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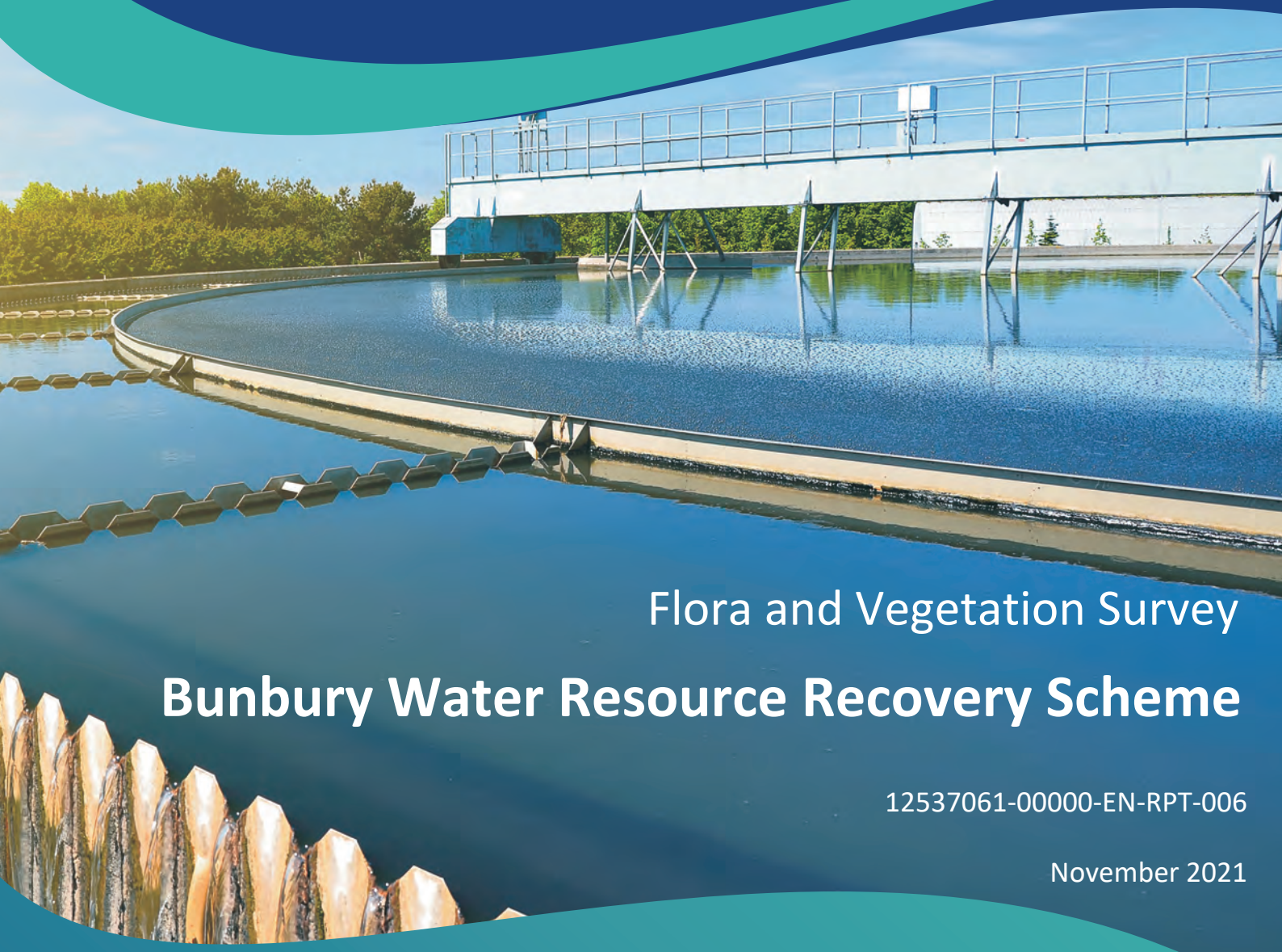

Flora and Vegetation Survey

Bunbury Water Resource Recovery Scheme

12537061-00000-EN-RPT-006

November 2021

Aqwest

Bunbury Water Resources Recovery Scheme
Flora and Vegetation Survey

November 2021

Executive summary

Aqwest is currently exploring the opportunity to provide recycled water for the irrigation of the existing open spaces (Hay Park, Hands Oval and Forrest Park) and for the construction water requirements of the Bunbury Outer Ring Road (BORR) project. The project consists of the following two stages:

- Stage 1: The irrigation of existing open spaces (Hay Park, Hands Oval and Forrest Park) with a direct supply of treated wastewater (TWW) from the Bunbury Wastewater Treatment Plant (WWTP). This option provides the benefit of allowing reallocation of existing groundwater use for drinking water purposes. This stage includes the construction of an additional water treatment plant adjacent to the existing Bunbury WWPT.
- Stage 2: The Bunbury Outer Ring Road (BORR) project is being delivered by Main Roads Western Australia (MRWA) and consists of 27 km section of highway connecting the existing Forrest Highway to Bussell Highway on the eastern outskirts of Bunbury. Road construction requires water for several key aspects including concrete production, earthworks and dust suppression.

The survey area covers the Stage 1 and 2 alignments and the additional treatment plant. The survey area runs from the Water Corporation's Bunbury WWTP in an easterly direction until intersecting with Parade Road. Stage 1 then runs north along Parade Road connecting Hay Park, Hands Oval and Forrest Park. Stage 2 runs east along Centenary Road until its termination when it reaches South Western Highway. The survey area is 63.97 ha in size. A primary two-phase detailed flora and vegetation survey was undertaken in spring and summer of 2020. Three smaller additional areas surveys were undertaken in 2021.

The results of the survey will inform the statutory environmental assessment and approvals process.

This report is subject to, and must be read in conjunction with, the limitations and assumptions contained throughout the report.

Key findings (Flora)

- 294 flora taxa (including subspecies and varieties) representing 67 families were recorded from the survey area during the field survey. This total comprised 229 native taxa and 65 introduced flora taxa
- No EPBC Act or BC Act listed flora were recorded from the survey area, or identified by the desktop as likely to occur. One DBCA Priority 4 listed flora species, *Caladenia speciose*, and two Priority 3 listed flora species*, Blennospora doliiformis* and *Lasiopetalum membranaceum* were recorded within the survey area.
  - *Caladenia speciose* - Tuberous, perennial, herb, 0.3-0.6 m high. White-pink flowers in Sep to Oct. Commonly found in white, grey or black sand.
  - *Blennospora doliiformis* - Erect annual, herb, up to 0.15 m high. Yellow flowers in Oct to Nov. Commonly found in grey or red clay soils over ironstone. Seasonally wet flats.
  - *Lasiopetalum membranaceum* - Multi-stemmed shrub, 0.2-1 m high. Pink-blue-purple flowers in Sep to Dec. Sand over limestone.

Key findings (Vegetation)

- The survey identified six primary vegetation units (vegetation units A-F). For some of these vegetation units, sub-units with minor variation were identified. The primary and sub-units identified are:
  - Sub-unit A1- *Agonis flexuosa* Low Open-woodland over *Acacia cochlearis, Alyxia buxifolia, Diplolaena dampieri* Low Open-scrub
  - Sub-unit A2- *Eucalyptus gomphocephala* Woodland over *Acacia cochlearis, Alyxia buxifolia, Diplolaena dampieri* Tall Open-scrub
  - Sub-unit A3- *Eucalyptus gomphocephala, Agonis flexuosa* open woodland over *Spyridium globulosum, Alyxia buxifolia, Acacia cochlearis* tall shrubland
  - Primary-unit B- *Eucalyptus gomphocephala* (*Eucalyptus marginata*) Tall Woodland over *Agonis flexuosa* Low Open-forest
  - Sub-unit C1- *Eucalyptus marginata, Banksia attenuata, Xylomelum occidentale* Woodland over *Kunzea glabrescens* Tall Shrubland
  - Sub-unit C2- *Corymbia calophylla* Open Forest over *Kunzea glabrescens* Tall Shrubland
  - Sub-unit C3- *Corymbia calophylla, Eucalyptus marginata* Open Forest over *Agonis flexuosa, Banksia attenuata*
  - Sub-unit D1- *Eucalyptus rudis* Tall Woodland over *Agonis flexuosa, Melaleuca rhaphiophylla* Low Open-forest/Woodland
  - Sub-unit D2- *Corymbia calophylla, Melaleuca preissiana, M. rhaphiophylla* (*Agonis flexuosa, Eucalyptus rudis*) Open Forest/Woodland
  - Sub-unit E1- *Hakea varia, Melaleuca viminea* Open-shrubland, with emergent *Melaleuca rhaphiophylla* and (scattered emergent *Eucalyptus rudis*)
  - Sub-unit E2- *Eucalyptus rudis, Melaleuca rhaphiophylla* Woodland over *Acacia saligna, Melaleuca viminea* Tall Open-shrubland
  - Primary-unit F- Scattered *Eucalyptus gomphocephala* and/or *Eucalyptus marginata* over introduced species
- Six conservation significant ecological communities were within the survey area. Some of these communities share an overlapping distribution and diagnostic criteria, but are assigned differing conservation status. These communities are:
  - Banksia Woodlands of the Swan Coastal Plain (EPBC Act – Endangered TEC)
  - Banksia dominated woodlands of the Swan Coastal Plain IBRA region (BC Act/DBCA – Priority 3 PEC
  - Clay pans of the Swan Coastal Plain (EPBC Act – Critically Endangered TEC)
  - Herb rich saline shrublands in clay pans (FCT07)/ Dense shrublands on clay flats (FCT09) (BC Act/DBCA–TEC Vulnerable)
  - Tuart (*Eucalyptus gomphocephala*) woodland and forests of the Swan Coastal Plain (EPBC Act – Critically Endangered TEC)
  - Tuart (*Eucalyptus gomphocephala*) woodlands of the Swan Coastal Plain (BC Act/DBCA– Priority 3 PEC)
  - Quindalup *Eucalyptus gomphocephala* and / or *Agonis flexuosa* woodlands (SCP30b) (BC Act/DBCA– Priority 3 PEC)
- The vegetation condition of the survey area ranged from Excellent to Completely Degraded. A high proportion of the survey area was cleared or showed high levels of disturbance, and were classified as Completely Degraded (36.61 ha (57.23%)).

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1. Introduction

1.1 Project background

Aqwest is exploring the opportunity to provide recycled water for the irrigation of the existing open spaces (Hay Park, Hands Oval and Forrest Park) and for the construction water requirements of the Bunbury Outer Ring Road (BORR) project. The project consists of the following two stages:

- Stage 1: The irrigation of existing open spaces (Hay Park, Hands Oval and Forrest Park) with a direct supply of treated wastewater (TWW) from the Bunbury WWTP. This option provides the benefit of allowing reallocation of existing groundwater use for drinking water purposes. This stage includes the construction of an additional water treatment plant adjacent to the existing Bunbury WWPT.
- Stage 2: The Bunbury Outer Ring Road (BORR) project is being delivered by Main Roads Western Australia (MRWA) and consists of 27 km section of highway connecting the existing Forrest Highway to Bussell Highway on the eastern outskirts of Bunbury. Road construction requires water for several key aspects including concrete production, earthworks and dust suppression.

This project is referred herein as the Bunbury Water Resources Recovery Scheme (WRRS).

1.2 Purpose of this report

The purpose of this study is to identify and record the flora and vegetation within the survey area in order to support environmental approvals.

The aim of the study was to:

- Identify, map and describe vegetation units
- Assess and map the condition of vegetation
- Identify and map the location of Threatened and Priority Ecological Communities
- Identify areas of high floristic value including those that provide habitat for conservation significant flora, wetland / riparian vegetation, vegetation units that are poorly represented and those with high diversity
- Compile a flora inventory
- Map the location of conservation significant species

1.3 Project location

1.3.1 Survey area

The survey area covers the Stage 1 and 2 alignments and the additional treatment plant. The survey area runs from the Water Corporation's Bunbury Wastewater Treatment Plant in an easterly direction until intersecting with Parade Road. Stage 1 then runs north along Parade Road connecting Hay Park, Hands Oval and Forrest Park. Stage 2 runs east along Centenary Road until its termination when it reaches South Western Highway. The survey area is 63.97 ha in size. A primary two-phase detailed flora and vegetation survey was undertaken in spring and summer of 2020. Three smaller additional areas surveys were undertaken in 2021. The extent of the primary and additional area surveys are mapped in Figure 1 (Appendix A).

1.3.2 Study Area

A study area was defined for the desktop-based searches for the assessment and includes a 10 km buffer of the survey area.

1.4 Scope of works

The scope of works was to undertake an assessment of the flora and vegetation values of the survey area. The following actions were completed to fulfil the scope:

A desktop review of publicly available information and relevant reports to determine the environmental values of the survey area.

A single season two phase detailed and targeted flora and vegetation to identify:

- Vegetation community types present, including presence of any Threatened or Priority Ecological Communities (TECs or PECs) or other significant vegetation
- Vegetation condition, including the location of any Weeds of National Significance (WONS) or Declared Weeds
- Flora species present including introduced species
- The presence or potential presence of any Threatened or Priority Flora

Preparation of a report (this document) that:

- Documents the results of the desktop assessment and field survey, including mapping
- Identifies and discusses potentially occurring significant flora and vegetation communities
- Provision of spatial files in GIS format.

In WA, some ecological communities, flora are protected under both Federal and State Government legislation. In addition, regulatory authorities also provide a range of guidance and information on expected standards and protocols for environmental surveys.

An overview of key legislation and guidelines, conservation codes and background information relevant to this biological survey is provided in Appendix B.

1.5 Limitations and assumptions

This report has been prepared by GHD for Aqwest and may only be used and relied on by Aqwest for the purpose agreed between GHD and Aqwest as set out in section 1.2 of this report.

GHD otherwise disclaims responsibility to any person other than Aqwest arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

The opinions, conclusions and any recommendations in this report are based on assumptions made by GHD described in this report. GHD disclaims liability arising from any of the assumptions being incorrect.

GHD has prepared this report on the basis of information provided by Aqwest and others who provided information to GHD (including Government authorities), which GHD has not independently verified or checked beyond the agreed scope of work. GHD does not accept liability in connection with such unverified information, including errors and omissions in the report which were caused by errors or omissions in that information.

The opinions, conclusions and any recommendations in this report are based on information obtained from, and testing undertaken at or in connection with, specific sample points. Site conditions at other parts of the site may be different from the site conditions found at the specific sample points.

Investigations undertaken in respect of this report are constrained by the particular site conditions, such as the location of infrastructure, services and vegetation, and access. As a result, not all relevant site features and conditions may have been identified in this report.

Site conditions may change after the date of this Report. GHD does not accept responsibility arising from, or in connection with, any change to the site conditions. GHD is also not responsible for updating this report if the site conditions change.

This report has assessed the flora and vegetation values within the survey area, as shown in Figure 1, Appendix A. Should the survey area change or be refined, further assessment may be required.

2. Methodology

2.1 Desktop assessment

Prior to the commencement of the field survey, a desktop assessment was undertaken to identify relevant environmental information pertaining to both the survey area and study area and to assist in survey design. The desktop assessment involved a review of:

- Department of Agriculture, Water and the Environment (DAWE) (previously the Department of the Environment and Energy (DoEE)) Protected Matters Search Tool (PMST) to identify communities and species listed under the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) potentially occurring within the study area (DAWE 2020a) (Appendix C)
- The Department of Biodiversity, Conservation and Attractions (DBCA) TEC and PEC database to determine the potential for significant ecological communities to be present within the study area (search reference 25092020)
- The DBCA NatureMap database for flora species previously recorded within the study area (DBCA 2007-2020)
- The DBCA Threatened (Declared Rare) and Priority Flora database (TPFL) and the WA Herbarium database (WAHERB) for Threatened flora species listed under the *Biodiversity Conservation Act 2016* (BC Act) (which replaced the *Wildlife Conservation Act 1950*) or listed as priority by DBCA, previously recorded within the study area (search reference 06-0920FL)
- Existing datasets including previous vegetation mapping of the survey area, aerial photography, geology/soils and hydrology information to provide background information on the variability of the environment, likely vegetation units and to identify areas with potential to contain TECs, PECs, and Threatened and Priority listed flora species
- Previous studies undertaken within or in close proximity to the survey area

2.2 Field survey

2.2.1 Flora and vegetation

Field surveys were undertaken by Ecoedge botanists Russell Smith (SL flora permit FB62000192) and Colin Spencer (SL flora permit FB62000169) and GHD botanist Andrew Fry (FB62000002). The surveys were undertaken across four events these being:

- Primary detailed survey phase in September and October 2020 (eight person days effort, Ecoedge)
- Follow up targeted survey in early December 2020 as part of primary detailed survey of wetland/claypan habitats to sample late flowering species and target late flowering orchids such as *Diuris drummondii* (two person days effort, Ecoedge)
- An additional area survey immediately adjacent to the detailed survey area, to extend and validate vegetation unit mapping. The area was located at the western end of the survey area in coastal dunes adjacent to the WWTP and comprised 0.99 ha. This was undertaken in March 2021 (one person day effort, Ecoedge).
- An additional area survey adjacent to the detailed survey area, following the WWTP access road and Mosedale Rd. This route was introduced as an option in order to maximise

usage of existing roads and verges and comprised 7.61 ha. This was undertaken on 9 April 2021 (one person day effort, GHD).

- An additional area survey immediately adjacent to the detailed survey area, to extend and validate vegetation unit mapping. The area was located at the western end of the survey area in coastal dunes adjacent to the WWTP and comprised 1.74 ha. This was undertaken on 22 April 2021 (one person day effort, Ecoedge).

The field survey was undertaken to identify and describe the dominant vegetation units, assess vegetation condition, and identify and record vascular flora taxa present at the time of survey. Searches for conservation significant or other significant ecological communities and flora taxa were also undertaken during the field survey. Information on species present, vegetation structure and condition were collected at 89 relevés, and 17 floristic quadrats

The survey methodology was undertaken with reference to the Environmental Protection Authority (EPA) *Technical Guidance – Flora and Vegetation Surveys for Environmental Impact Assessment* (EPA 2016a).

Data collection

Information on species present, vegetation structure and condition were collected at 89 recording sites, or relevés, and 17 floristic quadrats (Figure 9, Appendix A). Quadrat and flora data are provided in Appendix D.

Quadrats (measuring 10 m x 10 m) were located within each identified vegetation unit. A minimum of three quadrats were located within each identified vegetation unit in better than degraded condition.

Flora species not identified in the field were collected or photographed for later identification. Taxonomy and conservation status of flora species was checked against Parks and Wildlife Service databases (DBCA 2020a).

Field data at each quadrat were recorded on a pro-forma data sheet and included the parameters detailed in Table 1.

Table 1 Data collected during the field survey

Aspect	Measurement
Collection attributes	Site code, personnel/recorder; date, quadrat dimensions, photograph of the quadrat.
Physical features	Aspect, slope, landform, soil attributes, ground surface cover, leaf and wood litter.
Location	Coordinates recorded in GDA94 datum using a hand-held GPS tool to accuracy approximately ± 5 m.
Vegetation condition	Vegetation condition was assessed using the condition rating scale adapted by EPA (2016a) for the South West Botanical Province.
Disturbance	Level and nature of disturbances (e.g. weed presence, fire and time since last fire, impacts from grazing, exploration activities).
Flora	List of dominant flora from each structural layer. List of all species within the quadrat including average height and cover (using NVIS)

A flora inventory was compiled from taxa listed in described relevés and quadrats and from opportunistic floristic records throughout the survey area and across all survey events.

Vegetation units

Vegetation units were identified and boundaries delineated using a combination of aerial photography, topographical features and field data/observations. Vegetation units were

described based on structure, dominant taxa and cover characteristics as defined by quadrat data and field observations. Vegetation unit descriptions follow NVIS and are consistent with NVIS Level V (Association) (NVIS Technical Working Group 2017).

Statistical analysis

The floristic quadrat data from the survey area were subject to MVA (multivariate analysis) using the software PATN (Belbin, 2003) to determine the relationship of the vegetation units described and mapped within the survey area to the floristic community types derived for the Swan Coastal Plain by Gibson et al. (1994).

A matrix showing the species in each quadrat for the Survey Area is presented as a site by species matrix in Appendix D.

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

Firstly, an MVA using just the 17 quadrats installed in the Survey Area was conducted to examine floristic variation and relationships, see Appendix E.

Secondly, data from all relevant quadrats from the Southern Swan Coastal Plain (SCP) survey dataset (Gibson et al., 1994) were used in the MVA after taxonomic updating was complete. Taxonomic updating of the 25-year-old SCP data was required as many taxonomic changes have taken place since the original survey was carried out (e.g. Dryandra to Banksia, *Eucalyptus calophylla* to *Corymbia calophylla*, etc.). In addition, there is some uncertainty about the identification of such species as *Thysanotus manglesianus* and *T. patersonii*, where many Swan Coastal Plain specimens have intermediate characteristics between the two. In such cases terms such as '*Thysanotus manglesianus/patersonii* complex' were used. In addition, "singletons" (flora taxa recorded at only one site) were excluded. Due to the properties of the Bray-Curtis coefficient, singletons are seen as 'indicators' for grouping and therefore sway results.

For the quadrats from the Gibson et al. (1994) report, the assigned FCT code was affixed to the quadrat name to facilitate understanding the MVA outputs.

Mapping

Derivation and mapping of vegetation units was based mainly on the results of the MVA of Aqwest quadrats, supplemented by data from the relevés. Seven primary vegetation units were recognized (units A-F, plus unit P for cleared and completely degraded areas). Four of these were divided into sub-units and mapped as such.

Additional mapping has been included in Revision 1 of the report for project area gaps outside the survey area. Vegetation types and condition, within the project area gaps, has been extrapolated based on the existing site survey (survey track logs outside the survey area) and aerial photography to update mapping.

Vegetation condition

The vegetation condition was assessed and mapped in accordance with the vegetation condition rating scale for the South West and Interzone Botanical Provinces of Western Australia (EPA 2016a). The scale recognises the intactness of vegetation and consists of six rating levels. The vegetation condition rating scale is located in Appendix B.

Conservation significant flora

Prior to the field survey, information obtained from the desktop assessments (e.g. EPBC Act PMST, *NatureMap* and DBCA database search results) was reviewed to determine conservation significant flora taxa potentially present within the survey area. Targeted searches for conservation significant flora based on desktop assessments and habitat availability was undertaken throughout the survey area. For areas identified as potentially suitable habitat for threatened species (e.g. *Diuris drummondii, Caladenia huegelii, Austrostipa jacobsiana*) surveyors increased the intensity of surveys, covering the corridor in an approximately 10 m spaced zig zag or parallel traverse. Microhabitats including wetland transitions, open spaces in dense native vegetation and claypans received additional survey effort. In addition to the primary spring survey phase a targeted follow up early summer survey was undertaken in areas identified as potentially suitable habitat to target wetlands and late flowering species.

Flora identification and nomenclature

Species well known to the survey botanist were identified in the field. All other species were collected and assigned a unique collection number to facilitate tracking. Specimens collected during the field assessment were dried and processed in accordance with the requirements of the WA Herbarium. Species were identified by the use of taxonomic literature, electronic keys and online electronic databases.

The conservation status of all recorded flora was compared against the current lists available on *FloraBase* (WA Herbarium 1998–2020) and the EPBC Act Threatened species database provided by DAWE (2020b). Nomenclature used in this report follows that used by the WA Herbarium as reported on *FloraBase* (WA Herbarium 1998–2020).

Targeted surveys for Threatened and Priority Ecological Communities (TEC/PEC)

Targeted surveys for the presence of TECs and PECs were undertaken by identifying vegetation units and delineating boundaries using a combination of aerial photography, topographical features, field data/observations and statistical analyses (multivariate analyses). Vegetation units were described based on structure, dominant species and cover characteristics as defined by quadrat data and field observations. For communities with size, condition and connectivity conditions (e.g Banksia Woodlands of the Swan Coastal Plain TEC) condition assessment points, patch size measurements and connectivity to surrounding vegetation was assessed.

2.3 Limitations

2.3.1 Desktop limitations

Desktop investigations use a variety of online resources such as the WA Museum and DBCA NatureMap database (DBCA 2007-2020), and the EPBC Act PMST (DAWE 2020a). The EPBC Act PMST is based on bioclimatic modelling for the potential presence of species. As such, this does not represent actual records of the species within the area. The records from the DBCA searches of threatened flora provide more accurate information for the general area. However, some records of collections cannot be dated and often misrepresent the current range of threatened species, therefore when undertaking desktop assessment flora database records need to be interrogated.

2.3.2 Field survey limitations

The EPA (2016a) Technical Guide states flora survey reports for environmental impact assessment in WA should contain a section describing the limitations of the survey methods used. The limitations and constraints associated with this field survey are discussed in Table 2.

Table 2 Field survey limitations

Aspect	Constraint	Comment
Sources of information and availability of contextual information	Nil	Adequate information is available for the survey area. This information includes: • Broad scale (1:250,000) mapping by Beard (1979) and digitised by Shepherd et al. (2002) • Vegetation mapping by Heddle et al. 1980 and • Webb (DBCA) (2016).
Scope (what life forms were sampled etc.)	Nil	Vascular flora were sampled during the survey. Non-vascular flora were not surveyed.
Proportion of flora collected and identified (based on sampling, timing and intensity)	Minor	The primary detailed and targeted vegetation and flora surveys were undertaken as a two-phase survey in a single year. The major phase was undertaken during the primary spring survey season, with surveys undertaken in September and early October. The second phase was undertaken in early summer (December). The additional areas surveys were undertaken outside of the primary spring survey season. Due to these additional areas being small in extent, occurring adjacent to areas covered in the primary survey and not containing any previously undescribed vegetation types or landscape elements, it is not considered that this seasonality of survey poses a major constraint to the proportion of flora collected. A total of 13 person days was spent across the phases of survey covering 27.52 ha of remnant vegetation. The flora recorded from the field survey is detailed in section 4 and a full flora species list is provided in Appendix D. The portion of flora collected and identified was considered high, based on the condition and diversity of the survey area, survey effort and timing of multiple survey phases. For some vegetation units, in particular wetland units D-E it was not possible to place three or more quadrats in vegetation in Good or Better condition. This is due to the restricted extent of the unit present in the area and the degraded condition of those units. This is not considered to pose a major constraint to the adequacy of the surveys.
Completeness and further work which might be needed (e.g. was the relevant area fully surveyed)	Minor	The survey area was adequately surveyed during the field survey in line with the scope. Some small sections of private properties were not accessed, however, these areas were cleared or contained scattered trees (parkland cleared) that could be assessed from adjacent areas. Information gained from the survey was extrapolated across those sections of the survey area not accessed on foot during the field survey to assist with determining the vegetation units and condition. The context area was assessed based on extrapolated survey area and aerial imagery interpretation. Due to the seasonality of survey for the additional areas, some species such as orchids could not be included in targeted searches. If clearing is proposed in areas of potentially suitable habitat for

Aspect	Constraint	Comment
		conservation significant species further targeted searches may be required during a suitable season.
Mapping reliability	Nil	The vegetation units were mapped using high-resolution ESRI aerial imagery obtained from Landgate, topographical features, previous broad scale mapping (Beard 1979) and field data. Data were recorded in the field using hand-held GPS tools (e.g. Samsung tablet and Garmin GPS).
Timing/weather/season/cycle	Minor	The primary field survey was undertaken in spring and summer 2020. This timing of the flora and vegetation survey is considered the optimal season to complete flora and vegetation surveys on the Swan Coastal Plain. Rainfall recorded in the three months prior to survey was 346 mm compared to a long-term average of 394 mm (BoM 2020).. The additional areas surveys were undertaken outside of the primary spring survey season. Due to these additional areas being small in extent, occurring adjacent to areas covered in the primary survey and not containing any previously undescribed vegetation types or landscape elements, it is not considered that this seasonality of survey poses a major constraint to the proportion of flora collected or vegetation type mapping.
Disturbances (e.g. fire, flood, accidental human intervention)	Nil	Parts of the survey area have been subject to historical disturbances such as clearing and weeds. These disturbances did not impact the survey.
Resources	Nil	Adequate resources were employed during the field surveys. 13 person days were spent undertaking the surveys.
Access restrictions	Nil	The survey area was accessed on foot and traversed by vehicle. Some small sections of private properties were not accessed, however, these areas were cleared or contained scattered trees (parkland cleared) that could be assessed from adjacent areas
Experience levels	Nil	The ecologist and botanists who executed the survey are suitably qualified and experienced in the field with eight to 20 years experience undertaking flora surveys in the bioregion

3. Desktop Assessment

3.1 Climate

The Bunbury area experiences a Mediterranean climate and is characterised by warm, dry summers and cool, wet winters. Rainfall is largely received during the winter months as a result of cold fronts that regularly cross the South West coast. The closest BoM weather station is Bunbury (site number 009965) (BoM 2020). Climate statistics for the Bunbury weather station have been presented in Plate 1.

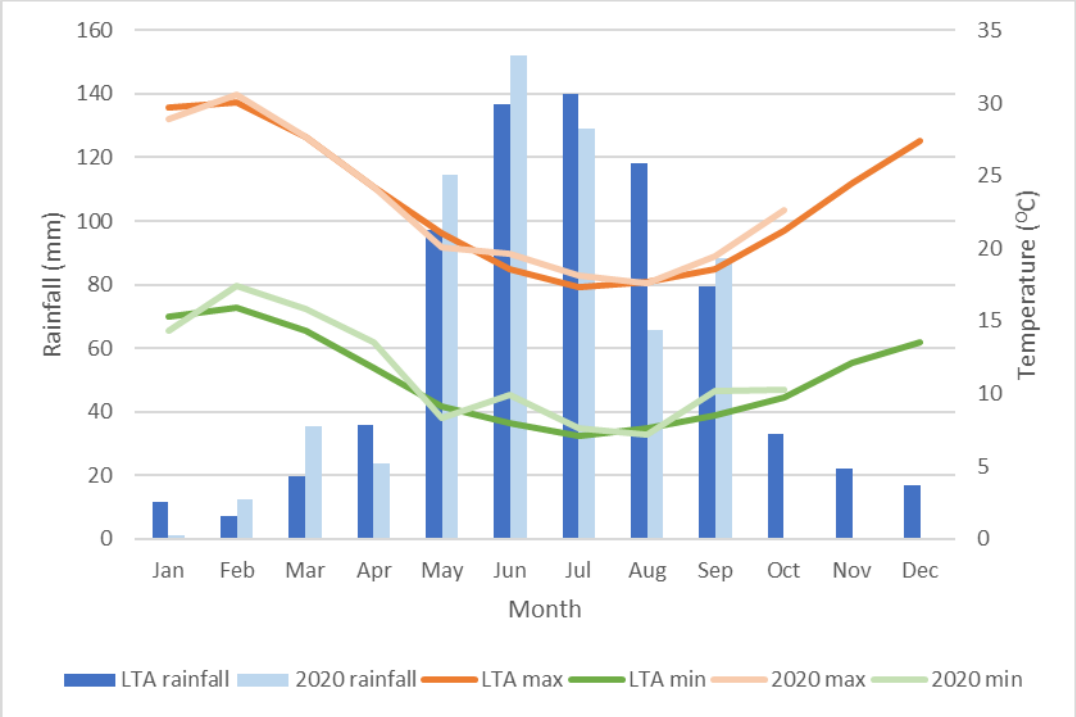

Plate 1 Climate statistics for Bunbury Weather Station (No. 9965) Annual and 2020

Note: Annual climate statistics are from November 1995 to current.

3.2 Province

The study area is located in the South West Botanical Province of WA (Beard 1990), which falls within the Swan Coastal Plain Bioregion and Perth (SWA2) subregion as described by the Interim Biogeographic Region of Australia (IBRA) (DAWE 2020b).

The Perth subregion is composed of colluvial and aeolian sands, alluvial river flats and coastal limestone. Heath and/or Tuart woodlands occur on limestone, Banksia and Jarrah-Banksia woodlands on Quaternary marine dunes of various ages and Marri on colluvial and alluvial soils. The subregion also includes a complex series of seasonal wetlands (Mitchell *et al.* 2002).

3.3 Landforms and soils

The Swan Coastal Plain is comprised of five major geomorphological units, which lie approximately parallel to the coast, being the Quindalup, Spearwood and Bassendean Dunes, the Pinjarra Plain and Ridge Hill Shelf (McArthur and Bettenay 1960). The Department of Primary Industries and Regional Development soil-landscape mapping of the South West of WA (DPIRD, 2020) provides soil and landform data compiled from various sources. This mapping identifies four different soil zones within the survey area (Figure 6).

The survey area lies within the Bassendean Dune, Pinjarra Plain, Quindalup South System, and Spearwood System elements, which are broadly described as:

- Bassendean dune and sandplain system: Pleistocene sand dunes with very low relief, leached grey siliceous sand intervening sandy and clayey swamps and gently undulating plains. These occur immediately west of, and partly overlie, the Pinjarra Plain. Topography becomes more subdued from west to east.
- Pinjarra Plain: Broad low relief plain west of the foothills, comprising predominantly Pleistocene fluvial sediments and some Holocene alluvium associated with major current drainage systems. Major soils are naturally poorly drained with many swamps.
- Quindalup Dune system: Unconsolidated Holocene sand west of the Spearwood Dunes. The major formations are low relief complex parabolic dunes fronted by foredunes with moderately inclined to steep slopes. The soils are well to rapidly drained, uniform pale calcareous sands.
- Spearwood dune and sandplain system: Gently to moderately inclined low hills and gently undulating plain located west of the Bassendean System associated with Pleistocene, Tamala Limestone. Hills consist of a core of friable aeolianite, capped by secondary calcite and overlain by variable depths of well to rapidly drained siliceous yellow-brown sands. The gently undulating plain is the surface expression of the consolidated marine limestone component of the Tamala Limestone.

3.4 Hydrology

3.4.1 Watercourses

There are no natural drainage lines intersecting the survey area. Large parts of the survey area have been extensively modified for agricultural drainage and for construction of surrounding roads. An artificial drainage line, the 5 Mile Brook, runs parallel to the survey area, along Parade Road. The Preston River is 700 m east of the most eastern extent of the survey area.

3.4.2 Wetlands

Sections of the survey area occur within a low-lying palusplain, which is seasonally inundated or has a high-water table during winter. The EPBC Act PMST did not identify any wetlands of international importance (Ramsar wetland) or Nationally Important Wetlands within a 5 km buffer of the survey area.

The Geomorphic Wetlands Swan Coastal Plain dataset (Department of Biodiversity, Conservation and Attractions 2019) identified seven wetlands occurring within the survey area (Table 3 and Figure 3, Appendix A).

Table 3 Geomorphic Wetlands

Geomorphic Wetland ID	Management Category	Wetland Type
ID 14471	Multiple Use	Sumpland
ID 1104	Multiple Use	Dampland
ID 15492	Multiple Use	Palusplain
ID 1249	Multiple Use	Dampland
ID 1105	Multiple Use	Palusplain
ID 15500	Multiple Use	Dampland
ID 15450	Multiple Use	Palusplain

3.5 Land use

3.5.1 Conservation reserves and estates

The western portion of the survey area between the wastewater treatment plant and Parade Road as well as the northern edge of the Centenary Road alignment falls within the recently proclaimed Kalgulup Regional Park. These portions are also zoned Regional Open Space under the Bunbury Greater Regional Scheme. The survey area does not intersect with any DBCA legislated lands or proclaimed conservation reserves.

3.5.2 Environmentally Sensitive Areas

The northern extent of the survey area in the vicinity of Hay Park intersects an Environmentally Sensitive Area (ESAs) which appears to be associated with the conservation class wetland (ID 15492) and TEC located to the east of Hay Park. (Figure 2, Appendix A).

3.6 Flora and Vegetation

3.6.1 Broad vegetation mapping and extents

Broad scale (1:250,000) pre-European vegetation mapping of the area has been completed by Beard (1979) at an association level. The survey area intersects the —

- Bassendean (association 1000) - Medium forest; Jarrah-Marri/Low woodland; Banksia/Low forest; Teatree (*Melaleuca* spp.) vegetation association.
- Spearwood (association 6) - Jarrah, Marri and Wandoo. *Eucalyptus marginata*, *Corymbia calophylla*, *E. wandoo* association.
- Spearwood (association 3) - Mainly Jarrah and Marri. *Eucalyptus marginata*, *Corymbia calophylla*, *E. wandoo* association.
- Bassendean (association 998) - Jarrah, Marri and Wandoo. *Eucalyptus marginata*, *Corymbia calophylla*, *E. wandoo* association.
- Bassendean (association 37) - Wattle, Casuarina and teatree Acacia-Allocasuarina Melaleuca alliance.

The pre-European mapping has been adapted and digitised by Shepherd *et al*. (2002). The extent of the vegetation associations has been determined by the state-wide vegetation remaining extent calculations maintained by the DBCA (latest update March 2019 – GoWA 2019a). As shown in Table 4, the current extents of vegetation associations 3, 6 and 1000 are less than 30 % of their pre-European extent at the IBRA Bioregion and IBRA subregion levels. Current extents of vegetation association 37 are less than 5% of their pre-European extent at the LGA level.

Table 4 Extents of vegetation associations mapped within the survey area (GoWA 2019a)

Vegetation Association	Scale	Pre-European extent (ha)	Current extent (ha)	Remaining extent (%)	Current extent remaining within all DBCA managed land (%)
Swan Coastal Plain IBRA Bioregion		1,501,221.93	579,813.47	38.62	38.45
3	State: WA	2,661,404.62	1,803,437.48	39.35	23.00
	IBRA Bioregion: Swan Coastal Plain	17,364.58	3,150.77	18.14	11.62
	Sub-region: Perth	16,754.96	2,789.47	16.65	13.12
	LGA: City of Bunbury	859.72	275.38	32.03	0.01
37	State: WA	39,296.52	24,727.17	62.92	20.92
	IBRA Bioregion: Swan Coastal Plain	15,617.85	5,404.74	34.61	40.96
	Sub-region: Perth	14,018.45	4,784.19	34.13	44.87
	LGA: City of Bunbury	693.97	20.59	2.97	
998	State: WA	51,015.33	18,492.63	36.25	48.68
	IBRA Bioregion: Swan Coastal Plain	50,867.50	18,492.32	36.35	48.68
	Sub-region: Perth	50,867.50	18,492.32	36.35	48.68
	LGA: City of Bunbury	1,405.24	150.28	10.69	
6	State: WA	56,343.01	13,362.25	23.72	39.83
	IBRA Bioregion:	56,343.01	13,362.25	23.72	39.83

Vegetation Association	Scale	Pre-European extent (ha)	Current extent (ha)	Remaining extent (%)	Current extent remaining within all DBCA managed land (%)
	Swan Coastal Plain				
	Sub-region: Perth	56,343.01	13,362.25	23.72	39.83
	LGA: City of Bunbury	712.97	281.18	39.44	
1000	State: WA	99,835.86	27,768.84	27.81	18.64
	IBRA Bioregion: Swan Coastal Plain	94,175.31	24,869.20	26.41	19.18
	Sub-region: Perth	94,175.31	24,869.20	26.41	19.18
	LGA: City of Bunbury	2,171.67	621.00	28.60	2.12

Regional vegetation for the Swan Coastal Plain (at vegetation complex level) was mapped by Heddle *et al*. (1980). Pre European vegetation complexes intersecting the survey area are shown in Figure 7, Appendix A. The mapping indicates that five vegetation complexes are present within the survey area:

- Southern River Complex – Open woodland of *Corymbia calophylla* (Marri) – *Eucalyptus marginata* (Jarrah) – *Banksia* species on elevated areas and a fringing woodland of *Eucalyptus rudis* (Flooded Gum) – *Melaleuca rhaphiophylla* (Swamp Paperbark) along streams. South of the Murray River *Agonis flexuosa* (Peppermint) occurs in association with the Flooded Gum and Swamp Paperbark.
- Quindalup Complex: Coastal dune complex consisting mainly of two alliances – the strand and fore-dune alliance and the mobile and stable dune alliance. Local variations include the low closed forest of *Melaleuca lanceolata* (Rottnest Teatree) – *Callitris preissii* (Rottnest Island Pine), the closed scrub of *Acacia rostellifera* (Summer-scented Wattle) and the low closed *Agonis flexuosa* (Peppermint) forest of Geographe Bay
- Vasse Complex: Mixture of the closed scrub of Melaleuca species fringing woodland of *Eucalyptus rudis* (Flooded Gum) – Melaleuca species and open forest of *Eucalyptus gomphocephala* (Tuart) – *Eucalyptus marginata* (Jarrah) – *Corymbia calophylla* (Marri). Will include areas dominated by *Tecticornia* and *Sarcocornia* species (Samphire) near Mandurah and south of the Capel River
- Yoongarillup Complex: Woodland to tall woodland of *Eucalyptus gomphocephala* (Tuart) with *Agonis flexuosa* in the second storey. Less consistently an open forest of *Eucalyptus gomphocephala* (Tuart) – *Eucalyptus marginata* (Jarrah) – *Corymbia calophylla* (Marri).

South of Bunbury is characterised by *Eucalyptus rudis* (Flooded Gum) – *Melaleuca* species open forests

- Karrakatta Complex – Central and South: Predominantly open forest of *Eucalyptus gomphocephala* (Tuart) – *Eucalyptus marginata* (Jarrah) – *Corymbia calophylla* (Marri) and woodland of *Eucalyptus marginata* (Jarrah) – Banksia species. *Agonis flexuosa* (Peppermint) is co-dominant south of the Capel River

GoWA (2018b) has assessed the vegetation complexes against presumed pre-European extents within the SWA IBRA Bioregion (Table 5) and LGA levels (Table 6). The current extents of the Southern River Complex and Karrakatta Complex-Central and South vegetation complexes occurring within the survey area are less than 30% of the pre-European distribution within the SWA IBRA Bioregion and LGAs. The current extent of the Vasse Complex is less than 10% of the pre-European distribution within the LGA.

Table 5 Extent of vegetation complexes on the Swan Coastal Plain mapped within the survey area (GoWA 2019b)

Vegetation complex	Pre-European extent (ha)	Current extent (ha)	Remaining extent (%)	Current extent remaining within all DBCA managed land (%)
Southern River Complex	58,781.48	10,828.04	18.42	1.59
Quindalup Complex	54,573.87	33,011.64	60.49	10.98
Karrakatta Complex-Central and South	53,080.99	12,467.20	23.49	8.07
Vasse Complex	15,691.63	4,926.97	31.40	14.62
Yoongarillup Complex	27,977.93	10,018.14	35.81	18.41

Table 6 Extent of vegetation complexes within Local Government Areas mapped within the survey area (GoWA 2019c)

Vegetation complex	LGA	Pre-European extent (ha)	Current extent (ha	Remaining extent (%)	Proportion of the vegetation complex within the LGA (%)
Southern River Complex	City Bunbury	2,205.16	635.67	28.83	3.75
Quindalup Complex	City Bunbury	787.82	259.46	32.93	1.44
Karrakatta Complex-Central and South	City Bunbury	756.61	283.96	37.53	1.43
Vasse Complex	City Bunbury	782.73	41.37	5.29	4.99
Yoongarillup Complex	City Bunbury	1,435.65	156.36	10.89	5.13

Note: red and orange indicate that less than 10 % and 30 %, respectively, of the pre-European extent is remains.

3.6.2 Conservation significant ecological communities

A search of the EPBC Act PMST identified three EPBC Act-listed TECs potentially occurring within the survey area see Table 7 and Figure 4, Appendix A). Sixteen TECs and PECs were identified in a search of the DBCA TEC/PEC database (DBCA 2020a).

The survey area intersects with seven mapped TEC/PECs locations listed below. These may be directly intersected by the survey area or may only intersect with the buffers of these TEC/PEC locations.

- (SCP07) - Herb rich shrublands in clay pans (floristic community type 8 as originally described in Gibson et al. (1994))
- (SCP18) - Shrublands on calcareous silts of the Swan Coastal Plain (floristic community type 18 as originally described in in Gibson et al. (1994))
- (SCP10a) - Shrublands on dry clay flats (floristic community type 10a as originally described in Gibson et al. (1994))
- (SCP19a) - Sedgelands in Holocene dune swales of the southern Swan Coastal Plain (floristic community type 19 as originally described in in Gibson et al. (1994))
- (SCP25) - Southern *Eucalyptus gomphocephala-Agonis flexuosa* woodlands
- Banksia Dominated Woodlands of the Swan Coastal Plain IBRA Region
- Tuart (*Eucalyptus gomphocephala*) woodlands and forests of the Swan Coastal Plain

Table 7 Threatened and Priority Ecological Communities

Community type	EPBC Act	BC Act/ DBCA	Description
Banksia woodlands of the Swan Coastal Plain (TEC) Banksia dominated woodlands of the Swan Coastal Plain IBRA region (PEC)	Endangered	Priority 3	The ecological community is a woodland associated with the Swan Coastal Plain. A key diagnostic feature is a prominent tree layer of Banksia, with scattered eucalypts and other tree species often present among or emerging above the Banksia canopy. The understorey is a species rich mix of sclerophyllous shrubs, graminoids and forbs. The ecological community is characterised by a high endemism and considerable localised variation in species composition across its range (TSSC 2016).
Coastal shrublands on shallow sands (SCP29a)		Priority 3	Mostly heaths on shallow sands over limestone close to the coast. No single dominant but important species include *Spyridium globulosum, Rhagodia baccata*, and *Olearia axillaris*.
Corymbia calophylla - *Xanthorrhoea preissii* woodlands and shrublands, Swan Coastal Plain (floristic community type 3c as originally described in in Gibson et al. (1994))	Endangered	Critically Endangered	Plant community located on heavy soils of the eastern side of the Swan Coastal Plain between Bullsbrook, and Waterloo near Bunbury. Dominant species in the community are the trees *Corymbia calophylla* and occasionally *Eucalyptus wandoo*; the shrubs *Xanthorrhoea preissii*, *Acacia pulchella*, *Dryandra nivea*, *Gompholobium marginatum*, and *Hypocalymma angustifolia* and the herbs *Burchardia umbellata*, *Cyathochaeta avenacea* and *Neurachne allopecuroidea* (Gibson *et al.* 1994). The introduced species *Briza maxima* and *Romulea rosea* are also common.
Corymbia calophylla woodlands on heavy soils of the southern Swan Coastal Plain (floristic community type 1b as originally described in Gibson et al. (1994))		Vulnerable	Plant community located on heavy soils of the eastern side of the Swan Coastal Plain between Waroona and Forrestfield. Typical and common native taxa in the community are: *Corymbia calophylla*; the shrubs *Dryandra nivea, Eriostemon spicatus, Kingia australis* and *Xanthorrhoea preissii*; and the herbs, *Cyathochaeta avenacea, Dampiera linearis, Haemodorum laxum, Loxocarya fasciculata, Mesomelaena tetragona* and *Tetraria octandra*. The introduced grass *Briza maxima* is also common in the community.
Dense shrublands on clay flats (floristic community type 9 as originally described in Gibson et al. (1994))	Critically Endangered	Vulnerable	The shrublands or open woodlands of this community are inundated for longer periods and have lower species richness and numbers of weed taxa than the other clay pan types. Sedges including *Chorizandra enodis, Cyathochaeta avenacea, Lepidosperma longitudinale* and *Meeboldina coangustata* are more common in this community. Shrubs including *Hakea varia, Melaleuca viminea* and *Eutaxia virgata* are common.
Herb rich saline shrublands in clay pans (floristic community type 7 as originally described in Gibson et al. (1994))	Critically Endangered	Vulnerable	The community can occur under a shrub layer comprising *Melaleuca viminea, M. osullivanii, M. cuticularis* or *Casuarina obesa* or other shrubs but can also occur as woodlands or herblands. Some areas such as where *Melaleuca cuticularis* or *Casuarina obesa* occur as an overstorey may be saline for part of the year due to evaporation resulting in increased salinity. A suite of herbs such as *Philydrella pygmaea, Brachyscome bellidioides, Centrolepis aristata, Centrolepis polygyna, Pogonolepis stricta* and *Cotula coronopifolia*;

Community type	EPBC Act	BC Act/ DBCA	Description
			frequently occur in the community. Species such as *Angianthus drummondii, Eryngium pinnatifidum subsp. palustre* and *Blennospora drummondii* occur in low frequency
Herb Rich Shrublands in Clay Pans (SCP08)	Critically Endangered	Vulnerable	This vegetation community type occurs in low lying flats with a clay impeding layer allowing seasonal inundation. While aquatic annuals are common. This vegetation community type is dominated by one or more of the shrubs: *Viminaria juncea, Melaleuca viminea, M. lateritia, broom bush, Kunzea micrantha* or *K. recurva* with occasional emergents of *Eucalyptus wandoo*. Species such as *Hypocalymma angustifolium* (white myrtle), *Acacia lasiocarpa var. bracteolata* long peduncle variant (G. J. Keighery 5026) and *Verticordia huegelii* (variegated featherflower) occur at moderate frequencies. This vegetation community type has a high percentage of weeds and appears to be the clay pan vegetation community type that has the greatest disturbance.
Subtropical and Temperate Coastal Saltmarsh	Vulnerable	Priority 3	Consists of the assemblage of plants, animals and micro-organisms associated with saltmarsh in coastal regions of sub-tropical and temperate Australia (south of 23oS latitude).
Tuart (*Eucalyptus gomphocephala*) woodlands and Forests of the Swan Coastal Plain (TEC) Tuart (*Eucalyptus gomphocephala*) woodlands of the Swan Coastal Plain (PEC)	Critically Endangered	Priority 3	Mostly confined to Quindalup Dunes and Spearwood Dunes from Jurien Bay to the Sabina River, with outliers along some rivers. Tuart is the key dominant canopy species however Tuart communities comprise a variety of flora assemblages. Flora commonly occurring with Tuart include *Agonis flexuosa, Banksia attenuata, B. grandis, Allocasuarina fraseriana, Xylomelum occidentale, Macrozamia riedlei, Xanthorrhoea preissii, Spyridium globulosum, Templetonia retusa* and *Diplolaena dampieri*
Southern *Eucalyptus gomphocephala – Agonis flexuosa woodlands* (SCP25) (Can form a component of the Endangered Banksia Woodlands of the Swan Coastal Plain EPBC listed TEC or the Tuart Woodlands of the Swan Coastal Plain PEC)		Priority 3	Woodlands of *Eucalyptus gomphocephala - Agonis flexuosa* south of Woodman Point. Recorded from the Karrakatta, Cottesloe and Vasse units. Dominants other than tuart were occasionally recorded, including Corymbia calophylla at Paganoni block and *Eucalyptus decipiens* at Kemerton. Occasionally dominants other than tuarts were recorded (*Corymbia calophylla and Eucalyptus decipiens*) however tuarts are emergent nearby. Banksias found in this community include *Banksia attenuata, B. grandis* and *B. littoralis*. Tuart formed the overstorey nearby however.

Community type	EPBC Act	BC Act/ DBCA	Description
Quindalup *Eucalyptus gomphocephala* and / or *Agonis flexuosa* woodlands (SCP30b) (Can form a component of the Tuart Woodlands of the Swan Coastal Plain PEC)		Priority 3	This community is dominated by either Tuart or *Agonis flexuosa*. The presence of *Hibbertia cuneiformis, Geranium retrorsum* and *Dichondra repens* differentiate this group from other Quindalup community types. The type is found from the Leschenault Peninsular south to Busselton
Low lying *Banksia attenuata* woodlands or shrublands	Endangered	Priority 3	This type occurs sporadically between Gingin and Bunbury, and is largely restricted to the Bassendean system. The type tends to occupy lower lying wetter sites and is variously dominated by *Melaleuca preissiana*, *Banksia attenuata*, *B. menziesii*, *Regelia ciliata*, *Eucalyptus marginata* or *Corymbia calophylla*. Structurally, this community type may be either a woodland or occasionally shrubland.
Shrublands on dry clay flats (floristic community type 10a as originally described in Gibson et al. (1994))	Critically Endangered	Endangered	The community occurs on skeletal soils that have shallow microtopography and the habitat is the most rapidly drying of the four clay pans identified in Gibson et al. (1994). Shrubs in the community include *Hakea sulcata, Hakea varia, Pericalymma ellipticum* and *Verticordia densiflora*. Herbs and sedges that are also common include *Schoenus rigens, Aphelia cyperoides, Centrolepis aristata, Schoenolaena juncea, Drosera gigantea* subsp. *gigantea*, 11 and *Drosera menziesii* subsp. *menziesii*
Southern *Banksia attenuata* woodlands	Endangered	Priority 3	Southern Banksia attenuata woodlands ('community type 21b') (a component of the Endangered Banksia Woodlands of the Swan Coastal Plain EPBC listed TEC) Priority 3(i) Endangered TEC (part) This community is restricted to sand sheets at the base of the Whicher Scarp, the sand sheets on elevated ridges or the sand plain south of Bunbury. Structurally, this community type is normally *Banksia attenuata* or *Eucalyptus marginata – B. attenuata* woodlands. Common taxa include *Acacia extensa, Jacksonia* sp. Busselton, *Laxmannia sessiliflora*, *Lysinema ciliatum* and *Johnsonia acaulis*.
Sedgelands in Holocene dune swales of the southern Swan Coastal Plain (floristic community type 19 as originally described in in Gibson et al. (1994))	Endangered	Critically Endangered	The community occurs in linear damplands and occasionally sumplands, between Holocene dunes. Typical and common native species are the shrubs *Acacia rostellifera, Acacia saligna, Xanthorrhoea preissii*, the sedges *Baumea juncea, Ficinia nodosa, Lepidosperma gladiatum,* and the grass *Poa porphyroclados*. Several exotic weeds are found in this community but generally at low cover values.
Shrublands on calcareous silts of the Swan Coastal Plain (floristic community type 18 as originally described in in Gibson et al. (1994))		Vulnerable	A suckering form of *Acacia saligna* (orange wattle), *Melaleuca viminea* (mohan), *Melaleuca teretifolia* (banbar), *Hakea varia* (variable-leaved hakea), *Xanthorrhoea preissii* (balga) and *Leptomeria ellytes* are common in the shrub layer, with sedges including *Lepidosperma longitudinale* (pithy sword-sedge) and *Gahnia trifida* (coast sawsedge), and a suite of herbs including *Meionectes tenuifolia* a priority 3 flora taxon also common.

3.6.3 Conservation significant flora

Desktop searches of the EPBC Act PMST (DAWE 2020a), NatureMap (DBCA 2007-2020), DBCA TPFL, WAHERB databases (search reference 06-0920FL) (DBCA 2020a) identified the presence/potential presence of 61 conservation significant flora species within the study area. The desktop searches recorded:

- 22 taxa under the EPBC Act and/or Threatened under the BC Act
- Five Priority 1
- Seven Priority 2
- 15 Priority 3
- 12 Priority 4

The locations of conservation significant flora registered on the DBCA databases are mapped in Figure 4, Appendix A and listed with likelihood of occurrence in Appendix C There are no previous records of conservation listed flora species mapped within the survey area (DBCA TPFL, WAHERB databases (search reference 06-0920FL)).

4. Field Survey Results

4.1 Flora and vegetation

4.1.1 Vegetation units

The survey identified six primary vegetation units (vegetation units A-F). For some of these vegetation units, sub-units with minor variation were identified. Because of the degree of degradation of much of the vegetation it is difficult to determine to what extent these “sub-units” are an expression of different floristics or a result of loss of some species because of historic grazing, changes of hydrology etc.

An assessment to define the main vegetation units was made in the field during the surveys, based on structure, floristics and soil characteristics (including drainage). Quadrats were installed in Good, Very Good or Excellent condition vegetation within these units to sample the range of floristic variation, however, this was minorly constrained by the lack of vegetation in better than Good condition vegetation in some units, particularly the wetland units D-E.

The vegetation units and sub-units are described in further detail in Table 8 and shown in Figure 9, Appendix A.

Table 8 Vegetation units recorded in the survey area

Vegetation unit description	Photograph	Sample sites (quadrats and releves), condition and extent within survey area
Primary vegetation unit A: Occuring on the Quindalup Dune system. Vegetation sub-units: A1, A2, A3 FCT: Affinity to SCP29a, SCP30b and SCP25 (Southern Tuart woodland) Strength of FCT affinity: SCP29a, SCP30b, High, SCP25, Moderate/High A mixture of *Agonis flexuosa* and *Eucalyptus gomphocephala* woodlands over *Acacia cochlearis, Alyxia buxifolia* and *Diplolaena dampieri* shrublands. Sub-units A2 and A3 are a variant of A1 where the calcareous soil has been leached to a greater extent and *Eucalyptus gomphocephala* is more prevalent. At these sub-units margins they merge into unit B.		Quadrats AQW01, AQW02, AQW03. 46 releves Very Good-Good condition 6.92 ha total 10.82% of survey area
Sub-unit A1: *Agonis flexuosa* low open woodland over *Acacia cochlearis*, *Alyxia buxifolia*, *Diplolaena dampieri*, *Leucopogon parviflorus*, *Olearia axillaris*, *Spyridium globulosum* mid-height open shrubland over *Phyllanthus calycinus*, *Rhagodia baccata* low open shrubland over *Acanthocarpus preissii*, *Calandrinia brevipetala*, *Conostylis aculeata* subsp. *preissii*, **Trachyandra divaricata* open forbland, *Austrostipa flavescens*, **Lagurus ovatus* open grassland and *Lepidosperma calcicola* open sedgeland on calcareous bleached sand.		3.57 ha 5.58% of survey area

Vegetation unit description	Photograph	Sample sites (quadrats and releves), condition and extent within survey area
Sub-unit A2: *Eucalyptus gomphocephala* woodland over *Acacia cochlearis, Alyxia buxifolia, Diplolaena dampieri, Leucopogon parviflorus, Hibbertia cuneiformis, Olearia axillaris, Spyridium globulosum* mid-height shrubland over *Clematis microphylla, Rhagodia baccata* low shrubland over *Acanthocarpus preissii, Dichopogon capillipes, Daucus glochidiatus, *Lysimachia arvensis* open forbland on calcareous yellow brown sand. All areas mapped as this vegetation unit are associated with EPBC TEC Tuart woodlands and forests of the Swan Coastal Plain, WA P3 PEC Tuart (*Eucalyptus gomphocephala*) woodlands of the Swan Coastal Plain and WA P3 PEC Quindalup *Eucalyptus gomphocephala* and / or *Agonis flexuosa* woodlands (SCP30b).		3.13 ha 4.90% of survey area
Sub-unit A3: *Eucalyptus gomphocephala* mid-height open woodland over *Agonis flexuosa* low open woodland over *Spyridium globulosum*, *Alyxia buxifolia*, *Acacia cochlearis* and *Hibbertia cuneiformis* tall shrubland over *Acanthocarpus preissii*, *Phyllanthus calycinus* sparse forbland and *Lepidosperma calcicola* and *Schoenus grandiflorus* sparse sedgeland on calcareous bleached sand All areas mapped as this vegetation unit are associated with EPBC TEC Tuart woodlands and forests of the Swan Coastal Plain, WA P3 PEC Tuart (*Eucalyptus gomphocephala*) woodlands of the Swan Coastal Plain and WA P3 PEC Quindalup *Eucalyptus gomphocephala* and / or *Agonis flexuosa* woodlands (SCP30b).		0.17 ha 0.27% of survey area

Vegetation unit description	Photograph	Sample sites (quadrats and releves), condition and extent within survey area
Primary vegetation unit B: Occurring on the Spearwood soil-landscape FCT: Affinity to SCP25 (Southern Tuart woodland) with eastern quadrats showing affinity to SCP21a Strength of FCT affinity: SCP21a; High, SCP25; Moderate *Eucalyptus gomphocephala* with scattered *Eucalyptus marginata* tall woodland over *Agonis flexuosa* mid-height open forest over *Hibbertia hypericoides, Phyllanthus calycinus, Xanthorrhoea brunonis* mid-height shrubland over *Caladenia flava, Conostylis aculeata* subsp. *preissii, Daucus glochidiatus, *Hypochaeris glabra, Sowerbaea laxiflora, Trachymene pilosa* open forbland on yellow-brown or grey-brown sand or loamy sand *(Corymbia calophylla* and *Melaleuca preissiana* become a component in damper low-lying areas). All areas mapped as this vegetation unit are associated with EPBC TEC Tuart woodlands and forests of the Swan Coastal Plain, WA P3 PEC Tuart (*Eucalyptus gomphocephala*) woodlands of the Swan Coastal Plain.		Quadrats: AQW04, AQW07, AQW08, AQW17 13 releves Very Good-Good with some areas of Degraded condition 10.63 ha 16.61% of the survey area

Vegetation unit description	Photograph	Sample sites (quadrats and releves), condition and extent within survey area
Primary vegetation unit C: Bassendean dunes and Pinjarra Plain soil-landscapes Vegetation sub-units: C1, C2, C3 Strength of FCT affinity: C1: SCP21a, High, SCP21b, Moderate; C2: SCP21a, Moderate, SCP21b, Low/Moderate Sub-unit C2 is a variant of C1 which occurs in the transition zone around the edges of the claypan unit (E1) – it occurs on sandy loam over clay at depth. Sub-unit C2 is limited in extent and occupies only a narrow band (25-30 m wide) between sub-units C1 and E1. It has some of the characteristics of both sub-units but is floristically closer to C1 (e.g. the presence of *Leucopogon racemulosus, Dichopogon capillipes, Xanthorrhoea brunonis*). Sub-unit C2 is not considered to be part of the Banksia woodlands of the SCP because of the absence of *Banksia attenuata*, or other *Banksia* sp. typical of that community). Sub-unit C3 is significantly degraded and occurs only on road verge adjacent to farmland. Originally it would have likely been similar to C1.		Quadrats: AQW10, AQW11, AQW13, AQW14 One releve Good-Very Good condition with areas of Degraded condition 5.56 ha total 8.96% of survey area
Sub-unit C1: *Eucalyptus marginata*, *Banksia attenuata*, *Xylomelum occidentale* mid-height woodland over *Kunzea glabrescens* tall shrubland over *Calytrix flavescens*, *Hibbertia hypericoides, Macrozamia riedlei, Stirlingia latifolia, Xanthorrhoea brunonis* low shrubland over *Caladenia flava*, *Dasypogon bromeliifolius*, *Lomandra caespitosa, L. hermaphrodita, Trachymene pilosa forbland* over *Lepidosperma squamatum* very open sedgeland on grey sand. All areas mapped as this vegetation unit are associated with EPBC TEC Banksia Woodlands of the Swan Coastal Plain, WA P3 PEC Banksia Woodlands of the Swan Coastal Plain		3.68 ha 5.75 of survey area

Vegetation unit description	Photograph	Sample sites (quadrats and releves), condition and extent within survey area
Sub-unit: C2: *Corymbia calophylla* mid-height open forest over *Kunzea glabrescens* tall shrubland over *Acacia pulchella*, *Kennedia prostrata*, *Leucopogon racemulosus*, *Xanthorrhoea brunonis* low shrubland over *Dampiera linearis*, *Dichopogon capillipes*, **Oxalis purpurea* open forbland and *Mesomelaena tetragona*, *Lepidosperma longitudinale* sedgeland on grey sandy-loam.		0.35 ha 0.55% of survey area
Sub-unit: C3: *Corymbia calophylla*, *Eucalyptus marginata* mid-height open forest over *Agonis flexuosa*, *Banksia attenuata* low woodland over scattered *Leucopogon racemulosus* shrubs over mainly introduced grasses (**Briza maxima*, **B. minor*, **Ehrharta longiflora*) and herbs such as **Hypochaeris glabra* on grey sand.		1.53 ha 2.39% of survey area

Vegetation unit description	Photograph	Sample sites (quadrats and releves), condition and extent within survey area
Primary vegetation unit D: Spearwood dunes soil-landscape Vegetation sub-units: D1, D2 Strength of FCT affinity: D1 and D2, SCP11, Moderate, SCP17, Moderate/High Transitional wetland community located in a broad swale between the western and eastern Spearwood dune ridges. Sub-unit D1 represents the “wetter” and D2 the “drier” variations of unit D.		Quadrats: AQW09, AQW05, AQW06 One releve 1.54 ha 2.41% of survey area Degraded condition
Sub-unit: D1 *Eucalyptus rudis* tall woodland over *Agonis flexuosa*, *Melaleuca rhaphiophylla* mid-height open forest/woodland over *Acacia saligna*, *Gastrolobium ebracteolatum*, *Spyridium globulosum* tall shrubland over *Gahnia trifida*, *Hypolaena pubescens,Leptocarpus coangustatus*, *Lepidosperma longitudinale* sedgeland, with scattered herbs including *Caladenia flava* and *C. latifolia* on grey-brown on grey sandy-clay or sandy clay-loam. (Heavily affected by disturbance in places).		0.30 ha 0.46% of survey area
Sub-unit: D2 *Corymbia calophylla*, *Melaleuca preissiana*, *M. rhaphiophylla* (*Agonis flexuosa*, *Eucalyptus rudis*) mid-height open forest/woodland over *Acacia saligna*, *Jacksonia furcellata*, *Spyridium globulosum*, *Xanthorrhoea brunonis* tall open shrubland over *Lepidosperma longitudinale*, *Hypolaena pubescens* sedgeland, **Ehrharta calycina* Open Grassland and *Burchardia multiflora*, *Caladenia latifolia*, *Conostylis aculeata* subsp. *preissii* open forbland on grey sandy clay. (Occurs in drier areas than unit D1 – very degraded in places).		1.24 ha 1.95% of survey area

Vegetation unit description	Photograph	Sample sites (quadrats and releves), condition and extent within survey area
Primary vegetation type: E Bassendean dunes and Pinjarra Plain soil-landscapes Vegetation sub-units E1, E2 FCT: As it only occurs in Degraded or worse condition, alignment with an FCT has not been confirmed. Affinity to both FCT09 and FCT07. Both sub-units have been severely degraded. They occur on shallow sandy lenses over (or directly on the) heavy clay of the Pinjarra Plain at shallow depth. Past disturbance has obscured the original floristic signature of the E2 sub-unit and how this sub-unit relates to E1 and the other wetland vegetation of Manea Park is not clear. Sub-units E1 and E2 resemble both Gibson et.al, 1994 FCT09 and FCT07, but due to degradation and a patchwork of claypan FCTs (see Webb, 2016) in the area cannot be confidently assigned to either. What is clear, is that there was a great deal of variability within this wetland vegetation deriving from the depth to the impeding layer.		Quadrats: AQW12, AQW15, AQW16 Nine releves Mainly Degraded condition with some areas of Good and Very Good condition 2.03 ha 3.17% of survey area
Sub-unit: E1 *Hakea varia*, *Melaleuca viminea* open shrubland, with emergent *Melaleuca rhaphiophylla* and (scattered emergent *Eucalyptus rudis*) over *Lepidosperma longitudinale*, *Leptocarpus coangustatus* sedgeland and *Cassytha glabella*, **Hypochaeris glabra*, *Trachymene pilosa* open forbland and (in less disturbed areas) *Centrolepis aristata*, *Drosera glanduligera*, *Ficinia* spp. and *Triglochin* spp. forbland on grey clay (most of this unit has been heavily disturbed in the past). All areas mapped as this vegetation unit are associated with EPBC TEC Clay pans of the Swan Coastal Plain and WA TEC Herb rich saline shrublands in clay pans (FCT07) / Dense shrublands on clay flats (FCT09).		1.06 ha 1.65% of survey area
Sub-unit: E2 *Eucalyptus rudis*, *Melaleuca rhaphiophylla* mid-height woodland over *Acacia saligna*, *Melaleuca viminea* tall open shrubland over *Lepidosperma longitudinale* open sedgeland and **Rumex* spp., **Zantedeschia aethiopica* forbland and weedy grasses on grey-brown clay. All areas mapped as this vegetation unit are associated with EPBC TEC Clay pans of the Swan Coastal Plain, WA TEC Herb rich saline shrublands in clay pans (FCT07) / Dense shrublands on clay flats (FCT09).		0.97 ha 1.52% of survey area

Vegetation unit description	Photograph	Sample sites (quadrats and releves), condition and extent within survey area
Primary vegetation Unit: F FCT: Not applicable Scattered *Eucalyptus gomphocephala* and/or *Eucalyptus marginata* tall open woodland over introduced species such as **Ehrharta calycina* and **Avena barbata* on grey-brown sand. This is a broad unit for Degraded- Completely Degraded areas on the Spearwood soil-landscape where generally only the overstorey survives.		Degraded- Completely Degraded condition Two releves 0.84 ha 1.31% of survey area
Vegetation Unit: P FCT: Not applicable Roads and tracks, cleared road verge (sometimes with planted trees) and pasture and parkland with scattered trees. Includes areas with no vegetation.		Completely Degraded condition or not vegetation 17 releves 36.45 ha 56.98% of survey area
Total		**63.97 ha**

4.1.2 Vegetation condition

The vegetation condition of the survey area ranged from Excellent to Completely Degraded. A high proportion of the survey area was cleared or showed high levels of disturbance, and were classified as Completely Degraded (36.61 ha (57.23%)). Degradation is attributed to historical clearing, road and verge construction, firebreaks, agriculture, changes to hydrology, aggressive weed species and edge effects.

A summary of the vegetation condition is provided in Table 9 and vegetation condition mapping is shown in Figure 10, Appendix A.

Table 9 Extent of vegetation condition ratings mapped within the survey area

Vegetation condition	Extent in survey area (ha)	Extent in survey area (%)
Excellent	0.43	0.67%
Very Good	8.87	13.87%
Good	9.75	15.25%
Degraded	8.30	12.97%
Completely Degraded	36.61	57.23%
Grand Total	**63.97**	**100.00%**

4.1.3 Flora diversity

294 flora taxa (including subspecies and varieties) representing 67 families were recorded from the survey area during the field survey. This total comprised 229 native taxa and 65 introduced flora taxa.

Dominant families recorded from the survey area included:

- Fabaceae (35 taxa)
- Orchidaceae (26 taxa)
- Asteraceae (19 taxa)
- Cyperaceae (17 taxa)
- Poaceae (17 taxa).

The combined species list is provided in Appendix D.

A species accumulation curve was generated to assess adequacy of sampling effort within the survey area. The species accumulation curve for the survey area, based on flora recorded within quadrats alone, is approaching an asymptote, which suggests that the current survey effort is sufficient. See Plate 2 below for the accumulation curve.

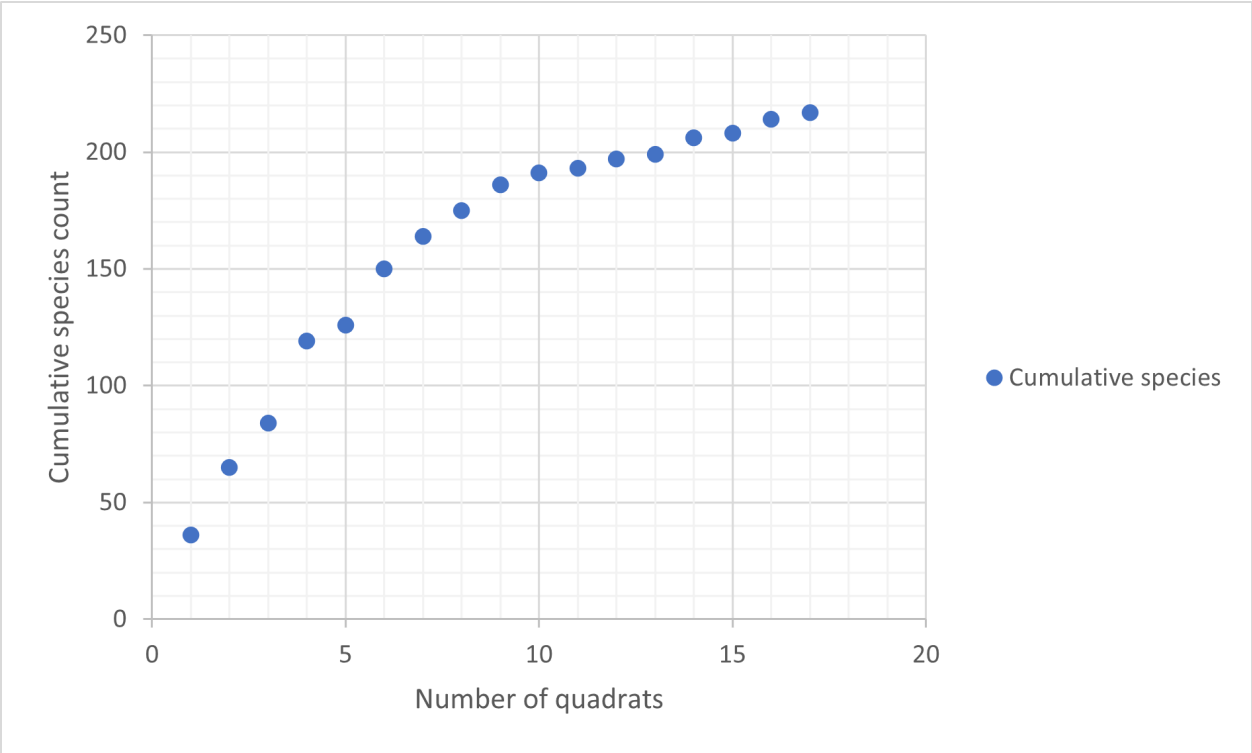

Plate 2 Species accumulation curve

4.2 Conservation significant flora and vegetation

4.2.1 Conservation significant ecological communities

The field survey identified six conservation significant ecological communities within the survey area. Some of these communities share an overlapping distribution and diagnostic criteria, but are assigned differing conservation status. For example, the Banksia Woodlands of the Swan Coastal Plain TEC which is listed as Endangered under the EPBC Act shares the same diagnostic criteria as the Banksia dominated woodlands of the Swan Coastal Plain IBRA region PEC listed by DBCA as a Priority 3. A summary of these communities and their extent is provided in Table 10.

Table 10 Summary of conservation significant ecological communities present in survey

Community	Conservation status	Description	Extent within survey area (ha)	Proportion of survey area	Vegetation unit association
Banksia Woodlands of the Swan Coastal Plain	EPBC Act – Endangered TEC	The ecological community is a woodland associated with the Swan Coastal Plain. The key diagnostic feature is a prominent tree layer of *Banksia*, with scattered eucalypts and other tree species often present among or emerging above the *Banksia* canopy. The understorey is a species rich mix of sclerophyllous shrubs, graminoids and forbs. The ecological community is characterised by a high endemism and considerable localised variation in species composition across its range (TSSC 2016). The TSSC (2016) provides guidance for determining whether the TEC is present based on presence of key diagnostic species, patch size and condition thresholds. The sub-unit C1 *Eucalyptus marginata, Banksia attenuata, Xylomelum occidentale* Woodland over *Kunzea glabrescens* Tall Shrubland community is consistent with the TEC. This occurs along the edges of existing tracks and disturbed areas but is connected to larger continuous patches of the Banksia Woodlands TEC satisfying patch area and condition thresholds. A patch may include small scale (<30 m) variations, gaps and disturbances, such as tracks, that do not significantly alter the over functionality of the ecological community.	3.68	5.57%	Sub-unit C1:
Banksia dominated woodlands of the Swan Coastal Plain IBRA region (This community shares diagnostic criteria with the Banksia Woodlands of the Swan Coastal Plain community)	BC Act/DBCA – Priority 3 PEC				

Community	Conservation status	Description	Extent within survey area (ha)	Proportion of survey area	Vegetation unit association
EPBC TEC Clay pans of the Swan Coastal Plain,	EPBC Act – Critically Endangered TEC	Occurs where clay soils form an impermeable layer close to the ground surface, and wetlands form that rely solely on rainfall to fill and then dry to impervious pans in summers (TSSC 2012). A distinctive feature of the clay pan wetlands is the suite of geophytes and annual flora that germinates, grows and flowers sequentially as these areas dry over summer. The clay pans have a high species richness, a number of local endemics and are the most floristically diverse of the SCP wetlands. For a community to be considered a claypan TEC under the EPBC Act it should have a functioning hydrological regime and meet at least the Good condition category (TSSC 2012). Given the ecological community occurs in very localised locations that can be very small, no minimum patch size is recommended in the TSSC (2012).	2.03	3.17%	Sub-unit E1 Sub-unit E2
WA TEC Herb rich saline shrublands in clay pans (FCT07)/ Dense shrublands on clay flats (FCT09) (Due to past disturbance the floristic signature of the sub-units could not be differentiated between the two communities)	BC Act/DBCA– TEC Vulnerable	FCT07 Occurs on heavy clay soils that are generally inundated from winter to mid-summer. Structurally this vegetation community type is quite variable ranging from woodlands to herblands, the most common overstorey species being *Melaleuca viminea, M. uncinata, M. cuticularis* or *Casuarina obesa*. Typical species in the understorey include the common herbs *Brachyscome bellidioides, Centrolepis polygyna, Pogonolepis stricta* and *Cotula coronopifolia*. In addition, species such as *Angianthus* aff. *drummondii*, *Eryngium pinnatifidum* subsp. Palustre (G.J. Keighery 13459) and *Blennospora drummondii* occur in low frequency.			

Community	Conservation status	Description	Extent within survey area (ha)	Proportion of survey area	Vegetation unit association
		FCT09 comprises shrublands or low open woodlands on clay flats that are inundated for long periods occurring very low in the landscape. Sedges are more apparent in this ecological community and include *Chorizandra enodis*, *Cyathochaeta avenacea*, *Lepidosperma longitudinale* and *Meeboldina coangustata*. Shrubs include *Hakea varia* and *Melaleuca viminea* and occasionally *Xanthorrhoea preissii, X. drummondii* and *Kingia australis*. This vegetation community type has a lower species richness and weed frequency than in the other clay pan community types, presumably because of the longer inundation times (TSSC 2012).			

Community	Conservation status	Description	Extent within survey area (ha)	Proportion of survey area	Vegetation unit association
Tuart (*Eucalyptus gomphocephala*) woodland and forests of the Swan Coastal Plain	EPBC Act – Critically Endangered TEC	Mostly confined to Quindalup Dunes and Spearwood Dunes from Jurien Bay to the Sabina River, with outliers along some rivers. Tuart is the key dominant canopy species however Tuart communities comprise a variety of flora and fauna assemblages. Flora commonly occurring with Tuart include *Agonis flexuosa, Banksia attenuata, B. grandis, Allocasuarina fraseriana, Xylomelum occidentale, Macrozamia riedlei, Xanthorrhoea preissii, Spyridium globulosum, Templetonia retusa* and *Diplolaena dampieri* (DBCA 2019). The distance between the canopy of Tuart trees within and adjacent to the survey area was calculated in the field to determine the presence of the EPBC TEC Tuart (*Eucalyptus gomphocephala)* woodlands and forests of the Swan Coastal Plain in accordance with (TSSC, 2019).	13.93	21.78%	Sub-unit A2 Sub-unit A3 Primary unit B
Tuart (*Eucalyptus gomphocephala*) woodlands of the Swan Coastal Plain (This community shares diagnostic criteria with the Tuart (*Eucalyptus gomphocephala*) woodland and forests of the Swan Coastal Plain community)	BC Act/DBCA– Priority 3 PEC				
Quindalup *Eucalyptus gomphocephala* and / or *Agonis flexuosa* woodlands (SCP30b) (All areas of this PEC are overlapping with the above listed TEC)	BC Act/DBCA– Priority 3 PEC	This community is dominated by either Tuart or *Agonis flexuosa*. The presence of *Hibbertia cuneiformis, Geranium retrorsum* and *Dichondra repens* differentiate this group from other Quindalup community types. The type is found from the Leschenault Peninsular south to Busselton on Quindalup dunes.	3.30	5.17%	Sub-unit A2 Sub-unit A3

4.2.2 Conservation significant flora

No EPBC Act or BC Act listed flora were recorded from the survey area. One DBCA Priority 4 listed flora species, *Caladenia speciose*, and two Priority 3 listed flora species, *Blennospora doliiformis* and *Lasiopetalum membranaceum* were recorded within the survey area. The species *Stylidium longitubum* (Priority 4) was not recorded during the survey but is considered likely to occur. This species was recorded within the survey area associated with claypan habitat at the eastern end of the survey area in a 2017 survey.

The locations of the recorded DBCA Priority-listed flora recorded within the survey area are mapped in Figure 11, Appendix A. Species location data and number of plants recorded is presented in Appendix F.

***Caladenia speciosa* – Priority 4**

The Sandplain White Spider Orchid (*Caladenia speciosa*) is a tuberous, perennial herb approximately 0.35 to 0.6 m high, with white to pink flowers. This species is reported to flower in September to October. It grows in white, grey or black sands and is recorded from the Jarrah Forest and Swan Coastal Plain IBRA Bioregions (WA Herbarium 1998–2021). *C. speciosa* was recorded from one population associated with vegetation sub-unit C1 with five individuals recorded. The survey period was during the flowering season of this and other *Caladenia* species.

***Blennospora doliiformis*-Priority 3**

An erect annual herb, up to 0.15 m high. This species is reported to flower in October to November. The specie is commonly found associated with wetlands and seasonally wet flats in grey or red clay soils over ironstone (WA Herbarium 1998–2021). One population with one individual was recorded growing in association with claypan wetland vegetation sub-unit E1. The primary flora survey was undertaken early in the flowering season of this species and due to its small size and seasonally variable growth, its abundance may have been under sampled. As an annual species it is considered likely that this species would occur at different abundances in different seasons in claypan habitat.

***Lasiopetalum membranaceum*- Priority 3**

An erect multi stem shrub, 0.2-1 m high. The species has Pink-blue-purple flowers and flowers throughout September to December. The species is also readily identifiable in vegetative form from its leaf shape and habit. The species occurs in coastal areas of sand over limestone. Three populations were recorded:

- West of Parade Road- 79 individuals
- Along Parade Road- four individuals
- East of Parade Road- two individuals

All populations were recorded growing in association with vegetation unit B.

Targeted search results

Desktop searches have identified several EPBC Act / BC Act listed flora that were assessed as possibly occurring, a full potential for occurrence table is provided in Appendix C. Information on targeted searches and the post survey assessment of likelihood of occurrence for these EPBC Act / BC Act listed flora species identified as possibly occurring is provided below:

***Austrostipa bronwenae* EPBC Act – Endangered / BC Act – Endangered and *Austrostipa jacobsiana* EPBC Act – Critically Endangered / BC Act – Critically Endangered**

The post survey likelihood for *Austrostipa bronwenae* and *Austrostipa jacobsiana* is that the species are unlikely to occur in the survey area, considering that suitable survey effort using transects covering all suitable habitats over multiple surveys was undertaken. Both species are associated with wetland habitats (vegetation sub-units C2, D1, D2, E1, and E2) which were subject to spring and early summer targeted surveys. The size of the plants and their long persistent and visible glumes on old inflorescences make the species readily identifiable in vegetation and allow for a high level of confidence in detectability (TSSC 2017, TSSC 2018).

***Caladenia huegelii* (King Spider Orchid). EPBC Act – Endangered / BC Act – Critically Endangered**

The post survey likelihood of occurrence assessment for *Caladenia huegelii* is that the species is unlikely to occur in areas covered by the primary survey (survey one). See Figure 1 for extent of survey phases. This assessment was formed considering that suitable survey effort using transects covering habitats identified as potentially suitable was undertaken during the preferred survey timing for species detection using suitably experienced assessors.

Caladenia huegelii habitat consists of mixed woodlands of Jarrah, Marri and Banksia with a dense shrubby understory occurring on grey-white sands, usually associated with the Bassendean sand dune system (DEC,2009a). For this survey, habitats identified as most suitable occur to the east of Bussel Highway, associated with vegetation unit C and B, when occurring on or in a mosaic with Bassendean type sands. It is also identified in the Bunbury region that rare plants have been recorded as occurring on the Spearwood system, in association with Tuart woodland on the transition to Marri-Banksia vegetation (Leschenault population) (DEC,2009a). As such, areas of vegetation type B occurring from the eastern edge of the WWTP to Bussel highway may be considered to comprise a low suitability potential habitat area.

For the additional area surveys in the vicinity of the WWTP (survey two and four) the post survey likelihood of occurrence was also assessed as unlikely due the absence of suitable habitat in these areas. These areas fall within the Quindalup dune system and vegetation is coastal scrubland dominated by Acacia species.

The areas of vegetation type B within the additional area survey covering the WWTP access road and along Mosedale Road (survey three) comprises the above described vegetation type B on Spearwood dunes low suitability potential habitat area. Due to the timing of the survey (April, 2021) targeted searches for this species were not possible. While low suitability potential habitat exists within the survey three area, disturbances such as weed invasion, grazing, edge effects, tracks, clearing and rubbish dumping have led to the habitat being disturbed and reducing the habitat condition. Considering the habitat condition and the rare records of occurrences for the species on Spearwood type dunes it is considered that a low residual risk for likelihood of occurrence exists.

***Diuris drummondii* (Tall Donkey orchid). EPBC Act/ BC Act – Vulnerable**

The post survey likelihood for *Diuris drummondii* is that the species is unlikely to occur in the survey area, considering that suitable survey effort using transects covering all suitable habitats over multiple surveys was undertaken. The species is associated with wetland habitats (vegetation sub-units C2, D1, D2, E1, and E2) which were subject to survey during the flowering period of spring and early summer (DEWHA,2008a). Prior to completing the early summer search, a nearby known location *of Diuris drummondii* was visited, and the species was confirmed to be flowering. While the species may not flower each year, targeted surveys for the presence of the *Diuris drummondii* were undertaken during appropriate survey timing for the

species, the species was not detected either from flowering or vegetative growth (long stem and leaf).

***Drakaea elastica* (Glossy-leaved hammer orchid). EPBC Act – Endangered / BC Act – Critically Endangered** and ***Drakaea micrantha* (Dwarf hammer orchid). EPBC Act – Vulnerable / BC Act – Endangered**

The post survey likelihood for both *Drakaea elastica* and *D. micrantha* concludes that these species are unlikely to occur in the survey area when considering that suitable survey effort covering all potential habitats by experienced assessors has been undertaken during the preferred survey timing for species detection. Due to similar habitat requirements the species *D. elastica and D. micrantha* are assessed together. The species grows on bare patches of sand within otherwise dense vegetation in low-lying areas alongside winter-wet swamps, typically in Banksia (*Banksia menziesii, B. attenuata* and *B. ilicifolia*) woodland or spearwood (*Kunzea glabrescens*) thicket vegetation. The species requires locations with relatively little direct sun exposure (DEWHA, 2008b; DEC, 2009b). Suitable habitats for these species are associated with vegetation types C1, C2 and C3. These habitats occur between Bussel Highway and the eastern terminus of the alignment at Southwest Highway.

While suitable habitat exists within the survey area, disturbances such as weed invasion, grazing, edge effects, tracks, clearing and rubbish dumping have led to the habitat being disturbed and reducing the habitat condition. Known locations of *Drakaea elastica* and *D. micrantha* outside of the survey area are typically in larger continuous patches containing suitable habitat that is in Very Good to Excellent condition. This specific habitat was not commonly recorded in the survey area, and when targeted the habitat was often degraded by one or a number of disturbances listed above. While the species may not flower each year, targeted surveys for the presence of the *Drakaea* leaf were undertaken as part of the target searches, with no unidentified orchid species recorded.

***Eleocharis keigheryi* (Keighery's Eleocharis). EPBC Act/ BC Act – Vulnerable**

The post survey likelihood for *Eleocharis keigheryi* is that the species is unlikely to occur in the survey area when considering that suitable survey effort covering all potential specific claypan habitats has been undertaken during the preferred survey timing for species detection using experienced assessors. Suitable small areas of the species preferred claypan habitat exists within the survey area associated with vegetation types C2 and E1 (DEWH, 2008c). These habitats occur between Bussel Highway and the eastern terminus of the alignment at Southwest Highway. Disturbances such as weed invasion, edge effects, tracks, clearing and rubbish dumping have led to the habitat being disturbed and reducing the habitat condition. Areas in better condition, were adequately surveyed.

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Appendices

Appendix A – Figures

Figure 1 Project Locality

LEGEND

- Study area 10K
- Project Area
- Survey One - 8/09/2020-20/12/2020
- Survey Two - 9/03/2021
- Survey Three - 9/04/2021
- Survey Four - 22/04/2021
- Major Road

WELLESLEY
LESCHENAULT
BRUNSWICK
BEELA
Ommaney Rd
Paris Rd
AUSTRALIND
Raymond Rd
ROELANDS
Old Coast Rd
Coalfields Rd
VITTORIA
Estuary Dr
EATON
South Western Hwy
Clifton St
Koombana Dr
Victoria St
Stirling St
PELICAN POINT
Forrest Hwy
WATERLOO
BUREKUP
EAST BUNBURY
BUNBURY
Sandridge Rd
Spencer St
GLEN IRIS
PICTON EAST
Picton Rd
Mangles St
Blair St
Dodson Rd
Willinge Dr
PICTON
SOUTH BUNBURY
CAREY PARK
Waterloo Rd
Robertson Dr
Ocean Dr
Parade Rd
DAVENPORT
Washington Av
Bunbury Outer Ring Rd
PARADISE
HENTY
COLLEGE GROVE
USHER
DARDANUP WEST
Ferguson Rd
DARDANUP
WELLINGTON FOREST
DALYELLUP
GELORUP
NORTH BOYANUP
Bussell Hwy
STRATHAM
Boyanup-Picton Rd
BOYANUP
Boyanup Rd
Bridge St
STIRLING ESTATE
ELGIN
Landgate / SLIP

YANCHEP
PERTH
MANDURAH
BUSSELTON
AUGUSTA

Paper Size ISO A3

0 1 2 3 4

Kilometres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 50

N

Aqwest
Bunbury WWRS EPCM

Project locality

Project No. 12537061
Revision No. 0
Date 10 May 2021

FIGURE 1

G:\61\12537061\12_GIS\Maps\Working\Aqwest-Bunbury WWRS EPCM\12537061_1_Project_locality_Rev1.mxd
Print date: 10 May 2021 - 13:50

Data source: GHD: Survey Area - 20210325; Landgate: Roads (17 June 2016), Railway (6 Sep 2017) - 20180221, Suburb Boundary, Imagery Oct. 2020 (accessed: 20210329). Created by: htaniza

LEGEND

- Study area 10K
- Project Area
- Regional Ecological Linkages
- Major Road
- ESAs

DBCA Legislated lands

- National Park
- Nature Reserve
- Conservation Park
- Section 34A Freehold
- Section 5(1)(h) Reserve
- State Forest

WELLESLEY
LESCHENAULT
BRUNSWICK
Ommaney Rd
BEELA
Paris Rd
AUSTRALIND
Raymond Rd
Old Coast Rd
ROELANDS
Coalfields Rd
VITTORIA
Estuary Dr
EATON
South Western Hwy
BUNBURY
Clifton St
Victoria St
Stirling St
Koombana Dr
PELICAN POINT
Forrest Hwy
WATERLOO
BUREKUP
EAST BUNBURY
Sandridge Rd
GLEN IRIS
PICTON EAST
Spencer St
Blair St
Picton Rd
Mangles St
Dodson Rd
Willinge Dr
PICTON
SOUTH BUNBURY
CAREY PARK
Robertson Dr
Waterloo Rd
Parade Rd
Ocean Dr
Washington Av
Bunbury Outer Ring Rd
PARADISE
HENTY
USHER
COLLEGE GROVE
DAVENPORT
DARDANUP WEST
Ferguson Rd
DARDANUP
WELLINGTON FOREST
DALYELLUP
GELORUP
NORTH BOYANUP
FERGUSON
CROOKED BROOK
Bussell Hwy
STRATHAM
Boyanup-Picton Rd
BOYANUP
Boyanup Rd
Bridge St
STIRLING ESTATE
ELGIN
Trigwell Rd
Landgate / SLIP

Paper Size ISO A3

0 1 2 3 4

Kilometres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 50

N

GHD

Aqwest
Bunbury WWRS EPCM

Land use constraints

Project No. 12537061
Revision No. 0
Date 10 May 2021

FIGURE 2

G:\61\12537061\12_GIS\Maps\Working\Aqwest-Bunbury WWRS EPCM\12537061_2_Land_use_constraints_A.mxd
Print date: 10 May 2021 - 14:15

Data source: GHD: Survey Area - 20210325; Landgate: Roads (17 June 2016), Railway (6 Sep 2017) - 20180221, Suburb Boundary, Imagery - Oct. 2020 (accessed: 20210329). Created by: htaniza

LEGEND

- Project area
- Major Road

DBCA Geomorphic wetlands

- Conservation
- Multiple Use
- Not Assessed
- Resource Enhancement
- Watercourses

BUNBURY
SOUTH BUNBURY
EAST BUNBURY
GLEN IRIS
PICTON
CAREY PARK
WITHERS
USHER
COLLEGE GROVE
DAVENPORT
PICTON EAST
DARDANUP WEST
DALYELLUP
GELORUP
NORTH BOYANUP

Koombana Dr
Estuary Dr
Eelup Rd
Forrest Hwy
Sandridge Rd
Blair St
Spencer St
Picton Rd
South Western Hwy
Mangles St
Dodson Rd
Boyanup-Picton Rd
Robertson Dr
Ocean Dr
Parade Rd
Bussell Hwy
Willinge Dr
Washington Av
Bunbury Outer Ring Rd
Bussell Hwy

SLIP

Landgate / SLIP

Paper Size ISO A3

0 250 500 750 1,000

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 50

N

GHD

Aqwest
Bunbury WWRS EPCM

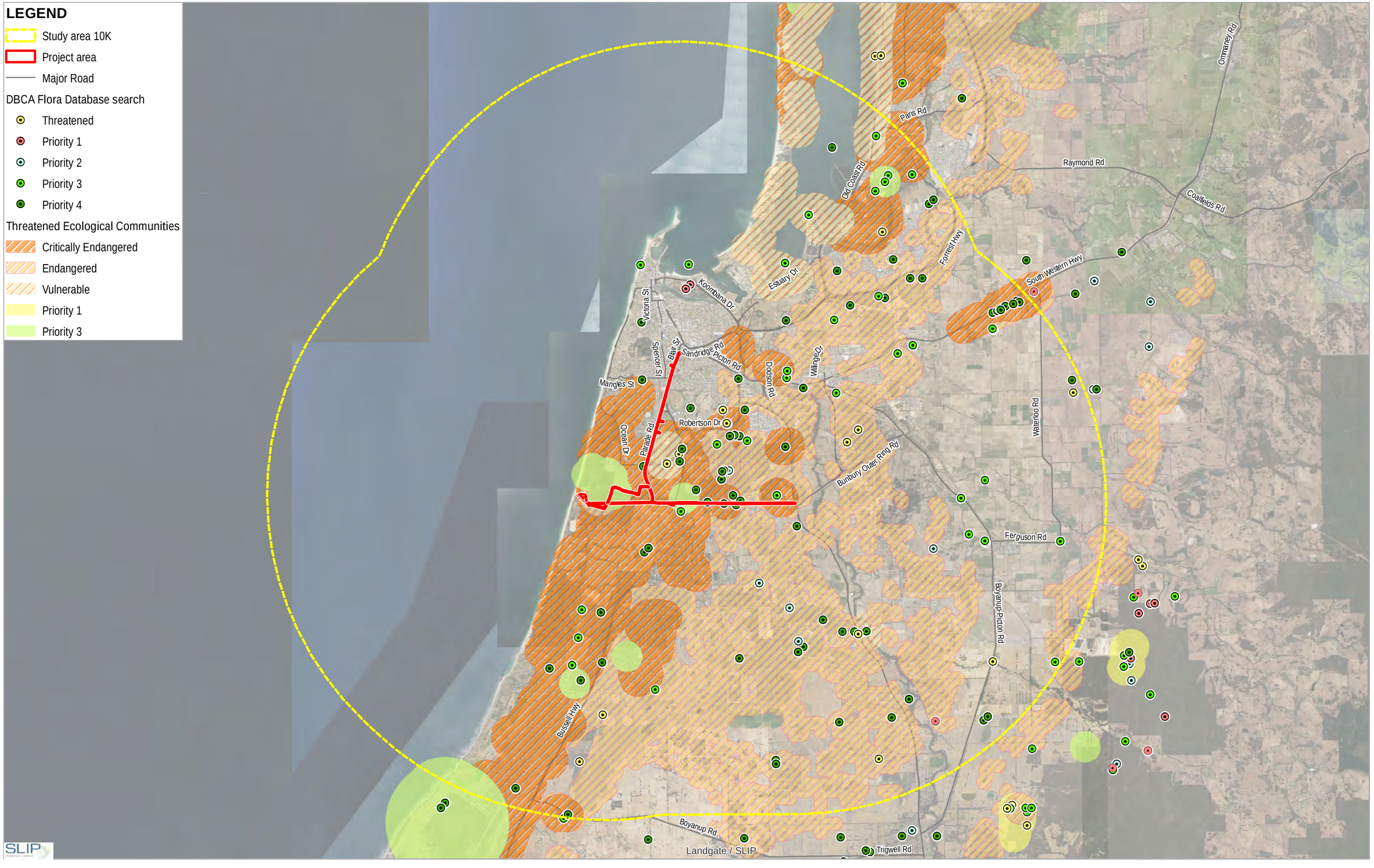
Project No. 12537061
Revision No. 0
Date 10 May 2021

Hydrology constraints

FIGURE 3

G:\61\12537061\12_GIS\Maps\Working\Aqwest-Bunbury WWRS EPCM\12537061_3_Hydrology_constraints_Rev11.mxd
Print date: 10 May 2021 - 14:28

Data source: GHD: Survey Area - 20210325; Landgate: Roads (17 June 2016), Railway (6 Sep 2017) - 20180221, Suburb Boundary, Imagery - Oct. 2020 (accessed: 20210329). Created by: htaniza



Paper Size ISO A3

0 1 2 3 4

Kilometres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 50

N

GHD

Aqwest
Bunbury WWRS EPCM

Biological constraints

Project No. 12537061
Revision No. 0
Date 10 May 2021

FIGURE 4

G:\61\12537061\12_GIS\Maps\Working\Aqwest-Bunbury WWRS EPCM\12537061_4_Biological_constraints_A_AA.mxd
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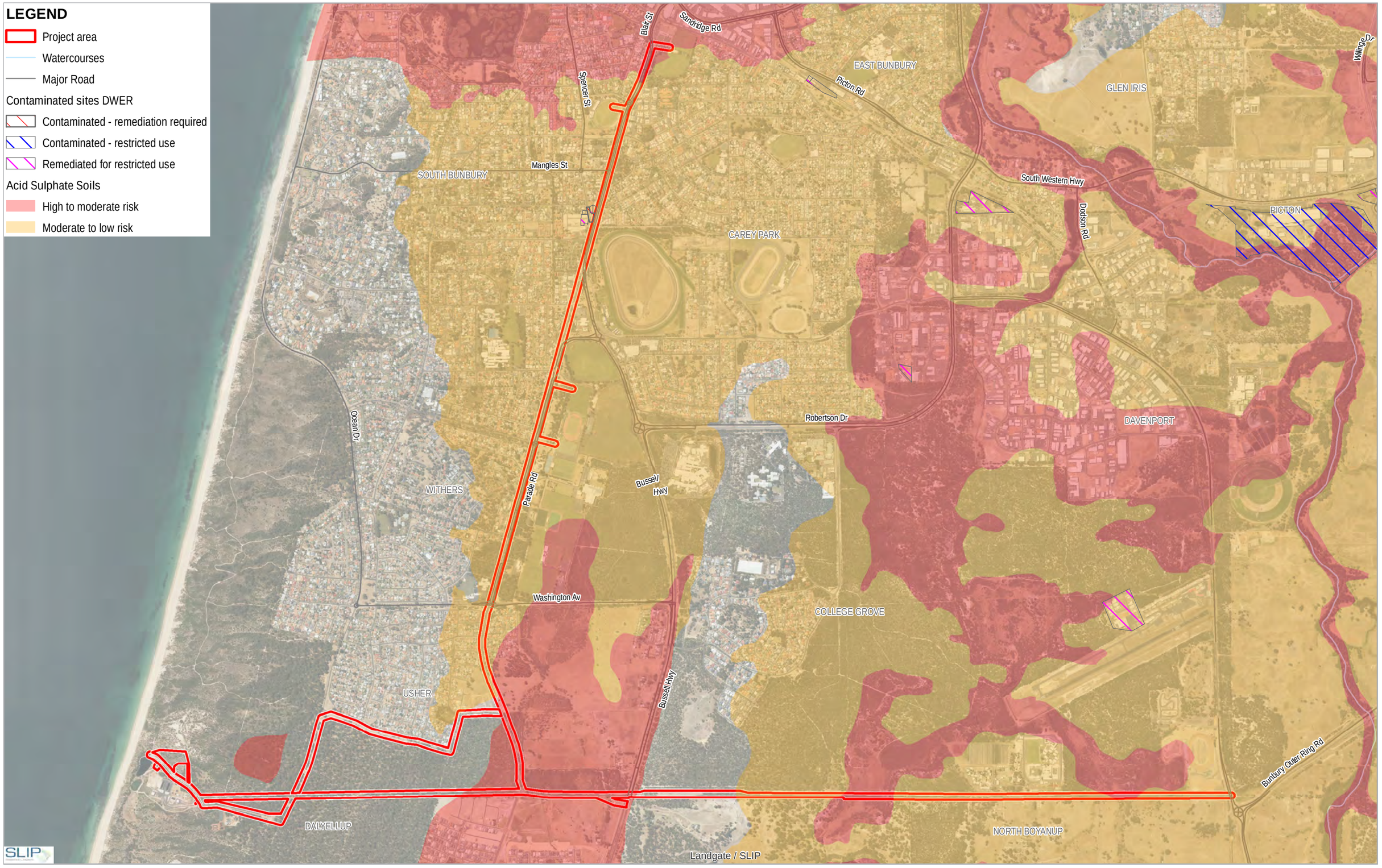

Paper Size ISO A3

0 250 500 750 1,000 Metres

N

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 50

GHD

Aqwest
Bunbury WWRS EPCM

Potential Acid Sulphate Soils and Contaminated Sites

Project No. 12537061
Revision No. 0
Date 10 May 2021

FIGURE 5

G:\61\12537061\12_GIS\Maps\Working\Aqwest-Bunbury WWRS EPCM\12537061_5_Potential Acid_Sulphate_soils_and_contaminated_sites_A.mxd
Print date: 10 May 2021 - 15:18

Data source: GHD: Survey Area - 20210325; Landgate: Roads (17 June 2016), Railway (6 Sep 2017) - 20180221, Suburb Boundary, Imagery - Oct. 2020 (accessed: 20210329). Created by: htaniza

LEGEND

- Project area
- Major Road

Soil Landscape Sub Systems

- Bassendean System
- Pinjarra System
- Quindalup South System
- Spearwood System
- Vasse System

Blair St
Sandridge Rd
Spencer St
EAST BUNBURY
Picton Rd
GLEN IRIS
Willinge Dr
SOUTH BUNBURY
Mangles St
South Western Hwy
Dodson Rd
PICTON
CAREY PARK
Ocean Dr
Robertson Dr
DAVENPORT
WITHERS
Parade Rd
Bussell Hwy
Washington Av
COLLEGE GROVE
USHER
Bussell Hwy
Bunbury Outer Ring Rd
DALYELLUP
NORTH BOYANUP

SLIP

Landgate / SLIP

Paper Size ISO A3

0 250 500 750 1,000

Metres

N

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 50

GHD

Aqwest
Bunbury WWRS EPCM

Soil Landscape Systems

Project No. 12537061
Revision No. 0
Date 10 May 2021

FIGURE 6

G:\61\12537061\12_GIS\Maps\Working\Aqwest-Bunbury WWRS EPCM\12537061_6_Soil_landscape_systems_A.mxd
Print date: 10 May 2021 - 15:27

Data source: GHD: Survey Area - 20210325; Landgate: Roads (17 June 2016), Railway (6 Sep 2017) - 20180221, Suburb Boundary, Imagery - Oct. 2020 (accessed: 20210329). Created by: htaniza

LEGEND

- Project area
- Major Road

Pre European Vegetation Complexes

- Karrakatta Complex-Central and South
- Quindalup Complex
- Southern River Complex
- Swan Complex
- Vasse Complex
- Yoongarillup Complex

Sandridge Rd
Blair St
Spencer St
Picton Rd
Wilmington Dr
Mangles St
South Western Hwy
Dodson Rd
Ocean Dr
Robertson Dr
Parade Rd
Washington Av
Bussell Hwy
Bunbury Outer Ring Rd

SLIP

Landgate / SLIP

Paper Size ISO A3

0 250 500 750 1,000

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 50

N

GHD

Aqwest
Bunbury WWRS EPCM

Project No. 12537061
Revision No. 0
Date 10 May 2021

Vegetation complexes

FIGURE 7

G:\61\12537061\12_GIS\Maps\Working\Aqwest-Bunbury WWRS EPCM\12537061_7_Vegetation_complexes_A.mxd
Print date: 10 May 2021 - 15:41

Data source: GHD: Survey Area - 20210325; Landgate: Roads (17 June 2016), Railway (6 Sep 2017) - 20180221, Suburb Boundary, Imagery - Oct. 2020 (accessed: 20210329). Created by: htaniza

LEGEND

- Project area
- Major Road

Status

- Other Heritage Sites
- Registered Aboriginal Sites

Paper Size ISO A3

0 250 500 750 1,000

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 50

N

GHD

Aqwest
Bunbury WWRS EPCM

Heritage constraints

Project No. 12537061
Revision No. 0
Date 10 May 2021

FIGURE 8

G:\61\12537061\12_GIS\Maps\Working\Aqwest-Bunbury WWRS EPCM\12537061_8_Heritage_constraints_A.mxd
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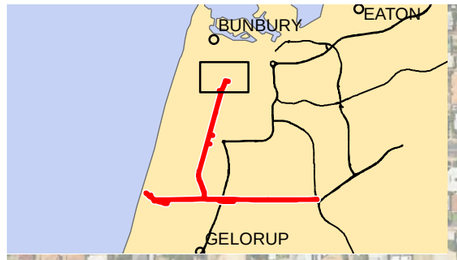

LEGEND

Project area

Survey track logs

Vegetation Type

F - Scattered *Eucalyptus gomphocephala* and/or *Eucalyptus marginata* Tall Open Woodland over introduced species

P - Roads and tracks, cleared road verge (sometimes with planted trees) and pasture and parkland

SLIP

Landgate / SLIP

Paper Size ISO A3

0 25 50 75 100

Meters

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 50

N

GHD

Aqwest
Bunbury WWRS EPCM

Flora and Vegetation Survey Results

Project No. 12537061
Revision No. 2
Date 17 Nov 2021

FIGURE 9 - 1

\\ghdnet.internal\ghd\AU\Perth\Projects\61\12537061\12_GIS\Maps\Working\Aqwest-Bunbury WWRS EPCM\12537061_9_Flora_and_Vegetation_Survey_Results_1.mxd
Print date: 17 Nov 2021 - 16:43

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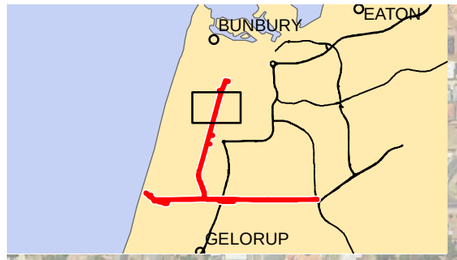

LEGEND

Project area

Major Roads

Survey track logs

Vegetation Type

P - Roads and tracks, cleared road verge (sometimes with planted trees) and pasture and parkland

Bussell Hwy

Landgate / SLIP

SLIP

Paper Size ISO A3

0 25 50 75 100

Meters

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 50

N

GHD

Aqwest
Bunbury WWRS EPCM

Flora and Vegetation Survey Results

Project No. 12537061
Revision No. 2
Date 17 Nov 2021

FIGURE 9 - 2

\\ghdnet.internal\ghd\AU\Perth\Projects\61\12537061\12_GIS\Maps\Working\Aqwest-Bunbury WWRS EPCM\12537061_9_Flora_and_Vegetation_Survey_Results_1.mxd
Print date: 17 Nov 2021 - 16:44

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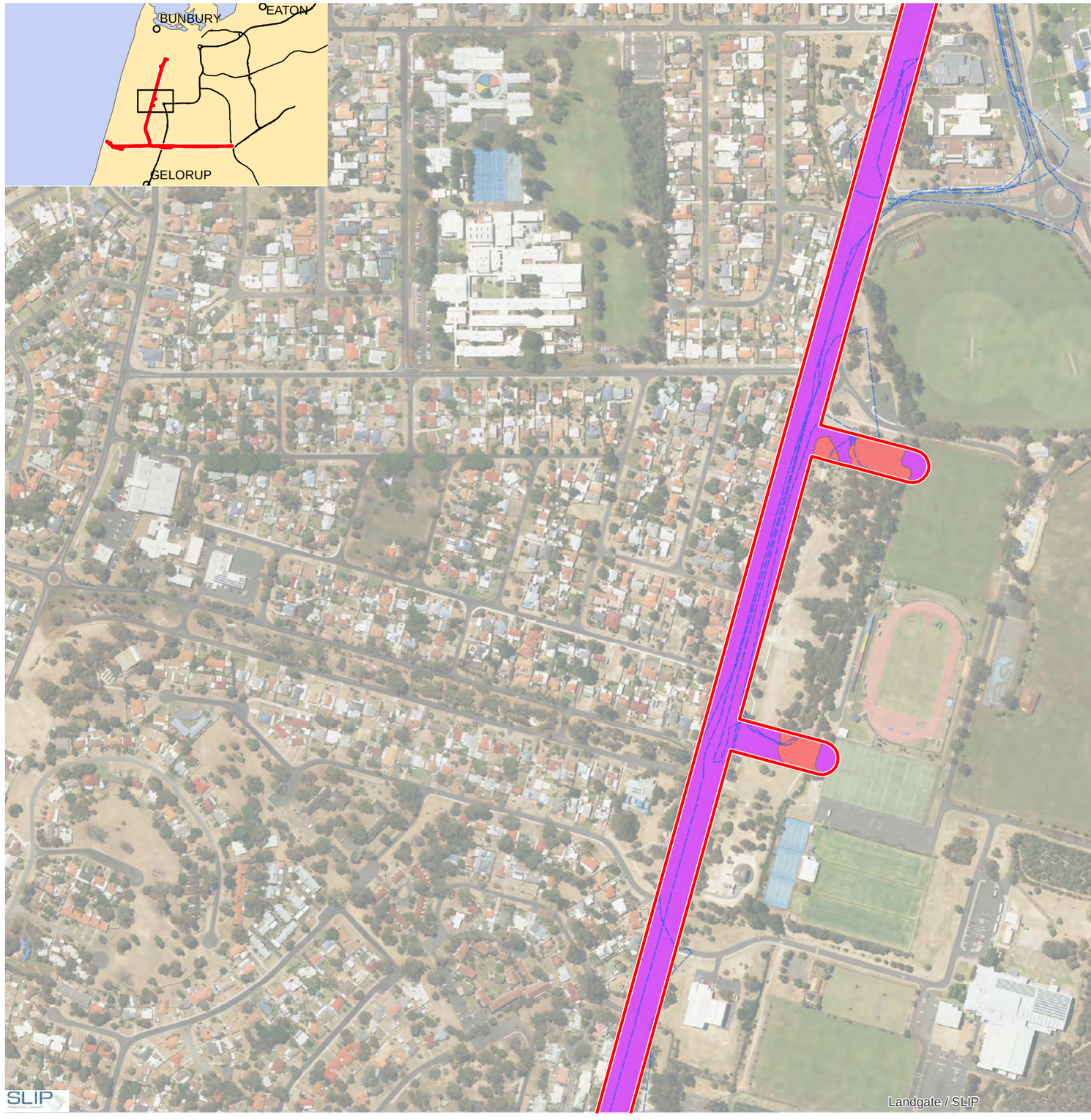

LEGEND

Project area

Major Roads

Survey track logs

Vegetation Type

F - Scattered *Eucalyptus gomphocephala* and/or *Eucalyptus marginata* Tall Open Woodland over introduced species

P - Roads and tracks, cleared road verge (sometimes with planted trees) and pasture and parkland

Paper Size ISO A3

0 25 50 75 100

Meters

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 50

N

GHD

Aqwest
Bunbury WWRS EPCM

Flora and Vegetation Survey Results

Project No. 12537061
Revision No. 2
Date 17 Nov 2021

FIGURE 9 - 3

\\ghdnet.internal\ghd\AU\Perth\Projects\61\12537061\12_GIS\Maps\Working\Aqwest-Bunbury WWRS EPCM\12537061_9_Flora_and_Vegetation_Survey_Results_1.mxd
Print date: 17 Nov 2021 - 16:45

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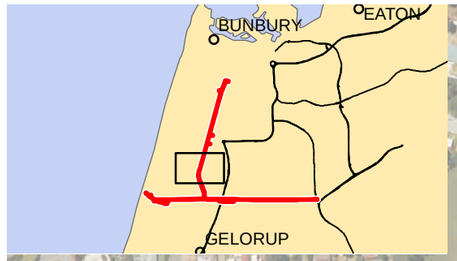

LEGEND

Project area

Major Roads

Survey track logs

Vegetation Type

B - *Eucalyptus gomphocephala* with scattered *Eucalyptus marginata* Tall Woodland over *Agonis flexuosa* Mid-height Open Forest

F - Scattered *Eucalyptus gomphocephala* and/or *Eucalyptus marginata* Tall Open Woodland over introduced species

P - Roads and tracks, cleared road verge (sometimes with planted trees) and pasture and parkland

Paper Size ISO A3

0 25 50 75 100

Meters

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 50

N

GHD

Aqwest
Bunbury WWRS EPCM

Flora and Vegetation Survey Results

Project No. 12537061
Revision No. 2
Date 17 Nov 2021

FIGURE 9 - 4

\\ghdnet.internal\ghd\AU\Perth\Projects\61\12537061\2_GIS\Maps\Working\Aqwest-Bunbury WWRS EPCM\12537061_9_Flora_and_Vegetation_Survey_Results_1.mxd
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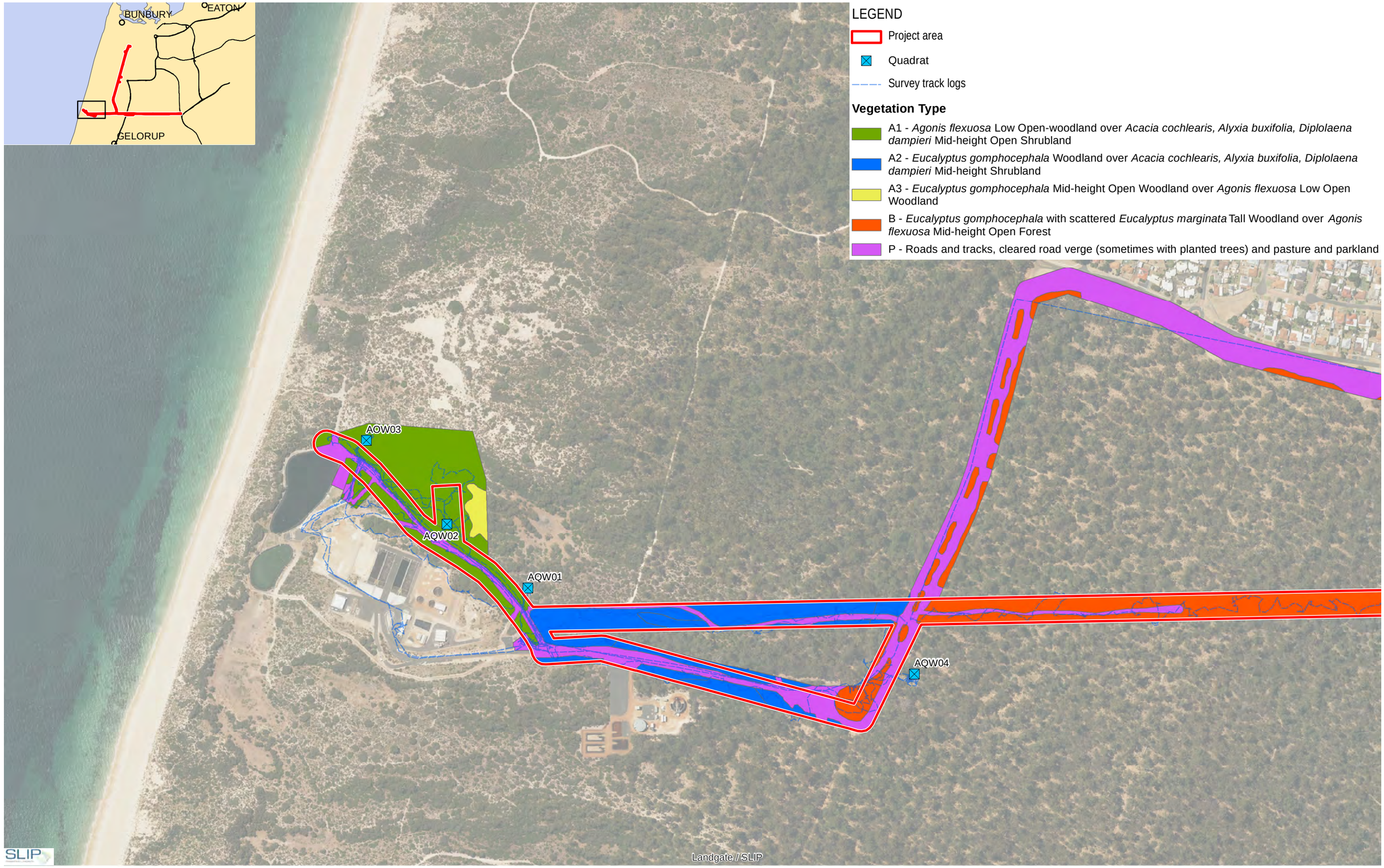

LEGEND

- Project area
- Quadrat
- Survey track logs

Vegetation Type

- A1 - *Agonis flexuosa* Low Open-woodland over *Acacia cochlearis, Alyxia buxifolia, Diplolaena dampieri* Mid-height Open Shrubland
- A2 - *Eucalyptus gomphocephala* Woodland over *Acacia cochlearis, Alyxia buxifolia, Diplolaena dampieri* Mid-height Shrubland
- A3 - *Eucalyptus gomphocephala* Mid-height Open Woodland over *Agonis flexuosa* Low Open Woodland
- B - *Eucalyptus gomphocephala* with scattered *Eucalyptus marginata* Tall Woodland over *Agonis flexuosa* Mid-height Open Forest
- P - Roads and tracks, cleared road verge (sometimes with planted trees) and pasture and parkland

Paper Size ISO A3

0 25 50 75 100

Meters

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 50

N

GHD

Aqwest
Bunbury WWRS EPCM

Flora and Vegetation Survey Results

Project No. 12537061
Revision No. 2
Date 17 Nov 2021

FIGURE 9 - 5

\\ghdnet.internal\ghd\AU\Perth\Projects\61\12537061\12_GIS\Maps\Working\Aqwest-Bunbury WWRS EPCM\12537061_9_Flora_and_Vegetation_Survey_Results_1.mxd
Print date: 17 Nov 2021 - 16:47

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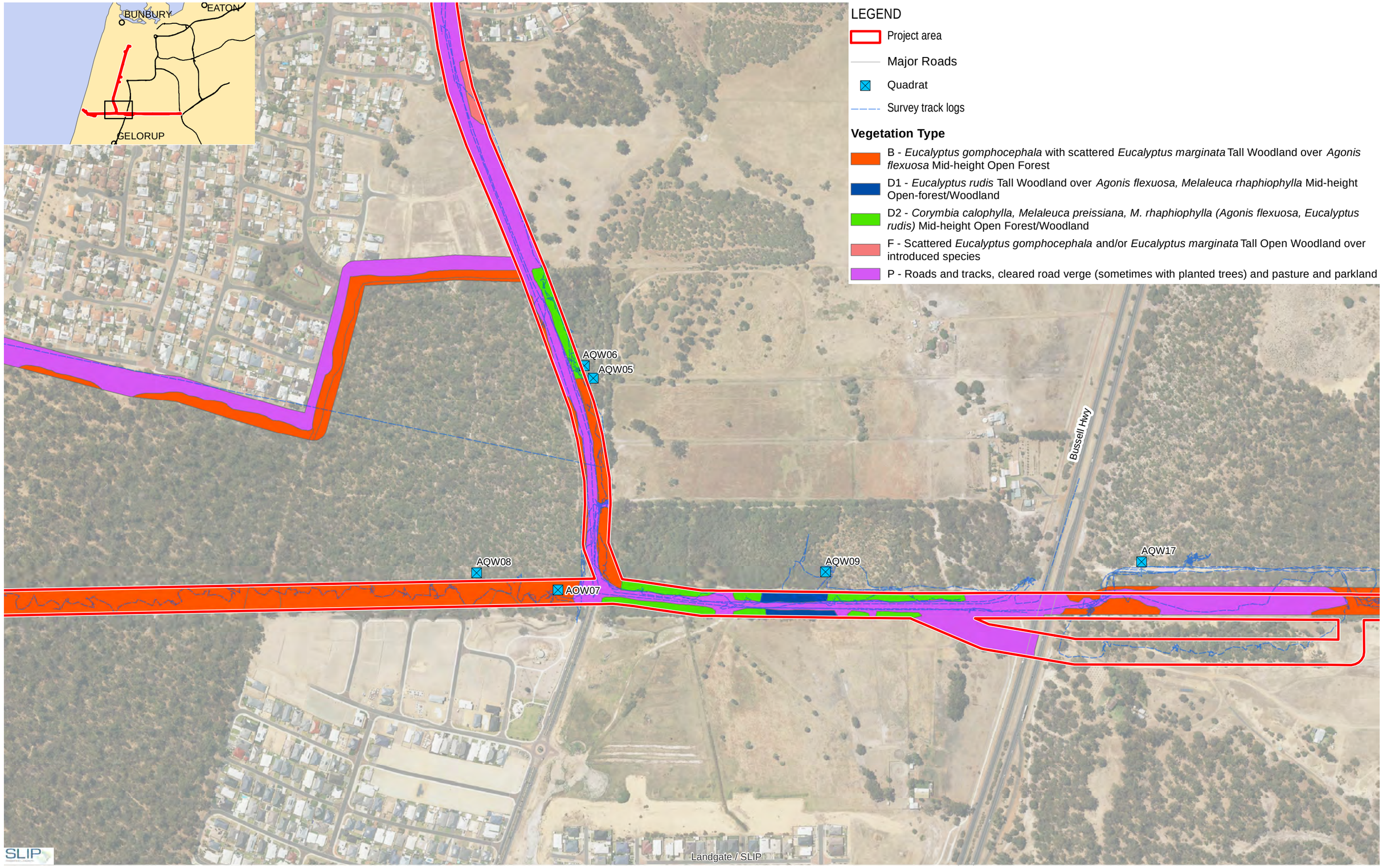


LEGEND

- Project area
- Major Roads
- Quadrat
- Survey track logs

Vegetation Type

- B - *Eucalyptus gomphocephala* with scattered *Eucalyptus marginata* Tall Woodland over *Agonis flexuosa* Mid-height Open Forest
- D1 - *Eucalyptus rudis* Tall Woodland over *Agonis flexuosa, Melaleuca rhaphiophylla* Mid-height Open-forest/Woodland
- D2 - *Corymbia calophylla, Melaleuca preissiana, M. rhaphiophylla (Agonis flexuosa, Eucalyptus rudis)* Mid-height Open Forest/Woodland
- F - Scattered *Eucalyptus gomphocephala* and/or *Eucalyptus marginata* Tall Open Woodland over introduced species
- P - Roads and tracks, cleared road verge (sometimes with planted trees) and pasture and parkland

Paper Size ISO A3

0 25 50 75 100

Meters

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 50

N

GHD

Aqwest
Bunbury WWRS EPCM

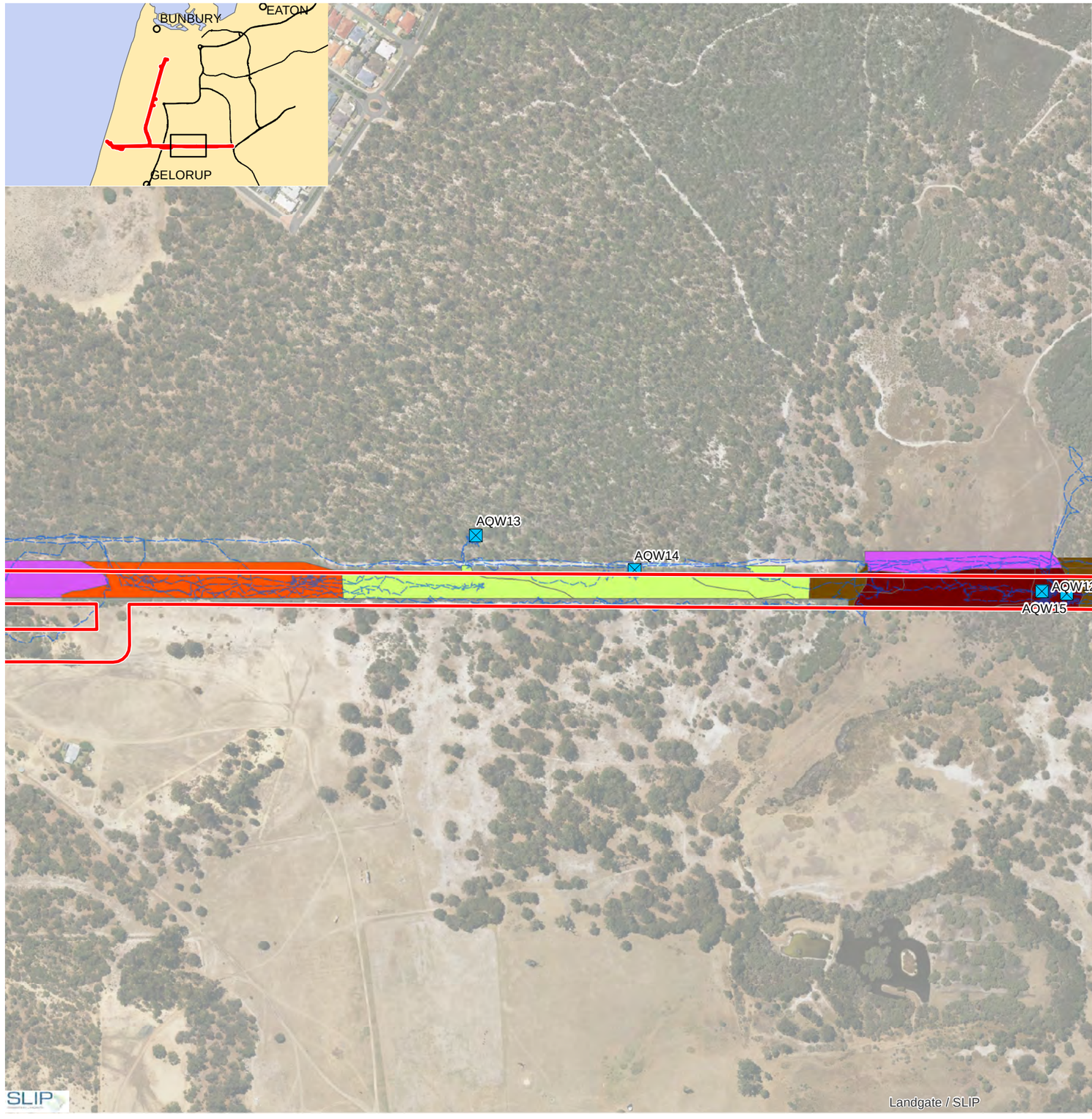
Flora and Vegetation Survey Results

Project No. 12537061
Revision No. 2
Date 17 Nov 2021

FIGURE 9 - 6

\\ghdnet.internal\ghd\AU\Perth\Projects\61\12537061\12_GIS\Maps\Working\Aqwest-Bunbury WWRS EPCM\12537061_9_Flora_and_Vegetation_Survey_Results_1.mxd
Print date: 17 Nov 2021 - 16:48

Data source: GHD: Survey Area - 20181019; Landgate: Roads (17 June 2016), Railway (6 Sep 2017) - 20180221, Suburb Boundary, Imagery (Apr. 2020). Created by: vdavies



LEGEND

Project area

Quadrat

Survey track logs

Vegetation Type

B - *Eucalyptus gomphocephala* with scattered *Eucalyptus marginata* Tall Woodland over *Agonis flexuosa* Mid-height Open Forest

C1 - *Eucalyptus marginata, Banksia attenuata, Xylomelum occidentale* Woodland over *Kunzea glabrescens* Tall Shrubland

C2 - *Corymbia calophylla* Open Forest over *Kunzea glabrescens* Tall Shrubland

C3 - *Corymbia calophylla, Eucalyptus marginata* Open Forest over *Agonis flexuosa, Banksia attenuata* Low Woodland

E1 - *Hakea varia, Melaleuca viminea* Open-shrubland, with emergent *Melaleuca rhaphiophylla* and (scattered emergent *Eucalyptus rudis*)

P - Roads and tracks, cleared road verge (sometimes with planted trees) and pasture and parkland

Paper Size ISO A3

0 25 50 75 100

Meters

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 50

N

GHD

Aqwest
Bunbury WWRS EPCM

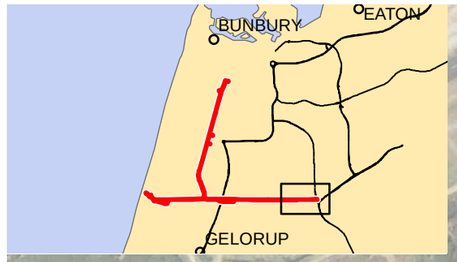
Flora and Vegetation Survey Results

Project No. 12537061
Revision No. 2
Date 17 Nov 2021

FIGURE 9 - 7

\\ghdnet.internal\ghd\AU\Perth\Projects\61\12537061\12_GIS\Maps\Working\Aqwest-Bunbury WWRS EPCM\12537061_9_Flora_and_Vegetation_Survey_Results_1.mxd
Print date: 17 Nov 2021 - 16:49

Data source: GHD: Survey Area - 20181019; Landgate: Roads (17 June 2016), Railway (6 Sep 2017) - 20180221, Suburb Boundary, Imagery (Apr. 2020). Created by: vdavies



LEGEND

Project area

Major Roads

Quadrat

Survey track logs

Vegetation Type

C3 - *Corymbia calophylla, Eucalyptus marginata* Open Forest over *Agonis flexuosa, Banksia attenuata* Low Woodland

E2 - *Eucalyptus rudis, Melaleuca rhaphiophylla* Woodland over *Acacia saligna, Melaleuca viminea* Tall Open-shrubland

P - Roads and tracks, cleared road verge (sometimes with planted trees) and pasture and parkland

Paper Size ISO A3

0 25 50 75 100

Meters

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 50

N

GHD

Aqwest
Bunbury WWRS EPCM

Flora and Vegetation Survey Results

Project No. 12537061
Revision No. 2
Date 17 Nov 2021

FIGURE 9 - 8

\\ghdnet.internal\ghd\AU\Perth\Projects\61\12537061\12_GIS\Maps\Working\Aqwest-Bunbury WWRS EPCM\12537061_9_Flora_and_Vegetation_Survey_Results_1.mxd
Print date: 17 Nov 2021 - 16:50

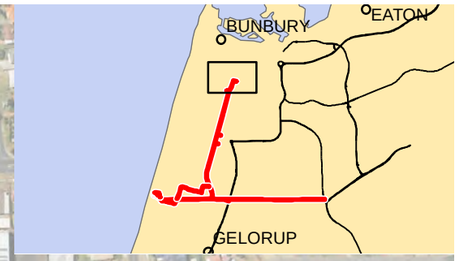
Data source: GHD: Survey Area - 20181019; Landgate: Roads (17 June 2016), Railway (6 Sep 2017) - 20180221, Suburb Boundary, Imagery (Apr. 2020). Created by: vdavies

LEGEND

Project area

Vegetation Condition

Completely Degraded



SLIP

Landgate / SLIP

Paper Size ISO A3

0 25 50 75 100

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 50

N

GHD

Aqwest
Bunbury WWRS EPCM

Vegetation Condition
Survey Results

Project No. 12537061
Revision No. 1
Date 02 Nov 2021

FIGURE 10 - 1

\\ghdnet.internal\ghd\AU\Perth\Projects\61\12537061\12_GIS\Maps\Working\Aqwest-Bunbury WWRS EPCM\12537061_10_B_Vegetation_Condition_Survey_Results_A1.mxd
Print date: 02 Nov 2021 - 12:29

Data source: GHD: Survey Area, Vegetation Condition - 20210325; Landgate: Roads (17 June 2016), Railway (6 Sep 2017) - 20180221, Suburb Boundary, Imagery Oct. 2020 (accessed 20210330). Created by: vdavies

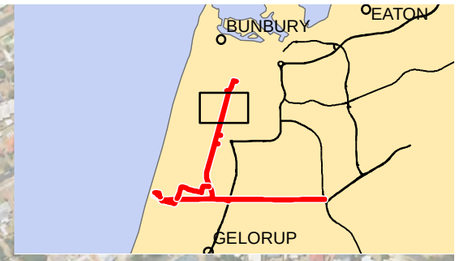
LEGEND

Project area

Major Roads

Vegetation Condition

Completely Degraded



Bussell Hwy

SLIP

Landgate / SLIP

Paper Size ISO A3

0 25 50 75 100

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 50

N

GHD

Aqwest
Bunbury WWRS EPCM

Vegetation Condition
Survey Results

Project No. 12537061
Revision No. 1
Date 02 Nov 2021

FIGURE 10 - 2

\\ghdnet.internal\ghd\AU\Perth\Projects\61\12537061\12_GIS\Maps\Working\Aqwest-Bunbury WWRS EPCM\12537061_10_B_Vegetation_Condition_Survey_Results_A1.mxd
Print date: 02 Nov 2021 - 12:30

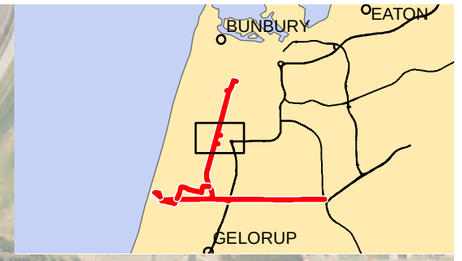
Data source: GHD: Survey Area, Vegetation Condition - 20210325; Landgate: Roads (17 June 2016), Railway (6 Sep 2017) - 20180221, Suburb Boundary, Imagery Oct. 2020 (accessed 20210330). Created by: vdavies

LEGEND

- Project area
- Major Roads

Vegetation Condition

- Degraded
- Completely Degraded



Bussell Hwy

Robertson Dr

SLIP

Landgate / SLIP

Paper Size ISO A3

0 25 50 75 100

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 50

N

GHD

Aqwest
Bunbury WWRS EPCM

Vegetation Condition
Survey Results

Project No. 12537061
Revision No. 1
Date 02 Nov 2021

FIGURE 10 - 3

\\ghdnet.internal\ghd\AU\Perth\Projects\61\12537061\12_GIS\Maps\Working\Aqwest-Bunbury WWRS EPCM\12537061_10_B_Vegetation_Condition_Survey_Results_A1.mxd
Print date: 02 Nov 2021 - 12:30

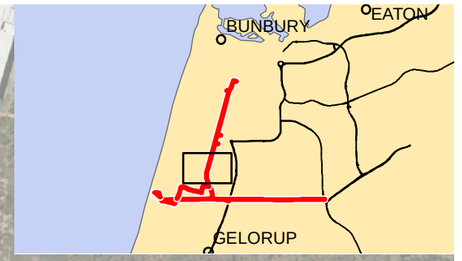
Data source: GHD: Survey Area, Vegetation Condition - 20210325; Landgate: Roads (17 June 2016), Railway (6 Sep 2017) - 20180221, Suburb Boundary, Imagery Oct. 2020 (accessed 20210330). Created by: vdavies

LEGEND

- Project area
- Major Roads

Vegetation Condition

- Good
- Degraded
- Completely Degraded



SLIP

Landgate / SLIP

Bussell Hwy

Paper Size ISO A3

0 25 50 75 100

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 50

N

GHD

Aqwest
Bunbury WWRS EPCM

Vegetation Condition Survey Results

Project No. 12537061
Revision No. 1
Date 02 Nov 2021

FIGURE 10 - 4

\\ghdnet.internal\ghd\AU\Perth\Projects\61\12537061\12_GIS\Maps\Working\Aqwest-Bunbury WWRS EPCM\12537061_10_B_Vegetation_Condition_Survey_Results_A1.mxd
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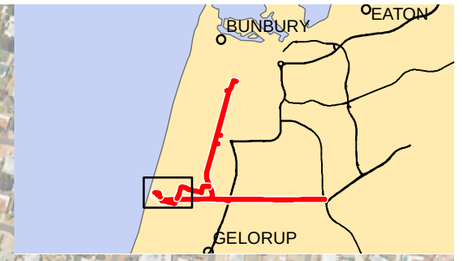
Data source: GHD: Survey Area, Vegetation Condition - 20210325; Landgate: Roads (17 June 2016), Railway (6 Sep 2017) - 20180221, Suburb Boundary, Imagery Oct. 2020 (accessed 20210330). Created by: vdavies

LEGEND

Project area

Vegetation Condition

- Excellent
- Very Good
- Good
- Degraded
- Completely Degraded



SLIP

Landgate / SLIP

Paper Size ISO A3

0 25 50 75 100

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 50

N

GHD

Aqwest
Bunbury WWRS EPCM

Vegetation Condition
Survey Results

Project No. 12537061
Revision No. 1
Date 02 Nov 2021

FIGURE 10 - 5

\\ghdnet.internal\ghd\AU\Perth\Projects\61\12537061\12_GIS\Maps\Working\Aqwest-Bunbury WWRS EPCM\12537061_10_B_Vegetation_Condition_Survey_Results_A1.mxd
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Data source: GHD: Survey Area, Vegetation Condition - 20210325; Landgate: Roads (17 June 2016), Railway (6 Sep 2017) - 20180221, Suburb Boundary, Imagery Oct. 2020 (accessed 20210330). Created by: vdavies

LEGEND

Project area

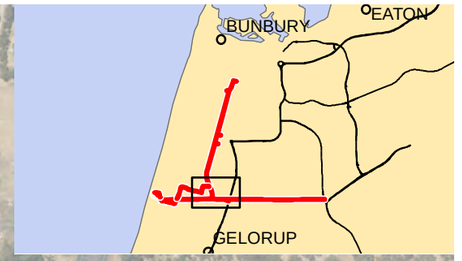
Major Roads

Declared pest plant and significant weed flora points

- *Acacia iteaphylla
- *Acacia longifolia
- *Asparagus asparagoides
- Ipomoea indica

Vegetation Condition

- Very Good
- Good
- Degraded
- Completely Degraded



Bussell Hwy

SLIP

Landgate / SLIP

Paper Size ISO A3

0 25 50 75 100

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 50

N

GHD

Aqwest
Bunbury WWRS EPCM

Vegetation Condition Survey Results

Project No. 12537061
Revision No. 1
Date 02 Nov 2021

FIGURE 10 - 6

\\ghdnet.internal\ghd\AU\Perth\Projects\61\12537061\12_GIS\Maps\Working\Aqwest-Bunbury WWRS EPCM\12537061_10_B_Vegetation_Condition_Survey_Results_A1.mxd
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Data source: GHD: Survey Area, Vegetation Condition - 20210325; Landgate: Roads (17 June 2016), Railway (6 Sep 2017) - 20180221, Suburb Boundary, Imagery Oct. 2020 (accessed 20210330). Created by: vdavies

LEGEND

Project area

Declared pest plant and significant weed flora points

*Acacia iteaphylla

*Acacia longifolia

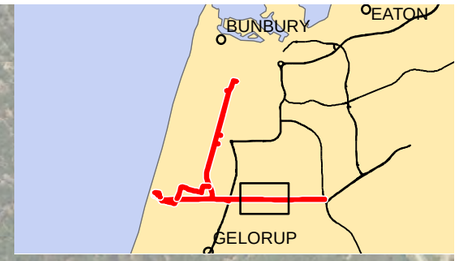
Vegetation Condition

Very Good

Good

Degraded

Completely Degraded



SLIP

Landgate / SLIP

Paper Size ISO A3

0 25 50 75 100

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 50

N

GHD

Aqwest
Bunbury WWRS EPCM

Vegetation Condition
Survey Results

Project No. 12537061
Revision No. 1
Date 02 Nov 2021

FIGURE 10 - 7

\\ghdnet.internal\ghd\AU\Perth\Projects\61\12537061\2_GIS\Maps\Working\Aqwest-Bunbury WWRS EPCM\12537061_10_B_Vegetation_Condition_Survey_Results_A1.mxd
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Data source: GHD: Survey Area, Vegetation Condition - 20210325; Landgate: Roads (17 June 2016), Railway (6 Sep 2017) - 20180221, Suburb Boundary, Imagery Oct. 2020 (accessed 20210330). Created by: vdavies

LEGEND

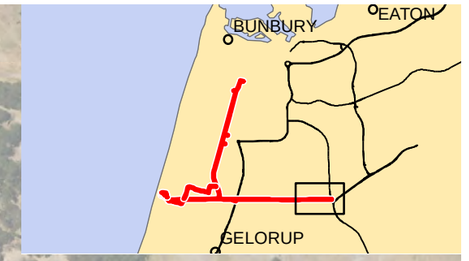
- Project area
- Major Roads

Declared pest plant and significant weed flora points

- ★ *Asparagus asparagoides

Vegetation Condition

- Good
- Degraded
- Completely Degraded



South Western Hwy

Bunbury Outer Ring Rd

SLIP

Landgate / SLIP

Paper Size ISO A3

0 25 50 75 100

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 50

N

GHD

Aqwest
Bunbury WWRS EPCM

Vegetation Condition Survey Results

Project No. 12537061
Revision No. 1
Date 02 Nov 2021

FIGURE 10 - 8

\\ghdnet.internal\ghd\AU\Perth\Projects\61\12537061\12_GIS\Maps\Working\Aqwest-Bunbury WWRS EPCM\12537061_10_B_Vegetation_Condition_Survey_Results_A1.mxd
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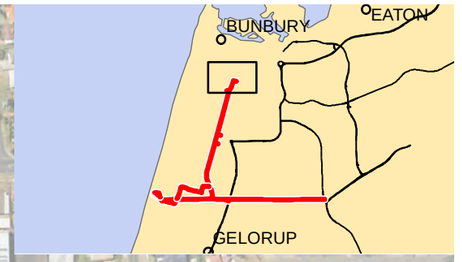
LEGEND

Project area



SLIP

Landgate / SLIP

Paper Size ISO A3

0 25 50 75 100

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 50

N

GHD

Aqwest
Bunbury WWRS EPCM

Conservation Significant Flora and Vegetation

Project No. 12537061
Revision No. 1
Date 02 Nov 2021

FIGURE 11 - 1

\\ghdnet.internal\ghd\AU\Perth\Projects\61\12537061\12_GIS\Maps\Working\Aqwest-Bunbury WWRS EPCM\12537061_11_B_Conservation_Significant_Flora_and_Vegetation_A1.mxd
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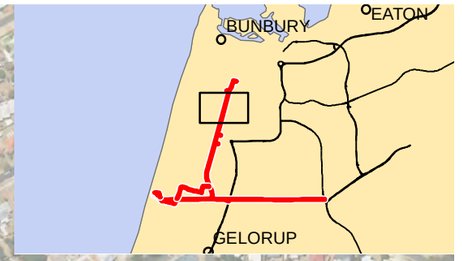
Data source: GHD: Survey Area, Flora Points, TEC and PEC Vegetation - 20210325; Landgate: Roads (17 June 2016), Railway (6 Sep 2017) - 20180221, Suburb Boundary, Imagery Oct. 2020 (accessed 20210330) . Created by: vdavies

LEGEND

Project area



Bussell Hwy

Landgate / SLIP

SLIP

Paper Size ISO A3

0 25 50 75 100

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 50

N

GHD

Aqwest
Bunbury WWRS EPCM

Conservation Significant Flora and Vegetation

Project No. 12537061
Revision No. 1
Date 02 Nov 2021

FIGURE 11 - 2

\\ghdnet.internal\ghd\AU\Perth\Projects\61\12537061\12_GIS\Maps\Working\Aqwest-Bunbury WWRS EPCM\12537061_11_B_Conservation_Significant_Flora_and_Vegetation_A1.mxd
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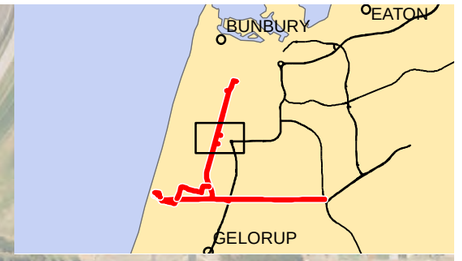
Data source: GHD: Survey Area, Flora Points, TEC and PEC Vegetation - 20210325; Landgate: Roads (17 June 2016), Railway (6 Sep 2017) - 20180221, Suburb Boundary, Imagery Oct. 2020 (accessed 20210330) . Created by: vdavies

LEGEND

Project area



Bussell Hwy

Robertson Dr

Landgate / SLIP

SLIP

Paper Size ISO A3

0 25 50 75 100

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 50

N

GHD

Aqwest
Bunbury WWRS EPCM

Conservation Significant Flora and Vegetation

Project No. 12537061
Revision No. 1
Date 02 Nov 2021

FIGURE 11 - 3

\\ghdnet.internal\ghd\AU\Perth\Projects\61\12537061\12_GIS\Maps\Working\Aqwest-Bunbury WWRS EPCM\12537061_11_B_Conservation_Significant_Flora_and_Vegetation_A1.mxd
Print date: 02 Nov 2021 - 10:23

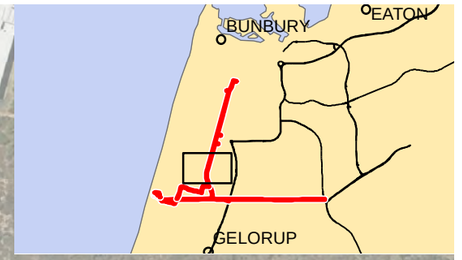
Data source: GHD: Survey Area, Flora Points, TEC and PEC Vegetation - 20210325; Landgate: Roads (17 June 2016), Railway (6 Sep 2017) - 20180221, Suburb Boundary, Imagery Oct. 2020 (accessed 20210330) . Created by: vdavies

LEGEND

Project area

TEC and PEC Vegetation

EPBC TEC Tuart*(Eucalyptus gomphocephala)* woodlands and forests of the Swan Coastal Plain



Landgate / SLIP

Bussell Hwy

Paper Size ISO A3

0 25 50 75 100

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 50

N

GHD

Aqwest
Bunbury WWRS EPCM

Conservation Significant Flora and Vegetation

Project No. 12537061
Revision No. 1
Date 02 Nov 2021

FIGURE 11 - 4

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Data source: GHD: Survey Area, Flora Points, TEC and PEC Vegetation - 20210325; Landgate: Roads (17 June 2016), Railway (6 Sep 2017) - 20180221, Suburb Boundary, Imagery Oct. 2020 (accessed 20210330) . Created by: vdavies

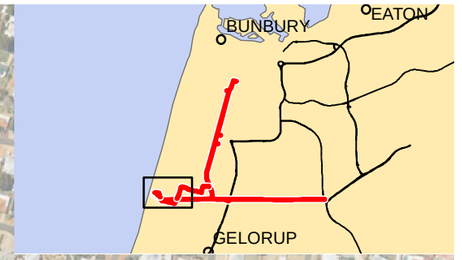
LEGEND

Project area

TEC and PEC Vegetation

EPBC TEC Tuart*(Eucalyptus gomphocephala)* woodlands and forests of the Swan Coastal Plain

EPBC TEC Tuart (Eucalyptus gomphocephala) woodlands and forests of the Swan Coastal Plain, WA PEC Quindalup *Eucalyptus gomphocephala* and / or *Agonis flexuosa* woodlands



Lasiopetalum membranaceum

Lasiopetalum membranaceum

Lasiopetalum membranaceum

Lasiopetalum membranaceum

Lasiopetalum membranaceum

Lasiopetalum membranaceum

SLIP

Landgate / SLIP

Paper Size ISO A3

0 25 50 75 100

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 50

N

GHD

Aqwest
Bunbury WWRS EPCM

Conservation Significant Flora and Vegetation

Project No. 12537061
Revision No. 1
Date 02 Nov 2021

FIGURE 11 - 5

\\ghdnet.internal\ghd\AU\Perth\Projects\61\12537061\12_GIS\Maps\Working\Aqwest-Bunbury WWRS EPCM\12537061_11_B_Conservation_Significant_Flora_and_Vegetation_A1.mxd
Print date: 02 Nov 2021 - 10:25

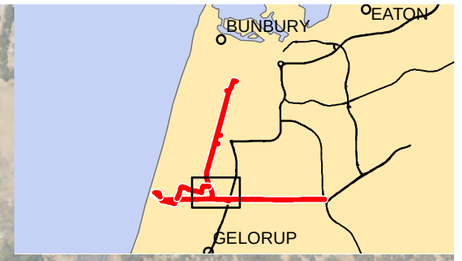
Data source: GHD: Survey Area, Flora Points, TEC and PEC Vegetation - 20210325; Landgate: Roads (17 June 2016), Railway (6 Sep 2017) - 20180221, Suburb Boundary, Imagery Oct. 2020 (accessed 20210330) . Created by: vdavies

LEGEND

Project area

TEC and PEC Vegetation

EPBC TEC Tuart*(Eucalyptus gomphocephala)* woodlands and forests of the Swan Coastal Plain



Lasiopetalum membranaceum

Lasiopetalum membranaceum

Lasiopetalum membranaceum

Bussell Hwy

Landgate / SLIP

SLIP

Paper Size ISO A3

0 25 50 75 100

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 50

N

GHD

Aqwest
Bunbury WWRS EPCM

Conservation Significant Flora and Vegetation

Project No. 12537061
Revision No. 1
Date 02 Nov 2021

FIGURE 11 - 6

\\ghdnet.internal\ghd\AU\Perth\Projects\61\12537061\12_GIS\Maps\Working\Aqwest-Bunbury WWRS EPCM\12537061_11_B_Conservation_Significant_Flora_and_Vegetation_A1.mxd
Print date: 02 Nov 2021 - 10:26

Data source: GHD: Survey Area, Flora Points, TEC and PEC Vegetation - 20210325; Landgate: Roads (17 June 2016), Railway (6 Sep 2017) - 20180221, Suburb Boundary, Imagery Oct. 2020 (accessed 20210330) . Created by: vdavies

LEGEND

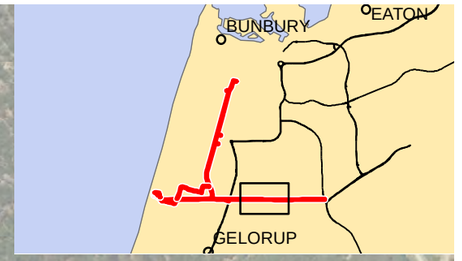
Project area

TEC and PEC Vegetation

EPBC TEC Banksia Woodlands of the Swan Coastal Plain, WA PEC Banksia Woodlands of the Swan Coastal Plain

EPBC TEC Clay pans of the Swan Coastal Plain, WA TEC Herb rich saline shrublands in clay pans (FCT07) / Dense shrublands on clay flats (FCT09)

EPBC TEC Tuart*(Eucalyptus gomphocephala)* woodlands and forests of the Swan Coastal Plain



Caladenia speciosa

Caladenia speciosa

Blennospora doliiformis

Lasiopetalum membranaceum

SLIP

Landgate / SLIP

Paper Size ISO A3

0 25 50 75 100

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 50

N

GHD

Aqwest
Bunbury WWRS EPCM

Conservation Significant Flora and Vegetation

Project No. 12537061
Revision No. 1
Date 02 Nov 2021

FIGURE 11 - 7

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Print date: 02 Nov 2021 - 10:26

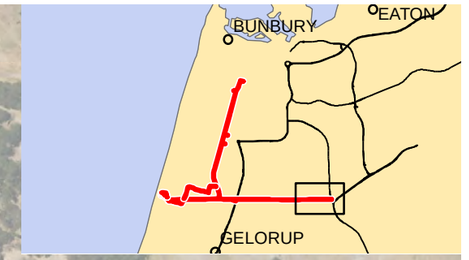
Data source: GHD: Survey Area, Flora Points, TEC and PEC Vegetation - 20210325; Landgate: Roads (17 June 2016), Railway (6 Sep 2017) - 20180221, Suburb Boundary, Imagery Oct. 2020 (accessed 20210330) . Created by: vdavies

LEGEND

Project area

TEC and PEC Vegetation

EPBC TEC Clay pans of the Swan Coastal Plain, WA TEC Herb rich saline shrublands in clay pans (FCT07) / Dense shrublands on clay flats (FCT09)



South Western Hwy

Bunbury Outer Ring Rd

SLIP

Landgate / SLIP

Paper Size ISO A3

0 25 50 75 100

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 50

N

GHD

Aqwest
Bunbury WWRS EPCM

Conservation Significant Flora and Vegetation

Project No. 12537061
Revision No. 1
Date 02 Nov 2021

FIGURE 11 - 8

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Print date: 02 Nov 2021 - 10:27

Data source: GHD: Survey Area, Flora Points, TEC and PEC Vegetation - 20210325; Landgate: Roads (17 June 2016), Railway (6 Sep 2017) - 20180221, Suburb Boundary, Imagery Oct. 2020 (accessed 20210330) . Created by: vdavies

Appendix B – Relevant legislation, background information and conservation codes

Relevant legislation

Federal *Environment Protection and Biodiversity Conservation Act 1999*

The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) is the Federal Government's central piece of environmental legislation. It provides a legal framework to protect and manage nationally and internationally important flora, fauna, ecological communities and heritage places, which are defined in the EPBC Act as Matters of National Environmental Significance (MNES).

The biological aspects listed as MNES include:

- Nationally threatened flora and fauna species and ecological communities
- Migratory species

A person must not undertake an action that has, will have, or is likely to have a significant impact (direct or indirect) on MNES, without approval from the Federal Minister for the Environment.

The EPBC Act is administered by the Department of Agriculture, Water and the Environment (DAWE).

State *Environmental Protection Act 1986*

The *Environmental Protection Act 1986* (EP Act) is the primary legislative Act dealing with the protection of the environment in Western Australia. The Act allows the Environmental Protection Authority (EPA), to prevent, control and abate pollution and environmental harm, for the conservation, preservation, protection, enhancement and management of the environment and for matters incidental to or connected with the foregoing. Part IV of the EP Act is administered by the EPA and makes provisions for the EPA to undertake environmental impact assessment of significant proposals, strategic proposals and land use planning schemes.

The Department of Water and Environment Regulation (DWER) is responsible for administering the clearing provisions of the EP Act (Part V). Clearing of native vegetation in Western Australia requires a permit from the DWER, unless exemptions apply. Applications for clearing permits are assessed by the Department and decisions are made to grant or refuse the application in accordance with the Act. When making a decision the assessment considers clearing against the ten clearing principles as specified in Schedule 5 of the EP Act:

a) Native vegetation should not be cleared if it comprises a high level of biodiversity.

b) Native vegetation should not be cleared if it comprises the whole or a part of, or is necessary for the maintenance of a significance habitat for fauna indigenous to Western Australia.

c) Native vegetation should not be cleared if it includes, or is necessary, for the continued existence of rare flora.

d) Native vegetation should not be cleared if it comprises the whole or part of native vegetation in an area that has been extensively cleared.

e) Native vegetation should not be cleared if it is significant as a remnant of native vegetation in an area that has been extensively cleared.

f) Native vegetation should not be cleared if it is growing in, or in association with, an environment associated with a watercourse or wetland.

g) Native vegetation should not be cleared if the clearing of the vegetation is likely to have an impact on the environmental values of any adjacent or nearby conservation area.

h) Native vegetation should not be cleared if the clearing of the vegetation is likely to cause appreciable land degradation.

i) Native vegetation should not be cleared if the clearing of the vegetation is likely to cause deterioration in the quality of surface or underground water.

j) Native vegetation should not be cleared if clearing the vegetation is likely to cause, or exacerbate, the incidence of flooding.

Exemptions for clearing include clearing that is a requirement of a written law or authorised under certain statutory processes (listed in Schedule 6 of the EP Act) and exemptions for prescribed low impact day-to-day activities (prescribed in the Environmental Protection (Clearing of Native Vegetation) Regulations 2004); these exemptions do not apply in environmentally sensitive areas (ESAs).

State *Biodiversity and Conservation Act 2016*

The *Biodiversity Conservation Act 2016* (BC Act) provides for the conservation and protection of biodiversity and biodiversity components, as well as the promotion of the ecologically sustainable use of biodiversity components in Western Australia. The BC Act replaces both the repealed *Wildlife Conservation Act 1950* (WC Act) and the *Sandalwood Act 1929* (Sandalwood Act), as well as their associated regulations. To attain the objectives of the BC Act, principles of ecological sustainable development have been established:

- Decision-making processes should effectively integrate both long-term and short-term economic, environmental, social and equitable considerations
- If there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation
- The present generation should ensure that the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations
- The conservation of biodiversity and ecological integrity should be a fundamental consideration indecision-making
- Improved valuation, pricing and incentive mechanisms should be promoted.

The BC Act is administered by the Department of Biodiversity Conservation and Attractions (DBCA).

State *Biosecurity and Agriculture Management Act 2007*

The *Biosecurity and Agriculture Management Act 2007* (BAM Act) and associated regulations are administered by the Department of Primary Industries and Regional Development (DPIRD) and replace the repealed *Agriculture and Related Resources Protection Act 1976.* The main purposes of the BAM Act and its regulations are to:

- Prevent new animal and plant pests (vermin and weeds) and diseases from entering WA
- Manage the impact and spread of those pests already present in the state
- Safely manage the use of agricultural and veterinary chemicals
- Increased control over the sale of agricultural products that contain violative chemical residues.

The Western Australian Organism List (WAOL) provides the status of organisms which have been categorised under the BAM Act. A Declared Pest is a prohibited organism or an organism for which a declaration under Section 22(2) of the Act is in force. Declared Pests may be assigned a control category including: C1 (exclusion), C2 (eradication) and C3 (management). The category may apply to the whole of the State, LGAs, districts, individual properties or even paddocks, and all landholders are obliged to comply with the specific category of control. Categories of control are defined below.

DPIRD Categories for Declared Pests under the BAM Act

Control class code	Description
C1 (Exclusion)	Pests will be assigned to this category if they are not established in Western Australia and control measures are to be taken, including border checks, in order to prevent them entering and establishing in the State.
C2 (Eradication)	Pests will be assigned to this category if they are present in Western Australia in low enough numbers or in sufficiently limited areas that their eradication is still a possibility.
C3 (Management)	Pests will be assigned to this category if they are established in Western Australia but it is feasible, or desirable, to manage them in order to limit their damage. Control measures can prevent a C3 pest from increasing in population size or density or moving from an area in which it is established into an area which currently is free of that pest.

Background information

Environmentally Sensitive Areas

Environmentally Sensitive Areas (ESAs) are declared by the Minister for Environment under Section 51B of the EP Act. The Table below outlines the aspects of areas declared as ESA in the Environmental Protection (Environmentally Sensitive Areas) Notice 2005.

Aspects of ESAs

Aspects of Environmentally Sensitive Areas
A declared World Heritage property as defined in Section 13 of the EPBC Act.
An area that is included on the Register of the National Estate (RNE), because of its natural values, under the *Australian Heritage Commission Act 1975* of the Commonwealth (the RNE was closed in 2007 and is no longer a statutory list – all references to the RNE were removed from the EPBC Act on 19 February 2012).
A defined wetland and the area within 50 m of the wetland. Defined wetlands include Ramsar wetlands, conservation category wetlands and nationally important wetlands.
The area covered by vegetation within 50 m of rare flora, to the extent to which the vegetation is continuous with the vegetation in which the rare flora is located.
The area covered by a Threatened Ecological Community.
A Bush Forever Site listed in "Bush Forever" Volumes 1 and 2 (2000), published by the Western Australia Planning Commission, except to the extent to which the site is approved to be developed by the Western Australia Planning Commission.
The areas covered by the *Environmental Protection (Gnangara Mound Crown Land) Policy 1992*.
The areas covered by the *Environmental Protection (Western Swamp Tortoise Habitat) Policy 2002*.
The areas covered by the lakes to which the *Environmental Protection (Swan Coastal Plain Lakes) Policy 1992* (EPP Lakes) applies.
Protected wetlands as defined in the *Environmental Protection (South West Agricultural Zone Wetlands) Policy 1998*.

Reserves and conservation areas

Bush Forever

Bush Forever, which was released in December 2000 and proclaimed in 2010, is a Government initiate aimed to retain and protect regionally significant bushland on the Swan Coastal Plain within the Perth Metropolitan Region. Bush Forever aims to protect more than 51,000 hectares of regionally significant bushland within 287 sites across the metropolitan portion of the Swan Coastal Plain (Government of Western Australia (GoWA) 2000). Bush Forever sites constitute ESAs as declared by a notice under Section 51B of the EP Act.

Department of Biodiversity, Conservation and Attractions managed lands and waters

DBCA manages lands and waters throughout Western Australia to conserve ecosystems and species, and to provide for recreation and appreciation of the natural environment. DBCA managed lands and waters include national parks, conservation parks and reserves, marine parks and reserves, regional parks, nature reserves, State forest and timber reserves. Access to, or through, some areas of DBCA managed lands may require a permit or could be restricted due to management activities. Proposed

land use changes and development proposals that abut DBCA managed lands will generally be referred to DBCA throughout the assessment process.

Wetlands

Wetlands include not only lakes with open water, but areas of seasonally, intermittently or permanently waterlogged soil.

Ramsar Wetlands (Wetlands of International Importance)

The Convention of Wetlands of International Importance was signed in 1971 at the Iranian town of Ramsar. The Convention has since been referred to as the Ramsar Convention. Ramsar Listed wetlands are "sites containing representative, rare or unique wetlands, or wetlands that are important for conserving biological diversity … because of their ecological, botanical, zoological, limnological or hydrological importance" (DAWE 2020b). Once a Ramsar Listed Wetland is designated, the country agrees to manage its conservation and ensure its wise use. Under the Convention, wise use is broadly defined as "maintaining the ecological character of a wetland" (DAWE 2020b).

Nationally important wetlands

Wetlands of national significance are listed under the Directory of Important Wetlands in Australia. Nationally important wetlands are wetlands which meet at least one of the following criteria (DAWE 2020a):

- It is a good example of a wetland type occurring within a biogeographic region in Australia
- It is a wetland which plays an important ecological or hydrological role in the natural functioning of a major wetland system/complex
- It is a wetland which is important as the habitat for animal taxa at a vulnerable stage in their life cycles, or provides a refuge when adverse conditions such as drought prevail
- The wetland supports one percent or more of the national populations of any native plant or animal taxa
- The wetland supports native plant or animal taxa or communities which are considered endangered or vulnerable at the national level
- The wetland is of outstanding historical or cultural significance.

Geomorphic wetlands

Categorisation of wetlands has been conducted by Hill et al. (1996), delineating Swan Coastal Plain wetlands into levels of protection and management categories. Conservation Category Wetlands are wetlands that support high levels of attributes and functions. Resource Enhancement Wetlands are those that have been partly modified but still support substantial functions and attributes. Multiple Use Wetlands are classified as those wetlands with few attributes that still provide important wetland functions. Multiple Use wetlands have few important ecological attributes and functions remaining.

The Geomorphic Wetlands Swan Coastal Plain dataset displays the location, boundary, geomorphic classification (wetland type) and management category of wetlands on the Swan Coastal Plain.

Vegetation extent and status

The National Objectives and Targets for Biodiversity Conservation 2001–2005 (Commonwealth of Australia 2001) recognise that the retention of 30 percent or more of the pre-clearing extent of each ecological community is necessary if Australia's biological diversity is to be protected. This is the threshold level below which species loss appears to accelerate exponentially and loss below this level should not be permitted. This level of recognition is in keeping with the targets recommended in the

review of the National Strategy for the Conservation of Australia's Biological Diversity (ANZECC 2000).

The extent of remnant native vegetation in WA has been assessed by Shepherd et al. (2002) and the GoWA (2019), based on broadscale vegetation association mapping by Beard (various publications). The GoWA produces Statewide Vegetation Statistics Reports that are used for a number of purposes including conservation planning, land use planning and when assessing development applications. The reports are updated every 2-3 years.

Vegetation condition

The vegetation condition can be assessed in accordance with the vegetation condition rating scale for the South West and Interzone Botanical Provinces (EPA 2016a). The scale recognises the intactness of vegetation and consists of six rating levels as outlined below.

Vegetation condition rating scale for the South West and Interzone Botanical Provinces

Condition	South West and Interzone Botanical Provinces description
Pristine	Pristine or nearly so, no obvious signs of 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 vegetation is no longer intact and the area is completely or almost completely without native species. These areas are often described as 'parkland cleared' with the flora comprising weed or crop species with isolated native trees or shrubs.

Conservation codes

Species of significant flora, fauna and communities are protected under both Federal and State Acts. The Federal EPBC Act provides a legal framework to protect and manage nationally important flora and communities. The State BC Act is the primary wildlife conservation legislation in Western Australia. Information on the conservation codes is summarised in the following sections.

Ecological communities

Significant communities

Ecological communities are defined as naturally occurring biological assemblages that occur in a particular type of habitat (English and Blyth 1997). Federally listed Threatened Ecological Communities (TECs) are protected under the EPBC Act. The BC Act provides for the Minister to list an ecological community as a TEC (section 27), or as a collapsed ecological community (section 31) statutory listing of State TECs by the Minister. The legislation also describes statutory processes for preparing recovery plans for TECs, the registration of their critical habitat, and penalties for unauthorised modification of TECs.

Possible TECs that do not meet survey criteria are added to the DBCA Priority Ecological Community (PEC) List under Priorities 1, 2 and 3. These are ecological communities that are adequately known; are rare but not threatened, or meet criteria for Near Threatened. PECs that have been recently removed from the threatened list are placed in Priority 4. These ecological communities require regular monitoring. Conservation dependent ecological communities are placed in Priority 5. PECs are not listed under any formal Federal or State legislation, however, may be listed as TECs under the EPBC Act.

Codes and definitions for TECs listed under the EPBC Act and/ or BC Act

Categories	Definition
Federal Government Conservation Categories (EPBC Act)	
Critically Endangered (CR)	An ecological community if, at that time, is facing an extremely high risk of extinction in the wild in the immediate future, as determined in accordance with the prescribed criteria (as outlined in Environment Protection and Biodiversity Conservation Regulations 2000)
Endangered (EN)	An ecological community if, at that time: A) is not critically endangered; and B) is facing a very high risk of extinction in the wild in the near future, as determined in accordance with the prescribed criteria (as outlined in Environment Protection and Biodiversity Conservation Regulations 2000)
Vulnerable (VU)	An ecological community if, at that time: A) is not critically endangered or endangered; and B) is facing a high risk of extinction in the wild in the medium-term future, as determined in accordance with the prescribed criteria (as outlined in Environment Protection and Biodiversity Conservation Regulations 2000)
Western Australia Conservation Categories (BC Act)	
Threatened Ecological Communities	
Critically Endangered (CR)	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.

Categories	Definition
Endangered (EN)	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.
Vulnerable (VU)	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.
Collapsed ecological communities	
An ecological community is eligible for listing as a collapsed ecological community at a particular time if, at that time – (a) there is no reasonable doubt that the last occurrence of the ecological community has collapsed); or (b) the ecological community has been so extensively modified throughout its range that no occurrence of it is likely to recover – (i) its species composition or structure; or (ii) its species composition and structure. Section 33 of the BC Act provides for a collapsed ecological community to be regarded as a threatened ecological community if it is discovered in a state that no longer makes it eligible for listing as a collapsed ecological community.	

Categories and definitions for PECS as listed by the DBCA

Category	Description
Priority 1	Poorly known ecological communities. Ecological communities that are known from very few occurrences with a very restricted distribution (generally ≤5 occurrences or a total area of ≤100 ha). 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.
Priority 2	Poorly known ecological communities. Communities that are known from few occurrences with a restricted distribution (generally ≤10 occurrences or a total area of ≤200 ha). At least some occurrences are not believed to be under immediate threat of destruction or degradation. Communities may be included if they are comparatively well known from one or more localities but do not meet adequacy of survey requirements, and/or are not well defined, and appear to be under threat from known threatening processes.

Category	Description
Priority 3	Poorly known ecological communities. (i) Communities that are known from several to many occurrences, a significant number or area of which are not under threat of habitat destruction or degradation or: (ii) communities known from a few widespread occurrences, which are either large or with significant remaining areas of habitat in which other occurrences may occur, much of it not under imminent threat, or; (iii) communities made up of large, and/or widespread occurrences, that may or may not be represented in the reserve system, but are under threat of modification across much of their range from processes such as grazing by domestic and/or feral stock, and inappropriate fire regimes. Communities may be included if they are comparatively well known from several localities but do not meet adequacy of survey requirements and/or are not well defined, and known threatening processes exist that could affect them.
Priority 4	Ecological communities that are adequately known, rare but not threatened or meet criteria for Near Threatened, or that have been recently removed from the threatened list. These communities require regular monitoring. (i) Rare. Ecological communities known from few occurrences that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection, but could be if present circumstances change. These communities are usually represented on conservation lands. (ii) Near Threatened. Ecological communities that are considered to have been adequately surveyed and that do not qualify for Conservation Dependent, but that are close to qualifying for Vulnerable. (iii) Ecological communities that have been removed from the list of threatened communities during the past five years.
Priority 5	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.

Other significant vegetation

Vegetation may be significant for a range of reasons other than a statutory listing. The EPA (2016a, b) states that significant vegetation may include vegetation that includes the following:

- Restricted distribution
- Degree of historical impact from threatening processes
- A role as a refuge
- Providing an important function required to maintain ecological integrity of a significant ecosystem
- Local endemism in restricted habitats
- Novel combinations of taxa
- A role as a key habitat for Threatened species or large population representing a significant proportion of the local to regional total population of a species
- Being representative of a vegetation unit in ‘pristine’ condition in a highly cleared landscape, recently discovered range extensions, or isolated outliers of the main range.

This may apply at a number of levels, so the unit may be significant when considered at the fine-scale (intra-locality), intermediate-scale (locality or inter-locality) or broad-scale (local to region).

Flora and fauna

Significant flora and fauna

Species of significant flora are protected under both Federal and State legislation. Any activities that are deemed to have a significant impact on species that are recognised by the EPBC Act, and/or the BC Act can warrant referral to DAWE and/or the EPA.

The Federal conservation level of flora and fauna species and their significance status is assessed under the EPBC Act. The significance levels for flora and fauna used in the EPBC Act align with the International Union for Conservation of Nature (IUCN) Red List criteria, which are internationally recognised as providing best practice for assigning the conservation status of species. The EPBC Act also protects land and migratory species that are listed under International Agreements. The list of migratory species established under section 209 of the EPBC Act comprises:

- Migratory species which are native to Australia and are included in the appendices to the Bonn Convention (Convention on the Conservation of Migratory Species of Wild Animals Appendices I and II)
- Migratory species included in annexes established under the Japan-Australia Migratory Bird Agreement (JAMBA) and the China–Australia Migratory Bird Agreement (CAMBA)
- Native, migratory species identified in a list established under, or an instrument made under, an international agreement approved by the Minister, such as the republic of Korea–Australia Migratory Bird Agreement (ROKAMBA)

The State conservation level of flora and fauna species and their significance status also follows the IUCN Red List criteria. Under the BC Act flora and fauna can be listed as Threatened, Extinct and as Specially Protected species.

Threatened species are those are species which have been adequately searched for and are deemed to be, in the wild, either rare, under identifiable threat of extinction, or otherwise in need of special protection, and have been gazetted as such. The assessment of the conservation status of Threatened species is based on their national extent and ranked according to their level of threat using IUCN Red List categories and criteria. Specially protected species meet one or more of the following categories: species of special conservation interest; migratory species; cetaceans; species subject to international agreement; or species otherwise in need of special protection. Species that are listed as Threatened or Extinct species under the BC Act cannot also be listed as Specially Protected species.

Possibly threatened species that do not meet survey criteria, or are otherwise data deficient, are added to the Priority Fauna or Priority Flora Lists under Priorities 1, 2 or 3. These three categories are ranked in order of priority for survey and evaluation of conservation status so that consideration can be given to their declaration as threatened flora or fauna.

Species that are adequately known, are rare but not threatened, or meet criteria for near threatened, or that have been recently removed from the threatened species or other specially protected fauna lists for other than taxonomic reasons, are placed in Priority 4. These species require regular monitoring.

Assessment of Priority codes is based on the Western Australian distribution of the species, unless the distribution in WA is part of a contiguous population extending into adjacent States, as defined by the known spread of locations.

For the purposes of this assessment, all species listed under the EPBC Act, BC Act and DBCA Priority species are considered significant.

Categories and definitions for EPBC Act and BC Act listed flora and fauna species

Conservation category	Definition
Threatened species	
Critically Endangered (CR)	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". Listed as critically endangered under section 19(1)(a) of the BC Act in accordance with the criteria set out in section 20 and the ministerial guidelines.
Endangered (EN)	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". Listed as endangered under section 19(1)(b) of the BC Act in accordance with the criteria set out in section 21 and the ministerial guidelines
Vulnerable (VU)	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". Listed as vulnerable under section 19(1)(c) of the BC Act in accordance with the criteria set out in section 22 and the ministerial guidelines.
Extinct species	
Extinct (EX)	Species where "there is no reasonable doubt that the last member of the species has died", and listing is otherwise in accordance with the ministerial guidelines (section 24 of the BC Act).
Extinct in the Wild (EW)	Species that "is known only to survive in cultivation, in captivity or as a naturalised population well outside its past range; and it has not been recorded in its known habitat or expected habitat, at appropriate seasons, anywhere in its past range, despite surveys over a time frame appropriate to its life cycle and form", and listing is otherwise in accordance with the ministerial guidelines (section 25 of the BC Act).
Specially protected species	
Migratory (MI)	Fauna that periodically or occasionally visit Australia or an external Territory or the exclusive economic zone; or the species is subject of an international agreement that relates to the protection of migratory species and that binds the Commonwealth; and listing is otherwise in accordance with the ministerial guidelines (section 15 of the BC Act). Includes birds that are subject to an agreement between the government of Australia and the governments of Japan (JAMBA), China (CAMBA) and The Republic of Korea (ROKAMBA), and fauna subject to the Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention), an environmental treaty under the United Nations Environment Program. Migratory species listed under the BC Act are a subset of the migratory animals, that are known to visit Western Australia, protected under the international agreements or treaties, excluding species that are listed as Threatened species

Conservation category	Definition
Species of special conservation interest (conservation dependent fauna) (CD)	Fauna of special conservation need being species dependent on ongoing conservation intervention to prevent it becoming eligible for listing as threatened.
Other specially protected fauna (OS)	Fauna otherwise in need of special protection to ensure their conservation, and listing is otherwise in accordance with the ministerial guidelines (section 18 of the BC Act).

Codes for DBCA listed Priority flora and fauna

Priority category	Definition
Priority 1	Poorly-known taxa 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.
Priority 2	Poorly-known taxa 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.
Priority 3	Poorly-known taxa 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.
Priority 4	Rare, Near Threatened and other taxa in need of monitoring A. Rare: Taxa 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 taxa are usually represented on conservation lands. B. Near Threatened. Taxa that are considered to have been adequately surveyed and that do not qualify for Conservation Dependent, but that are close to qualifying for Vulnerable. C. Taxa that have been removed from the list of threatened taxa during the past five years for reasons other than taxonomy.

Other significant flora

Flora species, subspecies, varieties, hybrids and ecotypes may be significant for a range of reasons, other than a statutory listing. The EPA (2016a, b) states that significant flora may include taxa that have/are:

- A keystone role in a particular habitat for Threatened or Priority flora or fauna species, or large populations representing a considerable proportion of the local or regional total population of a species
- Relictual status, being representation of taxonomic or physiognomic groups that no longer occur widely in the broader landscape
- New species or anomalous features that indicate a potential new species
- Being representative of the range of a species (particularly, at the extremes of range, recently discovered range extensions, or isolated outliers of the main range)
- Unusual species, including restricted subspecies, varieties, or naturally occurring hybrids
- Local endemism (a restricted distribution) or association with a restricted habitat type (e.g. surface water or groundwater dependent ecosystems)

Other significant fauna

Fauna species may be significant for a range of reasons other than those protected by international agreement or treaty, Specially Protected or Priority Fauna. Significant fauna may include short-range endemic species, species that have declining populations or declining distributions, species at the extremes of their range, or isolated outlying populations, or species which may be undescribed (EPA 2010).

Introduced plants (weeds)

Declared Pests

Information on species considered to be Declared Pests is provided under *State Biosecurity and Agriculture Management Act 2007.*

Weeds of National Significance

The spread of weeds across a range of land uses or ecosystems is important in the context of socio-economic and environmental values. The assessment of Weeds of National Significance (WoNS) is based on four major criteria:

- Invasiveness
- Impacts
- Potential for spread
- Socio-economic and environmental values.

Australian state and territory governments have identified thirty-two Weeds of National Significance (WoNS); a list of 20 WoNS was endorsed in 1999 and a further 12 were added in 2012.

References

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Appendix C – Desktop searches

Flora and Vegetation Desktop

Definitions

Term	Description
Desktop area	A 10 km buffer around the project area
Project area	The potential project footprint of the alignment options
Cr	Critically endangered
En	Endangered
T	Threatened
Vu	Vulnerable
P1 – P4	Priority 1 – Priority 4
EPBC Act	Environmental Protection and Biodiversity Conservation Act 1999
DBCA	Department of Biodiversity and Conservation Attractions 2018. WA Government, Department of Parks and Wildlife Threatened (Declared Rare) and Priority Flora List
BC Act	Biodiversity Conservation Act 2016

Likely – Known to occur within one kilometres of the Survey Area with suitable habitat within the Survey Area

Possible – Suitable habitat within the Survey Area

Unlikely – No suitable habitat present within the Survey Area, species not known from the region

Unknown – Data deficient

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

Conservation significant flora desktop assessment and likelihood of occurrence

Taxon	Conservation status	Flowering Period	Description and closest record information (if available) (WA Herbarium 1998-2020)	Likelihood of occurrence Pre survey	Likelihood of occurrence Post survey
Andersonia gracilis	T (EN)	Sep-Nov	Slender erect or open straggly shrub, 0.1-0.5(-1) m high. Fl. white-pink-purple. White/grey sand, sandy clay, gravelly loam. Winter-wet areas, near swamps.	Unlikely	Unlikely- No suitable habitat identified
Austrostipa bronwenae	T (EN)	Sep-Oct	Caespitose perennial grass, 0.6 m high x 0.3 m wide. Flowers green. Calcareous, winter-wet grey-brown sandy-loam or dark brown loam over clay. *Melaleuca rhaphiophylla, Eucalyptus rudis* low open forest over *Hakea varia tall* open shrubland over *Gahnia trifida* and *Baumea juncea* sedges. Growing in Manea Park wetlands, 2 km east and 2.5 km north of the survey area	Possible	Unlikely- Suitable habitat present. Suitable search effort did not record the species.
Austrostipa jacobsiana	T (CR)	Aug-Sep	Tufted rhizomatous grass, to 1.2 m, leaf sheaths hairy. Marri woodland, Melaleuca tall shrubland. Growing in Hay Park wetlands, 600m east and 1.2 km north of the survey area. In Bunbury it grows in sandy-loam over lime-marl rock in a seasonal dampland.	Possible	Unlikely- Suitable habitat present. Suitable search effort did not record the species.
Banksia nivea subsp. *uliginosa*	T (EN)	July-Sep	Dense, erect, non-lignotuberous shrub, 0.2–1.5 m high. Fl. yellow, brown. Sandy clay, gravel.	Unlikely	Unlikely- No suitable habitat identified
Banksia squarrosa subsp. *argillacea*	T (VU)	Jun-Nov	Erect, open, non-lignotuberous shrub, 1.2–4 m high. Fl. yellow, Jun–Nov. White/grey sand, gravelly clay or loam. Winter-wet flats, clay flats. Not known from Bunbury region.	Unlikely	Unlikely- Not known from Bunbury region. Suitable search effort did not record the species
Brachyscias verecundus	T (CR)	Nov	Annual (or ephemeral), herb, 0.012-0.022 m high, entirely glabrous. Fl. white/cream. In a moss sward. On a granite outcrop.	Unlikely	Unlikely- No suitable habitat identified

Taxon	Conservation status	Flowering Period	Description and closest record information (if available) (WA Herbarium 1998-2020)	Likelihood of occurrence Pre survey	Likelihood of occurrence Post survey
Caladenia huegelii	T (EN)	Sep-Oct	Tuberous, perennial, herb, 0.25-0.6 m high. Fl. green, cream, red. Soil is usually deep grey-white sand usually associated with the Bassendean sand-dune system. However, rare plants have been known to extend into the Spearwood system in some areas. Nearest known population is 8 km south of the survey area.	Possible	(Survey one area) Unlikely- Suitable habitat present. Suitable search effort did not record the species. (Survey two and four area) Unlikely-No suitable habitat present (Survey three) Possible- low suitability potential habitat present
Chamelaucium sp. S Coastal Plain (R.D. Royce 4872)	T (VU)	Oct-Dec	Winter-wet areas, loams and ironstone. Not known from Bunbury region.	Unlikely	Unlikely- No suitable habitat identified
Darwinia whicherensis	T (EN)	Oct-Nov	Erect low shrub to 30 cm, flowers green, outer red. Winter-wet area of shrubland over shallow red clay over ironstone	Unlikely	Unlikely- No suitable habitat identified
Diuris drummondii	T (VU)	Nov-Jan	Tuberous, perennial, herb, 0.5-1.05 m high. Fl. yellow. Low-lying depressions, swamps. known to occur 2 km north east of the survey area.	Possible	Unlikely- Suitable habitat present. Suitable search effort did not record the species.

Taxon	Conservation status	Flowering Period	Description and closest record information (if available) (WA Herbarium 1998-2020)	Likelihood of occurrence Pre survey	Likelihood of occurrence Post survey
Diuris micrantha	T (VU)	Sep-Oct	Tuberous, perennial, herb, 0.15-0.3 m high. Fl. red & yellow, Sep to Oct. White-grey sand. Not known from Bunbury region.	Unlikely	Unlikely- Not known from Bunbury region. Suitable search effort did not record the species
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, not know from Bunbury region	Unlikely	Unlikely- Not known from Bunbury region. Suitable search effort did not record the species
Drakaea elastica	T (EN)	Oct-Nov	Tuberous, perennial, herb, 0.12-0.3 m high. Fl. red, green, yellow. White or grey sand. Low-lying situations adjoining winter-wet swamps. Known to occur 10 km south east of the survey area.	Possible	Unlikely- Suitable habitat present. Suitable search effort did not record the species.
Drakaea micrantha	T (VU)	Sep-Oct	Tuberous, perennial, herb, 0.15–0.3 m high. Fl. red, yellow. White-grey sand. Known to occur 5 km south east of the survey area.	Possible	Unlikely- Suitable habitat present. Suitable search effort did not record the species.
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. Known to occur 8 km east of the survey area	Possible	Unlikely- Suitable habitat present. Suitable search effort did not record the species.
Gastrolobium papilio	T (EN)	Oct-Dec	Tangled, clumped shrub, to 1.5 m high. Fl. cream-red. Sandy clay over ironstone and laterite. Flat plains.	Unlikely	Unlikely- No suitable habitat identified
Lambertia echinata subsp. *occidentalis*	T (EN)	Feb/May-Jun/Oct	Prickly, much-branched, non-lignotuberous shrub, to 3 m high. Fl. yellow. White sandy soils over laterite, orange/brown-red clay over ironstone.	Unlikely	Unlikely- No suitable habitat identified
Petrophile latericola	T (EN)	Nov	Multi-stemmed shrub, 0.4-1.5 m high. Fl. yellow. Red lateritic clay. Winter-wet flats.	Unlikely	Unlikely- No suitable habitat identified

Taxon	Conservation status	Flowering Period	Description and closest record information (if available) (WA Herbarium 1998-2020)	Likelihood of occurrence Pre survey	Likelihood of occurrence Post survey
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- No suitable habitat identified
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- No suitable habitat identified
Synaphea sp. *Serpentine*	T (CR)	Sep-Oct	Shrublands and woodlands on loamy soils	Unlikely	Unlikely- No suitable habitat identified
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- No suitable habitat identified
Verticordia densiflora var. *pedunculata*	T (EN)	Dec-Jan	Erect to spreading shrub, 0.3-0.6 m high. Fl. pink/pink-white. Grey/yellow sand, sandy loam. Winter-wet low-lying areas. Not known from the Bunbury Region	Unlikely	Unlikely- Not known from Bunbury region. Suitable search effort did not record the species
Carex tereticaulis	P1	Sep-Oct	Monoecious, rhizomatous, tufted perennial, grass-like or herb (sedge), 0.7 m high. Fl. brown. Black peaty sand. Known to occur 4 km north east of the survey area.	Possible	Unlikely- Suitable habitat present. Suitable search effort did not record the species.
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- No suitable habitat identified
Puccinellia vassica	P1	Sep-Nov	Caespitose annual or perennial, grass-like or herb, 0.41–0.55 m high. Saline soils. On the outer margins of coastal saltmarshes	Unlikely	Unlikely- No suitable habitat identified
Stylidium perplexum	P1	Dec	Cushion-like plant to 20 cm tall with scapes extending higher, flowers white. Grey sandy loam over laterite.	Unlikely	Unlikely- No suitable habitat identified

Taxon	Conservation status	Flowering Period	Description and closest record information (if available) (WA Herbarium 1998-2020)	Likelihood of occurrence Pre survey	Likelihood of occurrence Post survey
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- No suitable habitat identified
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- No suitable habitat identified
Grevillea rosieri	P2	Jul-Sep	Shrubs, 0.5 m high. Flowers red or brown. Gravelly soil, or sand; sandplains; gravel pits.	Unlikely	Unlikely- No suitable habitat identified
Leptomeria furtiva	P2	Jan, Aug-Oct	Lax, sprawling shrub, 0.2–0.45 m high. Fl. orange, brown. Grey or black peaty sand. Winter-wet flats. Known to occur 5 km south east of the survey area.	Possible	Unlikely- Suitable habitat present. Suitable search effort did not record the species.
Leucopogon sp. Busselton (D. Cooper 243)	P2	Aug-Sep	Slender, erect shrub to 70 cm; flowers white. *Pericalymma ellipticum* wet shrubland, Marri-Jarrah woodland. Known to occur 3 km south east of the survey area.	Possible	Unlikely- Suitable habitat present. Suitable search effort did not record the species.
Schoenus loliaceus	P2	Aug-Nov	Annual, grass-like or herb (sedge), 0.03–0.06 m high. Sandy soils. Winter-wet depressions. Known to occur 2.5 km south of the survey area.	Possible	Unlikely- Suitable habitat present. Suitable search effort did not record the species.
Synaphea petiolaris subsp. *simplex*	P2	Sep-Oct	Tufted shrub, 0.1–0.6 m high. Fl. yellow. Sandy soils. Flats, winter-wet areas. Known from the Caple region	Unlikely	Unlikely- known from the Caple region
Thelymitra variegata	P2	Jun-Sep	Tuberous, perennial, herb, 0.1–0.35 m high. Fl. orange, red, purple, pink. Sandy clay, sand, laterite. - Known to occur 1 km north of the survey area.	Possible	Unlikely- Suitable habitat present. Suitable search effort did not record the species.

Taxon	Conservation status	Flowering Period	Description and closest record information (if available) (WA Herbarium 1998-2020)	Likelihood of occurrence Pre survey	Likelihood of occurrence Post survey
Adelphacme minima	P3	Oct-Nov	Annual 10-20 cm tall. Fl. white. Swamp. Grey sand/loam. Woodland of *Melaleuca preissiana*. With *Astartea scoparia*, *Pericalymma ellipticum, Lachnagrostis filifolia, Meeboldina tephrina.* Known to occur 4.5 km south east of the survey area.	Possible	Unlikely- Suitable habitat present. Suitable search effort did not record the species.
Angianthus drummondii	P3	Oct-Dec	Erect annual, herb, to 0.1 m high. Fl. yellow. Grey or brown clay soils, ironstone. Seasonally wet flats. Known to occur 0.5 km north of the survey area.	Likley	Possible- Suitable habitat present. Suitable search effort did not record the species.
Blennospora doliiformis	P3	Oct-Nov	Erect annual, herb, to 0.15 m high. Fl. yellow, Oct to Nov. Grey or red clay soils over ironstone. Seasonally-wet flats.	Likley	Present
Boronia tetragona	P3	Oct-Dec	Perennial, herb, 0.3–0.7 m high, leaves sessile, entire, with papillate margins, branches quadrangular, sepals ciliate. Fl. pink, red. Black/white sand, laterite, brown sandy loam. Winter-wet flats, swamps, open woodland. Known to occur 3.5 km south east of the survey area.	Possible	Unlikely- Suitable habitat present. Suitable search effort did not record the species.
Caustis sp. Boyanup (G.S. McCutcheon 1706)	P3	Dec-Jan	Rhizomatous, clumped perennial, grass-like or herb (sedge), 0.7–1 m high. Growing on a gentle slope in grey sand over laterite.	Unlikely	Unlikely- No suitable habitat identified
Chamaescilla gibsonii	P3	Sep	Clumped tuberous, herb. Fl. blue. Clay to sandy clay. Winter-wet flats, shallow water-filled claypans.	Unlikely	Unlikely- No suitable habitat identified
Isopogon formosus subsp. *dasylepis*	P3	Jun-Dec	Low, bushy or slender, upright, non-lignotuberous shrub, 0.2–2 m high. Fl. pink, purple, red. Sand, sandy clay, gravelly sandy soils over laterite. Often swampy areas.	Unlikely	Unlikely- No suitable habitat identified
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- No suitable habitat identified
Lasiopetalum laxiflorum	P3	Sep-Oct	Jarrah forest, lateritic soils. 2-3 ft high. Mauve flowers. Brown on underside of leaf.	Unlikely	Unlikely- No suitable habitat identified

Taxon	Conservation status	Flowering Period	Description and closest record information (if available) (WA Herbarium 1998-2020)	Likelihood of occurrence Pre survey	Likelihood of occurrence Post survey
Lasiopetalum membranaceum	P3	Sep-Dec	Multi-stemmed shrub, 0.2-1 m high. Fl. pink, blue, purple. Sand over limestone. Known within 500 m south of the survey area.	Likley	Present
Platysace ramosissima	P3	Oct-Nov	Perennial, herb, to 0.3 m high. Fl. white, cream. Sandy soils. Known to occur 2 km north east of the survey area.	Possible	Unlikely- Suitable habitat present. Suitable search effort did not record the species.
Schoenus benthamii	P3	Oct-Nov	Tufted perennial, grass-like or herb (sedge), 0.15-0.45 m high. Fl. brown. White, grey sand, sandy clay. Winter-wet flats, swamps. Known to occur 2 km north east of the survey area	Possible	Unlikely- Suitable habitat present. Suitable search effort did not record the species.
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. Known to occur 6 km north east of the survey area.	Possible	Unlikely- Suitable habitat present. Suitable search effort did not record the species.
Synaphea hians	P3	Jul-Nov	Prostrate or decumbent shrub, 0.15-0.6 m high, to 1 m wide. Fl. Yellow. Sandy soils. Rises. Known to occur 10 km south east of the survey area.	Possible	Unlikely- Suitable habitat present. Suitable search effort did not record the species.
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- No suitable habitat identified
Verticordia attenuata	P3	Dec-May	Shrub, 0.4–1 m high. Fl. pink. White or grey sand. Winter-wet depressions. Known to occur 6 km north east of the survey area.	Possible	Unlikely- Suitable habitat present. Suitable search effort did not record the species.

Taxon	Conservation status	Flowering Period	Description and closest record information (if available) (WA Herbarium 1998-2020)	Likelihood of occurrence Pre survey	Likelihood of occurrence Post survey
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. Known to occur 400 m north east of the survey area.	Likely	Possible- Known to occur 400 m north east of the survey area. Suitable habitat present. Suitable search effort did not record the species
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. Known to occur 600 m west of the survey area.	Likley	Possible- Known to occur 600 m west of the survey area. Suitable habitat present. Suitable search effort did not record the species
Aponogeton hexatepalus	P4	Jul-Oct	Rhizomatous or cormous, aquatic perennial, herb, leaves floating. Fl. green, white. Mud. Freshwater: ponds, rivers, claypans.	Unlikely	Unlikely- No suitable habitat identified
Caladenia speciosa	P4	Sep-Oct	Tuberous, perennial, herb, 0.35-0.6 m high. Fl. white, pink. White, grey or black sand.	Likley	Present
Chamelaucium erythrochlorum	P4	Jul-Oct	Non-lignotuberous shrub, to 2.5 m high. Fl. cream, yellow. Jarrah-marri forest. Loams, sandy clays. Riverbanks, lower slopes, below laterite breakaways.	Unlikely	Unlikely- No suitable habitat identified
Eucalyptus rudis subsp. *cratyantha*	P4	Jul-Sep	Tree, 5-20 m high, bark rough, box-type. Fl. white. Loam. Flats, hillsides. Known to occur 2 km north east of the survey area. Recent taxonomic re assessment of the species suggests that plants in the Bunbury region are an intergrade between *Eucalyptus rudis* subsp. *cratyantha* and the common species *Eucalyptus rudis* subsp. *rudis*, with subsp. *cratyantha* confined to a near-coastal distribution in the Cape Naturaliste area (Mike Hislop, WA Herbarium, pers comm. 2020).	Possible	Unlikely- Suitable habitat present. Suitable search effort did not record the species.

Taxon	Conservation status	Flowering Period	Description and closest record information (if available) (WA Herbarium 1998-2020)	Likelihood of occurrence Pre survey	Likelihood of occurrence Post survey
Franklandia triaristata	P4	Aug-Oct	Erect, lignotuberous shrub, 0.2-1 m high. Fl. white, cream, yellow , brown, purple. White or grey sand. Jarrah over *Banksia attenuata*. *Dasypogon bromelioides, Hypocalymma angustifolia, Kunzea glabrascens*. Known to occur 6 km south of the survey area.	Possible	Unlikely- Suitable habitat present. Suitable search effort did not record the species.
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). Known to occur 7 km north east of the survey area	Possible	Unlikely- Suitable habitat present. Suitable search effort did not record the species.
Pultenaea skinneri	P4	Jul-Sep	Slender shrub, 1-2 m high. Fl. yellow, orange, red. Sandy or clayey soils. Winter-wet depressions. Known to occur less than 50 m south of the survey area.	Likely	Possible- Known to occur less than 50 m south of the survey area. Suitable habitat present. Suitable search effort did not record the species.
Rumex drummondii	P4		Erect perennial, herb, 0.6-0.9 m high. Winter-wet disturbed areas.	Unlikely	Unlikely- No suitable habitat identified
Stylidium longitubum	P4	Oct-Dec	Erect annual (ephemeral), herb, 0.05-0.12 m high. Fl. Pink. Sandy clay, clay. Seasonal wetlands. Recorded from within the survey are in 2017	Likely	Likely- Recorded from within the survey are in 2017
Trithuria australis	P4		Small aquatic herb. Ponds, pools	Unlikely	Unlikely- No suitable habitat identified

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Appendix D – Flora survey results

Flora recorded within the project area

Family	*Species*	Naturalised	Conservation status
Fabaceae	*Acacia applanata*		
Fabaceae	*Acacia cochlearis*		
Fabaceae	*Acacia incurva*		
Fabaceae	*Acacia iteaphylla*	*	
Fabaceae	*Acacia longifolia*	*	
Fabaceae	*Acacia pulchella*		
Fabaceae	*Acacia rostellifera*		
Fabaceae	*Acacia saligna*		
Fabaceae	*Acacia stenoptera*		
Asparagaceae	*Acanthocarpus preissii*		
Proteaceae	*Adenanthos meisneri*		
Proteaceae	*Adenanthos obovatus*		
Myrtaceae	*Agonis flexuosa*		
Alliaceae	*Allium triquetrum*	*	
Apocynaceae	*Alyxia buxifolia*		
Poaceae	*Amphipogon turbinatus*		
Haemodoraceae	*Anigozanthos manglesii*		
Poaceae	*Anthoxanthum odoratum*	*	
Centrolepidaceae	*Aphelia cyperoides*		
Asteraceae	*Arctotheca calendula*	*	
Asparagaceae	*Asparagus asparagoides*	*	
Myrtaceae	*Astartea scoparia*		
Poaceae	*Austrostipa compressa*		
Poaceae	*Austrostipa flavescens*		
Iridaceae	*Babiana angustifolia*	*	
Proteaceae	*Banksia attenuata*		
Proteaceae	*Banksia grandis*		
Proteaceae	*Banksia ilicifolia*		
Proteaceae	*Banksia littoralis*		
Cyperaceae	*Baumea juncea*		
Asteraceae	*Blennospora doliiformis*		P3
Rutaceae	*Boronia dichotoma*		
Fabaceae	*Bossiaea eriocarpa*		
Asteraceae	*Brachyscome bellidioides*		
Poaceae	*Briza maxima*	*	
Poaceae	*Briza minor*	*	

Family	*Species*	Naturalised	Conservation status
Poaceae	*Bromus diandrus*	*	
Colchicaceae	*Burchardia congesta*		
Colchicaceae	*Burchardia multiflora*		
Hemerocallidaceae	*Caesia micrantha*		
Orchidaceae	*Caladenia arenicola*		
Orchidaceae	*Caladenia attingens*		
Orchidaceae	*Caladenia flava*		
Orchidaceae	*Caladenia georgei*		
Orchidaceae	*Caladenia hirta* subsp. *hirta*		
Orchidaceae	*Caladenia latifolia*		
Orchidaceae	*Caladenia longicauda*		
Orchidaceae	*Caladenia paludosa*		
Orchidaceae	*Caladenia speciosa*		P4
Portulacaceae	*Calandrinia brevipedata*		
Portulacaceae	*Calandrinia liniflora*		
Dasypogonaceae	*Calectasia narragara*		
Myrtaceae	*Calytrix flavescens*		
Asteraceae	*Carduus pycnocephalus*	*	
Lauraceae	*Cassytha racemosa*		
Apiaceae	*Centella asiatica*		
Caprifoliaceae	*Centranthus macrosiphon*	*	
Centrolepidaceae	*Centrolepis aristata*		
Restionaceae	*Chaetanthus aristatus*		
Asparagaceae	*Chamaescilla corymbosa*		
Cyperaceae	*Chorizandra enodis*		
Gentianaceae	*Cicendia filiformis*	*	
Ranunculaceae	*Clematis linearifolia*		
Ranunculaceae	*Clematis pubescens*		
Ericaceae	*Conostephium pendulum*		
Haemodoraceae	*Conostylis aculeata* subsp. *preissii*		
Haemodoraceae	*Conostylis setigera*		
Asteraceae	*Conyza bonariensis*	*	
Asteraceae	*Conyza parva*	*	
Myrtaceae	*Corymbia calophylla*		
Asteraceae	*Cotula coronopifolia*	*	
Asteraceae	*Cotula turbinata*	*	
Asteraceae	*Craspedia variabilis*		
Crassulaceae	*Crassula colorata*		
Crassulaceae	*Crassula decumbens*		
Crassulaceae	*Crassula glomerata*	*	
Crassulaceae	*Crassula natans*	*	
Orchidaceae	*Cryptostylis ovata*		
Juncaginaceae	*Cycnogeton lineare*		

Family	*Species*	Naturalised	Conservation status
Poaceae	*Cynodon dactylon*	*	
Goodeniaceae	*Dampiera linearis*		
Goodeniaceae	*Dampiera pedunculata*		
Dasypogonaceae	*Dasypogon bromeliifolius*		
Apiaceae	*Daucus glochidiatus*		
Fabaceae	*Daviesia divaricata*		
Fabaceae	*Daviesia horrida*		
Fabaceae	*Daviesia physodes*		
Fabaceae	*Daviesia preissii*		
Restionaceae	*Desmocladus fasciculatus*		
Restionaceae	*Desmocladus flexuosus*		
Hemerocallidaceae	*Dianella revoluta*		
Convolvulaceae	*Dichondra repens*		
Asparagaceae	*Dichopogon capillipes*		
Rutaceae	*Diplolaena dampieri*		
Orchidaceae	*Diuris cruenta*		
Sapindaceae	*Dodonaea aptera*		
Droseraceae	*Drosera erythrorhiza*		
Droseraceae	*Drosera gigantea*		
Droseraceae	*Drosera glanduligera*		
Droseraceae	*Drosera menziesii*		
Droseraceae	*Drosera pallida*		
Droseraceae	*Drosera rosulata*		
Droseraceae	*Drosera stolonifera*		
Poaceae	*Ehrharta calycina*	*	
Poaceae	*Ehrharta longiflora*		
Orchidaceae	*Elythranthera brunonis*		
Poaceae	*Eragrostis curvula*	*	
Scrophulariaceae	*Eremophila glabra* subsp. *albicans*		
Geraniaceae	*Erodium cicutarium*	*	
Myrtaceae	*Eucalyptus gomphocephala*		
Myrtaceae	*Eucalyptus marginata*		
Myrtaceae	*Eucalyptus rudis*		
Fabaceae	*Euchilopsis linearis*		
Euphorbiaceae	*Euphorbia peplus*	*	
Euphorbiaceae	*Euphorbia terracina*	*	
Fabaceae	*Eutaxia virgata*		
Santalaceae	*Exocarpos sparteus*		
Cyperaceae	*Isolepis cernua*		
Cyperaceae	*Isolepis marginata*		
Cyperaceae	*Ficinia nodosa*		
Cyperaceae	*Isolepis oldfieldiana*		
Iridaceae	*Freesia alba x leichtlinii*	*	

Family	*Species*	Naturalised	Conservation status
Papaveraceae	*Fumaria capreolata*	*	
Cyperaceae	*Gahnia trifida*		
Cyperaceae	*Gahnia trifida*		
Rubiaceae	*Galium divaricatum*	*	
Rubiaceae	*Galium murale*	*	
Fabaceae	*Gastrolobium ebracteolatum*		
Geraniaceae	*Geranium molle*	*	
Geraniaceae	*Geranium solanderi*		
Fabaceae	*Gompholobium tomentosum*		
Proteaceae	*Hakea sulcata*		
Proteaceae	*Hakea varia*		
Chenopodiaceae	*Tecticornia indica* subsp. *bidens*		
Fabaceae	*Hardenbergia comptoniana*		
Lamiaceae	*Hemiandra pungens*		
Dilleniaceae	*Hibbertia cuneiformis*		
Dilleniaceae	*Hibbertia hypericoides*		
Dilleniaceae	*Hibbertia racemosa*		
Dilleniaceae	*Hibbertia vaginata*		
Apiaceae	*Homalosciadium homalocarpum*		
Fabaceae	*Hovea pungens*		
Fabaceae	*Hovea trisperma*		
Araliaceae	*Hydrocotyle alata*		
Araliaceae	*Hydrocotyle callicarpa*		
Asteraceae	*Hypochaeris glabra*	*	
Restionaceae	*Hypolaena exsulca*		
Restionaceae	*Hypolaena pubescens*		
Fabaceae	*Jacksonia furcellata*		
Fabaceae	*Jacksonia horrida*		
Juncaceae	*Juncus articulatus*		
Juncaceae	*Juncus microcephalus*	*	
Juncaceae	*Juncus pallidus*		
Fabaceae	*Kennedia prostrata*		
Myrtaceae	*Kunzea glabrescens*		
Myrtaceae	*Kunzea micrantha*		
Poaceae	*Lachnagrostis plebeia*		
Asteraceae	*Lagenophora huegelii*		
Poaceae	*Lagurus ovatus*	*	
Malvaceae	*Lasiopetalum membranaceum*		P3
Cyperaceae	*Lepidosperma calcicola*		
Cyperaceae	*Lepidosperma gladiatum*		
Cyperaceae	*Lepidosperma longitudinale*		
Cyperaceae	*Lepidosperma pubisquameum*		
Cyperaceae	*Lepidosperma squamatum*		

Family	*Species*	Naturalised	Conservation status
Orchidaceae	*Leporella fimbriata*		
Restionaceae	*Leptocarpus coangustatus*		
Ericaceae	*Leucopogon parviflorus*		
Ericaceae	*Styphelia racemulosa*		
Poaceae	*Lolium perenne*	*	
Asparagaceae	*Lomandra caespitosa*		
Asparagaceae	*Lomandra hermaphrodita*		
Asparagaceae	*Lomandra integra*		
Asparagaceae	*Lomandra micrantha*		
Asparagaceae	*Lomandra nigricans*		
Asparagaceae	*Lomandra preissii*		
Asparagaceae	*Lomandra purpurea*		
Asparagaceae	*Lomandra suaveolens*		
Fabaceae	*Lotus subbiflorus*	*	
Restionaceae	*Loxocarya cinerea*		
Fabaceae	*Lupinus angustifolius*	*	
Fabaceae	*Lupinus cosentinii*	*	
Fabaceae	*Lupinus luteus*	*	
Anarthriaceae	*Lyginia imberbis*		
Primulaceae	*Lysimachia arvensis*	*	
Lythraceae	*Lythrum hyssopifolia*	*	
Zamiaceae	*Macrozamia riedlei*		
Fabaceae	*Medicago arabica*		
Myrtaceae	*Melaleuca pauciflora*		
Myrtaceae	*Melaleuca preissiana*		
Myrtaceae	*Melaleuca rhaphiophylla*		
Myrtaceae	*Melaleuca thymoides*		
Myrtaceae	*Melaleuca viminea*		
Cyperaceae	*Mesomelaena tetragona*		
Poaceae	*Microlaena stipoides*		
Orchidaceae	*Microtis media*		
Orchidaceae	*Microtis orbicularis*		
Euphorbiaceae	*Monotaxis occidentalis*		
Iridaceae	*Moraea flaccida*	*	
Asteraceae	*Olearia axillaris*		
Rubiaceae	*Opercularia hispidula*		
Rubiaceae	*Opercularia vaginata*		
Fabaceae	*Ornithopus compressus*	*	
Iridaceae	*Orthrosanthus laxus*		
Asteraceae	*Monoculus monstrosus*	*	
Oxalidaceae	*Oxalis glabra*	*	
Oxalidaceae	*Oxalis perennans*		
Oxalidaceae	*Oxalis pes-caprae*	*	

Family	*Species*	Naturalised	Conservation status
Oxalidaceae	*Oxalis purpurea*	*	
Iridaceae	*Patersonia occidentalis*		
Geraniaceae	*Pelargonium capitatum*	*	
Poaceae	*Cenchrus setaceus*	*	
Proteaceae	*Persoonia longifolia*		
Proteaceae	*Petrophile linearis*		
Caryophyllaceae	*Petrorhagia dubia*	*	
Rutaceae	*Philotheca spicata*		
Philydraceae	*Philydrella drummondii*		
Haemodoraceae	*Phlebocarya ciliata*		
Loganiaceae	*Phyllangium paradoxum*		
Phyllanthaceae	*Phyllanthus calycinus*		
Thymelaeaceae	*Pimelea rosea*		
Plantaginaceae	*Plantago lanceolata*	*	
Apiaceae	*Platysace filiformis*		
Elaeocarpaceae	*Platytheca galioides*		
Poaceae	*Poa annua*	*	
Asteraceae	*Podolepis gracilis*		
Phyllanthaceae	*Poranthera microphylla*		
Urticaceae	*Parietaria debilis*		
Dennstaedtiaceae	*Pteridium esculentum*		
Orchidaceae	*Pterostylis glebosa*		
Orchidaceae	*Pterostylis recurva*		
Orchidaceae	*Pterostylis vittata*		
Orchidaceae	*Pterostylis* sp. Bloated snail orchid (W. Jackson BJ 486)		
Orchidaceae	*Pyrorchis nigricans*		
Asteraceae	*Quinetia urvillei*		
Ranunculaceae	*Ranunculus muricatus*	*	
Brassicaceae	*Raphanus raphanistrum*	*	
Rutaceae	*Rhadinothamnus anceps*		
Chenopodiaceae	*Rhagodia baccata*		
Iridaceae	*Romulea rosea*	*	
Primulaceae	*Samolus junceus*		
Santalaceae	*Santalum acuminatum*		
Goodeniaceae	*Scaevola anchusifolia*		
Cyperaceae	*Schoenus grandiflorus*		
Selaginellaceae	*Selaginella gracillima*		
Asteraceae	*Senecio pinnatifolius*		
Asteraceae	*Senecio pinnatifolius*		
Caryophyllaceae	*Silene gallica*	*	
Brassicaceae	*Sisymbrium orientale*		
Solanaceae	*Solanum nigrum*		
Asteraceae	*Sonchus oleraceus*	*	

Family	*Species*	Naturalised	Conservation status
Asparagaceae	*Sowerbaea laxiflora*		
Rhamnaceae	*Spyridium globulosum*		
Caryophyllaceae	*Stellaria media*	*	
Proteaceae	*Stirlingia latifolia*		
Stylidiaceae	*Stylidium brunonianum*		
Stylidiaceae	*Stylidium ciliatum*		
Stylidiaceae	*Stylidium hesperium*		
Stylidiaceae	*Stylidium junceum*		
Stylidiaceae	*Stylidium schoenoides*		
Fabaceae	*Templetonia retusa*		
Cyperaceae	*Tetraria octandra*		
Cyperaceae	*Tetraria octandra*		
Orchidaceae	*Thelymitra antennifera*		
Orchidaceae	*Thelymitra benthamiana*		
Orchidaceae	*Thelymitra crinita*		
Orchidaceae	*Thelymitra flexuosa*		
Orchidaceae	*Thelymitra graminea*		
Orchidaceae	*Thelymitra macrophylla*		
Malvaceae	*Thomasia cognata*		
Asparagaceae	*Thysanotus patersonii*		
Asphodelaceae	*Trachyandra divaricata*	*	
Araliaceae	*Trachymene pilosa*		
Fabaceae	*Trifolium campestre*	*	
Fabaceae	*Trifolium dubium*	*	
Fabaceae	*Trifolium repens*	*	
Juncaginaceae	*Triglochin calcitrapa*		
Juncaginaceae	*Triglochin centrocarpa*		
Juncaginaceae	*Triglochin centrocarpum*		
Juncaginaceae	*Triglochin muelleri*		
Tropaeolaceae	*Tropaeolum majus*	*	
Asteraceae	*Ursinia anthemoides*	*	
Lentibulariaceae	*Utricularia inaequalis*		
Lentibulariaceae	*Utricularia multifida*		
Lentibulariaceae	*Utricularia violacea*		
Scrophulariaceae	*Verbascum virgatum*	*	
Fabaceae	*Viminaria juncea*		
Xanthorrhoeaceae	*Xanthorrhoea brunonis*		
Xanthorrhoeaceae	*Xanthorrhoea gracilis*		
Xanthorrhoeaceae	*Xanthorrhoea preissii*		
Apiaceae	*Xanthosia huegelii*		
Proteaceae	*Xylomelum occidentale*		
Araceae	*Zantedeschia aethiopica*	*	

* Introduced (weed) species

DP	Declared Pest
WONS	Weed of National Significance
P3	Priority 3
P4	Priority 4

Site by species matrix

Taxon	AQW01	AQW02	AQW03	AQW04	AQW05	AQW06	AQW07	AQW08	AQW09	AQW10	AQW11	AQW12	AQW13	AQW14	AQW15	AQW16	AQW17
Acacia applanata							*				*						
Acacia cochlearis	*	*	*														
Acacia pulchella						*	*			*							
Acacia saligna					*	*						*				*	
Acacia stenoptera															*		
Acanthocarpus preissii	*	*	*														
Agonis flexuosa	*	*	*	*		*			*								
Alyxia buxifolia		*	*														
Amphipogon turbinatus															*		
Anthoxanthum odoratum																*	
Aphelia cyperoides															*		
Arctotheca calendula																*	
Asparagus asparagoides									*								
Astartea scoparia																*	
Asteridea pulverulenta																	*
Austrostipa compressa													*				*
Austrostipa flavescens	*	*	*														
Austrostipa sp.														*			
Banksia attenuata								*		*	*		*	*			*
Banksia grandis				*										*			
Baumea juncea												*					
Blennospora doliiformis												*			*		
Boronia dichotomum					*										*		
Bossiaea eriocarpa													*	*			
Brachyscome bellidioides												*	*				
Briza maxima				*	*	*	*	*			*			*	*	*	*
Briza minor								*		*	*	*				*	
Bromus diandrus			*														
Burchardia congesta							*							*			*
Burchardia multiflora												*					
Caesia micrantha					*	*	*	*									*
Caladenia attingens												*					
Caladenia flava				*	*	*	*	*		*			*	*	*		*
Caladenia latifolia					*				*		*					*	
Caladenia paludosa					*												
Calandrinia brevipedata	*	*	*														
Calytrix flavescens										*	*		*				
Cassytha racemosa	*					*						*				*	

Taxon	AQW01	AQW02	AQW03	AQW04	AQW05	AQW06	AQW07	AQW08	AQW09	AQW10	AQW11	AQW12	AQW13	AQW14	AQW15	AQW16	AQW17
Centrolepis aristata												*					
Chaetanthus aristatus												*			*		
Chaetophora curvifolia											*						
Chamaescilla corymbosa								*			*		*	*			
Cicendia filiformis												*					
Conostylis aculeata subsp. *preissii*	*	*	*		*		*	*		*							*
Conyza bonariensis						*											
Corymbia calophylla					*		*	*			*			*			
Cotula turbinata				*								*				*	
Craspedia variabilis																	*
Crassula colorata	*	*		*													
Crassula decumbens																*	
Crassula glomeratus	*	*	*														
Crassula natans												*					
Cycnogeton lineare												*					
Cynodon dactylon					*	*											
Dampiera linearis					*					*	*						
Dampiera pedunculata												*			*	*	
Dasypogon bromeliifolius					*		*			*	*		*	*			
Daucus glochidiatus	*			*	*		*	*									*
Daviesia divaricata											*						
Desmocladus fasciculatus								*		*	*		*	*			*
Desmocladus flexuosus										*							
Dianella revoluta	*						*										
Dichopogon capillipes				*													*
Diplolaena dampieri		*	*														
Drosera erythrorhiza							*							*			
Drosera glanduligera												*					
Drosera menziesii										*	*						
Drosera pallida				*						*	*		*	*			
Drosera rosulata												*			*		
Drosera stolonifera								*					*				*
Ehrharta calycina						*	*		*							*	*
Ehrharta longifolia	*								*							*	
Eremophila glabra subsp. *albicans*	*																
Erodium cicutarium	*																
Eucalyptus gomphocephala	*			*				*									*
Eucalyptus marginata				*						*			*	*			*
Eucalyptus rudis						*			*							*	

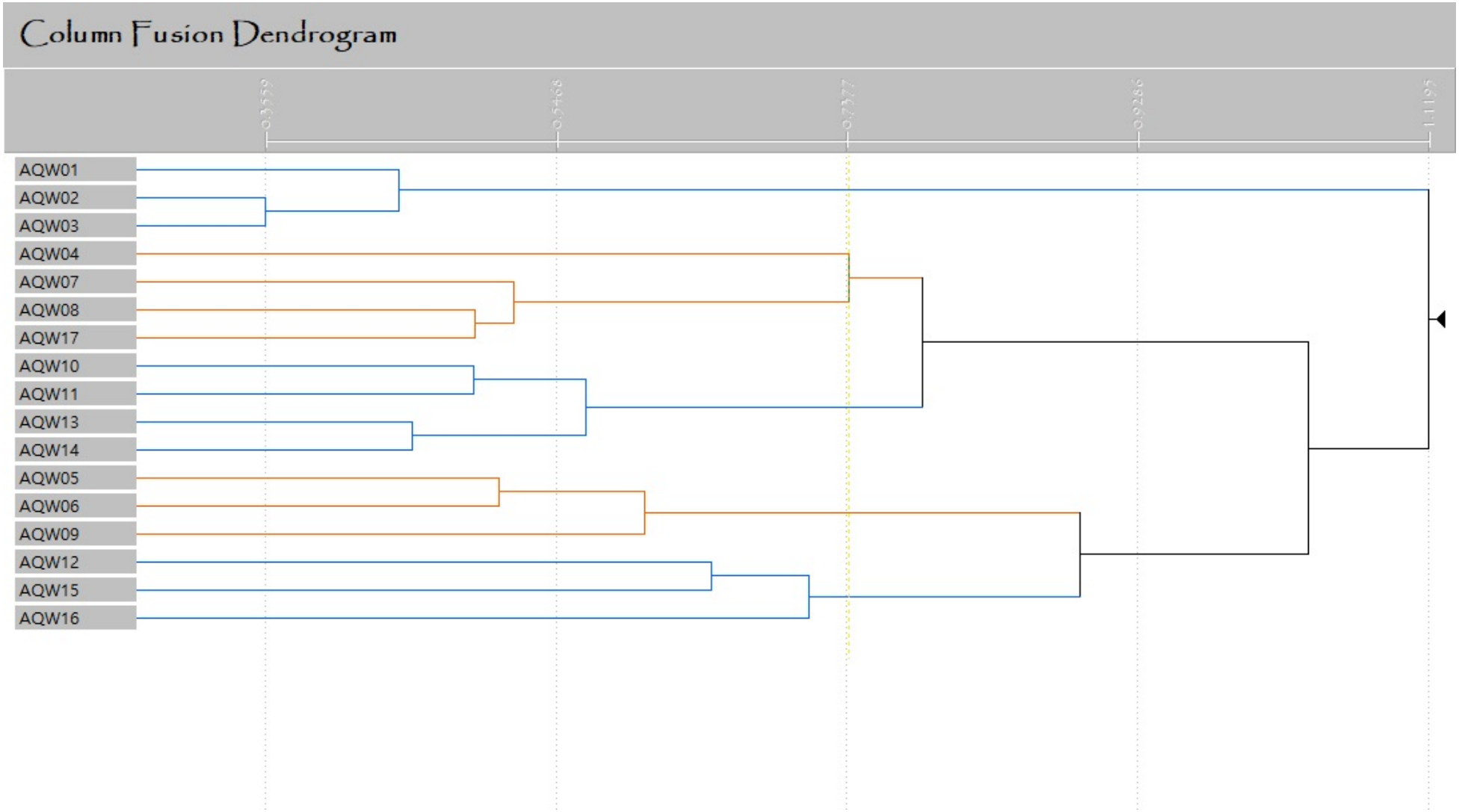
Taxon	AQW01	AQW02	AQW03	AQW04	AQW05	AQW06	AQW07	AQW08	AQW09	AQW10	AQW11	AQW12	AQW13	AQW14	AQW15	AQW16	AQW17
Euchilopsis linearis															*		
Euphorbia peplus	*			*													
Eutaxia virgata												*					
Exocarpos sparteus	*																
Ficinia cernua												*					
Ficinia marginata		*	*	*					*		*		*			*	
Ficinia nodosa			*														
Ficinia oldfieldii												*					
Fumaria capreolata			*		*												
Gahnia trifida					*	*			*								
Galium divaricatum	*	*		*													
Galium murale								*	*								
Gastrolobium ebracteolatum					*	*			*				-				
Geranium molle				*													
Geranium solanderi				*													
Gompholobium tomentosum		*											*	*			
Hakea sulcata															*		
Hakea varia					*							*			*		
Hardenbergia comptoniana	*			*													*
Hemiandra pungens			*														
Hibbertia cuneiformis			*	*													
Hibbertia hypericoides				*			*	*		*	*		*	*			*
Hibbertia racemosa				*													
Hibbertia vaginata											*		*				
Homalosciadium homalocarpum	*			*													
Hovea trisperma										*				*			
Hydrocotyle alata												*			*		
Hydrocotyle callicarpa				*													
Hydrocotyle sp.												*					
Hypochaeris glabra				*			*	*			*	*	*	*	*	*	*
Hypolaena exsulca										*			*	*			
Hypolaena pubescens					*	*											
Isolepis oldfieldiana												*					
Isotropis cuneiformis	*																
Jacksonia furcellata		*			*												
Juncus microcephalus												*					
Juncus pallidus									*								
Kennedia prostrata		*				*		*					*				*
Kunzea glabrescens								*		*	*		*				

Taxon	AQW01	AQW02	AQW03	AQW04	AQW05	AQW06	AQW07	AQW08	AQW09	AQW10	AQW11	AQW12	AQW13	AQW14	AQW15	AQW16	AQW17
Kunzea micrantha												*			*		
Lagenophora huegelii							*	*			*						*
Lagurus ovatus	*	*	*														
Lasiopetalum membranaceum				*													
Lepidosperma calcicola	*	*	*														
Lepidosperma gladiatum			*														
Lepidosperma longitudinale					*	*	*		*						*	*	
Lepidosperma pubisquameum													*	*			*
Lepidosperma squamatum							*	*		*	*		*				
Leporella fimbriata											*		*				
Leptocarpus coangustatus					*	*			*			*			*		
Leucopogon parviflorus		*	*														
Leucopogon racemulosus							*						*				*
Lomandra caespitosa										*			*				*
Lomandra hermaphrodita							*			*	*			*			*
Lomandra integra								*									
Lomandra micrantha						*	*				*						*
Lomandra nigricans										*	*						
Lomandra preissii										*			*	*			
Lomandra suaveolens							*										*
Lotus subbiflorus						*			*			*					
Lyginia imberbis													*				
Lysimachia arvensis	*	*	*	*				*	*								*
Macrozamia riedlei								*		*			*				
Melaleuca lateritia																*	
Melaleuca pauciflora															*		
Melaleuca preissiana							*										
Melaleuca rhaphiophylla					*	*			*			*				*	
Melaleuca thymoides										*	*						
Melaleuca viminea												*			*		
Mentha sp.												*					
Mesomelaena tetragona															*	*	
Microlaena stipoides							*	*									
Microtis media												*			*	*	
Microtis orbicularis												*					
Microtis sp.					*							*					
Monotaxis occidentalis													*				
Moraea flaccida																*	
Olearia axillaris	*	*	*														

Taxon	AQW01	AQW02	AQW03	AQW04	AQW05	AQW06	AQW07	AQW08	AQW09	AQW10	AQW11	AQW12	AQW13	AQW14	AQW15	AQW16	AQW17
Opercularia hispidula					*	*	*		*								
Opercularia vaginata	*		*														*
Orthrosanthus laxus							*	*									*
Oxalis perennans				*													
Oxalis purpurea												*					
Patersonia occidentalis					*									*			*
Petrophile linearis										*							
Petrorhagia velutina																	*
Philotheca spicata							*										
Phlebocarya ciliata							*							*			
Phyllangium paradoxum															*		
Phyllanthus calycinus	*	*	*	*			*										*
Platysace filiformis													*	*			
Podolepis gracilis												*					
Poranthera microphylla	*	*		*													
Pterostylis recurva										*				*			
Pyrorchis nigricans										*			*	*			
Quinetia urvillei				*													
Rhagodia baccata	*	*	*														
Romulea rosea		*							*			*			*	*	*
Samolus juncea					*												
Santalum acuminatum			*														
Sellaginella gracillima															*		
Senecio pinnatifolius	*		*														
Silene gallica																	*
Siloxerus humifusus																	*
Sisymbrium orientale	*	*															
Sonchus oleraceus	*		*		*				*								*
Sowerbaea laxiflora				*			*	*									*
Spyridium globulosum	*	*	*	*	*	*											
Stellaria media	*																
Stirlingia latifolia										*	*		*	*			
Stylidium brunonianum											*		*		*		
Stylidium ciliatum													*				
Stylidium junceum/hesperium														*			
Stylidium schoenoides										*							
Tetraria octandra								*			*						
Thelymitra antennifera												*					
Thelymitra benthamiana										*	*						

Taxon	AQW01	AQW02	AQW03	AQW04	AQW05	AQW06	AQW07	AQW08	AQW09	AQW10	AQW11	AQW12	AQW13	AQW14	AQW15	AQW16	AQW17
Thelymitra crinita														*			
Thelymitra crinita							*	*									
Thelymitra flexuosa															*		
Thelymitra graminea										*							
Thelymitra macrophylla					*												
Thomasia cognata	*																
Thysanotus manglesianus																*	
Thysanotus patersonii		*		*	*		*	*						*			
Thysanotus sp.					*					*							
Trachyandra divaricata	*	*	*														
Trachymene pilosa				*				*			*	*	*	*	*	*	*
Trifolium campestre				*													
Trifolium dubium								*									*
Triglochin centrocarpa												*					
Triglochin muelleri												*					
Triglochin sp. (CS01)		*															
Ursinia anthemoides											*		*		*	*	*
Viminaria juncea															*		
Waitzia acuminata																	*
Xanthorrhoea brunonis							*	*		*	*		*	*		*	*
Xanthosia huegelii													*		*		
Xylomelum occidentale										*			*	*			*
Zantedeschia aethiopicum										*	*					*	

Appendix E – Floristic Analysis


Column Fusion Dendrogram
0.3559
0.5468
0.7377
0.9286
1.1195
AQW01
AQW02
AQW03
AQW04
AQW07
AQW08
AQW17
AQW10
AQW11
AQW13
AQW14
AQW05
AQW06
AQW09
AQW12
AQW15
AQW16

Appendix F – Conservation Significant Flora Locations

Species	Conservation status	Abundance	Latitude	Longitude
Blennospora doliiformis	P3	1	-33.386072	115.661283
Caladenia speciosa	P4	1	-33.385813	115.655522
Caladenia speciosa	P4	1	-33.385736	115.65356
Caladenia speciosa	P4	2	-33.385874	115.655547
Caladenia speciosa	P4	1	-33.385913	115.655706
Caladenia speciosa	P4	1	-33.385727	115.655499
Lasiopetalum membranaceum	P3	1	-33.385585	115.627164
Lasiopetalum membranaceum	P3	1	-33.385757	115.626951
Lasiopetalum membranaceum	P3	5	-33.385636	115.625298
Lasiopetalum membranaceum	P3	1	-33.385651	115.625227
Lasiopetalum membranaceum	P3	1	-33.385524	115.625205
Lasiopetalum membranaceum	P3	1	-33.385502	115.624762
Lasiopetalum membranaceum	P3	6	-33.385496	115.624653
Lasiopetalum membranaceum	P3	3	-33.3856	115.621491
Lasiopetalum membranaceum	P3	1	-33.382865	115.636249
Lasiopetalum membranaceum	P3	1	-33.38657	115.620581
Lasiopetalum membranaceum	P3	1	-33.386002	115.65023
Lasiopetalum membranaceum	P3	1	-33.385481	115.645965
Lasiopetalum membranaceum	P3	1	-33.382875	115.636183
Lasiopetalum membranaceum	P3	1	-33.382847	115.636168
Lasiopetalum membranaceum	P3	1	-33.382806	115.636164
Lasiopetalum membranaceum	P3	12	-33.381179	115.623186
Lasiopetalum membranaceum	P3	15	-33.382576	115.622306
Lasiopetalum membranaceum	P3	2	-33.382773	115.62222
Lasiopetalum membranaceum	P3	30	-33.383884	115.621748

GHD

1st Floor
10 Victoria Street
T: 61 8 9721 0700 F: 61 8 9463 6012 E: bunmail@ghd.com

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