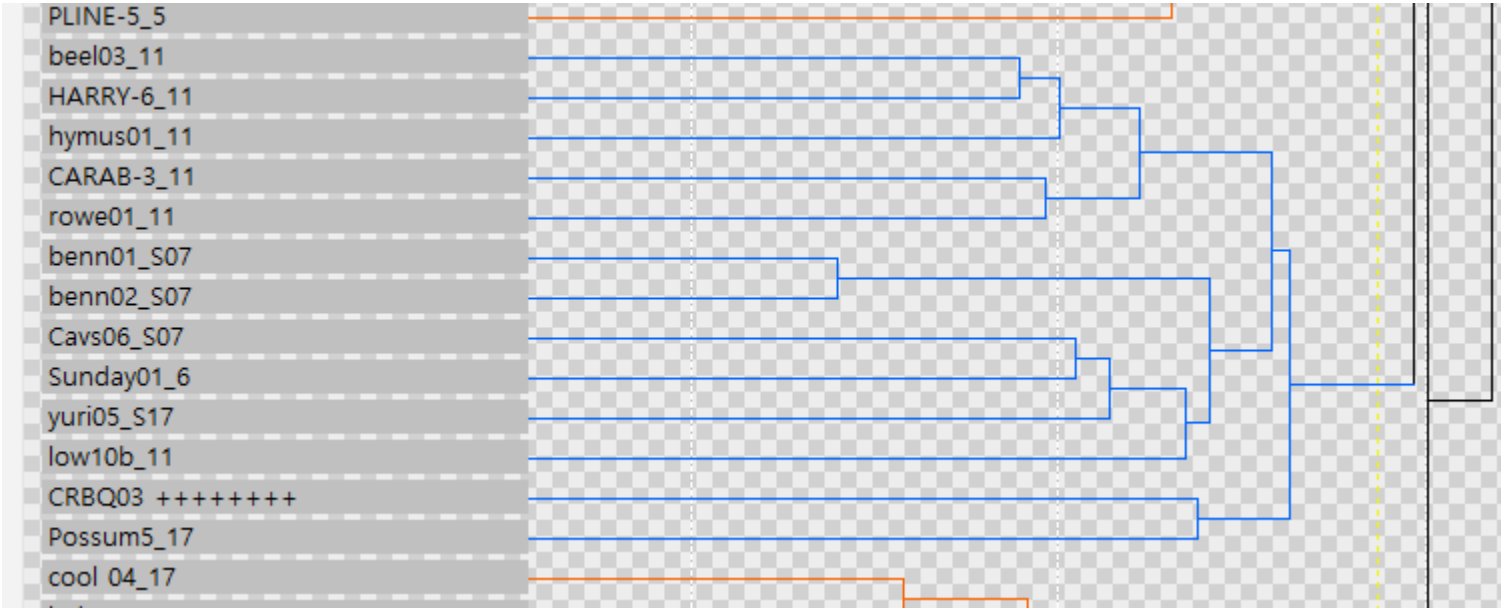


CRBQ03

Single site insertion - Gibson et al 1994

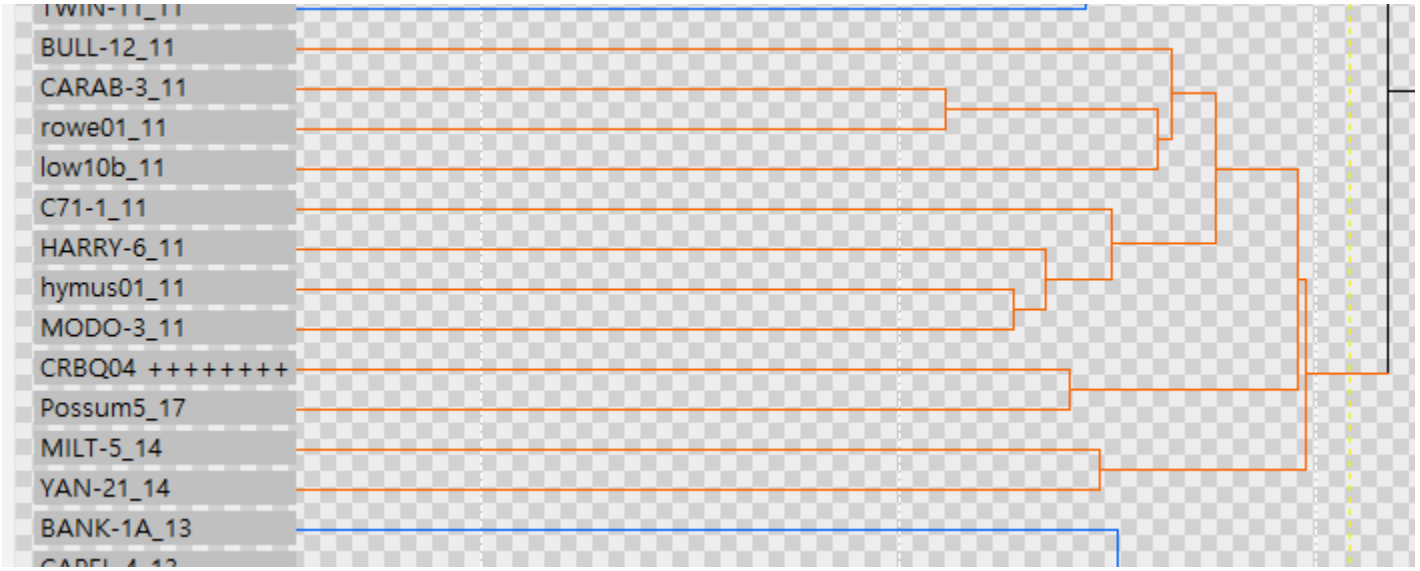


Single site insertion – Keighery et al 2012

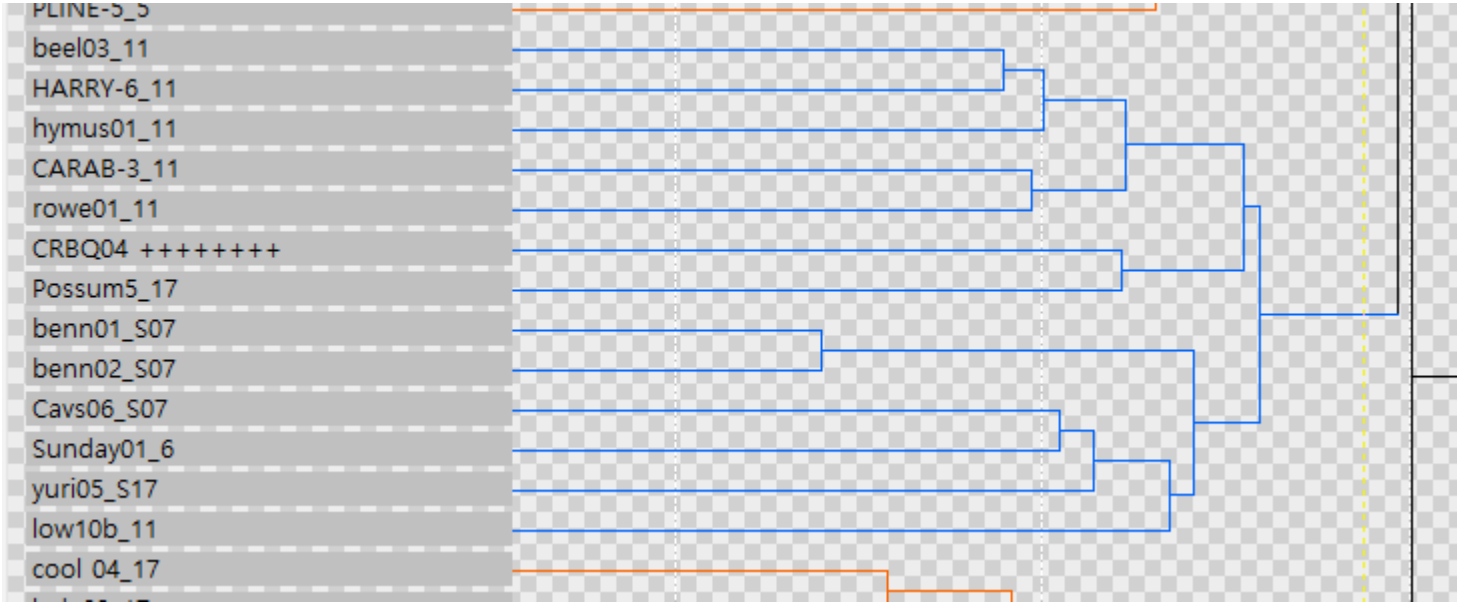


CRBQ04

Single site insertion - Gibson et al 1994

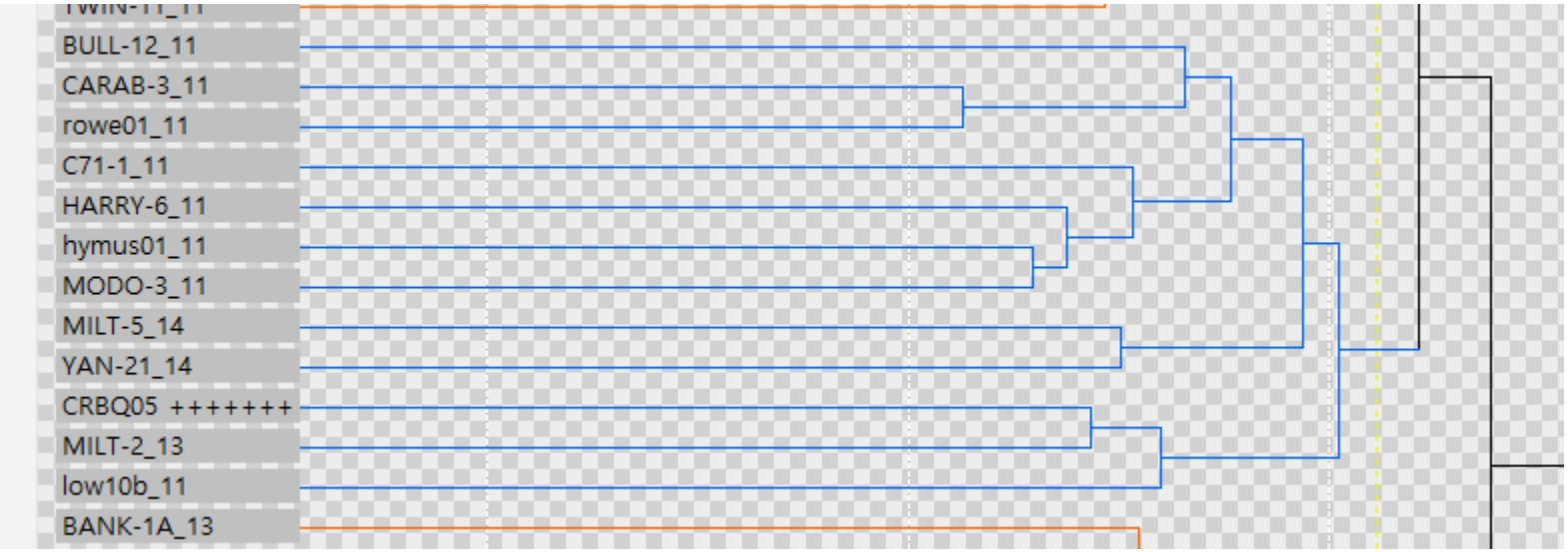


Single site insertion – Keighery et al 2012

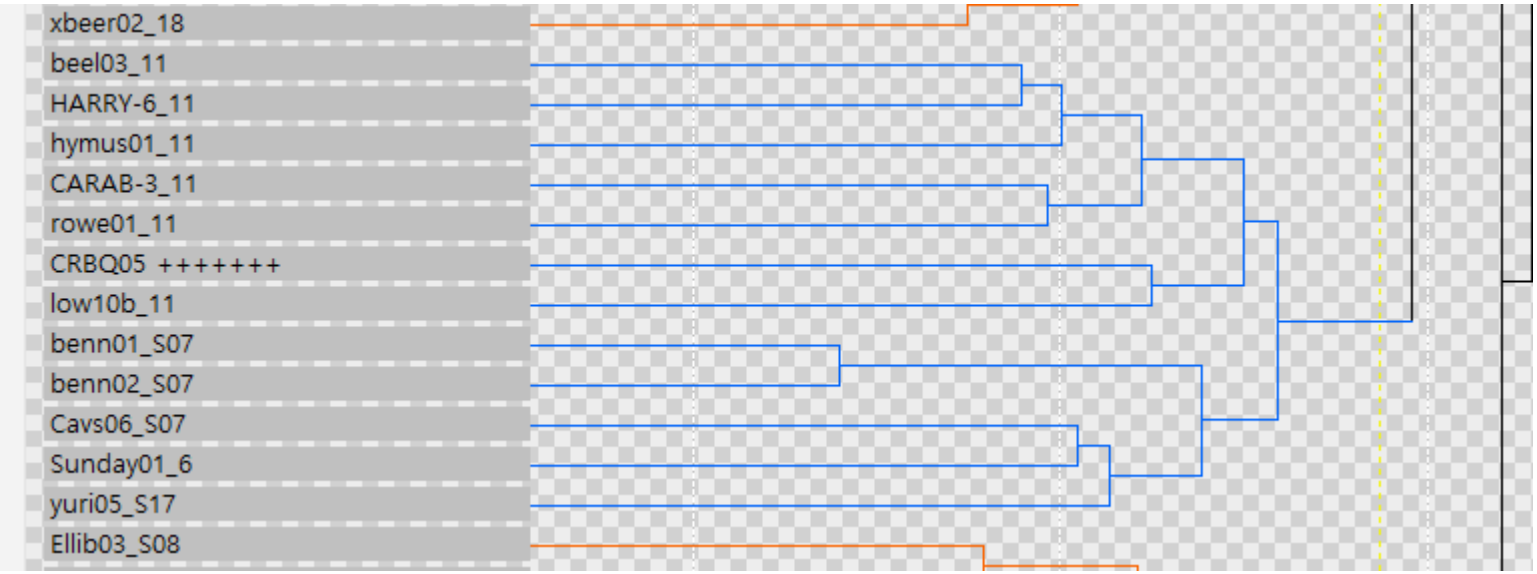


CRBQ05

Single site insertion - Gibson et al 1994

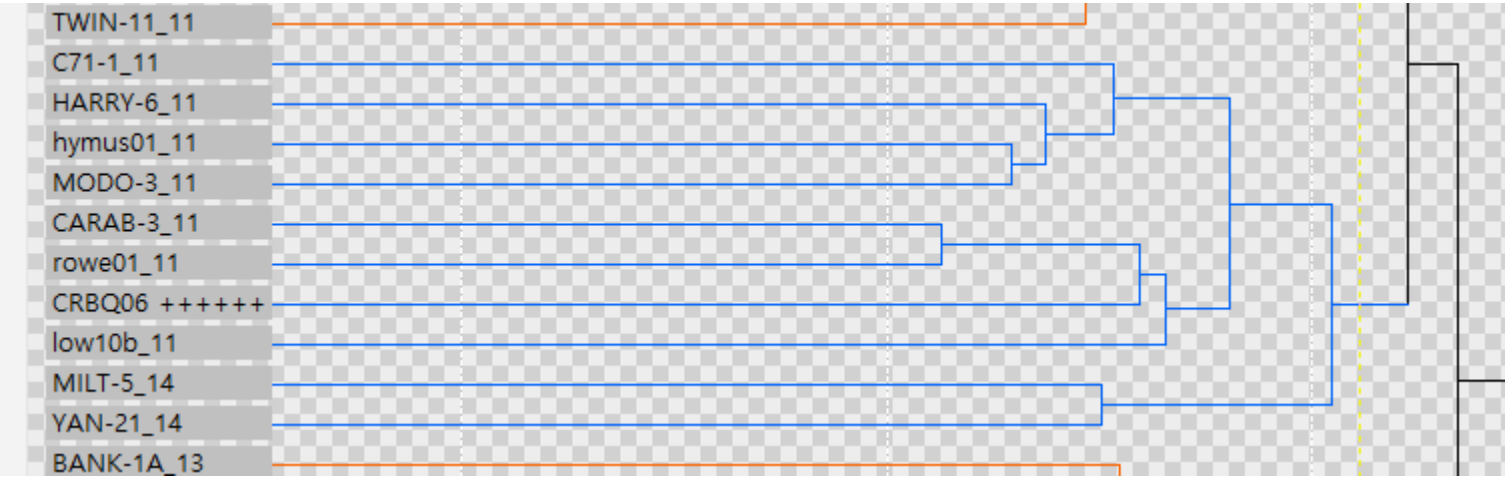


Single site insertion – Keighery et al 2012



CRBQ06

Single site insertion - Gibson et al 1994



Single site insertion – Keighery et al 2012