

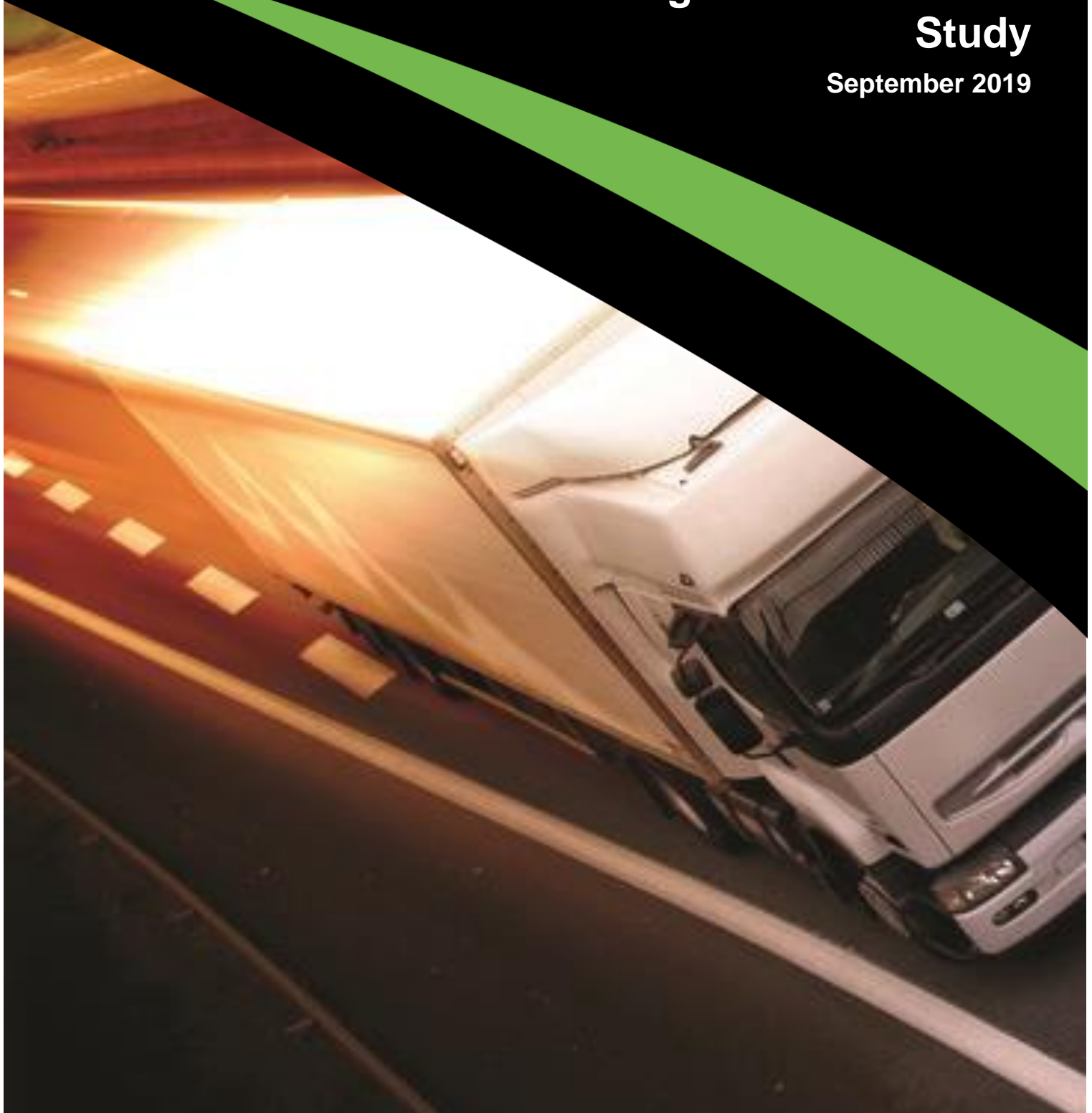
Bunbury Outer Ring Road Southern Section Vegetation and Flora Study (BORR IPT 2019a)

- Part 1 of 12



Bunbury Outer Ring Road Southern Section Vegetation and Flora Study

September 2019



Executive Summary

The Commissioner of Main Roads Western Australia (Main Roads) is planning for the construction of the Bunbury Outer Ring Road (BORR) Project. BORR is a planned Controlled Access Highway linking the Forrest Highway and Bussell Highway. The completed BORR will provide a high standard route for access to the Bunbury Port and facilitate proposed development to the east of the City of Bunbury. BORR will also provide an effective bypass of Bunbury for inter-regional traffic.

BORR forms a major component of the planned regional road network for the Greater Bunbury area. The land requirement for BORR is identified in the Greater Bunbury Region Scheme (GBRS).

The proposed BORR comprises three sections:

- 'BORR Northern Section' – Forrest Highway to Boyanup-Picton Road
- 'BORR Central Section' – The Central Section has been previously constructed however further improvements are proposed for this section, including the extension of Willinge Drive southwards to South Western Highway
- 'BORR Southern Section' – South Western Highway (near Bunbury Airport) to Bussell Highway.

Main Roads commissioned the BORR IPT to undertake a vegetation and flora study for BORR Southern Section (the Project). The purpose of the assessment was to delineate key flora and vegetation values within the survey area.

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

Key findings

Vegetation

The survey area contains a combination of native vegetation and highly disturbed areas, including roads, road reserve and paddocks. A total of nine vegetation types in addition to highly disturbed areas, regrowth / revegetation and planted vegetation were identified and described from the survey area.

The survey area occurs on the Bassendean and Spearwood Dunes and Pinjarra Plain. The sandy low dunes and plains that characterise the survey area were dominated by *Eucalyptus* / *Banksia* forests, in particular *Eucalyptus* / *Agonis* and *Banksia* woodlands / forests. Creek lines, swamps and low relief / seasonally inundated areas were dominated by *Eucalyptus rudis* / *Melaleuca preissiana* / *Melaleuca raphiophylla* woodlands. These were generally disturbed and dominated by introduced grasses and herbs in the ground-layer. In the agricultural areas and some road reserves, native vegetation occurred as scattered remnant trees or stands over introduced grasses. The survey area includes of 148 ha (50 %) native vegetation.

Vegetation condition within the survey area ranged from Excellent (2) to Completely Degraded (7). Almost half of the survey areas was cleared/highly modified (49.96 %). Historical clearing and aggressive weed species have influenced the structure and composition of the native vegetation. Approximately 14 % of the survey area (41.98 ha) was mapped as in Good or better condition.

Three conservation significant ecological communities were identified (based on results of desktop and field assessments) within the survey area:

- Banksia Woodlands of the Swan Coastal Plain TEC – listed as Endangered under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act)

- Banksia dominated woodlands of the Swan Coastal Plain IBRA region PEC – listed as Priority 3 by Department of Biodiversity, Conservation and Attractions (DBCA)
- Tuart (*Eucalyptus gomphocephala*) woodlands of the Swan Coastal Plain PEC – listed as Priority 3 by DBCA.

Since completion of the survey the Tuart (*E. gomphocephala*) woodlands and forests of the SCP ecological community has been listed as a TEC under the EPBC Act. Additional targeted surveys will be completed in spring 2019 to confirm the presence or absence of the TEC in the BORR Southern Alignment.

Flora

The floristic diversity of the survey area has been assessed by combining floristic survey data from GHD (2014 and 2015), Biota (2016 and 2018) and the current survey. A total of 409 species have been recorded across all floristic surveys, including 143 introduced or planted species (35 % of total number of species recorded).

During the current survey 267 plant species (including subspecies and varieties) representing 182 genera and 62 plant families were recorded within the survey area. This total was comprised of 178 native species and 89 introduced (exotic) and planted species.

The likelihood of occurrence assessment post-field survey for conservation significant species concluded that two species are known to occur, one species is likely to occur, 27 species possibly occur and the remaining 19 species are unlikely to occur within the survey area.

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- Appendix B Conservation Codes and Vegetation Condition Rating Scale
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Appendix D Quadrat and Photo Point Data

Appendix E Flora Data

Appendix F Vegetation Statistics

Appendix G Threatened Ecological Community (TEC) Assessment

Appendix H Flora Likelihood of Occurrence Assessment

<i>Document Control</i>					
Revision	Date	Description	Prepared	Reviewed	Approved
A	July 2019	Draft for Main Roads Review	BORR Team	MB	FH
B	September 2019	Final Draft for Main Roads review	BORR Team	MB, MP	FH
C	September 2019	Final Document	BORR Team	MB	FH

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1 INTRODUCTION

1.1 Project background

The Commissioner of Main Roads Western Australia (Main Roads) is proposing to construct and operate the Northern and Central sections of the Bunbury Outer Ring Road (BORR) project. The BORR is a planned Controlled Access Highway linking the Forrest Highway and Bussell Highway, and will provide a high standard route for access to the Bunbury Port. The completed BORR will also provide an effective bypass of Bunbury for inter-regional traffic and freight, reducing traffic on the local road network, and facilitate proposed development to the east of the city of Bunbury.

BORR forms a major component of the planned regional road network for the Greater Bunbury area.

The proposed BORR comprises three sections:

- 'BORR Northern Section' – Forrest Highway to Boyanup-Picton Road
- 'BORR Central Section' – The Central Section has been previously constructed however further improvements are proposed for this section, including the extension of Willinge Drive southwards to South Western Highway
- 'BORR Southern Section' – South Western Highway (near Bunbury Airport) to Bussell Highway.

Main Roads commissioned the BORR IPT to undertake a vegetation and flora study for BORR Southern Section (the Project).

1.2 Purpose of this report

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

The aim of the study was to:

- Identify, map and describe vegetation types
- Assess and map the condition of vegetation
- Identify and map the location of Threatened Ecological Communities (TECs) and Priority Ecological Communities (PECs)
- Identify areas of high floristic value including those that provide habitat for conservation significant flora, wetland / riparian vegetation, vegetation types that are poorly represented and those with high diversity
- Identify and map the location of conservation significant flora species.

1.3 Project location

1.3.1 Survey area

The survey area assessed in this flora and vegetation study covers approximately 297 hectares (ha) and includes existing road reserves, agricultural land and native vegetation.

The survey area is mapped in Figure 1, Appendix A.

1.3.2 Study area

A study area was defined for the desktop based searches of the assessment and includes a 5 kilometre (km) buffer of the survey area for the purpose of flora and vegetation database searches.

1.4 Scope of works

The scope of works for the flora and vegetation survey included:

- A desktop review of publically available information and relevant reports to determine the environmental values of the survey area
- A biological survey to identify:
 - Vegetation community types present, including the presence of any 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 biological survey 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.

1.5 Relevant legislation

In Western Australia (WA) significant communities and flora are protected under both Federal and State Government legislation. In addition, regulatory bodies 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 project are provided in **Error! Reference source not found..**

1.6 Limitations and assumptions

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

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

The services undertaken by BORR IPT 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. BORR IPT 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 BORR IPT described in this report. BORR IPT disclaims liability arising from any of the assumptions being incorrect.

BORR IPT has prepared this report on the basis of information provided by Main Roads and others who provided information to BORR IPT (including Government authorities), which BORR IPT has not independently verified or checked beyond the agreed scope of work. BORR IPT 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. BORR IPT does not accept responsibility arising from, or in connection with, any change to the site conditions. BORR IPT is also not responsible for updating this report if the site conditions change.

This report has assessed the flora values within the survey area, as shown in Figure 1, **Error! Reference source not found.**

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:

- GHD (2014) – Lot 1 Ducane Road Environmental Values Assessment
- GHD (2015) – Vegetation and Flora survey of the BORR South Alignment
- Biota (2016) – Bunbury Outer Ring Road Southern Section – Reassessment of Floristic Communities
- Biota (2018) – Bunbury Outer Ring Road Southern Section – Banksia Woodlands TEC Assessment
- Ecoedge (2017) – Report of a Targeted Rare Flora Survey for *Diuris drummondii* along four sections of the Bunbury Outer Ring Road proposed alignment

The desktop assessment also involved a review of:

- The Department of the Environment and Energy (DotEE) 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 (DotEE 2018) (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 (provided by Main Roads)
- The DBCA NatureMap database for flora species previously recorded within the study area (DBCA 2007–) (Appendix C)
- The DBCA Threatened (Declared Rare) and Priority Flora database (TPFL) and the WA Herbarium database (WAHERB) for Threatened and Priority flora species listed under the *Biodiversity Conservation Act 2016* (BC Act) (which replaced the *Wildlife Conservation Act 1950*) and listed as Priority by DBCA, previously recorded within the study area (provided by Main Roads)
- 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.
- Consultation with DBCA flora officer also identified additional conservation significant flora taxa not identified in desktop searches that are potentially present / have been recorded near the survey area.

2.2 Field assessment

BORR ITP botanists completed a detailed vegetation and flora assessment of the survey area in August (late winter/ early spring) and September 2018 (spring) (Table 2-1).

Table 2-1 Flora and vegetation survey timing and effort

Date	Survey effort	Field team
21 August 2018	Late winter / early spring assessment of wetland areas	Two senior botanists (flora Licence numbers: SL012417 and SL012366)

Date	Survey effort	Field team
	within the survey area / reconnaissance survey	
22 October, 30 October – 1 November 2018	Spring detailed survey within the survey area	One senior botanist and one ecologist (flora licence numbers: SL012417 and SL012418)

The field survey was undertaken to verify the results of the desktop assessment, identify and describe the dominant vegetation units, assess vegetation condition, and identify and record vascular flora species present at the time of survey. Searches for significant ecological communities and flora species were also undertaken during the field survey.

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

Data collection

Field survey methods involved a combination of sampling quadrats, releves and photographic reference points located in identified vegetation units and traversing the survey area by foot / vehicle. In total, 20 non-permanent quadrats, three releves and 109 photographic reference points (PPs) were described throughout the survey area (Figure 2, Appendix A). Copies of the quadrat and releve data and PPs are provided in Appendix D.

Quadrats (measuring 10 m x 10 m – area of 100 m²) were located within each identified vegetation unit. A minimum of three quadrats were located within each identified vegetation unit, except for those that were largely in a Degraded to Completely Degraded condition / represented by scattered trees over introduced understorey species. Releves were used to supplement quadrat data. At each PP, the vegetation type / condition was noted and searches for native flora via walking traverses were undertaken.

Field data at each quadrat was recorded on a pro-forma data sheet and included the parameters detailed in Table 2-2.

Table 2-2 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 Global Positioning System (GPS) tool to accuracy approximately ± 5 metres (m).
Vegetation condition	Vegetation condition was assessed using the condition rating scale adapted by EPA (2016) 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).

Aspect	Measurement
Flora	List of dominant flora from each structural layer. List of all species within the quadrat including stratum, average height and cover (using National Vegetation Information System (NVIS))

A flora inventory was compiled from species listed in described quadrats, releves, PPs and from opportunistic floristic records throughout the survey area.

Data from previous flora and vegetation investigations completed within the survey area were considered in the desktop assessment and were also included in the flora inventory. As shown in Table 2-3, flora assessments have been carried out within the survey area in September 2011, June 2013, June 2014, October 2016, November 2016 and November 2017. These surveys include an additional 34 quadrats / releves that were sampled within the survey area and have been used to describe the vegetation types and / or included in the floristic community type (FCT) analysis for this report.

The location of the previous survey areas is shown in Figure 3, Appendix A.

Table 2-3 Data collected from previous and related field surveys

Source	Measurement
GHD (2014)	Survey of Lot 1 Ducane Road. GHD completed a flora and vegetation assessment of Lot 1 Ducane Road on the 13 June 2013. This included nine quadrats, all of which are within the current survey area.
GHD (2015)	The survey was considered to be a level 2 assessment (as per the now superseded EPA guidelines). Phase 1 was carried out on the 21 to 23 September 2011 and Phase 2 from the 16 to 18 June 2014. A total of 21 quadrats (20 within the current survey area) were assessed and the vegetation types / their condition described.
Biota (2016)	Survey from the 25 to 26 October 2016 by two Biota botanists targeting areas identified in GHD (2015) as likely to correspond with FCT 8 and FCT21b. Seven sites were sampled, of which five (quadrats (three of which were re-sampled from GHD 2015) are within the current survey area.
Biota (2018)	The survey was carried out from the 4 to 6 November 2017 by two Biota botanists. Twenty-four target areas were sampled, using either quadrats (10 x 10 m) or mapping notes. Five quadrats and one releve were sampled (two quadrats and one releve within the current survey area).
Ecoedge (2017)	Ecoedge completed a targeted assessment on the 19 and 30 November 2016 of portions of the BORR South proposed alignment that provide suitable habitat for <i>Diuris drummondii</i> . 15.50 ha within the current survey were searched as part of this assessment.
Ecoedge (2019)	Ecoedge completed desktop review for the location of potential claypan wetlands, which identified one potential claypan wetland. A field survey determined that the wetland was not to be a claypan community.

Vegetation units

Vegetation units were identified and boundaries delineated in GHD (2015). During the current survey, the previous mapping was ground-truthed to detect any changes since the previous surveys. Areas not previously surveyed were mapped using a combination of aerial photography, topographical features, field data/observations and statistical analyses.

Vegetation units were described based on structure, dominant species and cover characteristics as defined by quadrat data and field observations. Vegetation unit descriptions follow NVIS and are consistent with NVIS Level V (Association). At Level V up to three species per stratum are used to describe the association (ESCAVI 2003).

Statistical analyses

PRIMER v6 (Clarke and Gorley 2006) was used to examine the similarity between sites using collected data. A presence/absence matrix was created of all species (including perennials and annuals) present in BORR IPT quadrats and quadrats from GHD (2014 and 2015) and Biota (2016 and 2018) that are within the current survey area. The dissimilarity between quadrats was determined using the Bray-Curtis measure and the Resemblance function in PRIMER. A Cluster analysis (using Agglomerative Hierarchical Clustering technique) based on group average was undertaken using the Bray-Curtis similarity matrix and results presented as a dendrogram. In addition, a nonmetric multi-dimensional scaling analysis (MDS) was undertaken using the Bray-Curtis similarity matrix and results presented as a two dimensional scatter plot. Analysis was run using two scenarios:

- All species (base quadrat data)
- Native species only (weed species removed from each quadrat)

The outputs of the PRIMER analysis were used to inform decisions on vegetation units.

Comparison of vegetation units with regional datasets

Statistical analysis

The Swan Coastal Plain dataset (SWA) (accessed through *NatureMap*) is derived from a database compiled and maintained over many years, combining the results of a number of floristic studies (conducted between 1990 and 1996) on plant communities of the SWA bioregion, south of Moore River. The SWA dataset includes sampling site details, the flora collected at these sampling sites and the FCT assigned to these sampling sites. The taxonomy of the flora in the SWA dataset used is current as of December 2018 updated by BORR IPT.

PRIMER v6 (Clarke and Gorley 2006) was used to compare the BORR IPT quadrats to existing data (where available) for FCTs described on the SWA. SWA site locations within a 5 km buffer of the survey area were located and the FCTs represented by these sites were identified. All site locations for these FCTs from the SWA dataset were extracted, along with those identified in the desktop searches (e.g. TEC and PEC searches). Representative quadrats from each FCT selected for the analysis are shown in Table 2-4.

The BORR IPT and SWA dataset quadrat data was combined, reconciled to align nomenclature and a presence/absence matrix created of all species (including perennials and annuals). Singleton species (those occurring in only one quadrat) were removed from the matrix as well as species that were only identified to family or genus level. The dissimilarity between quadrats was determined using the Bray-Curtis measure and the Resemblance function in PRIMER. A Cluster analysis (using Agglomerative Hierarchical Clustering technique) based on group average was undertaken using the Bray-Curtis similarity matrix and results presented as a dendrogram. In addition, a nonmetric multi-dimensional analysis (MDS) was undertaken using the Bray-Curtis similarity matrix and results

presented as a two dimensional scatter plot. A factor was added to the output to define sample groups by FCT. The outputs of the PRIMER analysis were used to inform decisions on vegetation units.

It is noted that PRIMER can be limited in use for this purpose as analysis is based on all species recorded in quadrats and does not take into account dominance of species. Further interpretation of statistical results, coupled with multiple field surveys and desktop information is needed to determine whether the vegetation units are representative of a certain FCT.

Table 2-4 List of SWA quadrats used in PRIMER analysis

Floristic Community Type Name and ID	Status	Quadrats
Southern <i>Corymbia calophylla</i> woodlands on heavy soils (1b)	TEC	AMBR-1, AMBR-4, AMBR-6, AMBR-9, AMBRAL-1, CAPEL-5, CARB-1, CARB-2, CARB-4, R116703, YALLIN-1, YOON-1
<i>Corymbia calophylla</i> – <i>Xanthorrhoea preissii</i> woodlands and shrublands (3c)	TEC	DUCK-1, DUCK-2, ELLEN-6, PEARCE-2, talb1, talb12, talb13, talb4, WATER-3, yar101
<i>Melaleuca preissiana</i> damplands (4)		AMBR-3, C58-1, CAPEL-3, dian02, FL-1, FL-9, GUTHR-1, Hamp01, kailis03, low14a, LYONS-1, MELA-1, Plant02, R116701, rowe02
Mixed shrub damplands (5)		AUSTB-5, GUTHR-4, jand06, low08, Mill01, MILT-1, PLINE-5, Swamp01
Weed dominated wetlands on heavy soils (6)		card10, card11, much02, PEARCE -1, Sunday01, TWIN-1, TWIN-2,
Herb rich saline shrublands in clay flats (7)	TEC ^	AUSTB-1, BAMBUN-1, BAMBUN-3, BULL-6, CARAB-2, FISH-1, gosn10, mrnp01, MUCK-2, Punr01, RUAB-4, Swamp02, YOON-3
Herb rich shrublands in clay pans (8)	TEC ^	C58-3, FL-3, FL-7, gosn08, Hay01, MEELON-1, MEELON-2, MUD-2, MUD-3, MUD-6, MUD-7, MUD-9, waro 03, waro 04, WATER-4
Dense shrublands on clay flats (9)	TEC ^	brick4, BYRD-1, DUCK-3, MANEA-1, Pind02, welr02, WONN-3, yar102
Shrublands on dry clay flats (10a)	TEC ^	C58-4, FISH-3, FISH-4, FL-2, gosn11, KOOLJ-6, KOOLJ-7, pinj10, Plant01, Punr03, waro 05
Wet forests and woodlands (11)		AUSTB-3, beel03, BULL-12, C71-1, CARAB-3, HARRY-6, hymus01, hymus02, low10b, MODO-3, rowe01, TWIN-11, yuri04
<i>Melaleuca raphiophylla</i> – <i>Gahnia trifida</i> seasonal wetlands (17)		Chid056, cool 01, cool 04, cool 11, ELLIS-1, Hay02, leda03, leda04, LESCH-6, MTB-5, PAGA-5, Possum5
Shrublands on calcareous silts (18)	TEC	boot01, boot03, ELE13, ELLIS-2, ELLIS-3, Hay05, xbeer02
Central <i>Banksia attenuata</i> – <i>Eucalyptus marginata</i> woodlands (21a)		AUSTRA-1, BULLER-1, C71-2, CAPEL-7, CLIFT01, CORON-1, FL-4, gelor02, Hamp03, KEME-2, KOOLI-2, MANEA-2, MGK01, MILT-6, NINE-2, REDL-1, RIVD-2, Sunday02

Floristic Community Type Name and ID	Status	Quadrats
Southern <i>Banksia attenuata</i> woodlands (21b)	PEC *	boyan01, buffer01, CAPEL-1, CARB-3, dard02, gibson01, kelly02, MANEA-3, MGK03, R116702, RUAB-1, RUAB-2
Low lying <i>Banksia attenuata</i> woodlands or shrublands (21c)	PEC *	5C07, BULLER-3, DEJONG02, dillo01, FL-6, KEME-3, low07, MODO-2, PLINE-7, raven03, SF03, TWIN-7, white05
Southern <i>Eucalyptus gomphocephala</i> and/or <i>Agonis flexuosa</i> woodlands (25)	PEC **	bunb01, C71-4, colriv01, CORON-2, gelro01, GMaid01, GMaid02, GMaid03, GMaid04, KEME-1, MEAL-1, MINN-2, MYALUP-2, NMaid05, tokyu01, yela03
Coastal shrublands on shallow sands (29a)		BMaid02, BU01, BU04, MI21, NAVB-2, NMaid01, NMaid03, Pinn02, PRES-1, rich02
Quindalup <i>Eucalyptus gomphocephala</i> and / or <i>Agonis flexuosa</i> woodlands (30b)		LESCH-1, LESCH-2, LESCH-3, LESCH-4, LESCH-5, NMaid04, PEPB-1, pip01, Possum3
<i>Astartea</i> aff. <i>fascicularis</i> / <i>Melaleuca</i> species dense shrublands (S01)		Cavs07, Della01, gosn06, pinj15, raven04, Swamp03, yang03
<i>Acacia saligna</i> wetlands (S05)		ELE09, ELE10, ELE36, Hay03

^ A component of the Critically Endangered Clay Pans of the Swan Coastal Plain EPBC listed TEC.

* A component of the Endangered *Banksia* Woodlands of the Swan Coastal Plain EPBC listed TEC.

** Can be a component of the Endangered *Banksia* Woodlands of the Swan Coastal Plain EPBC listed TEC.

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 (devised by Keighery (1994) and adapted by EPA (2016)). The scale recognises the intactness of vegetation and consists of six rating levels. The vegetation condition rating scale is located in Appendix B.

Flora identification and nomenclature

Species well known to the survey botanists were identified in the field; all other species were collected and assigned a unique collection number to facilitate tracking. All specimens collected during the field assessment were dried and processed in accordance with the requirements of the WA Herbarium. Species were identified by a qualified taxonomist using 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–) and the EPBC Act Threatened species database provided by DotEE (2019).

Nomenclature used in this report follows that used by the WA Herbarium as reported on FloraBase (WA Herbarium 1998–).

Surveys for conservation significant flora

Prior to the field survey, information obtained from the desktop assessments (e.g. aerial photography, geology, soils and topography data, EPBC Act PMST, TPFL, NatureMap and the

WAHERB databases search results) was reviewed to determine conservation significant flora species potentially present within the study area and locations. Additionally, ecological information (e.g. habitat, associated flora species and phenology) was sourced from FloraBase (WA Herbarium 1998–) to provide further details.

Potential habitats and locations of previous records were searched by opportunistic sampling. Where individuals were identified, the location and number of plants present were recorded using handheld GPS units.

2.3 Desktop and field assessment limitations

2.3.1 Desktop

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 and Priority flora provide more accurate information for the general area. However, some records of collections cannot be dated or are plain text interpretations of locations which can misrepresent the current range of Threatened or Priority species.

2.3.2 Field

The EPA (2016) 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 2-5. Based on this assessment, the present survey effort has not been subject to any constraints which affect the thoroughness of the assessment and the conclusions which have been formed.

Table 2-5 Field survey limitations

Aspect	Constraint	Comment
Sources of information and availability of contextual information.	Nil	Adequate information is available for the survey area, this includes: <ul style="list-style-type: none"> Broad scale (1:250,000) mapping by Beard (1979), Heddl <i>et al.</i> (1980) and Webb <i>et al.</i> (2016) Regional biogeography (Mitchell <i>et al.</i> 2002) Previous flora surveys within and adjacent to the survey area including GHD (2015); Ecoedge (2017) and Biota (2016; 2018) (see section 4).
Scope (what life forms were sampled etc.)	Nil	Vascular flora was sampled during the survey. Non-vascular flora were not surveyed.
Proportion of flora collected and identified (based on sampling, timing and intensity)	Minor	A reconnaissance survey was undertaken on the 21 August and a single season detailed vegetation and flora survey was undertaken on the 22 October and 30 October to 1 November 2018 (four days). The survey included an early spring and late spring. The flora recorded from the field survey is detailed in section 5.5 and a full flora species list is provided in Appendix E. The portion of flora collected and identified was considered moderate to high, based on survey effort and timing.

Aspect	Constraint	Comment
Flora determination	Moderate	<p>Flora determination was undertaken by the BORR IPT botanists in the field and consulting taxonomist at the WA Herbarium. During the recent surveys (2018) over 94 % of species were identified to a species level. 17 specimens could be identified to genera / tentative species only of which five were weeds. It is unlikely these un-identified species are conservation significant, with the exception of orchid (<i>Caladenia</i> species) which contained basal leaves only. The taxonomy and conservation status of the WA flora is dynamic. This report was prepared with reliance on taxonomy and conservation status current at the time report development, but it should be noted this may change in response to ongoing research and review of International Union for Conservation Nature criteria.</p>
Completeness and further work which might be needed (e.g. was the relevant area fully surveyed)	Moderate	<p>The survey area has previously been surveyed in the past (see section 4). During this current assessment, the focus was on areas that fell outside of the GHD (2015) and Biota (2016; 2018) assessments. Some areas that were previously assessed were also re-surveyed to determine change over time. Access to the survey area was made by vehicle tracks which extended along the site. 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.</p>
Mapping reliability	Minor	<p>The vegetation was mapped using high-resolution ESRI aerial imagery obtained from Landgate, topographical features, previous broad scale mapping, previous vegetation mapping and field data. Data was recorded in the field using hand-held GPS tools (e.g. Samsung Tablet with ArcGIS Collector and Garmin GPS). Certain atmospheric factors and other sources of error can affect the accuracy of GPS receivers. The Garmin GPS units used for this survey are accurate to within ± 5 metres on average. Therefore the data points consisting of coordinates recorded from the GPS may contain inaccuracies. Mapping was completed to a scale of 1:10,000.</p>
Timing/weather/season/cycle	Nil	<p>The field surveys were conducted from 20 August to 1 November 2018. The closest weather recording station to the survey area is Bunbury (No. 9965) (Bureau of Meteorology (BoM) 2019). As shown in Plate 1, section 3.1, the long-term averages (LTA) rainfall are slightly lower than the 2018 period for June and July, with the 2018 period recording lower rainfall averages in September, November and December. The temperature statistics indicate that the 2018 minimum and maximum temperatures were consistent with the LTAs. The weather conditions recorded during the survey periods are considered unlikely to have impacted upon the vegetation and flora survey. The survey timing was considered appropriate for the flora field survey.</p>

Aspect	Constraint	Comment
Disturbances (e.g. fire, flood, accidental human intervention)	Nil	The survey area is largely located in an agricultural setting and as such has had previous land clearing. At the time of the survey one small area area was burnt, not other disturbance such as fire / flooding etc. were present.
Intensity (in retrospect, was the intensity adequate)	Minor	The vascular flora of the survey area was sampled in accordance with EPA (2016); a minimum of three quadrats per vegetation type were established (where possible) along with relevés and photographic reference points to supplement the data. The survey area was sufficiently covered by the botanists during the survey.
Resources	Minor	Adequate resources were employed during the field survey. Field survey teams consisted of one senior botanist (more than 10 years' experience) and a field ecologist (2+ years' field experience). In total, 4 field survey team days were spent undertaking vegetation and flora surveys.
Access restrictions	Nil	The survey area included private properties; the BORR IPT arranged site access. However, not all properties were accessed for the survey. In some instances, access within and across properties was restricted due to biosecurity, electric fences and cattle. In these instances vegetation types and conditions were extrapolated from aerial photography / soil and landscape information and nearby survey points.
Experience levels	Nil	The botanists who executed the survey are practitioners suitably qualified and experienced in their respective fields. The detailed survey team consisted of a senior botanist a support personnel. The reconnaissance survey was carried out by two senior botanist. The senior botanist has more than 10 years' experience conducting flora surveys in WA, including the south-west. Field ecologists/ field support staff have 2 – 4 years' field experience.

3 DESKTOP ASSESSMENT

3.1 Climate

The Bunbury area experiences a Mediterranean climate and is characterised by hot, 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 2019). Climate statistics for the Bunbury weather station have been presented in Plate 1.

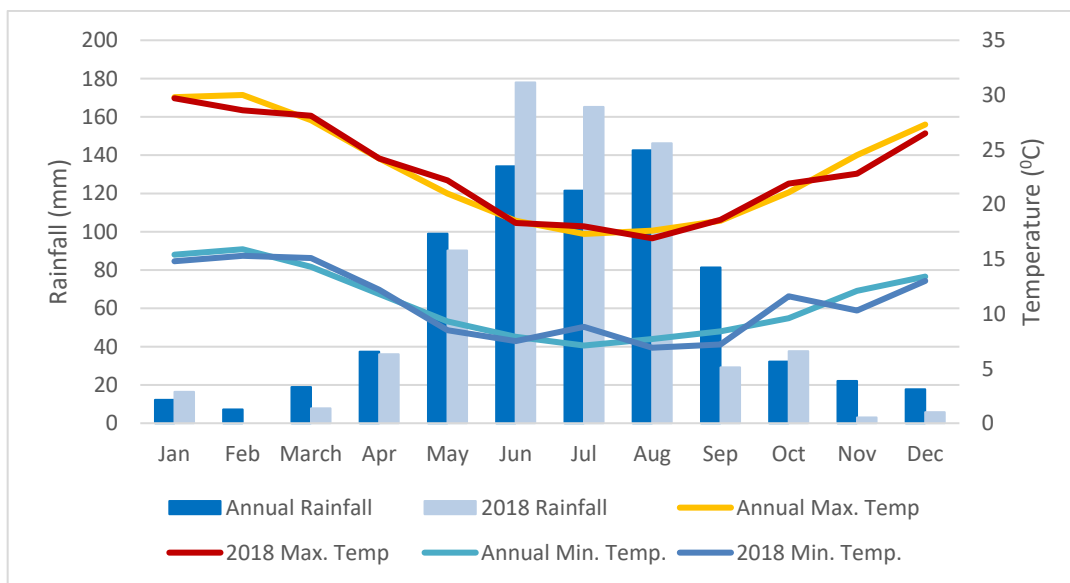


Plate 1 Climate statistics for Bunbury Weather Station (No. 9965) Annual and 2018

Note: April and May data for Bunbury Weather Station was not available at time of writing therefore data from Australind weather station (No. 9273) has been used instead for these two months. 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). The study area is located in the Swan Coastal Plain (SCP) bioregion and Perth (SWA2) subregion as described by the Interim Biogeographic Region of Western Australia (Department of the Environment 2012).

The Perth subregion is composed of colluvial, 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 Landform and soils

The SCP is comprised of five major geomorphological units, which lie more or less parallel to the coast, being the Quindalup, Spearwood and Bassendean Dunes, the Pinjarra Plain and the Ridge Hill Shelf (McArthur and Bettenay 1960; Churchwood and McArthur 1980). The survey area lies within the Spearwood and Bassendean Dunes and Pinjarra Plain elements, which are broadly described as:

- Spearwood dune system: Pleistocene and aeolian sands overlying Tamala limestone. Low dunes and swales of shallow pale grey sands over yellow sands are characteristic of the Spearwood system. Wetlands are associated with peats and carbonate sands, occasionally with clay overlaying sands.
- 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.
- 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.

Desktop assessment of broad geological formations indicates that the survey area occurs within three broad formations in addition to rivers and wetland areas, which are outlined in Table 3-1.

Table 3-1 Geology and landform information for the survey area (Geological Survey of WA 2009)

Formation	Geological type	Geological description/ landform
Tamala Limestone	Qts	Sand associated with Tamala Limestone, high dunes
Guildford Formation	Qpa	Mainly alluvial sandy clay
Bassendean Sand	Qpb	Low rounded dunes
	Qpb/Qpa	Thin Bassendean Sand over Guildford Formation
Rivers	Qha	Alluvium
Wetlands	Qhw	Swamp deposits, mainly peaty sand

Department of Primary Industries and Regional Development (DPIRD) soil-landscape mapping of the South West of WA (Government of Western Australia (GoWA) 2019c) provides soil and landform data compiled from various sources. This mapping identifies 23 different soil types within the survey area. In total, approximately 56 % of the mapped soil types occur within the Bassendean dune system, 24 % within the Spearwood dune system and 20 % within the Pinjarra Plain. The dominant soil types (greater than 20 ha / more than 7 % of the survey area each) are the:

- Spearwood S1b Phase (211Sp__S1b): Dune ridges with deep siliceous yellow brown sands or pale sands with yellow-brown subsoil and slopes up to 15%.
- Spearwood S2c Phase (211Sp__S2c): Lower slopes (1-5%) of dune ridge with bleached or pale sands with a yellow-brown or pale brown subsoil (like S1c). Usually occurs on the eastern edge of the Spearwood Dunes.
- Bassendean B1b Phase (212Bs_B1b): Very low relief dunes of undulating sand plain with deep bleached grey sandy A2 horizons and pale yellow B horizons.
- Bassendean B2 Phase (212Bs_B2): Flat to very gently undulating sandplain with well to moderately well drained deep bleached grey sands with a pale yellow B horizon or a weak iron-organic hardpan 1-2 m.
- Pinjarra P1b Phase (213Pj_P1b): Flat to very gently undulating plain with deep acidic mottled yellow duplex soils. Moderately deep pale sand to loamy sand over clay: imperfectly drained and moderately susceptible to salinity in limited areas.

Soil landscape types are illustrated in Figure 4.

3.4 Hydrology

3.4.1 Watercourses

The survey area intersects Five Mile Brook and a number of small drainage lines and man-made drains (Figure 5, Appendix A). Large parts of the survey area have been extensively modified for agricultural irrigation / drainage. For the purposes of this report, these irrigation channels are considered part of the agricultural areas and are not mapped as waterways.

3.4.2 Wetlands

Large sections of the survey area are low-lying palusplain, which is seasonally waterlogged or has a high water table during winter. A search of the EPBC Protected Matters Database (DotEE 2018) did not identify any Ramsar listed, Directory of Important Wetlands in Australia or National Heritage Listed wetlands within or in a 5 km buffer of the survey area.

The Geomorphic Wetlands dataset (Hill *et al.* 1996) identifies 27 wetlands within the survey area (Figure 5, Appendix A). These include one Conservation Category Wetland (CCW), 20 Multiple Use Wetlands (MUW) and five Resource Enhancement Wetlands (REW) and one Not Assessed wetland. Approximately 24 % of the survey area is mapped as geomorphic wetlands.

A separate wetland assessment has been completed (BORR IPT 2019) which provides further information on the geomorphic wetlands and an evaluation against their classification.

3.5 Vegetation and flora

3.5.1 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 mapping indicates that the survey area intersects three vegetation associations (Figure 6, Appendix A):

- Medium woodland; Tuart and Jarrah (association 6)
- Medium woodland; Tuart (association 998)
- Mosaic: Medium forest; Jarrah-Marri / Low woodland; Banksia / Low forest; Teatree (*Melaleuca spp.*) (association 1000).

As shown in 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 characterized by *Eucalyptus rudis* (Flooded Gum)-*Melaleuca* species open forests.

GoWA (2019a) has assessed the current extent of vegetation complexes against predicted pre-European extents within the SWA IBRA bioregion (Table 3-3) and LGA levels (Table 3-4). The current extents of the Bassendean Complex – Central and South, Karrakatta Complex – Central and South and Southern River Complex are less than 30 % of their pre-European extents within the SWA IBRA bioregion. The current extents of the Bassendean Complex – Central and South, Southern River Complex and Yoongarillup Complex are also less than 30 % of their pre-European extents within the City of Bunbury and Shire of Capel LGAs.

, the current extent of vegetation associations 6, 998 and 1000 are less than 30 % of their pre-European extent at the IBRA bioregion, IBRA subregion and within some of the Local Government Authority (LGA) levels (latest update March 2019) (GoWA 2019b).

Regional vegetation has been mapped by Heddle *et al.* (1980) and updated by Webb *et al.* (2016) based on major geomorphic units on the SCP. The mapping indicates that four vegetation complexes on Aeolian deposits of the SCP are present within the survey area (Figure 7, Appendix A):

- Bassendean Complex – Central and South: Vegetation ranges from woodland of *Eucalyptus marginata* (Jarrah) – *Allocasuarina fraseriana* (Sheoak) – *Banksia* species to low woodland of *Melaleuca* species, and sedgelands on the moister sites. This area includes the transition of *Eucalyptus marginata* to *Eucalyptus todtiana* (Pricklybark) in the vicinity of Perth
- Karrakatta Complex – Central and South: Predominantly open forest of *Eucalyptus gomphocephala* (Tuart) – *Eucalyptus marginata* – *Corymbia calophylla* (Marri) and woodland of *Eucalyptus marginata* – *Banksia* species. *Agonis flexuosa* (Peppermint) is co-dominant south of the Capel River
- Southern River Complex – Open woodland of *Corymbia calophylla* (Marri) - *Eucalyptus marginata* (Jarrah) - *Banksia* species with fringing woodland of *Eucalyptus rudis* (Flooded Gum) - *Melaleuca raphiophylla* (Swamp Paperbark) along creek beds
- 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 characterized by *Eucalyptus rudis* (Flooded Gum)-*Melaleuca* species open forests.

GoWA (2019a) has assessed the current extent of vegetation complexes against predicted pre-European extents within the SWA IBRA bioregion (Table 3-3) and LGA levels (Table 3-4). The current extents of the Bassendean Complex – Central and South, Karrakatta Complex – Central and South and Southern River Complex are less than 30 % of their pre-European extents within the SWA IBRA bioregion. The current extents of the Bassendean Complex – Central and South, Southern River Complex and Yoongarillup Complex are also less than 30 % of their pre-European extents within the City of Bunbury and Shire of Capel LGAs.

Table 3-2 Extents of vegetation associations mapped within the survey area (GoWA 2019b)

VEGETATION ASSOCIATION	SCALE	PRE-EUROPEAN EXTENT (HA)	CURRENT EXTENT (HA)	REMAINING (%)	REMAINING WITHIN DBCA MANAGED LANDS (%)	
Swan Coastal Plain IBRA bioregion		1,501,221.93	579,813.47	38.62	38.45	
6	State: WA	56,343.01	13,362.25	23.72	39.83	
	IBRA bioregion: Swan Coastal Plain	56,343.01	13,362.25	23.72	39.83	
	Sub-region: Perth	56,343.01	13,362.25	23.72	39.83	
	LGA	City of Bunbury	712.97	281.18	39.44	NA
	Shire of Capel	5,245.29	2,301.14	43.87	16.51	
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	NA
	Shire of Capel	234.63	24.28	10.35	NA	
1000	State: WA	99,835.86	27,768.84	27.81	18.64	

VEGETATION ASSOCIATION	SCALE	PRE-EUROPEAN EXTENT (HA)	CURRENT EXTENT (HA)	REMAINING (%)	REMAINING WITHIN DBCA MANAGED LANDS (%)	
	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
		Shire of Capel	15,173.76	3,189.87	21.02	7.27

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

Table 3-3 Extent of Heddle *et al.* (1980) vegetation complex on the Swan Coastal Plain within the survey area (GoWA 2019a)

VEGETATION COMPLEX	PRE-EUROPEAN EXTENT (HA)	CURRENT EXTENT (HA)	REMAINING EXTENT (%)	CURRENT EXTENT REMAINING WITHIN ALL DBCA MANAGED LAND (%)
Bassendean Complex – Central and South	87,476.26	23,508.66	26.87	5.00
Karrakatta Complex - Central and South	53,080.99	12,467.20	23.49	8.07
Southern River Complex	58,781.48	10,832.18	18.43	1.60
Yoongarillup Complex	27,977.93	10,018.14	35.81	18.41

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

Table 3-4 Extent of Heddle *et al.* (1980) vegetation complex within Local Government Areas within the survey area (GoWA 2019a)

VEGETATION COMPLEX	LGA	PRE-EUROPEAN EXTENT (HA)	CURRENT EXTENT (%)	REMAINING EXTENT (%)	PROPORTION OF THE VEGETATION COMPLEX WITHIN THE LGA (%)
Bassendean Complex – Central and South	City of Bunbury	0.0	0.0	0.0	0.0
	Shire of Capel	4,946.61	1,162.16	23.49	5.65
Karrakatta Complex - Central and South	City of Bunbury	756.61	283.96	37.53	1.43
	Shire of Capel	6,902.27	3,400.62	49.27	13.00
Southern River Complex	City of Bunbury	2,205.16	635.67	28.83	3.75
	Shire of Capel	7,876.12	1,794.33	22.78	13.40
Yoongarillup Complex	City of Bunbury	1,435.65	156.36	10.89	5.13
	Shire of Capel	1,022.21	233.64	22.86	3.65

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

Swan Coastal Plain Floristic Studies

Floristic studies on the SCP include those completed by Gibson *et al.* (1994) and other unpublished data collected as part of the System 6 and Part System 1 Update program and from various sources (e.g. Weston *et al.* 1993, Griffin 1994, DEP 1996 and Keighery 1996). This data has been compiled into a dataset, referred to in this report as the SWA dataset. A search of the SWA dataset identified 17 FCTs that are known to occur within a 5 km buffer of the survey area (Table 3-5).

Table 3-5 SWA dataset FCTs within 5 km of the survey area

FCT	Description and status
Foothills / Pinjarra Plain	
1b	Southern <i>Corymbia calophylla</i> woodlands on heavy soils.
Seasonal wetlands	
4	<i>Melaleuca preissiana</i> damplands
5	Mixed shrub damplands
6	Weed dominated wetlands on heavy soils
8	Herb rich shrublands in clay pans
9	Dense shrublands on clay flats
11	Wet forests and woodlands
17	<i>Melaleuca raphiophylla</i> – <i>Gahnia trifida</i> seasonal wetlands
18	Shrublands on calcareous silts
S01	<i>Astartea</i> aff. <i>fascicularis</i> / <i>Melaleuca</i> species dense shrublands
S05	<i>Acacia saligna</i> wetlands
Uplands centred on Bassendean dunes and Dandaragan Plateau	
21a	Central <i>Banksia attenuata</i> – <i>Eucalyptus marginata</i> woodlands
21b	Southern <i>Banksia attenuata</i> woodlands
21c	Low lying <i>Banksia attenuata</i> woodlands and shrublands
Uplands centred on Spearwood and Quindalup Dunes	
25	Southern <i>Eucalyptus gomphocephala</i> – <i>Agonis flexuosa</i> woodlands
29a	Coastal shrubland on shallow sands
30b	Quindalup <i>Eucalyptus gomphocephala</i> and/or <i>Agonis flexuosa</i> woodlands

3.5.2 Conservation significant ecological communities

A search of the EPBC Act PMST (DotEE 2018) and the DBCA TEC/PEC database identified 13 TEC / PECs that occur within the study area. A summary of the database findings is presented in Table 3-6 and the DBCA database results are shown in Figure 8 (Appendix A).

Table 3-6 Threatened and Priority Ecological Communities identified in the desktop searches

Community type	EPBC Act	DBCAs	Description	Location ¹
TECs / PECs within the survey area				
<i>Banksia</i> woodlands of the SCP (TEC)	Endangered	Priority 3	The ecological community is a woodland associated with the SWA. A key diagnostic feature is a prominent tree layer of <i>Banksia</i> , with scattered eucalypts and other tree species often present among or emerging above the <i>Banksia</i> 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 (Threatened Species Scientific Committee (TSSC) 2016).	89 occurrences mapped within the survey area
<i>Banksia</i> dominated woodlands of the SCP IBRA region (PEC)				702 occurrences within the 5 km buffer of the survey area
Shrublands on dry clay flats (SCP10a)	Critically Endangered	Endangered	This ecological community forms a component of the Critically Endangered Clay Pans of the SWA TEC. This is the most rapidly drying of the clay flats vegetation community types. This vegetation community type has a high species richness and includes the aquatic annuals and geophytes typical of other clay pan and clay flat vegetation community types. The shrub layer is dominated by species of <i>Hakea</i> (<i>H. varia</i> and <i>H. sulcata</i>) which, along with <i>Pericalymma ellipticum</i> , is indicative of a short inundation period (TSSC 2012).	One occurrence mapped within the survey area One occurrence within the 5 km buffer of the survey area
Southern SCP <i>Eucalyptus gomphocephala</i> – <i>Agonis flexuosa</i> woodlands (SCP25)		Priority 3	This ecological community can form a component of the Banksia Woodlands TEC or the Tuart Woodlands of the SCP PEC. Woodlands of <i>E. gomphocephala</i> – <i>A. flexuosa</i> south of Woodman Point. Recorded from the Karrakatta, Cottesloe and Vasse units. Dominants other than Tuart were occasionally recorded (including <i>Corymbia calophylla</i> and <i>E. decipiens</i>) however Tuart was emergent nearby (DBCAs 2019).	Three occurrences mapped within the survey area 11 occurrences within the 5 km buffer of the survey area
TECs / PECs within the 5 km buffer of the survey area				

¹ Some TECs and PECs identified occur further than the study area. However since they were identified in the DBCA database searches they have been included.

Community type	EPBC Act	DBCAs	Description	Location ¹
Herb rich saline shrublands in clay pans (SCP07)	Critically Endangered	Vulnerable	<p>This ecological community forms a component of the Critically Endangered Clay Pans of the SWA TEC.</p> <p>This vegetation community type 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 <i>Melaleuca viminea</i>, <i>M. uncinata</i>, <i>M. cuticularis</i> or <i>Casuarina obesa</i>. Typical species in the understorey include the common herbs <i>Brachyscome bellidioides</i>, <i>Centrolepis polygyna</i>, <i>Pogonolepis stricta</i> and <i>Cotula coronopifolia</i>. In addition, species such as <i>Angianthus</i> aff. <i>drummondii</i>, <i>Eryngium pinnatifidum</i> subsp. <i>Palustre</i> (G.J. Keighery 13459) and <i>Blennospora drummondii</i> occur in low frequency (<50%) and are absent from the other four vegetation community types (SCP08, SCP09, SCP10a and 117) (TSSC 2012).</p>	Two occurrences mapped within the 5 km buffer of the survey area
Herb rich shrublands in clay pans (FCT - SCP08)	Critically Endangered	Vulnerable	<p>This vegetation community type occurs in low lying flats with a clay impeding layer allowing seasonal inundation. This vegetation community type is dominated by one or more of the shrubs: <i>Viminaria juncea</i>, <i>Melaleuca viminea</i>, <i>M. lateritia</i>, <i>Kunzea micrantha</i> or <i>K. recurva</i> with occasional emergent of <i>Eucalyptus wandoo</i>. Species such as <i>Hypocalymma angustifolium</i>, <i>Acacia lasiocarpa</i> var. <i>bracteolata</i> long peduncle variant (G. J. Keighery 5026) (P1) and <i>Verticordia huegelii</i> 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 (TSSC 2012).</p>	Four occurrences mapped within the 5 km buffer of the survey area
Dense shrublands on clay flats (FCT - SCP09)	Critically Endangered	Vulnerable	<p>This vegetation community type is shrublands or low open woodlands on clay flats that are inundated for long periods because it usually occurs very low in the landscape. Sedges are more apparent in this ecological community and include <i>Chorizandra enodis</i>, <i>Cyathochaeta avenacea</i>, <i>Lepidosperma longitudinale</i> and <i>Meeboldina coangustata</i>. Shrubs include <i>Hakea varia</i> and <i>Melaleuca viminea</i> and occasionally <i>Xanthorrhoea preissii</i>, <i>X. drummondii</i> and <i>Kingia australis</i>. 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).</p>	Two occurrences mapped within the 5 km buffer of the survey area

Community type	EPBC Act	DBCAs	Description	Location ¹
Shrublands on calcareous silts of the SCP (SCP18)		Vulnerable	This ecological community is a very species rich community with a restricted distribution on calcareous silt flats. Common species are <i>Acacia saligna</i> , <i>Leptomeria lehmannii</i> , <i>Xanthorrhoea preissii</i> , <i>Gahnia trifida</i> and <i>Melaleuca teretifolia</i> (Gibson <i>et al.</i> 1994).	One occurrence within the 5 km buffer of the survey area
<i>Corymbia calophylla</i> woodlands on heavy soils of the southern SCP (SCP1b)		Vulnerable	This ecological community consists largely of <i>C. calophylla</i> forests and woodlands of bushland remnants on the plain south of Capel (Gibson <i>et al.</i> 1994).	One occurrence within the 5 km buffer of the survey area
Southern <i>Banksia attenuata</i> woodlands (SCP21b)	Endangered	Priority 3	This ecological community forms a component of the Endangered Banksia Woodland TEC. This community is restricted to the 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 <i>Banksia attenuata</i> or <i>Eucalyptus marginata</i> – <i>B. attenuata</i> woodlands. Common species include <i>Acacia extensa</i> , <i>Jacksonia</i> sp. Busselton, <i>Laxmannia sessiliflora</i> , <i>Lysinema ciliatum</i> and <i>Johnsonia acaulis</i> (DBCAs 2019).	Four occurrences mapped within the 5 km buffer of the survey area
Low lying <i>Banksia attenuata</i> woodlands or shrublands (SCP21c)	Endangered	Priority 3	This ecological community forms a component of the Banksia Woodlands TEC. 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 <i>Melaleuca preissiana</i> , <i>Banksia attenuata</i> , <i>B. menziesii</i> , <i>Regalia ciliata</i> , <i>Eucalyptus marginata</i> or <i>Corymbia calophylla</i> . Structurally, this community type may either be a woodland or occasionally shrubland (DBCAs 2019).	One occurrence within the 5 km buffer of the survey area
Coastal shrublands on shallow sands (SCP29a)		Priority 3	Coastal shrublands on shallow sands are largely restricted to the Quindalup system, mostly heaths on shallow sands over limestone close to the coast.	Four occurrences mapped within the 5 km buffer of the survey area
Quindalup <i>Eucalyptus gomphocephala</i> and/or <i>Agonis flexuosa</i> woodlands (SCP30b)		Priority 3	This ecological community can form a component of the Tuart Woodlands of the SCP PEC. This community is dominated by either Tuart or <i>Agonis flexuosa</i> . The presence of <i>Hibbertia cuneiformis</i> , <i>Geranium retrorsum</i> and <i>Dichondra repens</i> differentiate this group from other Quindalup community types. This type is found from the Leschenault Peninsular south to Busselton (DBCAs 2019).	One occurrence within the 5 km buffer of the survey area

Community type	EPBC Act	DBCAs	Description	Location ¹
<i>Corymbia calophylla</i> - <i>Xanthorrhoea preissii</i> woodlands and shrublands of the SCP (SCP3c)	Endangered	Priority 3	The <i>Corymbia calophylla</i> - <i>Xanthorrhoea preissii</i> woodlands and shrublands of the SCP ecological community is one of three <i>Corymbia calophylla</i> dominated plant communities, which were historically probably some of the most common vegetation types on heavy soils on the eastern side of the SCP. Gibson <i>et al.</i> (1994) recognised three distinct communities in this group. The floristic composition of these communities varies with water regime, with this driest type dominated by <i>Corymbia calophylla</i> and <i>Xanthorrhoea preissii</i> . This ecological community aligns with the Gibson <i>et al.</i> (1994) community type 3c (DotEE 2017).	Three occurrences mapped within the 5 km buffer of the survey area

3.5.3 Flora diversity

The NatureMap database search (DBCAs 2007–) identified 568 plant species, representing 92 families recorded within the study area. This total comprised 469 native flora species and 99 introduced flora species. Dominant families recorded within the study area included Fabaceae (70 species), Orchidaceae (50), Cyperaceae (39), Poaceae (39 species), and Asteraceae (32 species). The NatureMap database search is provided in Appendix C.

3.5.4 Conservation significant flora

Desktop searches of the EPBC Act PMST, NatureMap, DBCAs TPFL and WAHERB databases identified the presence/potential presence of 48 conservation significant flora species within the study area. A further three species were identified by DBCAs Flora Officer, Andruwe Webb, as occurring / potentially occur near the survey area.

The desktop searches and consultation with DBCAs identified 20 species listed under the EPBC Act and/or as Threatened under the BC Act and 28 listed as Priority species by the DBCAs.

The locations of conservation significant flora registered on the DBCAs databases are mapped in Figure 8, Appendix A.

4 SUMMARY OF PREVIOUS VEGETATION AND FLORA SURVEYS

A number of studies have previously been undertaken over sections of the survey area. An overview of previous survey effort is included in Table 4-1 and the location of these surveys is provided in Figure 3, Appendix A.

Table 4-1 Summary of previous surveys

Study name	Location/ extent in survey area	Comments
GHD (2014) – Lot 1 Ducane Road Environmental Values Assessment	GHD completed a flora and vegetation assessment of Lot 1 Ducane Road on the 13 June 2013. The assessment described the vegetation types present and their conditions and also searched for conservation significant flora. A total of 40.49 ha of this study is within the survey area.	The area assessed vegetation types and floristic diversity for Lot 1 Ducane Road, which is located within the current survey area.
GHD (2015) – Vegetation and Flora survey of the BORR South Alignment.	The GHD 2015 survey area was 112 ha in size and the report included a review of previous flora surveys for the alignment including: <ul style="list-style-type: none"> - Bennett Environmental Consulting (2003) Vegetation and Flora of Selected Areas – Bunbury Outer Ring Road and Port Access Road for Main Roads Western Australia. - Bennett Environmental Consulting (2008) Significant Flora Along Proposed Bunbury Ring Road for Main Roads Western Australia. - GHD (2002) Bunbury Outer Ring Road and Port Access Road – Wetlands and Threatened Community Survey for Main Roads Western Australia. - GHD (2009) Flora and Vegetation Survey for Main Roads Western Australia. - GHD (2012) Flora and Vegetation Survey for Main Roads Western Australia. <p>The survey was considered to be a level 2 assessment (as per the now superseded EPA guidelines). Phase 1 was carried out on the 21 – 23 September 2011 and Phase 2 from the 16 – 18 June 2014. A total of 21 quadrats were assessed and the vegetation types / their condition described. A total of 86.38 ha of this study is within the survey area.</p>	This report has been used as the basis for the current assessment, including information on vegetation types and condition and species composition.
Biota (2016) – Bunbury Outer	Biota completed a targeted flora survey to further resolve the conservation status of vegetation types	Re-assessment of FCTs within the

Study name	Location/ extent in survey area	Comments
Ring Road Southern Section – Reassessment of Floristic Communities	identified in the GHD (2012, 2015) flora surveys for BORR South. Two Biota botanists completed an additional seven quadrats on the 25 to 26 October 2016 and re-ran statistical analysis against both Biota and GHD quadrats to align vegetation types with Gibson <i>et al.</i> (1994) FCTs. The focus on this assessment was those vegetation types that were potentially TECs / PECs.	current survey area and assessment of an additional 7 quadrats (4 within the current survey area).
Biota (2018) – Bunbury Outer Ring Road Southern Section – Banksia Woodlands TEC Assessment	This assessment included a desktop component to identify potential areas of Banksia woodland TEC that were then targeted in the field survey. The field survey was carried out to determine the extent of Banksia Woodland TEC within the BORR South area and surrounds. The survey was carried out between the 4 to 6 of November 2017 by two Biota botanists. 24 target areas were sampled, using either quadrats (10 x 10 m) or mapping notes. A floristic analysis using PATN v3.1 was carried out to compare quadrats within the study area with those from the existing SCP vegetation data set arising from Gibson <i>et al.</i> (1994). A total of 25.58 ha of this study is within the survey area.	The area assessed provides the location of Banksia Woodland TEC within the survey area and surrounding vegetation.
Ecoedge (2017) – Report of a Targeted Rare Flora Survey for <i>Diuris drummondii</i> along four sections of the Bunbury Outer Ring Road proposed alignment	Ecoedge completed a targeted assessment on the 19 November and 30 November 2016 of portions of the BORR South proposed alignment that provide suitable habitat for <i>Diuris drummondii</i> . The survey was completed in accordance with the Commonwealths Draft Survey Guidelines for Australia’s Threatened Orchids (Commonwealth of Australia, 2013). A known population of the species nearby was used as a reference to determine when flowering had commenced and optimal timing for the survey. A total of 18.6 ha was searched, however no <i>D. drummondii</i> plants were found. A total of 15.50 ha of this study is within the survey area.	Provides information on the targeted survey for <i>D. drummondii</i> within the current survey area.
Ecoedge (2019) – Memorandum. Review of Potential Claypan Occurrences in the BORR Southern Section	Ecoedge completed desktop review for the location of potential claypan wetlands, which identified one potential claypan wetland. The field survey determined that the wetland was not to be a claypan community.	Assessment for Claypan TEC within the Proposal Area that confirmed the TEC is not present.

5 VEGETATION AND FLORA FIELD SURVEY RESULTS

5.1 Vegetation types

The survey area contains a combination of native vegetation and highly disturbed areas, including roads, road reserve and paddocks. A total of nine vegetation types, highly disturbed areas, regrowth / revegetation and planted vegetation were identified and described from the survey area (Table 5-1, Figure 9, Appendix A).

The survey area occurs on the Bassendean and Spearwood Dunes and Pinjarra Plain. The sandy low dunes and plains were dominated by *Eucalyptus* / *Banksia* forests, in particular *Eucalyptus* / *Agonis* and *Banksia* woodlands / forests. The creeklines, swamps and low relief / seasonally inundated areas were dominated by *Eucalyptus rudis* / *Melaleuca preissiana* / *M. raphiophylla* woodlands. These were generally disturbed and the ground layer was dominated by introduced grasses and herbs. In the agricultural areas and some road reserves, native vegetation occurred as scattered remnant trees or stands over introduced grasses. The survey area included approximately 148 ha (50%) of native vegetation.

5.1.1 Floristic analysis

The similarity between all quadrats sampled within the survey area (BORR IPT, GHD and Biota) sites was examined using PRIMER. Analysis was run using two scenarios:

- All species (base quadrat data)
- Native species only (weed species removed from each quadrat)

Of these two scenario's, the native species only scenario had the lowest stress value (0.13) indicating a reasonable representation. Using this scenario, the cluster analysis and resulting dendrogram (**Error! Reference source not found.**) and two dimensional MDS scatter plot (Plate 2) showed general groupings of quadrats that broadly aligned with vegetation types.

Those vegetation units that most closely grouped were:

- VT6 – Closed tall scrub of *Melaleuca preissiana*, *Astartea scoparia* and *Kunzea glabrescens* over sedgeland: all four quadrats grouped together
- VT7 - Low open forest of *Melaleuca preissiana* and *M. raphiophylla* over sedgeland: four of the five quadrats grouped together

The three *Eucalyptus* / *Agonis* / *Banksia* forest vegetation types (VT1, VT2 and VT4) generally grouped together across multiple clades. These vegetation types had 41 quadrats sampled from September 2011 to November 2018. They also occurred in varying degrees of condition (ranging from Degraded to Excellent). These vegetation types were very similar, with their differences in the field identified by changes in dominance of key species.

Those vegetation types that largely occurred in Degraded or worse condition and have experienced historical disturbance, occurred on multiple clades and showed limited similarity.

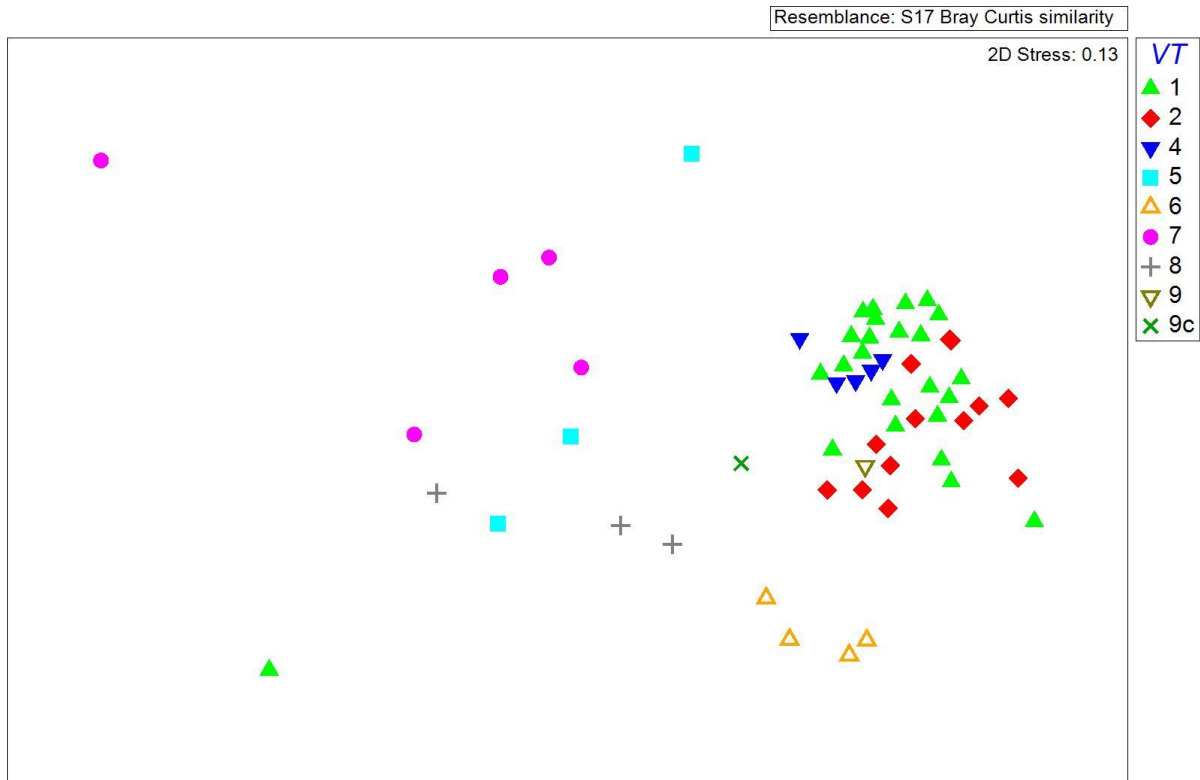


Plate 2 MDS showing general clustering of quadrats

All quadrats sampled within the survey area (BORR IPT, GHD and Biota) and the SWA dataset for sites within the 5 km buffer (see section 2.2) were compared to assist in FCT assignment. The cluster analysis and resulting dendrogram (Appendix F) showed some similarities between the BORR IPT quadrats and the SWA FCTs with some quadrats having affinities to:

- FCT 5
- FCT 21a and 21c
- FCT 6
- FCT 11

A two dimensional MDS scatter plot was also produced (Plate 3) and indicated that the survey quadrats plot near the following FCTs:

- FCT 17
- FCT 11
- FCT S05
- FCT 6
- FCT 25
- FCT 21c
- FCT 21a

However, there is no strong statistical alignment with any of the FCTs, and the stress value of 0.22 indicated a poor/random representation. Given the degraded nature of much of the survey area it was difficult to make firm conclusions regarding the appropriate FCT to assign to each vegetation type. Best matches were drawn from a combination of the statistical analysis and FCT descriptions.

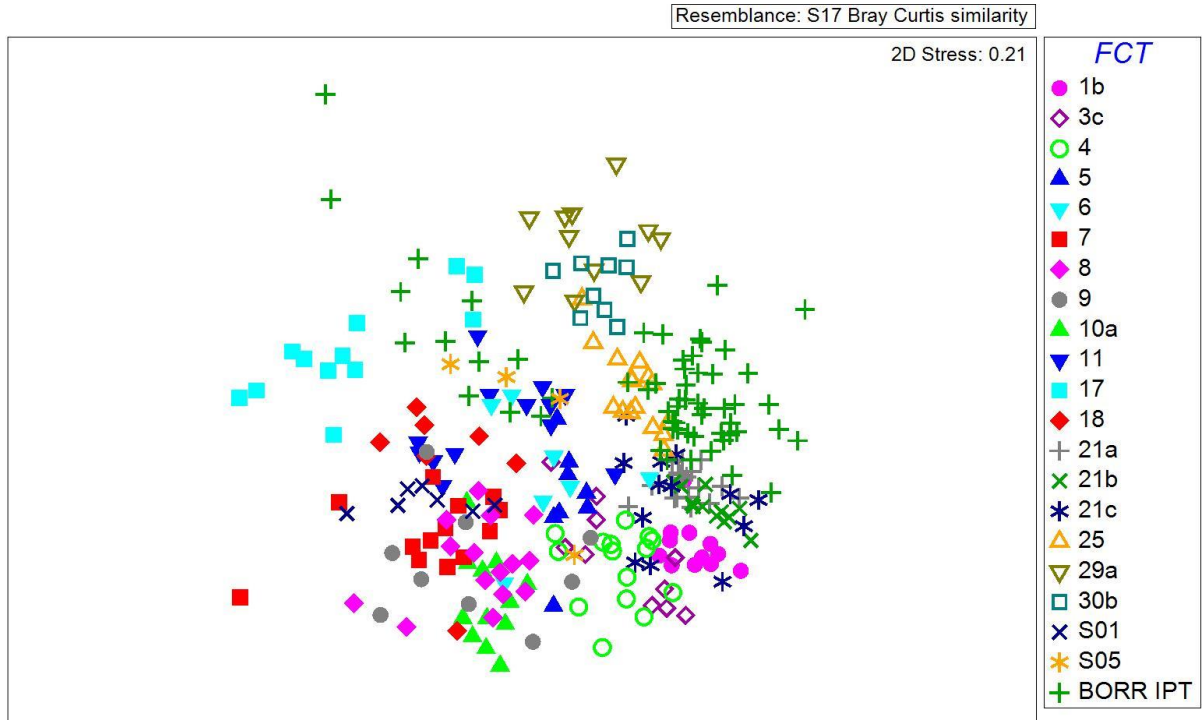


Plate 3 MDS showing showing BORR IPT quadrats compared to the SWA dataset

A species accumulation curve was generated using PRIMER to assess adequacy of sampling effort within the survey area. The species accumulation curve for the survey area, based on flora recorded within quadrats, is approaching an asymptote, which suggests that the current survey effort is sufficient. Furthermore, the bootstrap estimate of species richness generated from this data indicates that 289 species could be expected from the survey area based on the diversity recorded within quadrats. The total species recorded from the survey area was 409 flora species (267 recorded in the current survey), which is substantially above the predicted species diversity estimate. The survey area is considered representative of the floristic diversity in the area.

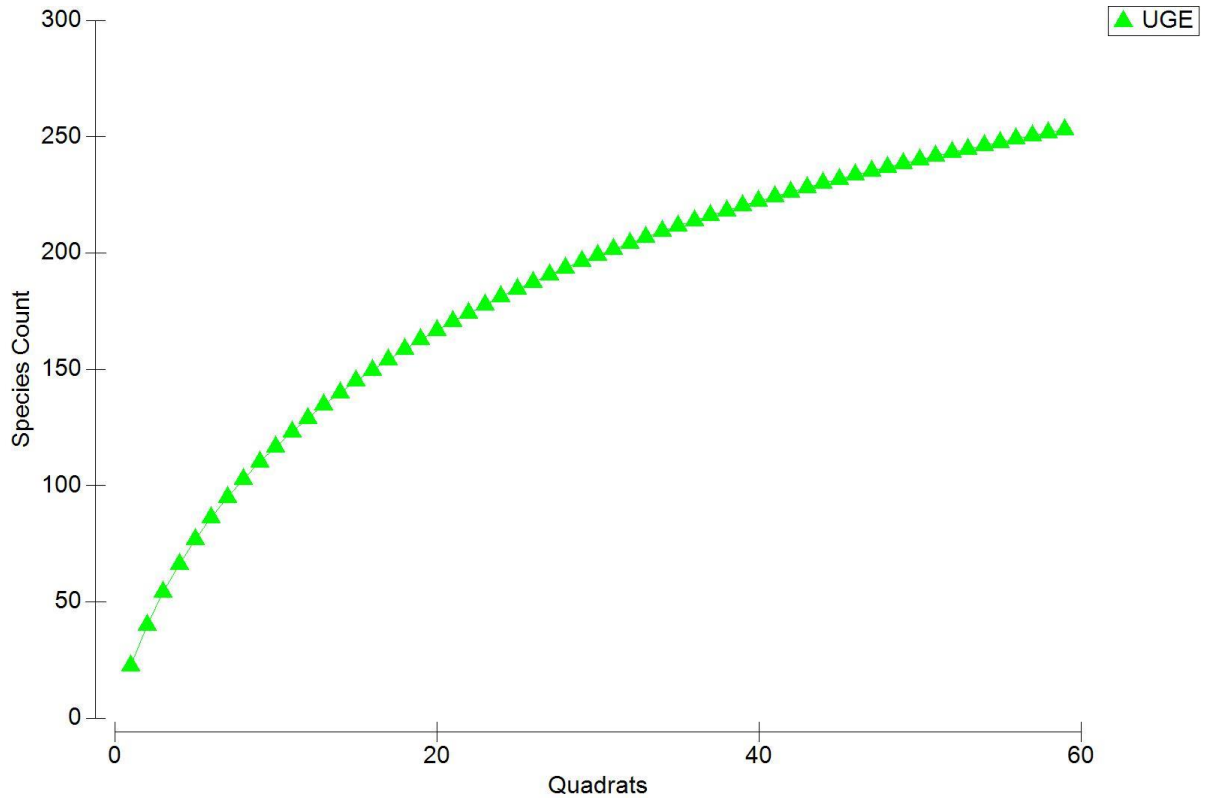


Plate 4 Species accumulation curve for quadrats with the survey area

Biota 2016



Biota (2016) completed additional floristic surveys (seven quadrats) and analysis of the combined GHD (2015) and Biota (2016) quadrat data against the SWA dataset. This assessment was targeted at the areas that were identified by GHD (2015) as potentially corresponding to SCP FCT 08 and SCP FCT 21b.



Biota (2016) concluded that floristic classification and analysis did not demonstrate that any of the quadrats sampled in the survey area should be assigned to either FCT 8 or FCT 21b. The most appropriate assignments for the vegetation types sampled comprise:



1. VT5 - Tall shrubland *Kunzea micrantha* subsp. *micrantha* and *Melaleuca viminea* over weeds: FCT 11, 'Wet forests and woodlands'.
2. VT2 'Open forest of *Eucalyptus marginata*, *Corymbia calophylla*, *Banksia attenuata* and *Agonis flexuosa* on Bassendean dunes': FCT 21a, 'Central *Banksia attenuata*-*Eucalyptus marginata* woodlands'.



Best matches were drawn from a combination of the statistical analysis and FCT descriptions (using dominant species and landform). FCT assignment to the BORR ITP vegetation types are shown in Table 5-1.



Table 5-1 Recorded vegetation types



Vegetation Description	Photograph	Location, condition and extent	Sample locations and Floristic Community Types (FCT) comparison
<i>Eucalyptus</i> / <i>Banksia</i> forests on sand dunes and plains			
<p>VT1 – Open forest of <i>Eucalyptus marginata</i>, <i>Corymbia calophylla</i> and <i>Banksia attenuata</i> on Karrakatta deep sands</p> <p>Open forest of <i>Eucalyptus marginata</i> and <i>Corymbia calophylla</i> +/- <i>Agonis flexuosa</i> with isolated occurrences of <i>Eucalyptus gomphocephala</i> over low open forest of <i>Banksia attenuata</i> over shrubland of <i>Hibbertia hypericoides</i>, <i>Macrozamia riedlei</i> and <i>Xanthorrhoea brunonis</i> over grassland over *<i>Ehrharta</i> spp., *<i>Briza maxima</i> over herbland of <i>Dasyopogon bromeliifolius</i>, <i>Lomandra</i> species and <i>Phlebocarya ciliata</i> over open sedgeland of <i>Lepidosperma pubisquameum</i>.</p>		<p>31.92 ha</p> <p>5.50 ha in Excellent to Very Good</p> <p>7.64 ha in Very Good</p> <p>4.14 ha in Good / Very Good</p> <p>13.64 ha in Good to Degraded</p> <p>1 ha in Degraded / Degraded – Completely Degraded</p>	<p>Quadrats:</p> <p>GHD (2015a): Q1, Q2, Q3, Q4, Q5, Q6, Q9, Q10, Q18, Q20, T1, T2, T5, T8, T9</p> <p>Biota (2018) : GEL01 and GELREL01, 2018 : Quadrats GBRS01, GBRS02, GBRS05, GBRS08, GBRS11, GBRS13, GBRS14, GBRS15, GBRS16, GBRS17, GBRS18, GBRS19.</p> <p>Photo points: GB01, GB04 - GB06, GB08 - GB10, GB22 - GB25, GB38, GB49 - GB51, GB58, GB75 - GB93.</p> <p>FCT: Southern <i>Eucalyptus gomphocephala</i>-<i>Agonis flexuosa</i> woodlands (FCT 25)</p>
<p>VT2 – Open forest of <i>Eucalyptus marginata</i>, <i>Corymbia calophylla</i>, <i>Banksia attenuata</i> and <i>Agonis flexuosa</i> on Bassendean dunes</p> <p>Open forest of <i>Eucalyptus marginata</i>, <i>Corymbia calophylla</i> and <i>Agonis flexuosa</i> over low forest of <i>Banksia attenuata</i> and <i>Banksia ilicifolia</i> over tall shrubland of <i>Kunzea glabrescens</i>, <i>Jacksonia furcellata</i> and <i>Xylomelum occidentale</i> over shrubland of <i>Hibbertia hypericoides</i>, <i>Acacia</i> spp. and <i>Xanthorrhoea brunonis</i> over grassland / Sedgeland of <i>Tetraria octandra</i>, <i>Desmocladius fascicularis</i> and introduced grasses.</p>		<p>42.41 ha</p> <p>0.07 ha in Excellent</p> <p>1.45 ha in Excellent – Very Good</p> <p>0.52 ha in Good</p> <p>36.89 ha in Good to Degraded</p> <p>3.49 ha in Degraded / Completely Degraded</p>	<p>Quadrats:</p> <p>GHD (2014): Q2, Q3, Q6, Q4 and Q9.</p> <p>GHD (2015a): Q11, Q12, Q17, T6</p> <p>Biota (2016) : BOR05, BOR06 and BOR07</p> <p>2018: Quadrat GBRS20</p> <p>Photo points: WPP53, WPP54, WPP57, WPP59 – WPP61, WPP63 – WPP65</p> <p>FCT: Central <i>Banksia attenuata</i> – <i>Eucalyptus marginata</i> woodland (FCT 21a).</p>

Vegetation Description	Photograph	Location, condition and extent	Sample locations and Floristic Community Types (FCT) comparison
<p>VT3 – <i>Corymbia calophylla</i> and <i>Eucalyptus marginata</i> +/- <i>Banksia</i> spp.</p> <p>Scattered <i>Eucalyptus marginata</i>, <i>Corymbia calophylla</i> and +/- <i>Agonis flexuosa</i> over a tall very open shrubland of <i>Banksia attenuata</i>, <i>B. ilicifolia</i>, <i>Xylomelum occidentale</i> and <i>Kunzea glabrescens</i> over a grassland of introduced species.</p> <p>Occurs in paddocks and road reserves.</p> <p>In the road reserve along South West Highway the shrubland is largely devoid and <i>Agonis flexuosa</i> is present in the tree layer.</p>		<p>3.34 ha</p> <p>All in Degraded to Completely Degraded.</p>	<p>Photo-points: GB18, GB26, GB27, GB35, GB36, GB43 – GB46, GB71.</p> <p>FCT: Likely to be a degraded form of Central <i>Banksia attenuata</i> – <i>Eucalyptus marginata</i> woodland (FCT 21a) but as it only occurs in Degraded or worse condition, alignment with an FCT has not been confirmed.</p>
<p>VT4 – Open forest of <i>Banksia attenuata</i> and <i>Agonis flexuosa</i></p> <p>Open forest of <i>Banksia attenuata</i> and <i>Agonis flexuosa</i> over shrubland of <i>Hibbertia hypericoides</i>, <i>Macrozamia riedlei</i> and <i>Leucopogon propinquus</i> over open grassland of *<i>Ehrharta</i> spp. and *<i>Briza maxima</i> over herbland of <i>Dichopogon capillipes</i>, <i>Phlebocarya ciliata</i> and <i>Conostylis aculeata</i>.</p> <p>Scattered <i>Eucalyptus marginata</i> as an emergent.</p> <p>Occurs in one location on grey sands on a rounded hill slope.</p>		<p>3.47 ha</p> <p>0.73 ha in Very Good</p> <p>2.74 ha in Very Good to Good</p>	<p>Quadrats:</p> <p>GHD (2015a): Q7, Q8</p> <p>Biota (2018): GEL03</p> <p>2018: Quadrats: GBR04 and GBR06</p> <p>Photo points: GB11, GB12, GB15, GB16.</p> <p>FTC: Southern <i>Eucalyptus gomphocephala</i>-<i>Agonis flexuosa</i> woodlands (FCT 25).</p>

Vegetation Description	Photograph	Location, condition and extent	Sample locations and Floristic Community Types (FCT) comparison
<i>Eucalyptus</i> / <i>Melaleuca</i> Woodlands and Shrublands in creeklines / swamps and seasonally wet areas			
<p>VT5 - Tall shrubland <i>Kunzea micrantha</i> subsp. <i>micrantha</i> and <i>Melaleuca viminea</i> over weeds</p> <p>Tall open shrubland of <i>Kunzea micrantha</i> subsp. <i>micrantha</i> and <i>Melaleuca viminea</i> over open sedgeland of <i>Lepidosperma longitudinale</i> and <i>Juncus subsecundus</i> over grassland of <i>*Briza maxima</i>, <i>*Briza minor</i> and <i>*Ehrharta calycina</i>.</p>		<p>0.05 ha</p> <p>All in Degraded to Completely Degraded</p>	<p>Quadrats: GHD (2015a): Q13 Biota (2016): BOR03 and BOR04 FCT: Wet forests and woodlands – FCT 11</p>
<p>VT6 - Closed tall scrub of <i>Melaleuca preissiana</i>, <i>Astartea scoparia</i> and <i>Kunzea glabrescens</i> over sedgeland</p> <p>Closed tall scrub of <i>Melaleuca preissiana</i>, <i>Kunzea glabrescens</i> and <i>Astartea scoparia</i> over a sedgeland of <i>Baumea juncea</i>, <i>Lyginia imberbis</i> and <i>*Cyperus tenellus</i> with introduced grass species over open herbland of <i>*Hypochaeris</i> sp., <i>*Ornithopus compressus</i> and <i>*Ursinia anthemoides</i>.</p>		<p>3.57 ha</p> <p>0.59 ha in Excellent – Good 2.07 ha in Very Good to Good 0.30 ha in Good 0.61 ha in Good to Degraded</p>	<p>Quadrats: GHD (2014): Q5, Q8 GHD (2015a): Q14 2018: Quadrat GBR510 Photo points: GB68 - GB70, PP16, WPP58, WPP62. FCT: <i>Melaleuca preissiana</i> damplands (FCT 4)</p>

Vegetation Description	Photograph	Location, condition and extent	Sample locations and Floristic Community Types (FCT) comparison
<p>VT7 – Low open forest of <i>Melaleuca preissiana</i> and <i>Melaleuca raphiophylla</i> over sedgeland</p> <p>Low open forest of <i>Melaleuca preissiana</i>, <i>M. raphiophylla</i> and <i>M. viminea</i> over sedgeland of <i>Lepidosperma longitudinale</i>, <i>Juncus pallidus</i> and *<i>Carex divisa</i> with introduced grasses and herbs including *<i>Cynodon dactylon</i>, *<i>Lotus subbiflorus</i> and *<i>Cotula</i> species.</p> <p>Attached and floating aquatic species were present including: <i>Lemna disperma</i>, <i>Cycnogeton lineare</i> and *<i>Callitriche stagnalis</i>.</p>		<p>30.75 ha</p> <p>15.13 ha in Good</p> <p>3.57 ha in Good to Degraded</p> <p>12.05 ha in Degraded / Completely Degraded</p>	<p>Quadrats:</p> <p>GHD (2015a): Q15, Q16, T7</p> <p>2018: Releve and Quadrats GBRel01, GBRel02, GBRel03 and GBRS09</p> <p>Photo points: GB56, GB57, GB61, GB64, GB67, GB73, PP14, PP19, PP22.</p> <p>FCT: <i>Melaleuca preissiana</i> damplands (FCT 4) / Wet forests and woodlands (FCT 11).</p>
<p>VT8 – Low open forest of <i>Eucalyptus rudis</i> and <i>Melaleuca preissiana</i> over sedgeland</p> <p>Low open forest of <i>Eucalyptus rudis</i> and <i>Melaleuca preissiana</i> over grassland of *<i>Ehrharta longiflora</i> and *<i>Avena</i> species over sedgeland of <i>Lepidosperma longitudinale</i> over herbland of *<i>Rumex</i> species.</p> <p>In Lot 1 Ducane Road an open tall shrubland of <i>Kunzea glabrescens</i> and <i>Melaleuca teretifolia</i> over open heath of <i>Astartea scoparia</i> over a sedgeland of <i>Hypolaena exsulca</i> and <i>Lepidosperma longitudinale</i> was present. This was the only occurrence of the vegetation in Very Good condition.</p> <p>Occurs along drainage lines and seasonally inundated areas.</p>		<p>3.37 ha</p> <p>1.11 in Excellent to Very Good</p> <p>2.26 ha in Degraded / Degraded to Completely Degraded</p>	<p>Quadrats:</p> <p>GHD (2014): Q7</p> <p>GHD (2015a): Q19, T3</p> <p>2018: Quadrat GBRS03</p> <p>Photo points: GB02, GB03, GB07, GB28, GB42, WPP55, WPP56, WPP42.</p> <p>FCT: Wet forests and woodlands (FCT 11).</p>

Vegetation Description	Photograph	Location, condition and extent	Sample locations and Floristic Community Types (FCT) comparison
Scattered remnant vegetation / Highly modified vegetation types			
<p>VT 9 - Scattered remnant vegetation present in agricultural areas and along road reserves:</p> <ul style="list-style-type: none"> • VT09a - <i>Corymbia calophylla</i> and <i>Eucalyptus marginata</i> +/- <i>Agonis flexuosa</i> with very occasional <i>E. gomphocephala</i> • VT09b – <i>Melaleuca raphiophylla</i> • VT09c – <i>Agonis flexuosa</i> stands • VT09d: <i>Eucalyptus rudis</i> and <i>Corymbia calophylla</i> +/- <i>M. raphiophylla</i> 		<p>24.07 ha</p> <p>9a: 16.66 ha</p> <p>9b: 1.50 ha</p> <p>9c: 4.87 ha</p> <p>9d: 1.04 ha</p> <p>All in Degraded to Completely Degraded</p>	<p>Quadrats: GHD (2015a): T1, T4 2018: Quadrats : GBRS07 Photo points: GB29 – GB31, GB40, GB53 – GB55, GB59, GB60, GB74, GB14, GB21, GB66, PP52, PP53</p> <p>FCT: N/A</p>
<p>VT 10 – Parkland cleared with scattered native / planted species</p> <p>Parkland cleared with occasional <i>Corymbia calophylla</i>, <i>Eucalyptus marginata</i> and <i>Agonis flexuosa</i> trees with planted tree species over an understorey of weedy herbs and grasses.</p>		<p>4.84 ha</p> <p>All in Degraded to Completely Degraded</p>	<p>Photo points: 2018: GB48, GB19, GB20, GB41, GB47.</p> <p>FCT: N/A</p>

Vegetation Description	Photograph	Location, condition and extent	Sample locations and Floristic Community Types (FCT) comparison
<p>VT 10b - Revegetation / Regrowth in road reserves</p> <p>This includes revegetation as well as areas planted with a mixture of native and non-native vegetation. There are scattered remnant trees occasionally present (including <i>Corymbia calophylla</i>, <i>Eucalyptus marginata</i>, <i>E. rudis</i>, <i>Agonis flexuosa</i> and <i>Casuarina obesa</i>). Common shrubs include <i>Melaleuca nesophila</i>, <i>M. lanceolata</i>, <i>Kunzea glabrescens</i> and <i>Acacia saligna</i>. The understorey was mostly dominated by introduced grasses and herbs. This vegetation unit occurred within the median strip of Bussell Highway.</p>		<p>1.17 ha</p> <p>All in Degraded to Completely Degraded</p>	<p>Photo points: 2018: GB45 and GB42 FCT: N/A</p>
<p>Cleared / highly modified</p> <p>Areas where clearing or other activities have fundamentally altered the composition of native vegetation and are not in a condition of self-sustaining. These areas are completely or almost completely without native species.</p>		<p>148.71 ha</p>	<p>Photo points: 2018 GB13, GB37, GB39, GB62, GB63, GB65, PP13, PP17, WPP43. FCT: N/A</p>

5.2 Vegetation condition

The vegetation condition of the survey area ranged from Excellent to Completely Degraded. Almost half of the survey areas was cleared/highly modified (148 ha or 49.96 %). Historical clearing and aggressive weed species have influenced the structure and composition of the remaining native vegetation. There was 41.98 ha of vegetation in Good or better condition (approximately 14 % of the survey area) and 52.22 ha in Degraded or worse condition (approximately 18% of the survey area).

Through the southern section of the survey area, the vegetation condition predominantly was rated between Very Good to Degraded. Native vegetation within this section has been severely impacted by partial clearing and weed invasion.

The northern section of the survey area was largely rated between Degraded to Completely Degraded. These areas were highly disturbed for agricultural purposes and comprised scattered native trees over weedy herbs and grasses.

The majority of vegetation within the survey area has not been burnt in the last 5 to 20 years. A section of recently burnt bushland located within the median strip along Bussell Highway has been burnt in the last year and was observed to be regenerating. Within the survey area, small patches of vegetation have been burnt in the last 5- 10 years, however, this has not significantly impacted the vegetation condition.

A summary of the vegetation condition is provided in Table 5-2 and vegetation condition mapping is shown in Figure 10, Appendix A.

Table 5-2 Extent of vegetation condition ratings mapped within the survey area

Vegetation Condition	Extent in survey area (ha) (%)
Excellent	0.07 ha (0.02%)
Excellent - Very Good	8.64 ha (2.90%)
Very Good	8.37 ha (2.81%)
Very Good - Good	5.39 ha (1.81%)
Good	19.51 ha (6.55%)
Good – Degraded	54.76 ha (18.40%)
Degraded	17.86 ha (6.00%)
Degraded - Completely Degraded	23.18 ha (7.79%)
Completely Degraded	11.18 ha (3.76%)
Cleared / highly modified	148.71 ha (49.96%)
Total	297.67 ha

5.3 Threatened and Priority Ecological Communities

Threatened and Priority Ecological Communities were identified by assessing the vegetation types, landform features and field observations, coupled with the statistical analyses. One TEC and two PECs were identified within the survey area (

Table 5-3).

Table 5-3 Extent of TECs and PECs mapped within the survey area

TEC / PEC	Status	Extent in survey area
<i>Banksia</i> Woodlands of the SCP TEC	Endangered – EPBC Act	30.21 ha
<i>Banksia</i> dominated woodlands of the SCP IBRA region PEC	Priority 3 – DBCA	42.41 ha
Tuart (<i>Eucalyptus gomphocephala</i>) woodlands of the SCP PEC	Priority 3 – DBCA [‡]	35.39 ha

[‡] NB Since completion of the survey the Tuart (*Eucalyptus gomphocephala*) woodlands and forest of the SCP ecological community has been listed as a TEC under the EPBC Act (see below for discussion).

A discussion is also provided on other TECs / PECs considered to show affinities to vegetation but were deemed to not meet the descriptions / criteria for the TEC or PEC determination.

The spatial distribution of these communities are presented in Figure 11, Appendix A.

5.3.1 *Banksia* Woodlands of the Swan Coastal Plain (TEC)

The *Banksia* Woodlands of the SCP was listed in September 2016 as an Endangered TEC under the EPBC Act. The Commonwealth TEC encompasses a number of FCTs, some of which are also listed as State TECs/PECs.

The TSSC (2016) describes the key structural features of the community as:

- A prominent tree layer of *Banksia*, with scattered eucalypts and other tree species often present among, or emerging above, the canopy
- The understorey is a species rich mix of sclerophyllous shrubs, graminoides and forbs
- High endemism and considerable localised variation in species composition across its range.

The TSSC (2016) provides guidance for determining whether the TEC is present. These criteria area summarised in Table 5-4.

Table 5-4 Diagnostic characteristics and condition thresholds to determine *Banksia* Woodlands TEC (TSSC 2016)

Diagnostics characteristics / condition thresholds	Criteria
Floristic Community Type	<p>Location and physical environment:</p> <ul style="list-style-type: none"> • Occurs on the SCP IBRA bioregion <p>Soil and landform:</p> <ul style="list-style-type: none"> • Typically occurs on well drained, low nutrient soils on sandplain landforms, particularly in deep Bassendean and Spearwood sands and occasionally on Quindalup sands. <p>Structure:</p> <ul style="list-style-type: none"> • The community is a low woodland to forest, but may also include shrubland, open woodland or forest under some classification systems. The percentage canopy cover is more than 2% and

Diagnostics characteristics / condition thresholds	Criteria
	<p>typically less than 50%. The structure and appearance may also vary due to disturbance history.</p> <p>Composition:</p> <ul style="list-style-type: none"> The canopy is commonly dominated by <i>Banksia attenuata</i> and or <i>B. menziesii</i>. Other <i>Banksia</i> species that dominate include <i>B. prionotes</i> or <i>B. ilicifolia</i>. The patch must include at least one of these diagnostic species.
Vegetation condition ² and minimum patch size	<ul style="list-style-type: none"> Pristine – no minimum Excellent – 0.5 ha Very Good – 1 ha Good – 2 ha
Surrounding context	<p>A patch is a discrete and mostly continuous area of ecological community. A patch may include small scale (<30 m) variations, gaps and disturbances, such as tracks, that do not significantly alter the overall functionality of the ecological community. Such breaks are generally included in patch size calculations. The landscape and position of the patch including its position relative to surrounding vegetation also influences how important it is in the broader landscape.</p>

Biota (2018) completed a targeted assessment for the presence of the *Banksia* TEC over most of the survey area. BORR IPT completed an assessment for gaps within the survey area not assessed by Biota (2018). One additional area not assessed by Biota (2018) at Centenary Road was assessed and determined to meet the size, condition and floristic requirements of the *Banksia* TEC (Appendix G).

Figure 11 (Appendix A) shows the location of targeted patches for the *Banksia* TEC assessment within the survey area and adjacent sites. During the Biota (2018) assessment a total of 24 target areas were identified as potential *Banksia* TEC. The assessment confirmed the presence of 175.1 ha of *Banksia* TEC (including areas outside of the survey area). Combining the recent survey with Biota (2018) results there is 30.21 ha of *Banksia* TEC within the survey area.

During the recent survey it was noted that one of the Biota (2018) patches (T11), which was previously assigned a condition score of Good over part of the patch, is currently in a Degraded condition and does not meet the TEC condition thresholds.

The following vegetation types form part of the *Banksia* TEC within the survey area:

- VT1 – Open forest of *Eucalyptus marginata*, *Corymbia calophylla* and *Banksia attenuata* on Karrakatta deep sands
- VT2 – Open forest of *Eucalyptus marginata*, *Corymbia calophylla*, *Banksia attenuata* and *Agonis flexuosa* on Bassendean dunes
- VT4 – Open forest of *Banksia attenuata* and *Agonis flexuosa*

5.3.2 *Banksia* dominated woodlands of the SCP IBRA region (PEC)

The field assessment also confirmed the presence of the *Banksia* dominated woodlands of the SCP IBRA region PEC, listed as Priority 3 by DBCA. This PEC differs from the TEC in that it has no minimum condition

² As per the Keighery (1994) condition scale presented in Bush Forever (Government of Western Australia 2000).

and patch size thresholds. Vegetation type 2 is representative of the *Banksia* dominated woodlands of the SCP IBRA region PEC.

Although vegetation type 3 is likely to be a degraded form of FCT 21a - Central *Banksia attenuata* – *Eucalyptus marginata* woodland (FCT 21a), the dominant species *Corymbia calophylla* and *Eucalyptus marginata* with *Banksia* species tends to form less than 2 -10 % overall cover in the lower tree layer / tall shrub layer. As such, this vegetation type was not considered to be *Banksia* dominated and has not been included as a component of this PEC.

There is 42.41 ha of the *Banksia* dominated woodlands of the SCP IBRA region PEC present within the survey area, ranging from Excellent to Degraded in condition. This includes 2.03 ha in Good or better condition and 40.38 ha in Good – Degraded or worse condition. This total includes 2.87 ha which also aligns with the *Banksia* Woodlands of the SCP EPBC Act TEC.

5.3.3 Tuart (*Eucalyptus gomphocephala*) woodlands of the Swan Coastal Plain PEC

FCT 25 - Southern *Eucalyptus gomphocephala*-*Agonis flexuosa* woodlands has been mapped by DBCA within the survey area, within the vegetation type VT1 - 'Open forest of *Eucalyptus marginata*, *Corymbia calophylla*, *Banksia attenuata* and *Agonis flexuosa* on Karrakatta deep sands' and VT4 - 'Open forest of *Banksia attenuata* and *Agonis flexuosa*'. Consultation with Mr. Andrew Webb from DBCA (pers. comm. 2011 and 2015) has stated that the vegetation types in this area represent FCT 25.

The vegetation types 'Open forest of *Eucalyptus marginata*, *Corymbia calophylla*, *Banksia attenuata* and *Agonis flexuosa* on Karrakatta deep sands' and 'Open forest of *Banksia attenuata* and *Agonis flexuosa*' were inferred to be equivalent to FCT 25 based on geographic location, landforms and the species recorded within these vegetation types. These vegetation types contained isolated occurrences of *Eucalyptus gomphocephala*; however this is likely to be related to disturbance factors and the species is likely to have previously occurred within this area. Mapping of the Tuart Woodlands by DBCA (formerly known as the Department of Conservation and Land Management) (2003) shows that *Eucalyptus gomphocephala* woodlands with 0 to 9 % canopy cover and highly disturbed visible native understorey condition have been mapped within this section of the survey area, inferred to be equivalent to the PEC FCT 25.

A total of 35.39 ha of vegetation determined to be equivalent to this PEC was recorded within the survey. A total of 20.75 ha was mapped as in Good or better condition, 13.65 ha was mapped as in Good to Degraded condition and 1.00 ha was mapped in Degraded to Completely Degraded condition.

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

Since completion of the survey the Tuart (*E. gomphocephala*) woodlands and forests of the SCP ecological community has been listed as a TEC under the EPBC Act. Given that the criteria for the identification of the TEC were not available at the time of the survey it is not possible to definitively confirm the presence or absence of the TEC in the survey area. NB Presence of at least two living established *E. gomphocephala* in the uppermost canopy layer is a key diagnostic characteristic for TEC patch identification (DotEE 2019). Additional targeted surveys will be completed in spring 2019 to confirm the presence or absence of the TEC in the BORR Southern Alignment.

5.3.5 Herb rich shrublands in clay pans (TEC)

The clay pan communities occur where clay substrate is low in the landscape and form an impermeable layer close to the surface. These wetlands rely on rainfall and local surface drainage to fill and are unlikely to be connected to groundwater. A suite of perennial plants and annual herbs flower as the clay pans dry out (DBCA 2019b).

Herb rich shrublands in clay pans (FCT 8), which is a State (Vulnerable) and Federally listed (Critically Endangered) TEC (as a component of the Claypans of the SCP TEC), is located within 2.8 km of the survey area. GHD (2015) quadrat 13, which is located within vegetation type 5 shares some similarities in dominant overstorey species and annual weed species to that of FCT 8. Biota (2016) assessed two quadrats

at this location and determined that the most appropriate assignment for this vegetation type is ‘FCT 11 - Wet forests and woodlands’ and vegetation type 5 is therefore not considered to be consistent with the FCT 8 TEC.

Ecoedge (2019) (Appendix G) completed desktop review for the location of potential claypan wetlands, which identified one potential claypan wetland on lots 5 and 160 south of Centenary Road. The site was visited on 1 August 2019 by Ecoedge Botanists (Russell Smith & Colin Spencer), DBCA Senior Botanist (Andrew Webb) and a MRWA representative, Senior Environmental Officer (Freea Itzstein-Davey).

The wetland was found not to be a claypan community, the soil being a sandy-loam at the surface. The vegetation was dominated by *Melaleuca raphiophylla* and *M. viminea*, with an open sedgeland of *Lepidosperma longitudinale* over a grassland of *Sporobolus virginicus*. A copy of the memorandum on the site visit is included at Appendix G.

5.4 Other significant vegetation

The survey area traverses a number of creeklines, small drainage lines, as well as seasonally inundated areas (wetlands) that support riparian vegetation. Vegetation associated with the riverine and wetland areas includes remnant trees and shrubs (e.g. *E. rudis*, *Melaleuca preissiana* and *Melaleuca raphiophylla*) over introduced grasses and herbs, with mixed sedges present. Vegetation types 5, 6, 7 and 8 are all associated with riparian vegetation.

There is approximately 37.74 ha of vegetation within the survey area that grows in association with a watercourse and/or wetland. This vegetation has a restricted distribution and has been historically impacted by extensive clearing throughout the local and broad areas. Riparian and wetland vegetation in Good or better condition (approximately half of the riparian vegetation) is considered to be other significant vegetation:

- 19.20 ha in Good to Very Good condition – other significant vegetation
- 18.54 ha in Good – Degraded to Completely Degraded condition – mostly occurs as scattered trees over introduced grasses and herbs, not considered to be other significant vegetation.

5.5 Flora diversity

The floristic diversity of the survey area has been assessed by combining survey data from GHD (2014 and 2015), Biota (2016 and 2018) and the current survey (Appendix E). A total of 409 species have been recorded across these surveys including 118 introduced or planted species (28 %).

During the recent survey, 267 plant species (including subspecies and varieties) representing 182 genera and 62 plant families were recorded within the survey area. This total included 178 (66.7 %) native species and 89 introduced (exotic/planted) (33.3 %) species.

Table 5-5 provides a summary of the records of previous flora surveys and the current survey.

Table 5-5 Floristic diversity of the survey area

Survey	Total species	Total native: weed	Comments
Current survey	267	178: 89	Survey over multiple sites, August and October survey with over 30 % introduced species.
GHD 2014	104	81: 23	Smaller survey area with few vegetation types, winter survey only.

Survey	Total species	Total native: weed	Comments
GHD 2015	198	145: 53	Similar survey area as the current survey, September and June survey period.
Biota 2016	96	62: 34	Restricted to small survey area with only few vegetation types.
Biota 2018	112	92: 20	Survey of potential Banksia woodland TEC only.

5.6 Conservation significant flora

No EPBC Act or BC Act listed flora were recorded within the survey area in this assessment (October 2018). Furthermore, the previous surveys in November 2007 (Bennett 2008), October 2008 (GHD 2009), November 2011 and June 2014 (GHD 2015), June 2013 (GHD 2014), October 2016 (Biota 2016) and November 2017 (Biota 2018) surveys did not record any EPBC Act or BC Act listed flora. Ecoedge (2017) completed a targeted assessment for *Diuris drummondii* (an EPBC Act and BC Act listed species), this did not identify any *D. drummondii* plants (further details on this assessment are provided below).

The GHD (2014 and 2015) surveys confirmed the presence of two DBCA Priority flora species, *Caladenia speciosa* (Sandplain White Spider Orchid – Priority 4) and *Acacia semitrullata* (Priority 4). No other Priority flora have been recorded within the survey area during previous surveys or the current survey.

The location of the two priority flora is shown in Figure 11 (Appendix A) and the co-ordinates are provided in Appendix E.

***Caladenia speciosa* (Priority 4)**

Sandplain White Spider Orchid, was recorded within the survey area during the GHD (2015) Phase 1 survey. This species is a tuberous, perennial herb approximately 0.35 to 0.6 m high, with white to pink flowers. Sandplain White Spider Orchid grows in white, grey or black sands and is recorded from the Jarrah Forest and SCP IBRA bioregions (WA Herbarium 1998–).

Sandplain White Spider Orchid has previously been recorded directly adjacent to the survey area, in the southern end of the alignment beside Bussell Highway. During the Phase 1 survey this species was mostly recorded in small populations throughout the southern section of the alignment between Yalinda Drive and Bussell Highway. A total of 71 *Caladenia speciosa* plants were recorded within road reserve.

Population locations and plant numbers are mapped in Figure 11, Appendix A.

***Acacia semitrullata* (Priority 4)**

Acacia semitrullata is an erect, pungent shrub to about 0.5 m high with cream-white flowers. The species grows in white to grey sand on sand plains and is recorded from the Jarrah Forrest, SCP and Warren IBRA bioregions (WA Herbarium 1998–).

Two plants of *Acacia semitrullata* were recorded adjacent to GHD (2015) quadrat 17 during the Phase 2 survey. This plant is a small shrub and was flowering during the time of the phase 2 survey. This species was verified by taxonomists from the Western Australian Herbarium. GHD (2014) identified the presence of *Acacia semitrullata* within Lot 1 Ducane Road. *Acacia semitrullata* was recorded at an additional four locations predominantly within dampland areas (VT6). It was an uncommon component of the understorey and only individual plants were recorded.

Targeted search results

***Diuris drummondii* – Vulnerable under the EPBC Act and Vulnerable under the BC Act**

Ecoedge (2017) completed a targeted survey over four areas (Figure 3, Appendix A) within the survey area that were identified by Mr. Andrew Webb (Flora Conservation Officer, Department of Biodiversity Conservation and Attractions) as potential habitat for *Diuris drummondii*. A two day survey over the 18.6 ha of potential habitat was completed. No *D. drummondii* plants were found within the area. Ecoedge concluded that the majority of the potential habitat was too disturbed by many years of grazing by livestock for *D. drummondii* to be present. Other areas within the survey extent was considered by Ecoedge to be too dry for the orchid and a substantial part of their Area 3 survey extent (located within the current survey area) was probably too deeply inundated over winter and early spring for the orchid to be able to survive.

In total 15.50 ha of the current survey area was searched during the Ecoedge (2017) survey. There are additional areas within the current survey area that were not assessed by Ecoedge (2017) and may provide habitat for this species.

5.6.1 Likelihood of occurrence

A likelihood of occurrence assessment was conducted post-field survey for all conservation significant flora species identified in the desktop assessment, including TPFL and WAHERB database records (**Error! Reference source not found.**). This assessment took into account previous records, habitat requirements, efficacy of the survey, intensity of the survey, flowering times and the cryptic nature of the species.

The likelihood of occurrence assessment post-field survey concluded that two species are known to occur, one species is likely to occur, 27 species may possibly occur and the remaining 19 species are unlikely to occur within the survey area. A summary of conservation significant species which are known, likely or possibly occur within the survey area has been included in Table 5-6.

Table 5-6 Summary of conservation significant species recorded as occurring or potentially occurring within or near the survey area

Species	EPBC Act Status	BC Act/ DBCA Status	Likelihood of Occurrence
<i>Acacia flagelliformis</i>	-	P4	Possible
<i>Acacia semitrullata</i>	-	P4	Known
<i>Angianthus drummondii</i>	-	P3	Possible
<i>Aponogeton hexatepalus</i>	-	P4	Likely
<i>Austrostipa bronwenae</i>	E	T	Possible
<i>Austrostipa jacobiana</i>	CE	T	Possible
<i>Blennospora doliiformis</i>		P3	Possible
<i>Boronia tetragona</i>	-	P3	Possible
<i>Caladenia huegelii</i>	E	T	Possible
<i>Caladenia speciosa</i>	-	P4	Known
<i>Carex tereticaulis</i>	-	P3	Possible
<i>Chamaescilla gibsonii</i>	-	P3	Possible
<i>Diuris drummondii</i>	VU	VU	Possible
<i>Diuris micrantha</i>	VU	VU	Possible

Species	EPBC Act Status	BC Act/ DBCA Status	Likelihood of Occurrence
<i>Drakaea micrantha</i>	VU	EN	Possible
<i>Eucalyptus rudis</i> subsp. <i>cratyantha</i>	-	P4	Possible
<i>Lasiopetalum membranaceum</i>	-	P3	Possible
<i>Leptomeria furtiva</i>	-	P2	Possible
<i>Ornduffia submersa</i>	-	P4	Possible
<i>Platysace ramosissima</i>	-	P3	Possible
<i>Pultenaea skinneri</i>	-	P4	Possible
<i>Schoenus benthamii</i>	-	P3	Possible
<i>Schoenus loliaceus</i>	-	P2	Possible
<i>Schoenus natans</i>	-	P4	Possible
<i>Stylidium longitubum</i>	-	P4	Possible
<i>Stylidium paludicola</i>	-	P3	Possible
<i>Synaphea hians</i>	-	P3	Possible
<i>Trithuria australis</i>	-	P4	Possible
<i>Thelymitra variegata</i>	-	P2	Possible
<i>Verticordia attenuata</i>	-	P3	Possible

Note: CE: Critically Endangered, E: Endangered, VU: Vulnerable, P: Priority.

5.7 Other significant flora

None of the flora identified within the survey area are considered to be other significant flora i.e. they are not locally endemic, new species, range extensions, unusual species or relictual status.

5.8 Introduced flora

Eighty nine (89) introduced flora species were recorded in the survey area. Of the introduced species, four are listed as Declared Pests under the *Biosecurity and Management Act 2007* and/or as a WONS:

- **Asparagus asparagoides* (Bridal Creeper) – Declared Pest and WONS
- **Lantana camara* – Declared Pest and WONS
- **Moraea flaccida* (One-leaf Cape Tulip) – Declared Pest
- **Zantedeschia aethiopica* (Arum lily) – Declared Pest.

The remaining introduced species are considered environmental weeds and all have been previously recorded on the SWA. The locations of the declared weeds is shown in Figure 10, Appendix A and the coordinates for these species is provided in Appendix E.

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APPENDIX A

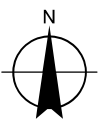
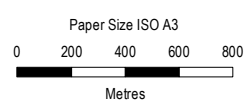
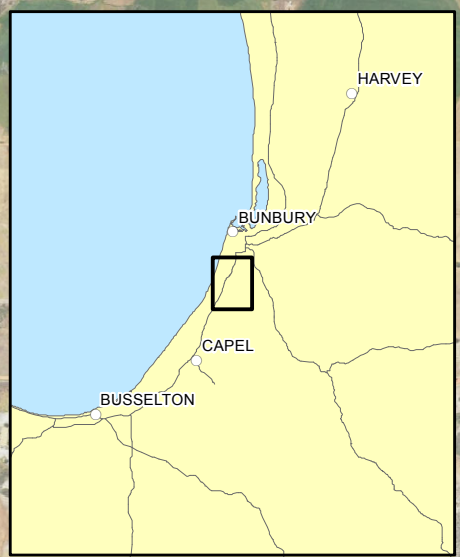
Figures

- Figure 1** Project locality
- Figure 2** Survey area and sample locations
- Figure 3** Combined survey effort
- Figure 4** Soil-landscape types within the survey area
- Figure 5** Hydrological aspects within the survey area
- Figure 6** Vegetation association mapping within the survey area
- Figure 7** Vegetation complex mapping within the survey area
- Figure 8** Biological constraints within the survey area
- Figure 9** Vegetation types
- Figure 10** Vegetation condition and significant weeds
- Figure 11** Conservation and other significant ecological communities and flora



LEGEND

- Major road
- BORR South
- Environmental Survey Area



Map Projection: Transverse Mercator
 Horizontal Datum: GDA 1994
 Grid: GDA 1994 Perth Coastal Grid 1994



Main Roads Western Australia
 Bunbury Outer Ring Road,
 Southern Section

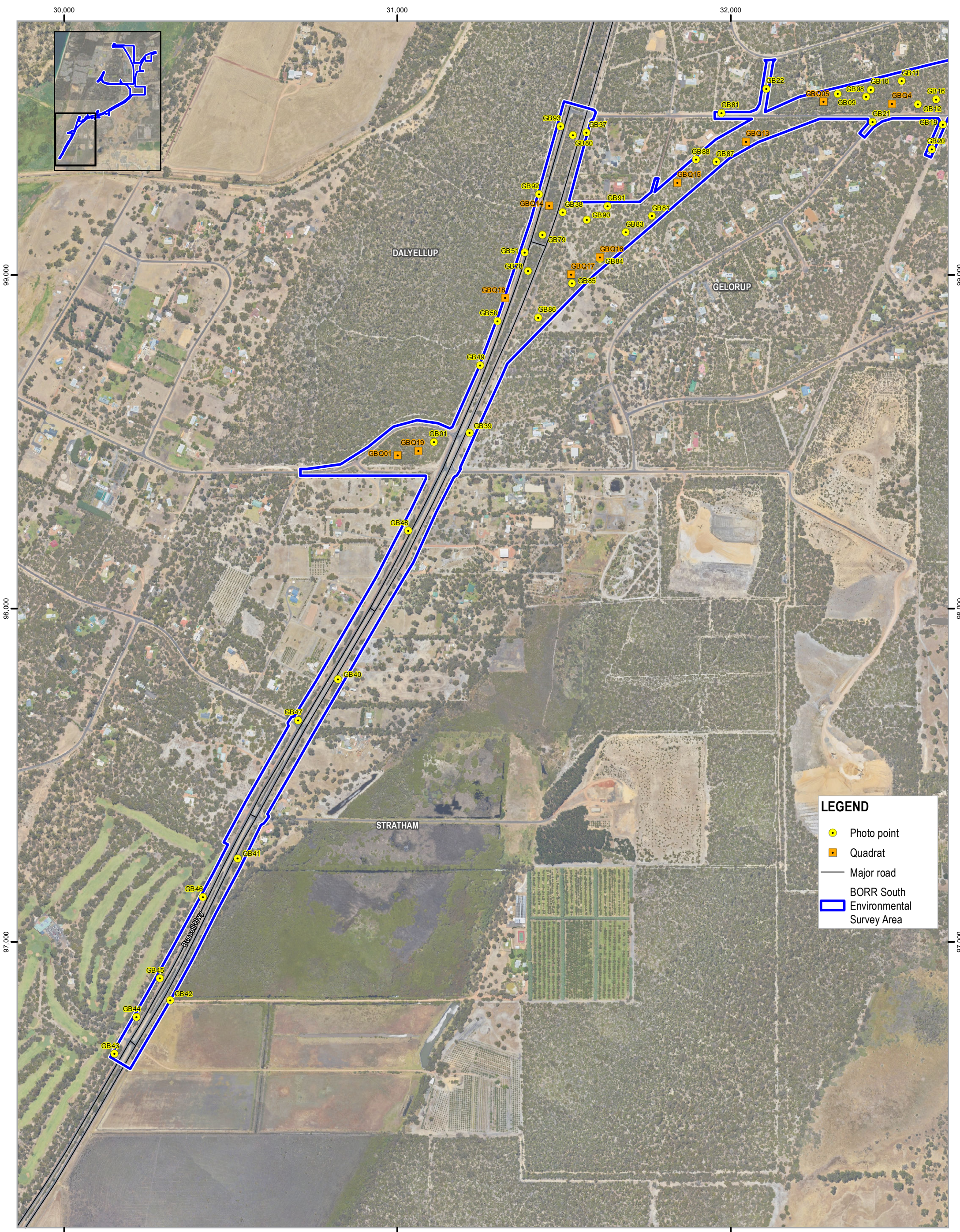
Project Locality

Project No. 61-37041
 Revision No. 0
 Date 02 Sep 2019

FIGURE 1

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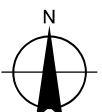
LEGEND

- Photo point
- Quadrat
- Major road
- BORR South
- Environmental Survey Area



Paper Size ISO A3
 0 50 100 150 200
 Metres

Map Projection: Transverse Mercator
 Horizontal Datum: GDA 1994
 Grid: GDA 1994 Perth Coastal Grid 1994



Main Roads Western Australia
 Bunbury Outer Ring Road,
 Southern Section

Survey Area and Sample Locations

Project No. 61-37041
 Revision No. 0
 Date 02 Sep 2019

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