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Shire of Dandaragan: Jurien East Road; Cockleshell Gully Road to Indian Ocean Drive Flora and Vegetation Reconnaissance Survey and Targeted Flora and Fauna Survey




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Version 2

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This document describes the results of a flora and vegetation reconnaissance survey and targeted flora and fauna survey carried out by Maia Environmental Consultancy (Maia) and Western Wildlife along Jurien East Road from Cockleshell Gully Road to Indian Ocean Drive for the Shire of Dandaragan.

Photographs on front page taken along Jurien East Road, October 2019.

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Table of Contents

Tables

Maps

Acronyms and Abbreviations

BC Act	*Biodiversity Conservation Act 2016* (Western Australia)
BoM	Bureau of Meteorology
CSFl	Conservation significant flora
CSFa	Conservation significant fauna
DAFWA	Department of Agriculture and Food Western Australia
DBH	Diameter at breast height
DAWE	Department of Agriculture, Water and Environment (Federal)
DBCA	Department of Biodiversity, Conservation and Attractions
DEC	Former Department of Environment and Conservation, current DBCA
DotEE	Former Department of the Environment and Energy, current DAWE
DPaW	Department of Parks and Wildlife
DPIRD	Department of Primary Industries and Regional Development
DWER	Department of Water and Environmental Regulation
EP Act	*Environmental Protection Act 1986* (Western Australia)
EPA	Environmental Protection Authority (Western Australia)
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999* (Federal)
ESA	Environmentally Sensitive Area
GDA94	Geocentric Datum of Australia, 1994
GDE	Groundwater Dependent Ecosystem
GFG	Griffin Floristic Group
GoWA	Government of Western Australia
GPS	Global Positioning System
ha	Hectare
IBRA	Interim Biogeographic Regionalisation for Australia
JER1	Jurien East Road, Brand Highway to Cockleshell Gully Road survey area
JER2	Jurien East Road, Cockleshell Gully Road to Indian Ocean Drive survey area
km	Kilometre
m	Metre
Maia	Maia Environmental Consultancy Pty Ltd
MGA50	Map Grid of Australia zone 50
MVT	Maia vegetation type
NVCP	Native Vegetation Clearing Permit
P (1-4)	Priority 1 to Priority 4 flora
PCZ	Proposed clearing zone
PEC	Priority Ecological Community
PMST	Protected Matters Search Tool
REn	Regional endemic
REx	Range extension
Shire	Shire of Dandaragan
SLK	Straight line kilometre
sp.	Species -single
sp. Indet.	Species cannot be determined, insufficient material
subsp.	Subspecies
TEC	Threatened Ecological Community
TPFL	Threatened and Priority Flora database

VA	Vegetation association
var.	Variety
VSA	Vegetation system association
WA	Western Australia
WAH / WA Herb	Western Australian Herbarium
*****	Indicates a weed species

Summary

Background

- The Shire of Dandaragan is planning to upgrade a section of Jurien East Road between Cockleshell Gully Road and Indian Ocean Drive. Jurien East Road is in the Wheatbelt Region of Western Australia (WA) and forms part of the Wheatbelt Secondary Freight Network. Wheatbelt Secondary Freight Network improvements was listed as a priority initiative in Infrastructure Australia's Infrastructure Priority List in February 2020. Jurien East Road is indicated as a Priority 1 secondary freight road in the Region.
- Maia Environmental Consultancy Pty Ltd (Maia) and Western Wildlife were contracted by the Shire to carry out a reconnaissance flora and vegetation survey and targeted vertebrate fauna survey over an 11.6 kilometres (km) long section of the road reserve. The flora survey was carried out in October 2019, and the fauna survey in January 2020. The section of road reserve surveyed is referred to as the Survey Area in this report and the 20 m wide corridor in which the road works will be carried out is referred to as the Proposed Clearing Zone (PCZ). The PCZ includes the existing road, road shoulder and current batter / maintenance strip and vegetation.

Survey Results - Flora and Vegetation

- Two hundred and forty-two (242) taxa from 153 genera and 54 families were recorded in the Survey Area. Species richness is relatively low compared with species richness in two other local survey areas, while NatureMap indicates the Survey Area as an area of low to moderate species richness.
- No threatened flora species protected by the *Environment Protection and Biodiversity Conservation Act 1999* or the *Biodiversity Conservation Act 2016* was located in the Survey Area. One Priority Three (P3) species (*Banksia dallanneyi* subsp. *pollosta*) was located and one potentially conservation significant flora species - *Thysanotus ? vernalis* (? P3). Both species will not be impacted by the proposed works because they are not in the PCZ.
- No declared pest plants were located in the Survey Area, while 44 weed species were located. Weeds were densest along and close to the existing road edges and in generally wetter and shadier areas.
- Clearing of all vegetation in the PCZ would not bring the level of total clearing of the vegetation system associations of the Survey Area to below the threshold level of 30% in the Swan Coastal Plain and Geraldton Sandplains (and relevant subregions), in the Shire of Dandaragan or in the local area (within 10 km of the road centreline). Post clearing, the remaining percentage of the vegetation system associations of the Survey Area will be between 35.71% and 93.84% respectively, and in the Shire of Dandaragan they will be between 68.8% and 92.8% respectively. The greatest reduction in the remaining extent to the vegetation system associations by bioregion, subregion and Shire would be 0.01%. In the local area native vegetation extent would decrease from 63.08% to 63.07%.
- Eleven vegetation types were mapped in the Survey Area: *Banksia* Low Open Forest to Low Woodland (*B***LOFLWL**); *Eucalyptus* Tall Open Forest (*E***TOF**); *Eucalyptus* Tall Open Mallee Forest (*E***TOMF**); two types of Mixed Low Open Shrubland (**MLOSL** (1) and **MLOSL** (2)); Mixed Open Shrubland (**MOSL** (1)); *Melaleuca* Open Shrubland (*M***OSL** (2)); Mixed Shrubland (MSL); *Melaleuca* Tall Shrubland (*M***TSL** (1)); Mixed Tall Shrubland (**MTSL** (2)); and, *Tecticornia* Low Sparse Samphire Shrubland (*T***LSSSL**). Each is similar to vegetation mapped in the surrounding areas and regionally. Approximately 4.58 ha of intact native vegetation will be cleared for the proposed road works (8.65% of that in the Survey Area).
- The condition of all intact vegetation in the PCZ was rated as 70.5% Good and 29.5% Very Good. These ratings reflect the high cover and density of weeds close to the road, track entrances and drain edges along the road.

Fauna

- Carnaby's Cockatoo (Threatened, Endangered) was recorded in the Survey Area and evidence of foraging was ubiquitous in the *Banksia* woodlands and shrublands and on *Eucalyptus todtiana*.
- The Survey Area contains high value / quality foraging habitat with important food plants in the *Banksia* woodlands and shrublands, vegetation types *B***LOFLWL**, **MSL** and *E***TOMF**.
- Carnaby's Cockatoo are not known to breed within 12 km of the Survey Area. The Survey Area contains potential (rather than known) breeding habitat for Carnaby's Cockatoo (vegetation type *E***TOF**). No trees with hollows of

sufficient size to support breeding were noted in the PCZ, although five trees fitting the diameter at breast height (DBH) criterion for potential breeding habitat were located. The foraging habitat in the Survey Area is unlikely to be supporting breeding birds (based on current available data) but it is likely to be important for birds in the non-breeding season as they move towards the coast to forage.

- A likely Carnaby's Cockatoo roost site was identified in Flooded Gum and other tall eucalypts near a farm dam and seasonally wet area adjacent to the Survey Area. This Flooded Gum woodland extends into the Survey Area (*E***TOF**) and that area is likely to be part of this roost site.
- Clearing of more than 1 ha of high value foraging habitat and / or any part of a vegetation community known to contain breeding habitat and / or a known night roosting site is considered to be a high risk of significant impact to Carnaby's Cockatoo. After minimising vegetation clearing in the PCZ, approximately 3.58 ha (in total) of the three high value foraging habitat vegetation types (*B***LOFLWL, MSL** and *E***TOMF**) will be cleared for the road works. While approximately 0.19 ha of potential breeding and roosting habitat (*E***TOF**) occurs in the PCZ, including five *Eucalyptus rudis* trees with a DBH ≥ 50 cm, the Shire will not remove these trees, and they will not prune any branches from the taller trees. They will prune some juvenile trees and shrubs in the shrub layer.

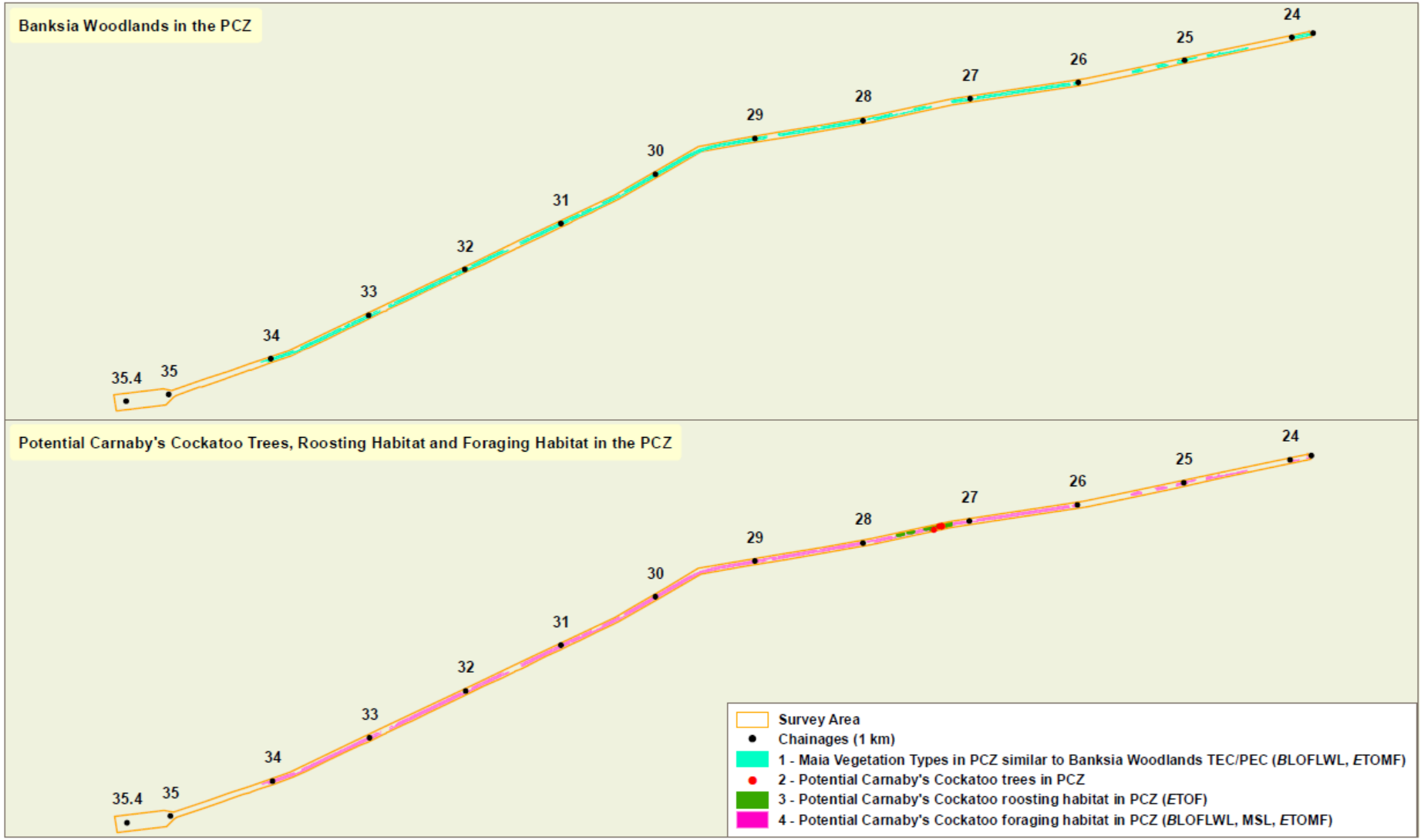
Ecological Communities and Other Significant Areas

- Vegetation types *B***LOFLWL** and *E***TOMF** are similar to vegetation communities that form the nationally protected, EPBC listed and Endangered threatened ecological community (TEC) - Banksia Woodlands of the Swan Coastal Plain. Based on an assessment of the key diagnostic characteristics, the TEC is present in the Swan Coastal Plain section of the Survey Area. This community is listed as the Banksia Dominated Woodlands of the Swan Coastal Plain IBRA region Priority 3(iii) priority ecological community in WA.
- After minimising vegetation clearing in the PCZ, approximately 3.53 ha of *B***LOFLWL** and *E***TOMF** will need to be cleared for the proposed road works. A patch size analysis was carried out on the *B***LOFLWL** in the Survey Area and PCZ (the *E***TOMF** is only mapped in the Geraldton Sandplains bioregion, which is not a key diagnostic for the TEC), and 3.29 ha of *B***LOFLWL** that meets the patch size and condition criteria will be cleared in the PCZ (however, that includes areas of Good condition *B***LOFLWL** that do not meet the size criterion, but that cannot be easily separated from the Very Good condition *B***LOFLWL**).
- Sections of the Survey Area are adjacent to, Drovers Cave National Park and Conservation Park R48717. Other sections are adjacent to a water reserve and two Class C reserves. It is in a Schedule 1 area - the Swan Coastal Plain and Geraldton Sandplains bioregions. An Environmentally Sensitive Area (ESA) extends into the northern side of the Survey Area for approximately 1.2 km; however, it is associated with the Drovers Cave National Park boundary, which should not include the road reserve.
- Areas mapped as Geomorphic Wetlands (palusplain and sumpland) intersect the Survey Area; none is classified as a conservation category wetland.

Phytophthora Dieback

- Vegetation association 1030 is rated as highly susceptible to Phytophthora Dieback and vegetation associations 1026 and 1029 as moderately so. One positive *Phytophthora arenaria* point has been located in the Survey Area in the past. Up to 2008 most of the Survey Area was classified as moderate confidence uninfested.

The map on the following page indicates the important areas in the PCZ.


Banksia Woodlands in the PCZ
24
25
26
27
28
29
30
31
32
33
34
35
35.4
Potential Carnaby's Cockatoo Trees, Roosting Habitat and Foraging Habitat in the PCZ
24
25
26
27
28
29
30
31
32
33
34
35
35.4
Survey Area
Chainages (1 km)
1 - Maia Vegetation Types in PCZ similar to Banksia Woodlands TEC/PEC (BLOFLWL, ETOMF)
2 - Potential Carnaby's Cockatoo trees in PCZ
3 - Potential Carnaby's Cockatoo roosting habitat in PCZ (ETOF)
4 - Potential Carnaby's Cockatoo foraging habitat in PCZ (BLOFLWL, MSL, ETOMF)

Shire of Dandaragan: Jurien East Road; Cockleshell Gully Road to Indian Ocean Drive

Flora and Vegetation Reconnaissance Survey and Targeted Flora and Fauna Survey

1 Introduction

The Shire of Dandaragan is planning to upgrade a section of Jurien East Road between Cockleshell Gully Road and Indian Ocean Drive (**Map 1, Section 11**). Upgrade works along the eastern 24 km of Jurien East Road between Brand Highway and Cockleshell Gully Road are currently in progress. Jurien East Road is in the Wheatbelt Region of Western Australia (WA) and it forms part of the Wheatbelt Secondary Freight Network. Wheatbelt Secondary Freight Network improvements was listed as one of the priority initiatives in Infrastructure Australia's Infrastructure Priority List in February 2020 (Australian Government, 2020). Jurien East Road has been identified as a Priority 1 secondary freight road for the Wheatbelt Region.

Maia Environmental Consultancy Pty Ltd (Maia) and Western Wildlife were engaged by the Shire of Dandaragan to carry out a reconnaissance flora and vegetation survey and a targeted vertebrate fauna survey within an 11.6 km long stretch of road reserve between Cockleshell Gully Road and Indian Ocean Drive. The 11.6 km long section of Jurien East Road reserve is referred to as the Survey Area in this report (**Map 1, Section 11**). The road works will be carried out between SLK 23.8 and SLK 35.0, within 10 metres (m) of the current road centreline on both sides of the road (i.e. within a 20 m wide corridor), and the approximately 11.2 km long, 20 m wide works corridor (that includes the current road clearance profile as well as any new clearing to be carried out) is referred to as the Proposed Clearing Zone (PCZ).

The Survey Area covers 75.91 hectares (ha) and the PCZ comprises 22.29 ha (29.36%) of the Survey Area. About 17.04 ha of the PCZ (76.44%) is either already cleared (for the road, road shoulder and current batter / maintenance strip) or degraded, and the remaining 5.25 ha (25.36%) is native vegetation. The vegetation outside of the PCZ and within the Survey Area will not be impacted by the proposed works.

This report includes background information relevant to a native vegetation clearing permit (NVCP) application, database search results, survey methods and results and a table addressing the 10 clearing principles.

2 Background Information

Information on the bioregion, sub-region, soil landscape units, geology, pre-European vegetation associations, protected and significant areas, watercourses and wetlands and *Phytophthora* Dieback is summarised in **Table 1**.

Table 1: Background information

Background information on the Survey Area	
IBRA bioregions and subregions (**Map 2A, Section 11**)	Most of the Survey Area is in the Perth subregion of the Swan Coastal Plain bioregion; however, the eastern approximately 180 m is in the Lesueur Sandplain subregion of the Geraldton Sandplains bioregion. Department of the Environment and Energy (DotEE) (2012).

Background information on the Survey Area	
Geology (**Map 2B, Section 11**)	The surface geology of the Survey Area is mapped as four units (Stewart et al., 2008): • Rsl: Feldspathic sandstone. • Qdc: Beach sand, sand dunes, coastal dunes, beaches, and beach ridges; calcareous and siliceous, locally shelly and/or cemented (beach rock); locally reworked. • Qdcb: Basal conglomerate overlain by dune quartz sand with heavy mineral concentrations. • Qdct: Unconsolidated to strongly lithified calcarenite with calcrete/kankar soils; aeolian. Locally quartzose, feldspathic, or heavy-mineral-bearing.
Soil landscape mapping units (**Map 2C, Section 11**)	Four soil landscape units are mapped in the Survey Area: • 211Qu, Quindalup South System: Coastal dunes, of the Swan Coastal Plain, with calcareous deep sands and yellow sands. Coastal scrub. • 211Sp, Spearwood System: Sand dunes and plains. Yellow deep sands, pale deep sands and yellow/brown shallow sands. • 212Bs, Bassendean System: Swan Coastal Plain from Busselton to Jurien. Sand dunes and sandplains with pale deep sand, semi-wet and wet soil. Banksia-paperbark woodlands and mixed heaths. • 224Ye, Yerramulla System: Subdued dissected lateritic plateau, undulating low hills and rises on lateritised weathered sandstone. Pale deep sand, sandy gravels and yellow deep sand. Banksia woodlands on lower slopes/depressions, heathlands elsewhere. Department of Agriculture and Food Western Australia (DAFWA) (2014).
Pre-European vegetation associations and system associations (**Map 2D, Section 11**)	The Environmental Protection Authority's (EPA) broad principles for the protection of native terrestrial vegetation and flora indicate that biodiversity should be maintained at sustainable levels. This generally means that ecological communities should be retained at an overall level of at least 30% of the original extent of the ecological community in each region (EPA, 2000). This level is the threshold level below which species loss appears to accelerate exponentially at an ecosystem level. A level of 10% of the original extent is regarded as being a level representing "endangered" (EPA, 2000). In 2018, 38.62% of the vegetation of the Swan Coastal Plain remained and 44.78% of the Geraldton Sandplains (GoWA, 2019). The Survey Area lies in three of the pre-European vegetation associations (VA) and vegetation system associations (VSA) mapped in the Swan Coastal Plain and Geraldton Sandplains bioregions (Department of Primary Industries and Rural Development (DPIRD), 2018): • VA 1026, VSA 1026.1: Mosaic: Shrublands; *Acacia rostellifera*, *A. cyclops* (in the south) and *Melaleuca cardiophylla* (in the north) thicket / Shrublands; *Acacia lasiocarpa* and *Melaleuca acerosa* heath. • VA1029, VSA 1029.1: Shrublands; scrub-heath Dryandra-Calothamnus association with *Banksia prionotes* on limestone in the northern Swan Region. • VA 1030; VSA 1030.2: Low woodland; *Banksia attenuata* and *B. menziesii*. The pre-European extent of these VAs and VSAs in the Swan Coastal Plain bioregion and Perth subregion, the Shire of Dandaragan, and the Geraldton Sandplains bioregion and Lesueur Sandplain subregion, along with the current extent, the percentage remaining and the current extent protected for conservation is listed in **Table 2**. Currently, between 69.5% and 93.8% of VSAs 1026.1, 1029.1 and 1030.2 remains in the Swan Coastal Plain bioregion and Perth subregion, 35.7% of VSA 1030.2 in the Geraldton Sandplains and Lesueur Sandplain and between 68.9% and 92.8% of the three VSAs remains in the Shire of Dandaragan (**Table 2**; GoWA, 2019).

Background information on the Survey Area	
Protected and significant areas (**Map 3, Section 11**)	• None of the Survey Area lies in DBCA Legislated Lands and Waters (Department of Biodiversity, Conservation and Attractions (DBCA), 2019a). Reserve 48717 (Class C), a Conservation Park, is adjacent to a section of the southern boundary of the Survey Area, approximately SLK 28.8 to 30.6, and Drovers Cave National Park (Class A reserve 31302) is adjacent to a section of the northern boundary of the Survey Area, from approximately SLK 30.3 to 32.5 (shown on **Map 3**). Water Reserve 44645 is adjacent to and north of the Survey Area from approximately SLK 32.5 to 35.1, while Class C reserves 18865 and 35191 are adjacent to and south of the Survey Area between SLK 34.4 and 35.1 (not shown on **Map 3**; DMIRS, 2020). • None of the Survey Area lies in DBCA Lands of Interest (DBCA, 2017). The closest is Crown Freehold (Department Interest) 2709/953, approximately 7 km north-east of the Survey Area. • A long and thin section of an Environmentally Sensitive Area (ESA) extends into the northern side of the Survey Area for approximately 1.2 km (from approximately SLK 31.4 km to 32.5 km) and approximately 0.2 km of it overlaps the PCZ (Department of Water, Environment and Regulation (DWER), 2018a). However, this is associated with Drovers Cave National Park and its boundary ends at the junction of the road reserve. • The Survey Area lies in a Schedule 1 Area – Swan Coastal Plain and Geraldton Sandplains bioregions (DWER, 2018b). Four EPA Redbook Recommended Conservation Reserves 1976-1991 areas are adjacent to but outside of the Survey Area boundary – Drovers Cave National Park and three other areas of Northern Sandheaths (DBCA, 2015a).
Watercourses and wetlands (**Map 4, Section 11**)	• None of the Survey Area lies in or close to a Ramsar Site (DBCA, 2015b). • None of the Survey Area occurs in or close to a Directory of Important Wetlands in Australia (DIWA) wetland (DBCA, 2018a). • A small section of a non-perennial lake intersects part of the southern boundary of the Survey Area: the lake does not extend into the Survey Area. No watercourse areas and lines, waterholes, water points or springs cross or occur within the Survey Area (Geoscience Australia, 2006). • The Survey Area intersects areas mapped as Geomorphic Wetlands. A seasonally waterlogged palusplain wetland (GWCCC_0135, Cervantes Coastal (DBCA, 2015c); identified as GWCE_0323 in DBCA (2015d)), a sumpland (GWCE_0326) and a palusplain (GWCE_0319) (Cervantes Eneabba (DBCA, 2015d)). The wetlands intersect the Survey Area in four places: none is listed as a conservation category wetland, but GWCCC_0135 is listed in the multiple use wetland management category (DBCA, 2015c).
Groundwater dependent ecosystems (GDE) **Figure 1A: Terrestrial GDE and the Survey Area (BoM 2020b)**	Much of the Survey Area is mapped as having high potential to be a GDE based on national assessment and some as having moderate potential (BoM, 2020b). 

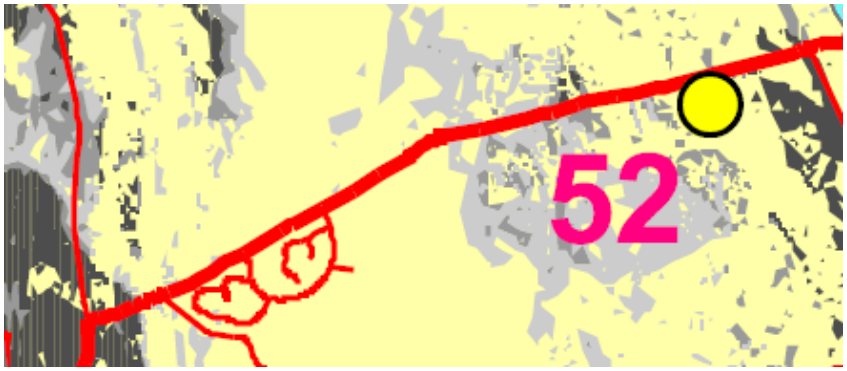
Background information on the Survey Area	
Figure 2B: Potential GDE site in the Survey Area (Rutherford et al., 2005)	A potential GDE site has been identified close to the junction of Jurien East Road with Cockleshell Gully Road (yellow circle), and the Survey Area crosses areas mapped as having areas of potential GDE, where the depth to water table is between 0 and 20 m (polygons of different shades of grey along the road – darkest = 0-5 m and lightest = 10-20 m). 
Phytophthora dieback	Project Dieback has created a publicly available map showing locations of soils samples with a positive reading for *Phytophthora cinnamomi* in the south-west of WA (Project Dieback, 2014a). It also shows vegetation susceptibility to *Phytophthora cinnamomic*. VA 1030 is rated as having high susceptibility and VAs 1029 and 1026 are rated as having moderate susceptibility. One positive *Phytophthora* species point is located within the Survey Area – *Phytophthora arenaria* (as of 30 June 2018) located at about SLK 29.3 km. **Figure 2** indicates vegetation susceptibility in the Survey Area and surrounds and the positive sample point along Jurien East Road (Project Dieback, 2014a). None of the Survey Area is in a Priority Protection Area (an area representing significant biodiverse ecosystems and communities vulnerable to Phytophthora Dieback in the south-west of WA and identified for state level Phytophthora Dieback management and investment (Project Dieback, 2014b)). Project Dieback also includes mapping layers indicating uninfested and infested vegetation up to 2008, along with some indication of the confidence of the mapping. Most of the Survey Area was classified as moderate confidence uninfested up to 2008, with some small sections mapped as high and low confidence uninfested and uninterpretable (Project Dieback, 2014a).

Figure 3: Susceptibility to *Phytophthora cinnamomi* and disease sample positive points (Project Dieback, 2014a)

Note: blue diamond = *Phytophthora arenaria* on Public Land (all years to 2018 June 30); black outline = the Survey Area; yellow shading = medium *Phytophthora cinnamomi* susceptible vegetation; orange shading = high *Phytophthora cinnamomi* susceptible vegetation.

Table 2: Pre-European vegetation associations and system associations of the Survey Area

	Bioregions and subregions				
	Swan Coastal Plain	Perth	Geraldton Sandplains	Lesueur Sandplain	Shire of Dandaragan
Vegetation associations (VA)					
Pre-European extent (ha)					
1026	58,419.39	58,419.39	**Section of Survey Area is not within GS and LS**		52,458.27
1029	68,329.04	68,329.04			49,462.51
1030	134,788.56	114,215.61	3,848.52	3,848.52	121,005.02
Current extent (ha)					
1026	54,819.58	54,819.58	**Section of Survey Area is not within GS and LS**		48,697.11
1029	49,086.11	49,086.11			39,711.90
1030	86,013.90	79,563.09	2,790.59	2,790.59	80,779.18
Remaining (%)					
1026	93.84	93.84	**Section of Survey Area is not within GS and LS**		92.83
1029	71.84	71.84			80.29
1030	63.81	69.66	72.51	72.51	66.76
Current extent of VA protected (IUCN 1-4) for conservation (proportion of pre-European extent) (%)					
1026	51.82	51.82	**Section of Survey Area is not within GS and LS**		51.37
1029	24.89	24.89			31.04
1030	8.38	9.66	54.24	54.24	10.89
Vegetation system associations (VSA)					
Pre-European extent (ha)					
1026.1	58,393.39	58,393.39	**Section of Survey Area is not within GS and LS**		52,458.27
1029.1	68,041.14	68,041.14			48,795.54
1030.2	114,213.39	114,213.39	1,556.67	1,556.67	107,600.18
Current extent (ha)					
1026.1	54,795.80	54,795.80	**Section of Survey Area is not within GS and LS**		48,697.11
1029.1	48,798.22	48,798.22			39,045.46
1030.2	79,634.78	79,560.88	555.90	555.90	74,135.08
Remaining (%)					
1026.1	93.84	93.84	**Section of Survey Area is not within GS and LS**		92.83
1029.1	71.72	71.72			80.02
1030.2	69.55	69.66	35.71	35.71	68.90
Current extent of VSA protected (IUCN 1-4) for conservation (proportion of pre-European extent) (%)					
1026.1	51.82	51.82	**Section of Survey Area is not within GS and LS**		51.37
1029.1	24.98	24.98			30.67
1030.2	9.63	9.66	4.86	4.86	10.30

Source: Government of Western Australia (GoWA) (2019). Swan Coastal Plain and Geraldton Sandplains = bioregions, Perth, and Lesueur Sandplain = subregions.

3 Database Search Results

Appendix 1 provides information on conservation significance of flora, fauna and vegetation in Australia and Western Australia and references for the relevant literature and current listings.

3.1 Conservation Significant Flora

Searches were requested of DBCA's Threatened and Priority Flora List (TPFL) and WA Herbarium (WAHerb) databases (DBCA search reference #46-0919FL) (**Map 5, Section 11**). Searches using the EPBC Act Protected Matters Search Tool (PMST) (DotEE, 2019a, search reference PMST 3TSOTP) and NatureMap (DBCA, 2007-) were also carried out to gather information on conservation significant flora (CSFl) species that could potentially occur in the Survey Area. The searches were carried out using the Jurien East Road centreline from Munbinea Rd to Indian Ocean Drive buffered by 2.5 km. The search results are summarised in **Table 20, Appendix 2**.

3.1.1 Threatened Flora

While 15 threatened species (or their habitats) protected by the federal *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and the WA *Biodiversity Conservation Act 2016* (BC Act) were listed in the search results for the 2.5 km buffered line search area, none of them have been located in or close to the Survey Area previously, and the habitats in which they are found are not in the Survey Area. The closest threatened flora species record to the Survey Area is a *Thelymitra stellata* record approximately 2.4 km to the east (**Map 5, Section 11**). It is possible that this species could occur in the Survey Area and the flora and vegetation survey was scheduled for October, the month when this species was located in areas between approximately 2.5 km and 9.5 km east north-east of Cockleshell Gully Road. However, the soil-landscape system and the topography are not the same in the current Survey Area, and it is unlikely that they will occur there.

3.1.2 Priority Flora

Thirteen priority (P) flora species have records within the search area – four P2 species, six P3 species and three P4 species. No priority species have been located within the Survey Area previously. While one P3 species record is shown within the Survey Area, it is a *Guichenotia alba* (P3) record and the FloraBase record details describes its location as 2 km west of Canover Road and 3.5 km south of Jurien East Road (i.e. the coordinates for this record in DBCA's database are not in the same location as described in the record). Priority flora records within 0.5 km of the Survey Area boundary are: *Scholtzia calcicola* (P2), *Hensmania stoniella* (P3) (approximately 0.3 km and 0.4 km north of the Survey Area, and four records at the same location in a cleared field about 70 m north of the Survey Area and 0.6 km west of Cockleshell Gully Road (*Dampiera* sp. Jurien (P2), *Banksia fraseri* var. *crebra* (P3), *Haemodorum loratum* (P3) and *Stylidium inversiflorum* (P4)) (**Map 5, Section 11**). It is possible that these six species could occur in the Survey Area. As they are all perennial species, and three of them are recorded as flowering in October (the others are either woody perennials or have distinctive leaf characteristics), they could be located during an October survey if present in the area.

3.2 Conservation Significant Fauna

The EPBC Act PMST and NatureMap (DAWE, 2019a, search reference PMST O0OEEU and DBCA, 2007-) were used to gather background information on conservation significant fauna (CSFa) species that could potentially occur in the Survey Area. The road centerline between Munbinea Road and Indian Ocean Drive was buffered by 10 km for the searches. The search results are summarised in **Table 21, Appendix 2**. [Note that some of the search area covers the ocean.]

3.2.1 Threatened Fauna

Thirty-eight threatened fauna species (birds, mammals, reptiles and sharks) protected by the EPBC Act were listed in the PMST search results. Three of the 38 are listed as Critically Endangered, 11 as Endangered and 24 as

Vulnerable. Ten of the 38 species are marine species that would not occur in the Survey Area and are not included in **Table 21** (turtles, sharks and whales). Fifteen of the threatened species listed are also listed as Migratory: migratory marine birds, migratory terrestrial species, and migratory wetlands species.

Seven of the species protected by the EPBC and BC acts have been located previously within the 10 km buffered search area: *Calyptorhynchus latirostris* (Carnaby's Cockatoo), *Ctenotus lancelini* (Lancelin Island Skink), *Liopholis pulchra* subsp. *longicauda* (Jurien Bay Skink), *Macroderma gigas* (Ghost Bat), *Neophoca cinerea* (Australian Sea-lion), *Parantechinus apicalis* (Dibbler) and *Sternula nereis* subsp. *nereis* (Fairy Tern) (**Table 21**). Two additional species have not been included in the table as they are marine species that would not occur in the area (one whale and one shark).

Only Carnaby's Cockatoo and Ghost Bat records occur on the mainland within 10 km of the Survey Area and all other current threatened fauna species records occur on islands surrounding Jurien Bay:

No current records for threatened fauna species are located within the Survey Area (**Map 6, Section 11**).

No confirmed breeding area for Carnaby's Cockatoo intersects the Survey Area (**Map 6, Section 11**) (DBCA, 2018b; DSEWPaC, 2012).

The Survey Area does not intersect with a Carnaby's Cockatoo confirmed roost site, the closest is approximately 36 km east north-east of Lancelin (DBCA, 2018c). A buffered Black Cockatoo roosting site is approximately 0.75 km north of the Survey Area at its closest (DBCA 2019e; **Map 6, Section 11**).

Most of the Survey Area lies in a large section of vegetation identified as requiring investigation for Carnaby's Cockatoo feeding habitat (DBCA, 2018d) (**Map 6, Section 11**); however, most of the road reserve is excised from this layer.

The nearest record for Carnaby's Cockatoo is 0.20 km south of the Survey Area (DBCA, 2007-).

The nearest Ghost Bat record is more than 4 km north of the Survey Area (DBCA, 2007-), although this record is of subfossil remains and does not reflect the current range of the species.

3.2.2 Migratory Fauna

Thirty Migratory Fauna species protected by the EPBC Act and BC Act were listed in the PMST search results (excluding ocean dwellers) and 15 of the 30 are also listed as threatened species (DAWE, 2019a; **Table 21**).

Seventeen of the 30 have been located previously within the 10 km buffered search area (DBCA, 2007-; **Map 6, Section 11**; **Table 21**).

All except *Pandion haliaetus* subsp. *cristatus* (Eastern Osprey) records occur on the mainland within 10 km of the Survey Area (DBCA, 2007-). *Plegadis falcinellus* (Glossy Ibis) and *Tringa glareola* (Wood Sandpiper) records occur within the Survey Area (DBCA, 2007-).

3.2.3 Specially Protected Fauna

One Specially Protected Fauna species has been located previously within the 10 km buffered search area – *Falco peregrinus* (Peregrine Falcon) (DBCA, 2007-; **Table 21**). The nearest record is approximately 2.4 km south-west of the Survey Area (DBCA, 2007-; **Map 6, Section 11**).

3.2.4 Priority Fauna

Four Priority Fauna species have been located previously within the 10 km buffered search area – *Hylaeus globuliferus* (Woolybush Bee) (P3), *Notamacropus irma* (Western Brush Wallaby), *Synemon gratiosa* (Graceful Sunmoth) and *Thinornis rubricollis* (Hooded Plover) (all P4) (DBCA, 2007-; **Map 6, Section 10**; **Table 21**).

One Graceful Sunmoth record is known from the Survey Area and the nearest record outside the Survey Area is about 1 km to the south (DBCA, 2007-). The closest Hooded Plover (P4) record is about 2 km to the south-west, the closest Woolybush Bee (P3) record is about 6 km to the south south-east and the closest Western Brush Wallaby (P4) record is about 7.3 km south south-east of the Survey Area (DBCA, 2007-).

3.3 Ecological Communities

The following databases were used to gather information on significant ecological communities that could potentially occur in the Survey Area: EPBC Act PMST (DAWE, 2019a; search reference PMST O0OEEU); and, DBCA Ecological Communities (search reference #53-0919EC). The PMST search was carried out over the Jurien East Road centreline from Munbinea Road to Indian Ocean Drive buffered by 10 km. A 20 km circular DBCA search was conducted centred on the middle of the Survey Area.

3.3.1 Threatened Ecological Communities

Two threatened ecological communities (TECs) were listed in the PMST search results as 'may occur within the area' and 'likely to occur within the area', respectively – Tuart (*Eucalyptus gomphocephala*) Woodlands and Forests of the Swan Coastal Plain ecological community (Critically Endangered) and Banksia Woodlands of the Swan Coastal Plain ecological community (Endangered).

The most recent WA TEC list is correct to June 28, 2018 (DBCA, 2018e). It lists 23 TECs for the Swan Coastal Plain bioregion and five for the Geraldton Sandplains bioregion. The Survey Area does not occur in any of the current WA listed TECs (**Map 7, Section 11**).

3.3.2 Priority Ecological Communities

The most recent PEC list is dated May 5, 2020 (DBCA, 2020a); it lists 109 PECs for the Midwest region. The eastern section of the Survey Area lies within the boundaries of buffers indicating potential areas of the Banksia Dominated Woodlands of the Swan Coastal Plain IBRA region, a P3(iii) PEC (**Map 7, Section 11**). This PEC forms part of the EPBC Act protected Banksia Woodlands of the Swan Coastal Plain ecological community TEC.

4 Rainfall

The closest Bureau of Meteorology (BoM) weather station to the Survey Area is at Jurien Bay (BoM station number 9131). Long-term (1968 to 2019) and October 2018 to September 2019 monthly total rainfall data for Jurien Bay are listed in **Table 3** (BoM, 2020a).

Rainfall received between the beginning of October 2018 and the end of September 2019 (372.9 millimetres (mm)) was lower than the annual long-term mean (532.5 mm) (BoM, 2020). Total rainfall in the four months before the October survey (June, July, August and September – 302.0 mm) was 40.4 mm lower than the long-term mean for those four months (342.4 mm) (BoM, 2020a).

Based on the rainfall data recorded in the months before the survey and the long-term rainfall records, the vegetation in the Survey Area could have been in average to below average condition in October 2019.

Table 3: Jurien Bay actual (Oct 2018 to Sept 2019) and long-term mean (1968-2019) monthly rainfall (mm)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Rainfall records (mm) from Jurien Bay (Station Number 9131, 1968 - 2019) (BoM, 2019)													
L-t	8.1	14.0	14.4	29.5	75.0	105.2	113.2	80.4	43.6	25.1	17.4	6.6	532.5
2018										22.8	2.6	5.2	30.6
2019	1.0	1.0	1.0	23.0	14.3	140.0	80.2	69.8	12.0				342.3

Note: L-t= long-term rainfall data (BoM, 2020a).

5 Survey Methods

5.1 Vegetation and Flora

EPA (2016a) was used in planning the flora and vegetation survey. A desktop study was carried out followed by a flora and vegetation reconnaissance survey and a targeted flora survey within the PCZ.

The survey was carried out by four botanists on October 15 and 17, 2019. The following parameters were assessed:

- Eighteen 10 m x 10 m quadrats.
- Two relevés of approximately the same area (100 m^2).
- Traverses were walked along both sides of Jurien East Road. Traverses were walked along the boundary of the existing maintenance strip with the intact native vegetation and a 10 m wide band was assessed (to the outer extent of the PCZ). Known or suspected conservation significant flora species (CSF) were targeted while walking the traverses and, if any were found, their location was recorded on a GPS and they were counted.
- Traverses were walked outside the PCZ in areas where suspected or known CSF where located within the PCZ.
- Any apparently different vegetation type, changes in vegetation condition and any disturbance to the vegetation was noted.
- If any Carnaby's Cockatoo were seen or heard the botanists made a note of the location, and approximately how many were seen.
- Any *Eucalyptus rudis* trees (the only Carnaby's Cockatoo habitat tree species meeting diameter at breast height (DBH) criteria in the Survey Area) with a DBH of ≥ 50 cm or greater occurring within 11 m of the road centreline were assessed. As well as DBH, notes were taken on the presence or absence of hollows of a suitable size, and any evidence of current use for breeding; the location of each tree was also recorded on a Global Positioning System (GPS). These trees were then assessed by Western Wildlife during the fauna survey.

The following parameters were recorded at each quadrat and relevé assessed:

- Location details including GPS co-ordinates (Geocentric Datum of Australia, 1994 (GDA94)).
- Site parameters such as soil description, topography and general habitat description, rock type and cover.
- A photograph of the site.
- Vegetation condition using the scale and criteria for the South West and Interzone botanical provinces in EPA (2016a) (**Appendix 8, Table 27**).
- Notes on any disturbance to the vegetation.
- Fire history.
- A description of the vegetation structure including the height, percentage cover and dominant species within each stratum.
- The name, height, percentage cover and any other significant recording details for any other species located at the quadrat or relevé.

Quadrat and relevé locations and traverses walked in the Survey Area are shown on **Map 8, Section 11**.

5.2 Targeted Fauna and Carnaby's Cockatoo Habitat Survey

The survey methodology was designed to comply with EPA and DPaW (2010), EPA (2016b) and DSEWPAC (2012).

A targeted fauna survey was conducted by one zoologist on the 30th January 2020 (one survey day), and the Survey Area was assessed through a combination of walking and driving the route (**Map 8, Section 11**). The primary focus of the survey was a search for potential breeding, roosting or foraging habitats for Carnaby's Cockatoo. In addition,

vertebrate fauna encountered were recorded, and the habitats assessed for their likelihood of supporting other conservation significant fauna.

Carnaby's Cockatoo foraging habitat in the Survey Area was identified by:

- Using the results of the flora and vegetation survey to determine the presence of known black-cockatoo food plants such as *Banksia* species in each habitat.
- Assessing the prevalence of black-cockatoo food plants in each habitat during the site visit.
- Searching for evidence of black-cockatoo foraging, such as chewed *Banksia* species nuts.

Potential breeding habitat in the study area was identified by:

- Recording any Flooded Gum (*Eucalyptus rudis*) trees with a diameter at breast height (DBH) ≥ 50 cm (there were no other eucalypt species with trunks of a size to be measured).
- Searching all trees identified above, for the presence of hollows of suitable size, and any evidence of current use for breeding. It should be noted that not all hollows are visible from the ground, and that hollows were not assessed for depth, aspect or other characteristics that may affect usage by birds.

Potential roosting habitat in the study area was identified by:

- Searching for locations that match the roost site characteristics for Carnaby's Cockatoo (e.g. large eucalypts or pines in riparian environments).
- Searching for evidence of roosting, such as scats or feathers, in any identified potential roost areas.

6 RESULTS

6.1 FLORA

6.1.1 Survey Coverage and General Flora Information

Eighteen 10 m x 10 m quadrats and two relevés (combined = sites) were assessed in the Survey Area and 24.68 km of traverses were walked in and adjacent to the PCZ. Coverage achieved over the Survey Area is listed in **Table 4**. Coverage achieved along traverses was determined by buffering the traverses by 10 m. The information collected at each quadrat and relevé is provided in **Table 23 (Appendix 3)** and their locations are shown on **Map 8, Section 11**.

Table 4: Survey coverage achieved

Attribute	Area (ha)
Quadrats	0.18
Traverses	24.68
Area surveyed	24.86
Coverage achieved (%)	32.74

Note: coverage achieved is calculated using the Survey Area as a whole; if already cleared and disturbed areas were excluded the coverage achieved would be higher.

A combined list of 242 taxa was collated from the Survey Area (**Table 23, Appendix 4**). The number of taxa recorded, along with the number of families and genera represented, the percentage of annual and perennial species and the percentage of the species list that was fertile when the survey was carried out is listed in **Table 5**.

Table 5: Flora information

Attribute	Number or percent
Families	54
Genera	153
Taxa	242
Annual / perennial (%)	22 / 78
Flowering / fruiting / flowering and fruiting / fertile overall (%)	40 / 32 / 12 / 84

Seven taxa could not be confirmed beyond genus: *Amphipogon* sp. Indet.*, Eremaea* sp. Indet.*, Haloragis* sp. Indet.*, Thysanotus* ? *manglesianus, Thysanotus* ? *vernalis* (P3)*, Typha* sp. Indet. and *Xanthorrhoea* ? sp. Lesueur. Two taxa could not be confirmed beyond family – Aizoaceae sp. Indet. and Poaceae sp. Indet..

Five taxa have not been included in the counts as they are likely to be one of the taxa already in the species list, however, they are listed in **Table 23 (Appendix 4)** – *Banksia* ? *sphaerocarpa, Cassytha aurea, Corynotheca micrantha, Melaleuca* ? *viminea* and *Sonchus* sp. Indet..

Native species richness at quadrats ranged from three (Q31, excluding the five weed species) to 35 (Q33, no weeds present) and mean species richness is 19.4 (± 9.2). When weeds are included in the counts mean species richness becomes 24.5 (± 9.2).

Maia (2017) carried out a reconnaissance survey along the eastern section of Jurien East Road in 2016 (Brand Highway to Cockleshell Gully Road (JER1)) and species richness at the 27 relevés assessed ranged from 11 to 49 (with a mean of 31.7 for all species (± 10.4) and 30.4 for native species only (± 11.3)). During the same week as the current survey (JER2) Maia carried out a reconnaissance survey in a gravel pit area off Cockleshell Gully Road and native species richness at the three quadrats assessed in that area was 39, 40 and 38 (mean of 39 (± 1.0) - no weed species were located).

The Survey Area therefore lies in an area of low species richness compared with the two other local survey areas. NatureMap indicates that the Survey Area (JER2) is in an area of low to moderate species diversity and that the JER1 survey area as in a moderate to high species diversity area (DBCA, 2007-).

6.1.2 Conservation Significant Flora

No threatened species protected by the Federal EPBC Act or the State BC Act were located in the Survey Area.

One confirmed priority species and one unconfirmed priority species was recorded in the Survey Area – *Banksia dallanneyi* subsp. *pollosta* (P3) and *Thysanotus* ? *vernalis* (? P3) (**Map 9, Section 11**). **Table 8** lists the number of known plants and populations in the Survey Area and in WA as well as their distribution and an impact estimate for *Banksia dallanneyi* subsp. *pollosta* and *Thysanotus vernalis*. Photographs of *Banksia dallanneyi* subsp. *pollosta* and *Thysanotus vernalis* (the actual P3 species) are provided in **Table 24 (Appendix 5)**; both conservation significant flora species were found on the slopes of Spearwood System sand dunes in mixed shrubland.

6.1.3 Regional Endemics

Regional endemics are plants that are geographically restricted to a particular locality or region. Two of the species recorded in the Survey Area are regional endemics:

- *Alexgeorgea subterranea*: NatureMap records spread over an approximately 75 km by 50 km area. Sixteen of the 20 records are in the Lesueur Sandplain subregion and four are in the Perth subregion (DBCA, 2007-).

- *Grevillea preissii* subsp. *glabrilimba*: NatureMap records spread over an approximately 75 km by 25 km area. Sixteen of the 28 records are in the Lesueur Sandplain subregion and 12 are in the Perth subregion (DBCA, 2007-).

6.1.4 Range Extension Species

Species have a typical range which is indicated by their known distribution records. Sometimes species are recorded during a survey, which have not been located previously in the area and these species are described as range extensions. In many cases a range extension reflects a lack of surveys in an area or submissions of flora records to the WA Herbarium rather than a true range extension.

Using 100 km as the minimum distance from an existing record to define a range extension, six range extension species were collected from the Survey Area (**Table 6**).

Table 6: Range extension species located in the Survey Area

Species (* indicates a weed species)	Closest WAH (1998 -) record from Survey Area (records from NatureMap (DBCA, 2007-))	Distance and direction from Survey Area
**Atriplex prostrata*	Bootine Nature Reserve (Perth subregion)	123 km south
Eucalyptus utilis (probably planted)	Hillarys (Perth subregion)	180 km south
Isolepis hookeriana	Nunkerri (Northern Jarrah Forest subregion)	156 km south south-east
**Lupinus luteus*	Gidgegannup (Northern Jarrah Forest subregion)	196 km south south-east
Olearia revoluta	Manners Valley (Merredin subregion)	98 km north-east
Petrophile brevifolia subsp. *brevifolia*	Yanchep (Perth subregion)	142 km south

6.1.5 Weed Species

No weed species listed on any of the national weeds lists or listed as a declared pest in Western Australia was found in the Survey Area.

Forty-four environmental weed species were collected from the Survey Area. The impact and invasiveness ratings for each are listed in **Table 7** (DPaW, 2014) (the list does not include *Sonchus* sp. Indet.). Fourteen of the 44 weed species have high ecological impact and rapid Invasiveness ratings.

Table 7: Environmental weed species located in the Survey Area

Species	Rank		Species	Rank	
	Ecological impact	Invasiveness		Ecological impact	Invasiveness
Arctotheca calendula	High	Rapid	*Lagurus ovatus*	Unknown	Rapid
Atriplex prostrata	Unknown	Rapid	*Lolium perenne* x *rigidum*	Unknown	Moderate
Avena barbata	High	Rapid	*Lupinus luteus*	Not available	
Briza maxima	Unknown	Rapid	*Lysimachia arvensis*	Low	Rapid
Briza minor	Unknown	Rapid	*Medicago laciniata*	Low	Moderate
Bromus diandrus	High	Rapid	*Oenothera drummondii* subsp. *drummondii*	Not available	
Bromus hordeaceus	Unknown	Slow	*Oenothera stricta*	Low	Rapid
Centaurea melitensis	High	Rapid	*Ornithopus sativus*	Low	Rapid
Centaurium erythraea	Low	Rapid	*Paspalum dilatatum*	Medium	Rapid
Chloris gayana	Unknown	Rapid	*Pelargonium capitatum*	High	Moderate

Species	Rank		Species	Rank	
	Ecological impact	Invasiveness		Ecological impact	Invasiveness
Cotula coronopifolia	High	Rapid	*Pentameris airoides*	Unknown	Rapid
Crassula glomerata	Unknown	Rapid	*Raphanus raphanistrum*	High	Rapid
Cynodon dactylon	High	Rapid	*Romulea rosea*	High	Rapid
Cyperus congestus	High	Rapid	*Rumex crispus*	Unknown	Moderate
Ehrharta calycina	High	Rapid	*Solanum nigrum*	Unknown	Rapid
Ehrharta longiflora	Unknown	Rapid	*Sonchus asper*	Unknown	Rapid
Eragrostis curvula	High	Rapid	*Sonchus oleraceus*	Unknown	Rapid
Gazania linearis	High	Rapid	*Symphyotrichum squamatum*	Unknown	Rapid
Gladiolus caryophyllaceus	High	Rapid	*Trifolium lappaceum*	Unknown	Moderate
Hordeum leporinum	Unknown	Rapid	*Ursinia anthemoides* subsp. *anthemoides*	High	Rapid
Hypochaeris glabra	Low	Rapid	*Vulpia bromoides*	Unknown	Rapid
Juncus bufonius	Low	Rapid	*Wahlenbergia capensis*	Unknown	Rapid

Table 8: Known records and distribution of priority flora species located in the Survey Area

Column 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
		Number of plants								Number of populations				Closest record outside of and to the Survey Area (km)	Furthest record from Survey Area (max distance between records)
Species	Rank	Government sources	Other surveys (not Maia)	Other Maia surveys	JER1 (Maia, 2017)	This survey	Total	Within PCZ	Impact from this project (%)	WA	Within PCZ	Impact from this project	DBCA Legislated Lands and Waters (IUCN I-IV only)		
Banksia dallanneyi subsp. *pollosta*	P3	43	12,004	5	0	9	12,015	0	0	36	0	0	8	54 km	153 km (110 km x 150 km)
*Thysanotus vernalis***	P3	11	Not applicable	0	100	0	111	0	0	11	0	0	4	3 km	97 km (110 km x 75 km)
Thysanotus ? *vernalis*	? P3	Not applicable	Not applicable	0	0	1	1	0	0	1	0	0	0	Not applicable	Not applicable

Note:

Column 1 = ***Thysanotus vernalis* was not recorded within the Survey Area, the collection was identified as *Thysanotus* ? *vernalis*.

Column 2 = P3 - Priority 3 species, ? P3 – possible P3 species.

Column 3 = data from FloraBase (WAH, 1998-), NatureMap (DBCA, 2007-) and DBCA search reference #46-0919FL. There is no overlap in records.

Column 4 = publicly available literature – Aecom (2014), Bennett (2010, in Woodman (2013)), Mattiske (2017), Woodman (2013, 2014 and 2015).

Column 5 = data from surveys conducted by Maia in other project areas.

Column 6 = numbers from of JER1 (Jurien East Road - eastern section) survey (Maia, 2017).

Column 7 = numbers from of JER2 (Jurien East Road - western section) survey (this survey).

Column 8 = total of columns 3 to column 7; column 3 for *Banksia dallanneyi* subsp. *pollosta* has been omitted from the total as numbers from Mattiske (2017) have been used and likely contain government sources.

Column 9 = number of plants recorded within the PCZ – Proposed Clearing Zone.

Column 10 = impact to known WA plants from PCZ = column 9 / column 8 * 100. No *Thysanotus vernalis* was recorded in the PCZ.

Column 11 = all known records have been buffered by 500 m (using ArcGIS) to get populations.

Column 12 = number of populations in the PCZ.

Column 13 = impact to populations from PCZ only = column 12 / column 11 * 100.

Column 14 = number of populations with IUCN I-IV DBCA Legislated Lands and Waters (DBCA, 2019a).

Column 15 = the closest record to the Survey Area using known records and measuring the distance in ArcGIS using the boundary of the Survey Area.

Column 16 = the furthest record from the Survey Area using known records and measuring the distance in ArcGIS using the boundary of the Survey Area.

6.2 FAUNA

6.2.1 Fauna Habitat

The fauna habitats present in the Survey Area are:

- Banksia / eucalypt woodlands and shrublands (vegetation types *B***LOFLWL**, M**SL** and *E***TOMF**).
- Flooded Gum woodland in a seasonally wet depression (vegetation type *E***TOF**).
- Small wetlands (vegetation types *M***OSL** (2), *M***TSL** (1) and *T***LSSSL**).
- Coastal shrubland on dunes and swales (vegetation types M**LOSL** (1) and M**TSL** (2)).
- Sandplain shrublands (vegetation type M**OSL** (1)).
- Laterite rise (vegetation type M**LOSL** (2)).

All fauna habitats are in good to excellent condition, although there is weed invasion in the understorey of some habitats. The section of the Survey Area adjacent to Drovers Cave National Park is part of a relatively extensive area of continuous habitat. The eastern section of the Survey Area is within a relatively continuous strip of habitat either side of the existing road but set within a more fragmented environment.

6.2.2 Fauna Assemblages

The faunal assemblages of the Survey Area are likely to be typical of the region and relatively intact when adjacent to large tracts of native vegetation such as in Drovers Cave National Park. In the eastern portion of the Survey Area the habitats are more fragmented, and it is likely that the faunal assemblage is less species rich. However, even vegetation in narrow road verges can provide important habitat for some species or provide an ecological linkage.

The Banksia / eucalypt woodlands and shrublands are likely to support a large suite of species, including honeyeaters and other nectar-feeding species that are likely to move into the area to take advantage of this seasonal resource. When the *Banksia* and *Hakea* species are seeding, these species provide a food resource for parrots and cockatoos. The dense vegetation in coastal and sandplain shrublands provides nesting habitat and shelter for small insectivorous bird species. Seasonally wet areas with Flooded Gum potentially support hollow-nesting birds such as the Striated pardalote (*Pardalotus striatus*), Sacred kingfisher (*Todiramphus sanctus*) and Australian ringneck (*Platycercus zonarius*). Hollows and tree crevices also provide habitat for roosting bats and arboreal reptiles such as some geckoes and the Black-tailed tree monitor (*Varanus tristis*). The sandy soils associated with the Banksia shrublands and woodlands are likely to support a diverse assemblage of reptiles, many of which burrow in sand, shelter in leaf litter or utilise understorey vegetation. The wetlands and seasonally wet depressions potentially support breeding of native frogs when water is present. Burrowing frog species such as the Moaning frog (*Heleioporus eyrei*) also forage in terrestrial habitats, often occurring at considerable distances from wetlands.

6.2.3 Conservation Significant Fauna

Several species of conservation significant fauna have been identified as potentially occurring in the area through database searches and literature review (**Table 21, Appendix 2**). Of these, many are unlikely to occur as their habitat requirements are not met within the Survey Area, or they are only known from offshore islands. This includes almost all migratory birds protected under an International Agreement (such as shorebirds and seabirds), the Hooded plover (*Thiornis rubricollis*), the Australian sea-lion (*Neophoca cinerea*) and whales, sharks and turtles, that require marine habitats, which are absent from the Survey Area. Species that may once have occurred, but are now locally extinct, are the Chuditch (*Dasyurus geoffroii*), Malleefowl (*Leipoa ocellata*) and Ghost bat (*Macroderma gigas*), with nearby records of the Ghost bat in Drovers Cave National Park comprising subfossil remains. The islands in Jurien Bay support three threatened species that are not known to occur on the mainland - the Dibbler

(*Parantechinus apicalis*), Jurien Bay skink (*Liopholis pulchra longicauda*) and Lancelin Island skink (*Ctenotus lancelini*).

The remaining species are currently known to occur in terrestrial and seasonal wetland habitats in the vicinity of the Survey Area and are discussed in the following sections.

6.2.3.1 CARNABY'S COCKATOO

Carnaby's Cockatoo (*Calyptorhynchus latirostris*) is listed as Endangered under both the EBPC Act and BC Act. It is endemic to the south-west of WA, occurring mostly in the wheatbelt but also on the Swan Coastal Plain and wetter south-west (Johnstone and Storr, 1998; DPaW, 2013). The population size is estimated to be 40,000 birds and still declining (Garnett et al., 2011).

Typically, Carnaby's Cockatoo breeds in the inland wheatbelt region, nesting in large hollows in smooth-barked eucalypts such as the Salmon Gum (*Eucalyptus salmonophloia*) and Wandoo (*Eucalyptus wandoo*), though it occasionally uses other tree species (Johnstone and Storr, 1998; DPaW, 2013): during the non-breeding season (January – July), most of the population moves west and south towards the coast (DPaW, 2013).

Carnaby's Cockatoo forage on the seeds of a range of plant species, but are particularly attracted to proteaceous heaths, *Banksia* and *Eucalyptus* woodlands and pine plantations (Johnstone and Storr, 1998). On the Swan Coastal Plain, important food plants include *Banksia attenuata*, *B. menziesii*, *B. grandis*, *B. ilicifolia*, *B sessilis*, *B. prionotes*, Marri (*Corymbia calophylla*) and Jarrah (*Eucalyptus marginata*) (Shah, 2006). In breeding areas, it is important to have sufficient foraging resources close to nest hollows, typically within 12 km (Garnett et al., 2011).

Carnaby's Cockatoo generally roosts in tall native or introduced eucalypts or pines in riparian habitats or near permanent water (DSEWPaC, 2012). Shah (2006) found that of 16 Carnaby's Cockatoo roost sites identified on the Swan Coastal Plain, all but one were in *Pinus* or *Eucalyptus* species. Similarly, Burnham et al. (2010) found that 29 Carnaby's Cockatoo roost sites for which the tree species were recorded were in *Pinus* or *Eucalyptus* species.

Main threats to Carnaby's Cockatoo are habitat loss, competition for nesting hollows, habitat degradation and illegal trade in eggs and nestlings (DSEWPaC, 2012). Habitat loss is the primary cause of decline of this species. Much of its wheatbelt habitat is cleared or fragmented, and the clearing of heathland around breeding sites has reduced the foraging opportunities for birds raising young (Cale, 2003). In remnant wheatbelt woodlands there is little regeneration of eucalypts, remaining hollows are deteriorating, and Carnaby's Cockatoo may face competition for remaining hollows from other bird species and feral bees (*Apis mellifera*) (DSEWPaC, 2012; Cale, 2003).

One Carnaby's Cockatoo was seen in the Survey Area in October 2019 and a flock of 60 birds was observed in January 2020 (**Map 10, Section 11**). There are also database records near the Survey Area **(Map 6, Section 11)**. The flock of 60 Carnaby's Cockatoo were foraging, and evidence of foraging Carnaby's Cockatoo was ubiquitous in the *Banksia* woodlands and shrublands of the Survey Area (vegetation types ***B*LOFLWL** and M**SL** (indicated on **Maps 12 to 22** and descriptions for the vegetation types in **Table 11**). Key food species in the Survey Area include *Banksia sessilis*, *B. prionotes*, *B. attenuata* and *B. menziesii*, with foraging also observed on *Eucalyptus todtiana*. The locations where evidence of foraging by Carnaby's Cockatoo on *Banksia* species nuts was recorded are shown on **Maps 10** to **22** (**Section 11)** and representative photographs of foraging by Carnaby's Cockatoo are shown in **Figure 3**.

No Carnaby's Cockatoo breeding areas are known to occur within 12 km of the Survey Area (DBCA, 2018b). Flooded Gum (*Eucalyptus rudis*) may provide Carnaby's Cockatoo breeding habitat. Five trees with a DBH $\geq$ 50 cm were recorded within the PCZ **(Map 10 and 15, Section 11)**, though none appeared to contain hollows of a suitable size to currently support cockatoo breeding. Comments on and a photograph of each tree are included in **Table 25 (Appendix 6)**.

Figure 4: Carnaby's Cockatoo foraging in the Survey Area January 2020 (top) and foraging signs on *Banksia menziesii* (bottom left) and *B. attenuata* (bottom right) in the Survey Area

Figure 5: Carnaby's Cockatoo feathers in Survey Area October 2019 (left) and January 2020 (right)

Carnaby's Cockatoo are unlikely to roost in the same place year-round as they undertake seasonal movements. However, one likely roost site was identified in tall eucalypts near a farm dam and seasonally wet area (**Map 10** and **15**). The flock of 60 birds was observed in this area during the day, and feathers were recorded under trees on the road verge (**Figure 4** and **Map 10** and **15**). It is considered likely that this is a roost site as its characteristics are consistent with those from known Carnaby's Cockatoo roost sites.

6.2.3.2 PEREGRINE FALCON

The Peregrine Falcon (*Falco peregrinus*) is listed as Other Specially Protected Fauna under the BC Act. The Peregrine Falcon is a widespread bird of prey that globally has a very large range and a very large population that appears to be secure (BirdLife International, 2020). In WA, the population is secure, though this species may experience reductions at a local level due to human disturbance at nesting sites (Debus, 1998). The Peregrine Falcon nests mainly on ledges on cliffs or rocky outcrops, and it may also use tall trees (Johnstone and Storr, 1998), or take advantage of man-made structures such as abandoned open pits or quarries. There are records for this species to the west of the Survey Area (**Map 6, Section 11**), and the species is likely to forage in the Survey Area. However, it is unlikely that breeding habitat is present, and clearing in the Survey Area is unlikely to significantly impact the conservation status of this species.

6.2.3.3 FORK-TAILED SWIFT

The Fork-tailed Swift (*Apus pacificus*) is listed under both the EPBC Act and the BC Act as a migratory bird protected under an International Agreement. The Fork-tailed Swift is a non-breeding visitor to Australia between September and April, and though it can be common further north, in south-west Australia this species is generally scarce (Boehm, 1962; Johnstone and Storr, 1998). Although a migratory species, it has a large range and a large population that appears to be stable (BirdLife International, 2020). In WA, the Fork-tailed Swift is a largely aerial species and is unlikely to be affected by changes to the Survey Area.

6.2.3.4 GLOSSY IBIS

The Glossy Ibis (*Plegadis falcinellus*) is listed under both the EPBC Act and the BC Act as a migratory bird protected under an International Agreement. There is a record for this species in the eastern section of the Survey Area (**Map 6, Section 11**). It is an uncommon but increasing visitor to the Swan Coastal Plain (Johntone and Storr, 1998). Although the occasional individual or small group may occur in the adjacent wetlands, the Survey Area is unlikely to provide important habitat for this species.

6.2.3.5 WOOD SANDPIPER

The Wood Sandpiper (*Tringa glareola*) is listed under both the EPBC Act and the BC Act as a migratory bird protected under an International Agreement. This shorebird is known to use freshwater wetlands in addition to coastal habitats (Geering et al. 2007). There is a record for this species in the Survey Area (**Map 6**), however, the small wetlands adjacent to the Survey Area are only likely to support the occasional individual. For a site to be important for this species, it would need to host at least 0.1% of the flyway population, or 130 birds (Hansen et al. 2016).

6.2.3.6 WOOLYBUSH BEE

The native Woolybush Bee (*Hylaeus globuliferus*) is listed as Priority 3 by DBCA and has been recorded to the south of the Survey Area on databases (**Map 6** and **Table 21, Appendix 2**). This species is endemic to south-west WA and poorly known. It is associated with proteaceous species in genera such as *Adenanthos*, *Banksia* and *Grevillea* (Walker, 2010), and potentially occurs in the Survey Area.

6.2.3.7 WESTERN BRUSH WALLABY

The Western Brush Wallaby (*Macropus irma*) is listed as Priority 4 by DBCA. In the Action Plan for Australian Mammals 2012 it is listed as of Least Concern (Woinarski et al., 2014), as although this species has decreased in range, its abundance has increased within its remaining range, due to fox control. The Western Brush Wallaby is endemic to the south-west of WA, favouring open forest and woodland, as well as seasonally wet flats with grasses and thickets (Van Dyck and Strahan, 2008). The home-range size of this species has been estimated at about 9.9 ha for males and 5.3 ha for females (Bamford and Bamford, 1999), so the Survey Area is likely to represent a small part of the home-range of a few individuals. There are nearby database records for this species **(Map 6, Section 11)**, and the Western Brush Wallaby is likely to occur in parts of the Survey Area that are continuous with larger areas of

native vegetation, using most habitats. However, the area to be cleared is only likely to represent a small reduction of habitat for this species in the local area.

6.2.3.8 GRACEFUL SUNMOTH

The Graceful Sunmoth (*Synemon gratiosa*) is listed as Priority 4 by DBCA. The larvae of this species feeds on *Lomandra maritima* in coastal areas and *Lomandra hermaphrodita* in *Banksia* woodlands, with sunmoths more common in coastal areas (Bishop et al., 2010). The Graceful Sunmoth has been recorded in the vicinity of the Survey Area on databases, with one record in the Survey Area (**Map 6** and **Table 21**). This species is likely to occur in the *Banksia* woodlands of the Survey Area.

6.3 VEGETATION TYPES

Eleven vegetation types were mapped in the Survey Area and the area and cover of each is listed in **Table 9**. The dominant vegetation type was *Banksia* Low Open Forest to Low Open Woodland covering 44.0% of the Survey Area, and the scarcest was *Tecticornia* Low Sparse Samphire Shrubland mapped over 0.2% of the Survey Area.

The vegetation types are described in **Table 11** and mapped on **Maps 12 to 22, Section 11**. The legend and map sequence are shown on **Map 11**. Information collected at the quadrats and relevés is included in **Table 22, Appendix 3**.

Table 9: Area and cover of vegetation types mapped in the Survey Area

Vegetation type code - broad floristic formation	Mapped in the Survey Area	
	Area (ha)	Cover (%)
*B***LOFLWL**: *Banksia* Low Open Forest to Low Woodland	33.41	44.01
*E***TOF**: *Eucalyptus* Tall Open Forest	1.29	1.70
*E***TOMF**: *Eucalyptus* Tall Open Mallee Forest	0.37	0.49
M**LOSL** (1): Mixed Low Open Shrubland	0.69	0.91
M**LOSL** (2): Mixed Low Open Shrubland	0.33	0.43
M**OSL** (1): Mixed Open Shrubland	2.54	3.35
*M***OSL** (2): *Melaleuca* Open Shrubland	0.58	0.76
M**SL**: Mixed Shrubland	1.51	1.99
*M***TSL** (1): *Melaleuca* Tall Shrubland	3.05	4.02
M**TSL** (2): Mixed Tall Shrubland	9.03	11.90
*T***LSSSL**: *Tecticornia* Low Sparse Samphire Shrubland	0.13	0.17
Native vegetation	52.93	69.73
Cleared and Disturbed	22.98	30.27
TOTAL	75.91	100

To correlate with the broad floristic formation description, vegetation descriptions have been ordered using the dominant cover class as the indicator e.g. Mixed Low Open Shrubland of *Gastrolobium oxylobioides*, *Hibbertia sericosepala* and *Daviesia incrassata* subsp. *incrassata* with a Low Open Sedgeland of *Desmocladus asper* and Isolated Shrubs of *Allocasuarina humilis* and *Calothamnus quadrifidus* subsp. *quadrifidus*.

The codes used in **Table 9** and **Table 11** for the vegetation types and on vegetation type maps are based on the broad floristic formation e.g. M**SL** for mixed Shrubland, *E***TOMF** for *Eucalyptus* Tall Open Mallee Forest and *B***LOFLWL** for *Banksia* Low Open Forest to Low Woodland and the code is suffixed by a number in brackets to distinguish between multiple mixed shrublands e.g. M**LOSL** (1) and M**LOSL** (2).

Areas already cleared for roads, tracks and drains are mapped as Cleared and areas that have been cleared / disturbed adjacent to paddocks are mapped as Disturbed.

6.4 Vegetation Condition

Vegetation condition is shown on **Maps 23** to **33, Section 11.** It was rated using: the average condition assigned to the quadrats surveyed in each vegetation type; weed information; notes recorded by botanists while working in the Survey Area; and, areas that were obviously disturbed on aerial imagery. A 1.5 m buffer was added to already disturbed areas (e.g. roadside, maintenance strip, firebreaks) and these areas were rated as Good to reflect generally higher weed cover in those areas. More information on the condition of the vegetation in the Survey Area is provided in **Table 10**. The dominant vegetation condition was Very Good (43.7% of the Survey Area).

Table 10: Vegetation condition

Vegetation condition	Area (ha) / cover (%) in the Survey Area	Percentage of sites at this rating	Mapped as	Comments
Very Good	33.17 / 43.70	65	***B*LOFLWL** M**OSL** (1), ***M*OSL** (2), M**SL**	These areas are generally away from cleared areas or set back from the road and contain few to no weed species.
Good	19.73 / 25.99	35	***B*LOFLWL**, ***E*TOF**, ***E*TOMF**, M**OSL** (1), ***M*OSL** (2) M**LOSL** (1), M**LOSL** (2), **MSL**, ***M*TSL** (1), M**TSL** (2), ***T*LSSSL**	These areas are closer to existing disturbance (roadside and adjacent to fence lines and firebreaks) and have a high to moderate number and cover of weed species. Some areas with dead *Banksia* species have been mapped as Good and these areas could be affected by dieback. Minor clearing was evident in these areas but there is native species regrowth. Areas mapped as Good include those buffered by 1.5 m from existing road edge or maintenance strip edge (see above).
Degraded	2.46 / 3.24	0	Disturbed	Areas adjacent to Jurien East Road (e.g. the maintenance strip), which are mostly cleared but where native species could return if managed correctly.
Completely Degraded	20.56 / 27.07	0	Cleared	Areas of bitumen or gravel tracks / roads.

Table 11: Vegetation types mapped in the Survey Area

Code	Broad floristic formation, vegetation type and associated information		Photograph
*B***LOFLWL**	**Broad floristic formation**: *Banksia* Low Open Forest to Low Woodland **Vegetation type**: Low Open Forest to Low Woodland of *Banksia prionotes*, +/- B. *menziesii* and / or *B. attenuata* with a mixed Shrubland mainly of *Scholtzia laxiflora*, *Banksia sphaerocarpa* var. *sphaerocarpa* and *Hibbertia sericosepala* and a Sparse Sedgeland to Isolated Sedges of *Mesomelaena tetragona*.	**Associated species:** *Allocasuarina humilis*, *Austrostipa elegantissima*, **Briza maxima*, *Conostylis candicans* subsp. *calcicola*, *Desmocladus asper*, **Ehrharta calycina*, *Eremaea pauciflora* var. *lonchophylla*, *Gompholobium tomentosum*, *Hypocalymma xanthopetalum*, *Lyginia barbata*, *Trachymene pilosa*, **Ursinia anthemoides* subsp. *anthemoides.* **Sites:** JER-32, JER-33, JER-34, JER-35, JER-36, JER-38, JER-44	
	Habitat: Gentle hills, sand plains, minor dunes and minor depressions (areas indicated as palusplain and sumpland).	**Vegetation condition:** Very Good; low to moderate weed cover, proximity to road and farming activities.	
*E***TOF**	**Broad floristic formation**: *Eucalyptus* Tall Open Forest **Vegetation type**: Tall Open Forest of *Eucalyptus rudis* subsp. *rudis* with a Low Woodland of *Melaleuca rhaphiophylla* and a Tall Open Shrubland of *Melaleuca rhaphiophylla* and *Acacia cyclops.*	**Associated species:** **Bromus diandrus*, **Ehrharta calycina*, **Lolium perenne* x *rigidum*, **Rumex crispus*, **Solanum nigrum.* **Sites:** JER-31	
	Habitat: Minor depression (low point between two hills, most of it in a section indicated as palusplain).	**Vegetation condition:** Good; high weed cover.	

Code	Broad floristic formation, vegetation type and associated information		Photograph
*E*TOMF	**Broad floristic formation**: *Eucalyptus* Tall Open Mallee Forest **Vegetation type**: Tall Open Mallee Forest of *Eucalyptus todtiana* with a Tall Sparse Shrubland of *Adenanthos cygnorum* subsp. *cygnorum* and a Tussock Grassland of **Ehrharta calycina.*	**Associated species:** *Alexgeorgea subterranea*, *Banksia prionotes*, *Lomandra hastilis*, *Melaleuca leiopyxis*, *Microtis media* subsp. *media*, *Regelia ciliata*, *Reichardia tingitana*, *Stirlingia latifolia.* **Sites:** JER-28	
	Habitat: Sandplain.	**Vegetation condition:** Good; weeds.	
MLOSL (1)	**Broad floristic formation**: Mixed Low Open Shrubland **Vegetation type**: Mixed Low Open Shrubland mainly of *Melaleuca leuropoma* and *Acacia lasiocarpa* var. *lasiocarpa* with a Sparse Tussock Grassland of **Vulpia bromoides* and **Lolium perenne* x *rigidum.*	**Associated species:** *Acanthocarpus preissii*, *Austrostipa flavescens*, **Bromus diandrus*, *Conostylis candicans* subsp. *calcicola*, *Desmocladus asper*, *Lepidosperma calcicola*, *Opercularia spermacocea.* **Sites:** JER-41	
	Habitat: Crests and upper slopes of coastal dunes.	**Vegetation condition:** Good; moderate weed cover.	

Code	Broad floristic formation, vegetation type and associated information		Photograph
M**LOSL** (2)	**Broad floristic formation**: Mixed Low Open Shrubland **Vegetation type**: Mixed Low Open Shrubland of *Gastrolobium oxylobioides*, *Hibbertia sericosepala* and *Daviesia incrassata* subsp. *incrassata* with a Low Open Sedgeland of *Desmocladus asper* and Isolated Shrubs of *Allocasuarina humilis* and *Calothamnus quadrifidus* subsp. *quadrifidus*.	**Associated species:** *Acacia lasiocarpa* var. *lasiocarpa*, *Austrostipa elegantissima*, **Avena barbata*, **Briza maxima*, **B. minor*, **Bromus diandrus*, *Dampiera spicigera*, **Ehrharta calycina*, *Hakea incrassata*, *Hibbertia aurea*, *Lepidosperma leptostachyum*, **Lolium perenne* x *rigidum*, *Lyginia barbata*, *Neurachne alopecuroidea*, *Trachymene pilosa*, *Xanthosia huegelii.* **Sites:** JER-29	
	Habitat: Laterite outcrop (within an area indicated as palusplain).	**Vegetation condition:** Good; moderate weed cover and most likely previously disturbed.	
M**OSL (1)**	**Broad floristic formation**: Mixed Open Shrubland. **Vegetation type**: Mixed Open Shrubland mainly of *Eremaea beaufortioides* var. *beaufortioides*, *Calothamnus quadrifidus* subsp. *quadrifidus* and *Melaleuca leuropoma* with an Open Tussock Grassland of *Austrostipa elegantissima* and **Ehrharta calycina* and a Low Sparse Shrubland of *Acacia dilatata*.	**Associated species:** **Avena barbata*, *Allocasuarina microstachya*, *Burchardia congesta*, *Caustis dioica*, *Desmocladus lateriflorus*, *Hakea incrassata*, *Mesomelaena tetragona*, *Rytidosperma acerosum*, *Scholtzia umbellifera*, **Sonchus oleraceus*, **Ursinia anthemoides* subsp. *anthemoides.* **Sites:** JER-30	
	Habitat: Sandplains (mostly in areas indicated as palusplain and a small patch of sumpland).	**Vegetation condition:** Very Good; low to moderate weed cover.	

Code	Broad floristic formation, vegetation type and associated information		Photograph
*M***OSL** (2)	**Broad floristic formation**: *Melaleuca* Open Shrubland **Vegetation type**: Open Shrubland of *Melaleuca viminea* subsp. *viminea* with an Open Sedgeland of *Typha* sp..	**Associated species:** *Atriplex prostrata*, *Austrostipa elegantissima*, **Briza minor*, *Cassytha racemosa*, *Cyperus congestus*, *Ficinia nodosa*, *Sporobolus virginicus*, **Symphyotrichum squamatum.* **Sites:** JER-39	
	Habitat: Seasonal wetland (in areas indicated as palusplain).	**Vegetation condition:** Very Good; low to moderate weed cover.	
M**SL**	**Broad floristic formation**: Mixed Shrubland **Vegetation type**: Mixed Shrubland mainly of *Banksia sessilis* var. *cygnorum*, *Hakea trifurcata* and *Melaleuca cardiophylla* and a mixed Open Low Shrubland mainly of *Labichea cassioides*, *Hibbertia sericosepala* and *Petrophile axillaris*.	**Associated species:** **Bromus diandrus*, *Calothamnus quadrifidus* subsp. *quadrifidus*, *Conostylis candicans* subsp. *calcicola*, *Desmocladus flexuosus*, *Grevillea preissii* subsp. *glabrilimba*, **Lysimachia arvensis*, **Ursinia anthemoides* subsp. *anthemoides.* **Sites:** JER-37, JER-45	
	Habitat: Dunes with a surface layer of fine white to yellow sand and limestone boulders and surface plates.	**Vegetation condition:** Very Good; low to moderate weed cover.	

Code	Broad floristic formation, vegetation type and associated information		Photograph
*M***TSL** (1)	**Broad floristic formation**: *Melaleuca* Tall Shrubland **Vegetation type**: Tall Shrubland of *Melaleuca rhaphiophylla* with a Low Woodland of *M. preissiana* and an Open Tussock Grassland of *Chloris gayana*, *Eragrostis curvula* and *Sporobolus virginicus*.	**Associated species:** *Acacia lasiocalyx*, *Baumea juncea*, **Bromus hordeaceus*, *Cassytha racemosa*, **Cyperus congestus*, *Gahnia trifida*, *Hakea varia*, *Melaleuca incana* subsp. *incana*, *M. viminea* subsp. *viminea*, **Ornithopus sativus*, *Stylidium rigidulum*, *Typha* sp., *Viminaria juncea.* **Sites:** JER-T01, JER-T02	
	Habitat: Seasonal wetland (almost all of it mapped in areas indicated as palusplain).	**Vegetation condition:** Good; moderate weed cover.	
M**TSL** (2)	**Broad floristic formation**: Mixed Tall Shrubland **Vegetation type**: Mixed Tall Shrubland of *Acacia rostellifera*, *Melaleuca huegelii* and +/- *Spyridium globulosum* with an Open Tussock Grassland of **Lolium perenne* x *rigidum.*	**Associated species:** **Bromus diandrus*, **Sonchus oleraceus*, *Lomandra maritima*, **Ehrharta longiflora*, *Clematis linearifolia*, *Myoporum insulare.* **Sites:** JER-40, JER-42	
	Habitat: Swales between coastal dunes.	**Vegetation condition:** Good; moderate to high weed cover, rubbish and grazing.	

Code	Broad floristic formation, vegetation type and associated information		Photograph
*T*LSSSL	**Broad floristic formation**: *Tecticornia* Low Sparse Samphire Shrubland **Vegetation type**: Low Sparse Samphire Shrubland of *Tecticornia indica* subsp. *bidens*, *T. pergranulata* subsp. *pergranulata* with a Sparse Tussock Grassland of **Lolium perenne* x *rigidum* and Isolated Shrubs of *Melaleuca acutifolia.*	**Associated species:** *Centrolepis polygyna*, *Gnephosis tenuissima*, *Isolepis hookeriana*, *Pogonolepis stricta*, *Triglochin mucronata.* **Sites:** JER-43	
	Habitat: Saline plain (edge of wetland, palusplain).	**Vegetation condition:** Good; moderate to high weed cover and salinity.	

Note: * in front of a plant name indicates a weed species.

7 Conservation Significance, Impacts, Impact Limitation and Clearing Principles

7.1 Conservation Significance and Impacts

7.1.1 Flora

Banksia dallanneyi subsp. *pollosta* (P3)) and *Thysanotus* ? *vernalis* (a potential P3)) were found in the Survey Area. The known distribution of *Banksia dallanneyi* subsp. *pollosta* and *Thysanotus vernalis* is shown on **Map 34 (Section 11)**. Nine *Banksia dallanneyi* subsp. *pollosta* (P3) plants (two populations) were recorded in the Survey Area. None of them are in the PCZ and so they should not be impacted by the proposed works (**Table 8, Section 6.2**).

Thysanotus ? *vernalis* was recorded outside of the PCZ and it should not be impacted by the proposed clearing. If the *Thysanotus* ? *vernalis* were confirmed to be the P3 species *Thysanotus vernalis* its local significance would be high because it has not been recorded in the Swan Coastal Plain (SWA) previously (although it was recorded at 54 locations (100 plants) in the JER1 survey area, adjacent to and east of the current Survey Area in the Geraldton Sandplains bioregion (GES)) (**Table 8, Section 6.2**).

7.1.2 Vegetation

7.1.2.1 Pre-European vegetation mapping and native vegetation extent

The Survey Area and PCZ are in EPA Position Statement 2 Agricultural Region (EPA, 2000). The broad principles for the protection of native terrestrial vegetation and flora indicate that biodiversity should be maintained at sustainable levels. This generally means that ecological communities should be retained at an overall level of at least 30% of the original extent of the ecological community in each region. This level is the threshold level below which species loss appears to accelerate exponentially at an ecosystem level. A level of 10% of the original extent is regarded as being a level representing “endangered” (EPA, 2000).

Impact to the vegetation system associations from the clearing proposed in the PCZ will not bring the level of total clearing in the Swan Coastal Plain and Geraldton Sandplains bioregions and the Perth and Lesueur Sandplains subregions below the threshold level of 30% (**Table 12**). The greatest reduction will be about 0.01% (Columns 5 and 9, **Table 12**) and the remaining percentages will range between 35.71% and 93.84%.

This is also true re the extent of the three vegetation system associations in the Shire of Dandaragan. The remaining extent will be reduced by about 0.01% and the remaining percentages will range between 68.8% and 92.8% (not included in **Table 12**; see **Table 2** for Shire of Dandaragan pre-European and current extents).

Native vegetation extent (using DPIRD, 2015a and Maia vegetation type mapping) in the local area (the area within 10 km of the Survey Area road centreline, excluding islands and ocean) is 63.08% pre PCZ clearing and it would go down by 0.01% to 63.07% if all 5.25 ha of intact native vegetation in the PCZ were to be cleared.

Intact native vegetation (i.e. excluding areas mapped as cleared and disturbed) covers 69.7% (52.93 ha) of the Survey Area (75.91 ha). If all 5.25 ha of intact native vegetation in the PCZ were to be cleared, intact native vegetation cover in the Survey Area would decrease by 6.9% to 62.8%.

Table 12: Extent, protection and impacts for vegetation associations and system associations of the Survey Area

Column 1	2	3	4	5	6	7	8	9
	Bio or sub	Pre-European extent (ha) (GoWA, 2019)	Current extent (ha) (GoWA, 2019)	Remaining (%) (GoWA, 2019)	Current extent protected (IUCN I - IV) for cons. (% of pre-European extent) (GoWA, 2019)	Impact to VA / VSA from new clearing in PCZ (ha)	Current extent post clearing in PCZ (ha)	Remaining post clearing of NVE in PCZ (%)
Vegetation association and bioregion								
1026	SWA	58,419.39	54,819.58	93.84	51.82	0.12	54,819.46	93.84
1029	SWA	68,329.04	49,086.11	71.84	24.98	2.88	49,083.23	71.83
1030	SWA	134,788.56	86,013.90	63.81	8.38	2.18	86,011.72	63.81
1030	GES	3,848.52	2,790.59	72.51	54.24	0.07	2,790.52	72.51
Vegetation system association and subregion								
1026.1	Perth	58,393.39	54,795.80	93.84	51.82	0.12	54,795.68	93.84
1029.1	Perth	68,041.14	48,798.22	71.72	24.98	2.88	48,795.34	71.71
1030.2	Perth	114,213.39	79,560.88	69.66	9.66	2.18	79,558.70	69.66
1030.2	LS	1,556.67	555.90	35.71	4.86	0.07	555.83	35.71

Notes: Bio or sub = bioregion or subregion, cons. = conservation; SWA = Swan Coastal Plain bioregion, GES = Geraldton Sandplains bioregion, LS = Lesueur Sandplain subregion. Impact to NVE in PCZ has been calculated using the area of native vegetation that was mapped by Maia in the PCZ and not using the remaining extent in the Survey Area using DPIRD NVE layer (DPIRD, 2015a) – because most of the vegetation in the Survey Area is not covered by the NVE layer.

7.1.2.2 VEGETATION TYPES MAPPED BY MAIA

Table 13 summarises some of the information in the following section, which discusses the habitats, occurrence, and wider distribution of the 11 vegetation types mapped by Maia (MVTs).

*B***LOFLWL** is mapped on a number of different habitats (gentle hills, sand plains, minor depressions, and minor sand dunes). No conservation significant flora were recorded in it. Maia (2017) mapped *B***LOFLWL** as *B***F** over 5.33% of the eastern section of Jurien East Road (JER1). Griffin (1994) carried out a survey of the northern sandplains between Perth and Geraldton and *B***LOFLWL** is similar to Griffin Floristic Group (GFG) 20-11, which was recorded on plains and pediment slopes with grey over yellow sand and occasionally lateritic gravels. Griffin's sites from this group were distributed between Eneabba and Chittering.

*E***TOF** is mapped on a minor depression between two hills. No CSF species were recorded in it. *E***TOF** was mapped as *E***F**-1 over 0.86% of JER1 (Maia, 2017). It is similar to Griffin's GFG 20-7, which was described as having a highly variable suite of species, occuring on depressions and valley flats with brown sand (or loamy sand), presumably over clay, and was widespread from Three Springs to Jurien and Chittering and Ellenbrook.

*E***TOMF** is mapped on sandplains. No CSF species were recorded in it. *E***TOMF** was mapped as *EB***WL** over 12.41% of JER1 (Maia, 2017). It is similar to Griffin's GFG 20-12 which was recorded on plains, flats and depressions on moderate to well drained grey to yellow sands. GFG 20-12 was relatively widespread, as sites from this group were distributed between Jurien Bay and Ellenbrook (Griffin, 1994).

M**LOSL** (1) is mapped on the crests and upperslopes of coastal dunes. No CSF species were recorded in it. It is similar to GFG 20-15, which was recorded on well drained dunes and plains on calcareous grey sand some over

limestone. GFG 20-15 was relatively widespread along the coast as sites from this group were distributed between Cliff Head and Swanbourne (Griffin, 1994).

M**LOSL** (2) is mapped on laterite outcrops of the Survey Area. No CSF species were recorded in it. It is similar to M**SL**-1 mapped over 21.76% of the eastern section of JER1; however, it lacks the mixed mid stratum of *Banksia attenuata*, *Adenanthos cygnorum* and *Eremaea* ? *pauciflora* x *beaufortioides* described in JER1's M**SL**-1. It is similar to GFG 20-11, which was recorded on plains and pediment slopes with grey over yellow sand and occasionally lateritic gravels. GFG 20-11 was relatively widespread as the sites from the group were distributed between Eneabba and Chittering (Griffin, 1994).

M**OSL** (1) is mapped on sandplains of the Survey Area. No CSF species were recorded in it. It is most similar to M**SL**-2 mapped over 21.16% of JER1. M**OSL** (1) is similar to Griffin's GFG 20-12, which was recorded on plains, flats and depressions on moderate to well drained grey to yellow sands. GFG 20-12 was relatively widespread as sites were distributed between Jurien Bay and Ellenbrook (Griffin, 1994).

*M***OSL** (2) is mapped on seasonal wetlands. No CSF species were recorded in it. It is similar to GFG 20-7, which was described as having a highly variable suite of species and was recorded on depressions and valley flats with brown sand (or loamy sand), presumably over clay, and was widespread from Three Springs to Jurien and Chittering and Ellenbrook (Griffin, 1994).

M**SL** is mapped on upper and mid slopes of dunes with a surface layer of white to yellow sand over limestone. *Banksia dallanneyi* subsp. *pollosta* (P3) and *Thysanotus* ? *vernalis* (? P3) were located in it. M**SL** is similar to Griffin's GFG 20-10, which was recorded on rises and hollows with grey and yellow sand over Tamala limestone; sites from GFG 20-10 were distributed between Cliff Head and Nambung (Griffin, 1994).

*M***TSL** (1) is mapped on seasonal wetlands, and no CSF species were recorded in it. It is similar to Griffin's GFG 20-7, which was described as having a highly variable suite of species and occurring on depressions and valley flats with brown sand (or loamy sand), presumably over clay, and was widespread from Three Springs to Jurien and Chittering and Ellenbrook (Griffin, 1994).

M**TSL** (2) is mapped on swales between coastal dunes. No CSF species were recorded in it. It is similar to Griffin's GFG 20-17, which was recorded on plains and dunes with well drained calcareous grey sand / limestone, and sites from this group were relatively widely distributed between Geraldton and Trigg (Griffin, 1994).

*T***LSSSL** is mapped on a saline area at the edge of a seasonal wetland and no CSF species were recorded in it. It is similar to Griffin's GFG 20-8, which was recorded on bentonitic playa lakes and depressions with some saline grey clay or sand over clay; sites from this group were distributed between Watheroo, Leeman and west of Moora (Griffin, 1994).

The average vegetation condition for three of the Survey Area vegetation types (*B***LOFLWL,** *M***OSL** (2) and M**SL**) was Very Good, and the average for the remaining eight vegetation types was Good (*E***TOF***, E***TOMF, MLOSL** (1) and **MLOSL** (2), **MOSL** (1), *M***TSL** (1), **MTSL** (2) and *T***LSSSL**).

Table 13: Summary information for vegetation types mapped in the Survey Area

Vegetation type	Cover in Survey Area		Conservation significant flora in vegetation type	Average vegetation type condition (at quadrats)	Visible and/or has been mapped outside the Survey Area?
	ha	%			
***B*LOFLWL**	33.41	44.01	None	Very Good	Yes
***E*TOF**	1.29	1.70	None	Good	Yes
***E*TOMF**	0.37	0.49	None	Good	Yes
M**LOSL** (1)	0.69	0.91	None	Good	Yes
M**LOSL** (2)	0.33	0.43	None	Good	Yes
M**OSL** (1)	2.54	3.35	None	Good	Yes
***M*OSL** (2)	0.58	0.76	None	Very Good	Yes
M**SL**	1.51	1.99	Bdp, T?v	Very Good	Yes
***M*TSL** (1)	3.05	4.02	None	Good	Yes
M**TSL** (2)	9.03	11.90	None	Good	Yes
***T*LSSSL**	0.13	0.17	None	Good	Yes
Disturbed (degraded to completely degraded)	22.98	30.27	None	-	-
Total	75.91	100			

Notes: VT = vegetation type; in Column 4 Bdp = *Banksia dallanneyi* subsp. *pollosta* (Priority 3); T?v = *Thysanotus* ? *vernalis* (? P3).

7.1.2.3 VEGETATION TYPES AND THREATENED AND PRIORITY ECOLOGICAL COMMUNITIES

Two of the vegetation types of the Survey Area (***B*LOFLWL** and ***E*TOMF**) are similar to vegetation communities of the nationally protected, EPBC listed and Endangered TEC - Banksia Woodlands of the Swan Coastal Plain ecological community.

Key diagnostic characteristics, condition thresholds and minimum patch sizes for this TEC are included in the approved conservation advice for the community (DotEE, 2016). Patches need to meet the key diagnostic characteristics, condition thresholds and minimum patch sizes to be the TEC. The two vegetation types were therefore assessed against the key diagnostic characteristics and condition thresholds.

Step 1: Key diagnostic characteristics

The first key diagnostic characteristic is that the ecological community is located in the Swan Coastal Plain IBRA bioregion or as pockets of the Darling and Whicher escarpments in the Jarrah Forest IBRA bioregion. Most of the Survey Area is in the Swan Coastal Plain bioregion, and the vegetation in that section of the Survey Area meet that key diagnostic characteristic. The eastern approximately 185 m of the Survey Area is in the Geraldton Sandplains bioregion and the vegetation in that section of the Survey Area does not meet that key diagnostic characteristic. As ***E*TOMF** is mapped only in the Geraldton Sandplains section of the Survey Area those small patches do not meet that characteristic. Some of the ***B*LOFLWL** is also mapped in the Geraldton Sandplains and therefore that section does not meet that diagnostic.

The soils and landform diagnostic is met by most of the Survey Area because it is on sandplain landforms of the Bassendean and Spearwood sands (the western-most 1,000 m is on landforms of the Quindalup sands and the eastern-most approximately 60 m is in the Yerramullah System). ***B*LOFLWL** and ***E*TOMF** are mapped on the Spearwood and Bassendean sands of the Survey Area and also in the Yerramullah System; they are not mapped in the section of the Survey Area on the Quindalup sands.

The Structure diagnostic is met by vegetation types ***B*LOFLWL** and ***E*TOMF** as they are a low open forest to low woodland and tall open mallee forest, respectively (however, they have lower species richness when compared with

species richness in Appendix C of DotEE, 2016). *B***LOFLWL** canopy composition is dominated by three of the diagnostic *Banksia* species for the TEC – *Banksia attenuata*, *B*. *menziesii* and *B*. *prionotes* - and it therefore meets that key diagnostic characteristic. *E***TOMF** has an emergent layer of *Eucalyptus todtiana* with *Banksia prionotes* in the lower stratum, and it also meets the composition diagnostic.

Based on the key diagnostic characteristics, the Banksia woodlands of the Swan Coastal Plain ecological community is therefore present in the Swan Coastal Plain section of the Survey Area.

Step 2: Condition thresholds

Excluding the Geraldton Sandplains section of the Survey Area (and *E***TOMF**, which only occurs in that section) - all intact polygons of *B***LOFLWL** meet the minimum Good Condition category as they were rated as either Good or Very Good.

Step 3: Minimum patch size

Patches of Good condition vegetation need to be a minimum of 2 ha in size and patches of Very Good need to be a minimum of 1 ha in size. Some of the patches of *B***LOFLWL** mapped in the Swan Coastal Plain section of the Survey Area meet the minimum patch size for the relevant conditions**.**

Step 4: Further information to assist in determining the presence of the ecological community and significant impacts

Patches of *B***LOFLWL** were discriminated by using gaps of more than 30 m between areas where the vegetation type was mapped (*E***TOMF** and *B***LOFLWL** in the Geraldton Sandplains section were excluded from the patch size analysis). The Swan Coastal Plain section of the Survey Area was subdivided into patches of *Banksia* woodland separated by different vegetation types not representative of the Banksia woodland vegetation. The gaps between patches ranged between 36 m and 495 m. The area of *Banksia* woodland in each discrete patch was then calculated. The patches could not easily be separated into distinct Good and Very Good sections and assessed by condition because most Very Good condition polygons had a strip of Good vegetation along its boundary with the road (on both sides of the road), because weed density is higher along the road edge than further from the road. The patch analysis within the Survey Area (by SLK and from east to west) is presented in **Table28, Appendix 9**. There are four patches of *Banksia* woodland in the Survey Area that meet the minimum patch size criteria for the ecological community. **Table 29, Appendix 9** presents the direct impacts estimated from the clearing proposed for the PCZ.

Impact to the Banksia woodlands ecological community from clearing in the PCZ is estimated to be 10.56% (3.29 ha of 31.15 ha) of the total area of patches in the Survey Area (**Table 29, Appendix 9**). However, 3.29 ha includes areas that are in Good condition but do not meet the minimum patch size because they are (mostly) around the boundary of Very Good condition patches and cannot easily be excluded from the calculations. As clearing will be a long thin strip of vegetation parallel to the road, most of the vegetation to be impacted will be the Good condition vegetation in the patches that do not meet the minimum patch size. The 10.56% impact comprises: 3.69% of Very Good condition patches, 6.61% of Good condition patches and 0.26% of Disturbed vegetation. When impacts are calculated by condition and clearing in the PCZ, 34.95% of Very Good condition patches occurring in the PCZ will be cleared, 62.61% of Good condition patches, and 2.43% of Disturbed vegetation i.e. most clearing will be of Good condition patches that do not meet the 2 ha minimum patch size requirements (**Table 28, Appendix 9**).

The Banksia Woodlands of the Swan Coastal Plain ecological community is listed as a Priority 3(iii) PEC for the Midwest in WA (Banksia Dominated Woodlands of the Swan Coastal Plain IBRA region; DBCA, 2020a).

The Banksia woodlands vegetation in the Survey Area is similar to the description for FCT 23b – Northern *Banksia attenuata-Banksia menziesii* woodlands in DotEE, 2016.

7.1.2.4 GEOMORPHIC WETLAND VEGETATION

None of the geomorphic wetlands mapped in the Survey Area is classified as a conservation category wetland. One palusplain wetland is classified as a multiple use management category (Cervantes Coastal 0135). Wetlands classified as multiple use have few remaining important attributes and functions (DBCA, 2020b).

7.1.2.5 CLEARING OF PCZ VEGETATION TYPES AND VEGETATION CONDITION

If all of the vegetation in the PCZ were to be cleared, then approximately 9.92% of the intact vegetation (excluding areas mapped as disturbed) mapped in the Survey Area would be impacted (**Table 14**). Clearing of the different vegetation types ranges from 0% (Mixed Low Open Shrubland (1)) to 6.91% (*Banksia* Low Open Forest to Low Woodland) of the intact native vegetation in the Survey Area. However, these percentages do not allow for any mitigation measures that the Shire has chosen to carry out (see **Table 16** for actual impacts).

Table 14: Clearing of vegetation types for the PCZ

Vegetation type code: broad floristic formation	Survey Area		PCZ 22 m wide		PCZ 20 m wide		Clearing for 20 m PCZ
	Area (ha)	Cover (%)	Area (ha)	Cover (%)	Area (ha)	Cover (%)	% of all intact NV in Survey Area
*B***LOFLWL**: *Banksia* Low Open Forest to Low Woodland	33.41	44.01	5.16	21.06	3.66	16.42	6.91
*E***TOF**: *Eucalyptus* Tall Open Forest	1.29	1.7	0.24	0.98	0.19	0.85	0.36
*E***TOMF**: *Eucalyptus* Tall Open Mallee Forest	0.37	0.49	0.07	0.28	0.05	0.22	0.09
M**LOSL** (1): Mixed Low Open Shrubland	0.69	0.91	0	0	0	0	0
M**LOSL** (2): Mixed Low Open Shrubland	0.33	0.43	0.05	0.19	0.03	0.13	0.06
M**OSL** (1): Mixed Open Shrubland	2.54	3.35	0.51	2.10	0.41	1.84	0.77
*M***OSL** (2): *Melaleuca* Open Shrubland	0.58	0.76	0.07	0.30	0.05	0.22	0.09
M**SL**: Mixed Shrubland	1.51	1.99	0.08	0.31	0.05	0.22	0.09
*M***TSL** (1): *Melaleuca* Tall Shrubland	3.05	4.02	0.68	2.76	0.53	2.38	1.00
M**TSL** (2): Mixed Tall Shrubland	9.03	11.9	0.40	1.65	0.27	1.21	0.51
*T***LSSSL**: *Tecticornia* Low Sparse Samphire Shrubland	0.13	0.17	0.01	0.06	0.01	0.04	0.02
Native vegetation	52.93	69.73	7.28	29.68	5.25	23.55	9.92
Cleared and disturbed	22.98	30.27	17.24	70.32	17.04	76.45	-
TOTAL	75.91	100	24.52	100	22.29	100	-

PCZ = proposed clearing zone, NV = native vegetation. 22 m wide PCZ included for comparison with 20 m wide PCZ.

The condition of the intact native vegetation mapped in the PCZ is predominantly Good (70.50%) and the remainder (29.50%) Very Good (**Table 15**). The vegetation rated as Good condition includes the 1.5 m buffer put in place to capture the higher density of weeds close to the boundary of the maintenance strip and areas cleared for drains and tracks. In some areas weed density was high more than 1.5 m from these edges e.g. in the *Eucalyptus* Tall Open Forest vegetation type, ***E*TOF**.

MLOSL (1) does not occur in the PCZ and six of the 10 remaining vegetation types in the PCZ were rated as in Good condition only; none was rated as Very Good only. Four of the PCZ vegetation types were rated as Good and Very Good (**Table 15**). Most of the ***B*LOFLWL** mapped in the PCZ is classed as Good (44.95%) and 24.78% as Very Good, while ***E*TOMF** is only mapped as Good in the PCZ (0.95% of the PCZ).

Table 15: PCZ vegetation condition

Vegetation type code: broad floristic formation	Area and cover in the PCZ overall		Condition (area and % of PCZ native vegetation)			
			Very Good		Good	
	Area (ha)	Cover (%)	Area (ha)	Cover (%)	Area (ha)	Cover (%)
***B*LOFLWL**: *Banksia* Low Open Forest to Low Woodland	3.66	16.42	1.30	24.78	2.36	44.95
***E*TOF**: *Eucalyptus* Tall Open Forest	0.19	0.85	0	0	0.19	3.54
***E*TOMF**: *Eucalyptus* Tall Open Mallee Forest	0.05	0.22	0	0	0.05	0.95
M**LOSL** (1): Mixed Low Open Shrubland	0	0	0	0	0	0
M**LOSL** (2): Mixed Low Open Shrubland	0.03	0.13	0	0	0.03	0.58
M**OSL** (1): Mixed Open Shrubland	0.41	1.84	0.20	3.80	0.21	4.04
*M***OSL** (2): *Melaleuca* Open Shrubland	0.05	0.22	0.03	0.57	0.02	0.43
M**SL**: Mixed Shrubland	0.05	0.22	0.02	0.35	0.03	0.65
*M***TSL** (1): *Melaleuca* Tall Shrubland	0.53	2.38	0	0	0.53	10.07
M**TSL** (2): Mixed Tall Shrubland	0.27	1.21	0	0	0.27	5.14
*T***LSSSL**: *Tecticornia* Low Sparse Samphire Shrubland	0.01	0.04	0	0	0.01	0.15
Native vegetation	5.25	23.55	1.55	29.50	3.70	70.50
Cleared and disturbed	17.04	76.45	0			
TOTAL	22.29	100	N/A			

PCZ = proposed clearing zone.

7.1.3 Fauna

Carnaby's Cockatoo was recorded in the Survey Area, evidence of foraging on *Banksia* species was recorded in the *Banksia* woodlands and shrublands and a likely roost site was identified in Flooded Gum (***E*TOF**) and tall eucalypts near a farm dam and seasonally wet area (both outside of and adjacent to the Survey Area and inside it). *Banksia* / eucalypt woodlands and shrublands (***B*LOFLWL**, **MSL** and ***E*TOMF**) are high value / quality foraging habitat containing important food plants. Carnaby's Cockatoo are not known to breed within 12 km of the Survey Area, and although five potential breeding habitat trees were recorded in the PCZ, none currently contained hollows of sufficient size to support breeding Carnaby's Cockatoo. Thus, the foraging habitat is unlikely to be supporting breeding birds (based on current available data) but it is likely to be important for birds in the non-breeding season as they move towards the coast to forage.

Foraging and potential breeding habitat and likely roost trees could be impacted by the proposed road works.

Carnaby's Cockatoo foraging habitat covers 3.76 ha of the PCZ and 35.29 ha of the Survey Area, i.e. 10.65% of the Survey Area foraging habitat is in the PCZ. Five *Eucalyptus rudis* trees providing potential Carnaby's Cockatoo breeding habitat occur in the PCZ (no hollows were observed in the trees): these trees will not be removed. Carnaby's Cockatoo likely roosting habitat covers 0.19 ha of the PCZ. The Shire will not remove these trees, and they will not need to prune any branches from them; some juvenile trees and small shrubs in the shrub layer will need to be pruned.

Other conservation significant species that potentially occur in the Survey Area are the Peregrine Falcon (Other Specially Protected Fauna), Fork-tailed Swift (Migratory), Glossy Ibis (Migratory), Wood Sandpiper (Migratory), a native bee - Woolybush Bee – (P3), and the Western Brush Wallaby (P4).

7.2 Impact Limitation

7.2.1 Avoidance

Jurien East Road forms part of the Wheatbelt Secondary Freight Network and it has been identified as a Priority 1 secondary freight road for the Wheatbelt Region. The eastern section of Jurien East Road (Brand Highway to Cockleshell Gully Road) is in the process of being upgraded and the Shire needs to continue the upgrade program with the section of its road reserve between Cockleshell Gully Road and Indian Ocean Drive. The Shire will not be able to avoid clearing some native vegetation when carrying out the planned road works.

The Shire originally requested impacts to be calculated for a 22 m wide works corridor (i.e. PCZ); however, following the surveys and the assessment of the significance of the flora, vegetation and fauna habitats and the calculation of the impacts associated with the 22 m wide PCZ, the Shire decided to reduce its width by 2 m to 20 m.

7.2.2 Minimisation

1. Narrowing the PCZ width from 22 m to 20 m reduced the native vegetation in the PCZ by 2.03 ha (from 7.28 ha to 5.25 ha) (**Table 14**).
2. Not clearing the section of the road corridor where the densest patch of *Melaleuca* Tall Shrubland vegetation occurs (in a wetland area between SLK 24.8 and SLK 25.4) further reduced total proposed clearing by 0.48 ha to 4.77 ha.
3. Not removing the five *Eucalyptus rudis* trees with a DBH ≥ 50 cm in the 20 m wide PCZ (potential Carnaby's Cockatoo breeding habitat) has reduced impact to these trees to zero. In addition to this, the Shire has checked the five trees and no branches will need to be pruned for the proposed works. Only branches from some small trees and shrubs in the shrub layer will need to be pruned. As a result, the 0.19 ha of *E***TOF** should also not be impacted. This has reduced total clearing of intact native vegetation in the PCZ to 4.58 ha.
4. Therefore, the Shire has reduced overall clearing proposed by 2.70 ha (from 7.28 ha to 4.58 ha), which is a reduction of 37.09%.
5. Reducing the PCZ width and not clearing in one of the wetland sections has reduced impact to Carnaby's Cockatoo foraging habitat (*B***LOFLWL,** *E***TOMF** and **MSL**) from an original 5.31 ha to 3.58 ha (a reduction of 32.53%).
6. Reducing the PCZ width and not removing any trees or pruning branches from the higher canopy of trees in *E***TOF** has reduced impact to Carnaby's Cockatoo potential breeding and roosting habitat from an original 0.24 ha to zero.
7. Reducing the PCZ width has reduced impact to the two Banksia woodland / forest vegetation types (*B***LOFLWL** and *E***TOMF**) by 1.53 ha (from an initial 5.23 ha to 3.71 ha). Not clearing in one of the wetland areas has reduced clearing of *B***LOFLWL** by another 0.18 ha to 3.53 ha. Therefore, clearing of these two vegetation types has been reduced by 32.51%.

Impacts for the vegetation overall, the TEC and for significant vegetation for Carnaby's Cockatoo - post impact minimisation measures - are listed in **Table 16**.

Table 16: Impacts to intact native vegetation, Banksia Woodlands TEC, and significant Carnaby's Cockatoo vegetation of the Survey Area, excluding wetlands area not going to be cleared

Attribute	Survey Area	To be cleared in 20 m PCZ	Impact (% of Survey Area extent)
	Area (ha) or Number		
All intact native vegetation (PCZ area does not include 0.48 ha of wetland vegetation and 0.19 ha of *E***TOF**)	52.93	4.58	8.65
Banksia woodlands vegetation (*B***LOFLWL** + *E***TOMF**) (PCZ area does not include section of wetland vegetation not going to be cleared)	33.78	3.53	10.45
Swan Coastal Plain component	33.16	3.46	
Geraldton Sandplains component	0.62	0.07	
Carnaby's Cockatoo foraging habitat (*B***LOFLWL, *E***TOMF**, M**SL**)	35.29	3.58	10.14
Carnaby's Cockatoo potential breeding habitat (trees) (*E***TOF**)	-*	0*	0
Carnaby's Cockatoo likely roosting habitat (*E***TOF**)	1.29	0**	0**

Notes: * Seven *Eucalyptus rudis* trees with a DBH > 50 cm in the 22 m wide PCZ were measured; trees with a DBH > 50 cm outside of a 22 m wide corridor were not measured. Five of the seven trees are within the 20 m wide PCZ, but they will not be removed. **only branches on juvenile trees and shrubs in the shrub layer to be pruned.

7.2.3 Mitigation

The Shire plans to mitigate impacts associated with the proposed vegetation clearing by ensuring that:

- Clearing boundaries are clearly marked before any work is carried out.
- Water drains adequately along the road and does not pond.
- Good weed management practices are used (especially when trucking excess rubble/soil away from site and when trucking gravel to site (to minimize the potential for the spread of weeds to and from what is already a weedy area)).
- Good dieback management practices are used to minimize the potential for the spread of dieback to, within and from the road corridor. Vehicles will be cleaned before clearing is carried out along the road and the main road works will be scheduled for low rainfall months and they will not be carried out in wet or muddy conditions.

7.3 Clearing Principles

Under the *Environmental Protection Act 1986* (EP Act), clearing of native vegetation requires a permit unless its purpose is exempt. Any vegetation clearing requiring a NVCP needs to address 10 clearing principles as part of the permitting process. The 10 clearing principles are addressed with respect to the Survey Area in **Table 17**.

Table 17: Clearing principles and the Survey Area

	Clearing principle	Jurien East Road (JER2; Cockleshell Gully Road to Indian Ocean Drive)
		Unlikely to be at variance to this principle
(a)	**Native vegetation should not be cleared if it comprises a high level of biological diversity.**	The Survey Area is in an area of low to moderate plants species richness (DBCA, 2007-; Hopper and Gioia, 2004). Native species richness (excluding weed species) at the 10 m x 10 m quadrats and the relevés ranged from 3 to 35 with a mean of 19.4 (± 9.2); including weed species it becomes 24.5 (± 9.2). Maia (2017) carried out a reconnaissance survey along the eastern section of Jurien East Road (Brand Highway to Cockleshell Gully Road; JER1) in 2016 and species richness at the 27, 10 m x 10 m, relevés assessed ranged from 11 to 49. In the same week as the JER2 survey, Maia carried out a reconnaissance survey at a gravel pit off Cockleshell Gully Road to the north of Jurien East Road, and native species richness at three, 10 m x 10 m, quadrats assessed was 38, 39 and 40 (average of 39 (± 1.0)). Survey Area species richness is lower than at these other local survey areas. Vegetation along the road edges is disturbed by weed species. In many areas the weeds have also invaded the native vegetation some distance from the road edge.
		At variance to this principle
(b)	**Native vegetation should not be cleared if it comprises the whole or part of, or is necessary for the maintenance of, a significant habitat for fauna indigenous to Western Australia.**	Most of the threatened fauna species listed for the database search area (road alignment buffered by 10 km) are considered unlikely to occur based on lack of suitable marine or coastal habitats. The only threatened species likely to occur is *Calyptorhynchus latirostris* (Carnaby's Cockatoo). A flock of 60 Carnaby's Cockatoo was observed in the Survey Area. Evidence of Carnaby's Cockatoo foraging on *Banksia* species was noted in the *Banksia* woodlands and shrublands of the Survey Area, and a likely roost site was identified in Flooded Gum (*Eucalyptus rudis*) and tall eucalypts near a farm dam and seasonally wet area. No confirmed breeding area for Carnaby's Cockatoo intersects the Survey Area (DBCA, 2018b). Ten migratory fauna (protected under International Agreement) have been located in the wider area previously and they are largely associated with marine and / or coastal environments, which do not occur in the Survey Area. *Plegadis falcinellus* (Glossy Ibis) and *Tringa glareola* (Wood Sandpiper), have been recorded in the Survey Area previously, however, the habitats of the Survey Area are not likely to support significant numbers of these species. One Specially Protected Fauna species has been recorded previously in the local area, *Falco peregrinus* (Peregrine falcon) (DBCA, 2007-). The habitats of the Survey Area are unlikely to be important for this species. Four priority fauna species have been recorded previously in the local area – *Hylaeus globuliferus* (Woolybush Bee – P3), *Notamacropus irma* (Western Brush Wallaby - P4), *Synemon gratiosa* (Graceful Sunmoth – P4) and *Thiornis rubricollis* (Hooded Plover – P4) (DBCA, 2007-). Hooded Plovers are only likely to occur on the coast in this region, while the three others could potentially occur. Evidence of foraging Carnaby's Cockatoo was noted in the Banksia / eucalypt woodlands and shrublands (vegetation types *B*LOFLWL, MSL, *E*TOMF). This habitat is likely to be of high value as foraging habitat. Although no current breeding population appears to be present, the Flooded Gum woodland (*E*TOF) is a vegetation type that potentially supports breeding by Carnaby's Cockatoo. The Flooded Gum woodland is also likely to be part of a roost site for Carnaby's Cockatoo.

	Clearing principle	Jurien East Road (JER2; Cockleshell Gully Road to Indian Ocean Drive)
		Clearing of more than 1 ha of high value foraging habitat and / or any part of a vegetation community known to contain breeding habitat and / or a known night roosting site is considered to be a high risk of significant impact to Carnaby's Cockatoo (DSEWPaC, 2012). In total, approximately 3.58 ha of the three high value foraging habitat vegetation types (*B***LOFLWL**, **MSL**, *E***TOMF**) will be cleared within the PCZ (**Table 16**). While five *Eucalyptus rudis* trees with a DBH ≥ 50 cm occur within the 20 m wide PCZ where 0.19 ha of *E***TOF** is mapped, the Shire will not remove the trees and there will also be no need to prune any of the taller branches. The Shire will only prune trees and shrubs in the shrub layer. Based on this information, the clearing will impact on significant habitat for Carnaby's Cockatoo, a fauna species indigenous to Western Australia.
(c)	**Native vegetation should not be cleared if it includes, or is necessary for the continued existence of, rare flora.**	**Not at variance to this principle** No threatened flora species were located in the Survey Area. One confirmed and one potential priority flora species were located - *Banksia dallanneyi* subsp. *pollosta* (P3) and *Thysanotus* ? *vernalis* (? P3) – both taxa were located in the Survey Area, but outside of the PCZ, and they will not be impacted by the proposed works.
(d)	**Native vegetation should not be cleared if it comprises the whole or a part of, or is necessary for the maintenance of a TEC.**	**At variance to this principle** Some of vegetation types *B***LOFLWL** and *E***TOMF** meet key diagnostic criteria for the EPBC listed Banksia Woodlands of the Swan Coastal Plain ecological community TEC (Endangered). The key diagnostic characteristics and condition thresholds for this TEC are included in the guidance notes for the community. Vegetation types *B***LOFLWL** and *E***TOMF** are dominated by three *Banksia* species diagnostic for the TEC - *Banksia attenuata*, *B. menziesii* and *B. prionotes* – they also meet other key diagnostics. These two vegetation types combined cover approximately 33.78 ha of the Survey Area and 3.71 ha of the PCZ. Excluding *B***LOFLWL** in the wetland area that will not be cleared, 3.53 ha of *B***LOFLWL** (3.48 ha) and *E***TOMF** (0.05) will be cleared in the PCZ. Following patch analysis (using the size and condition criteria in the conservation advice for the TEC (DotEE, 2016)), 31.15 ha of the Survey Area Banksia woodlands vegetation type meets the patch size requirement and 3.29 ha of the PCZ. However, these total areas include Good condition patches that do not meet the minimum patch size but that cannot be removed from the analysis because they mostly surround the boundary of Very Good patches. They are assessed as Good condition because of the density of weeds along road edges and drainage areas. Including Good condition areas mentioned above and some Disturbed areas that occur amongst the patches, 10.56% (3.29 ha) of the Banksia Woodlands of the Swan Coastal Plain ecological community will be impacted by the clearing proposed in the road reserve.
(e)	**Native vegetation should not be cleared if it is significant as a remnant of native vegetation in an area that has been extensively cleared.**	**Unlikely to be at variance to this principle** Currently, 38.62% of the vegetation of the Swan Coastal Plain remains and 44.78% of the Geraldton Sandplains (GoWA, 2019). Between 68.90% and 93.84% of VSAs 1026.1, 1029.1 and 1030.2 remains in the Swan Coastal Plain, the Perth subregion and the Shire of Dandaragan, while 35.71% of VSA 1030.2 remains in the Geraldton Sandplains and Lesueur Sandplain.

	Clearing principle	Jurien East Road (JER2; Cockleshell Gully Road to Indian Ocean Drive)
		Impact to the VSAs of the bioregion, subregion and Shire from the proposed clearing in the PCZ is about 0.01%. This small reduction in area will not lead to remaining extents falling below the threshold level of 30% (EPA, 2000). NVE in the local area (within 10 km of the Survey Area road centreline) is currently 63.08% and this will decrease by 0.01% to 63.07% post clearing. The Survey Area currently comprises 69.73% (52.93 ha) intact native vegetation. Clearing of 4.58 ha in the PCZ will reduce intact native vegetation by 6.03% to 63.70% of the Survey Area. The local area and Survey Area have been cleared but not extensively so. While clearing in the Swan Coastal Plain and Geraldton Sandplains bioregion has resulted in 39% and 45% of the pre-European vegetation remaining, the Survey Area sits in an area that has mostly not been extensively cleared. Vegetation to the north and south of the western-most 8 km is largely intact (especially to the north) and mostly bounded by reserves to the north and south. Vegetation to the north and south of the eastern 3.3 km has been largely cleared for farming. The Shire has decided not to widen the road for 0.6 km in this eastern section to minimise clearing in that area. In a local and Survey Area context, the vegetation in the PCZ is not part of a significant remnant. The vegetation of the Survey Area is a long and narrow corridor and the clearing proposed will not fragment it more than it already is.
(f)	**Native vegetation should not be cleared if it is growing in, or in association with, an environment associated with a watercourse or wetland.**	**Likely to be at variance to this principle** No Ramsar sites or Directory of Important Wetlands in Australia wetlands occur in the PCZ. Geomorphic Wetlands (Cervantes Coastal and Cervantes Eneabba) intersect the PCZ in four places. None of these wetlands is a conservation category wetland - one of them is a listed in the multiple use wetland management category. The vegetation in this area will not be cleared, just pruned. The Shire will not widen the road for 0.6 km between approximately SLK 24.8 and 25.4, where the densest section of *Melaleuca* tall shrubland vegetation occurs in one of the wetland areas (Pers. Comm., Brad Pepper). No water courses occur in the Survey Area.
(g)	**Native vegetation should not be cleared if the clearing of the vegetation is likely to cause appreciable land degradation.**	**Unlikely to be at variance to this principle** Four soil landscape units are mapped in the PCZ – 211Qu, 211Sp, 212Bs and 224Ye – in the Quindalup, Spearwood, Bassendean and Yerramulla systems. Most of the PCZ is mapped as low risk for flooding (DPIRD, 2015b), land instability (DPIRD, 2016a), salinity (DPIRD, 2016b) and water erosion (DPIRD, 2015d) with small patches mapped as having moderate flood, land instability and water erosion risk. Chainage 27.3 km to 35.4 km is rated as having low waterlogging risk (DPIRD, 2015c) and chainage 23.8 km to 27.3 km is rated as mostly high risk. From chainage 23.8 km to 34.4 km the soil is mapped mostly as having a high risk of wind erosion (DPIRD, 2015e) i.e. much of the PCZ has soils mapped as at high risk of wind erosion if left exposed, particularly if subject to strong winds. In the short term the proposed clearing could cause land degradation in the form of soil erosion; however, the road edges will be compacted and covered with gravel and the soil should not be exposed for long.

	Clearing principle	Jurien East Road (JER2; Cockleshell Gully Road to Indian Ocean Drive)
(h)	**Native vegetation should not be cleared if the clearing of vegetation is likely to have an impact on the environmental values of any adjacent or nearby conservation area.**	**Unlikely to be at variance to this principle** The PCZ is not located in DBCA Legislated Lands and Waters. For 1.8 km from approximately SLK 28.8 km to SLK 30.6, Conservation Park R48717 is adjacent to and south of the road reserve boundary, while Drovers Cave National Park is adjacent to and north of the road reserve boundary for 2.22 km from approximately SLK 30.3 km to 32.5 km. The proposed works should not affect the environmental values of any of these conservation areas.
(i)	**Native vegetation should not be cleared if the clearing of the vegetation is likely to cause deterioration in the quality of surface or underground water.**	**Unlikely to be at variance to this principle** Given the relatively long and thin strip of additional clearing along this existing main road, the proposed clearing is unlikely to cause long-term deterioration in the quality of surface or underground water. In the short term the quality of surface water could deteriorate before the road edges are compacted / gravelled. A large section of the Survey Area is mapped as having high potential to be a GDE and a smaller section as having moderate potential. However, it is unlikely that the proposed road works will affect the quality of underground water.
(j)	**Native vegetation should not be cleared if the clearing of the vegetation is likely to cause, or exacerbate, the incidence or intensity of flooding.**	**Unlikely to be at variance to this principle** Given the long and thin strip of additional clearing proposed and the low flood risk for the soils within the PCZ, the proposed clearing should not cause or exacerbate the incidence or intensity of flooding. Wetlands are mapped in the Survey Area (DBCA, 2015c and 2015d); the soil landscape units in these areas are assessed as having either a 3-10% or 10-30% moderate to high hazard for flood risk (DPIRD, 2015b). The road already exists in these areas and it does not currently flood. The new road works will include appropriate drainage.

8 Project Personnel, Licences and Limitations

The survey was carried out and the report prepared by the personnel listed in **Table 18**.

Table 18: Project personnel and licences

Botanist	Flora licence number
Christina Cox (survey and report)	FB62000152
Scott Hitchcock (survey and report)	FB62000064
Rochelle Haycock (survey and report)	TFL 72-1920 and FB62000153
Michael Pezzaniti (survey and report)	FB62000065
Cate Tauss (plant identification)	Not applicable
Jen Wilcox (fauna)	Not applicable

Technical Guidance, Flora and Vegetation Surveys for Environmental Impact Assessment (EPA, 2016a) and Technical Guidance, Terrestrial Fauna Surveys (EPA, 2016b), state that any survey-specific issues / limitations should be addressed in a limitations section and that the limitations should be addressed as standard, whether they were a limitation of survey or not. **Table 19** addresses any survey-specific issues / limitations.

Table 19: Limitations

Limitation	Comment
Availability of contextual information at a regional and local scale	**No limitation**
	A desktop study was carried out to gather contextual information at a regional and local scale. The EPBC Act Protected Matters search tool, NatureMap and NationalMap (Australian Government, 2019) were used to gather information. Relevant environmental GIS layers were downloaded and pre-European vegetation mapping, soil landscape mapping and GoWA's most recent vegetation statistics were used to provide context. Some information was available from other flora and vegetation surveys conducted close to the Survey Area. The Survey Area and current road centreline were digitised by Maia using Landgate's Locate Imagery uploaded through ESRI ArcGIS at a scale of 1:500.
Competency /experience of the team carrying out the survey, including experience in the bioregion surveyed	**No limitation**
	Christina Cox, Scott Hitchcock and Rochelle Haycock have more than 15, 13 and 11 years of experience in carrying out botanical surveys in WA, including in the Swan Coastal Plain and Geraldton Sandplain bioregions. Michael Pezzaniti is a trainee botanist with a year's experience in botanical surveys in WA. Michael worked with Christina and / or Rochelle. One or more specimens from each of the species encountered during the survey were collected for formal identification using the resources of the WA Herbarium in Perth. The specimens were identified by Cate Tauss, a botanist with more than 25 years of experience in the taxonomy of the flora of WA. Jen Wilcox has more than 20 years of experience in undertaking fauna surveys in WA, including in the Swan Coastal Plain and Geraldton Sandplains bioregions.
Proportion of flora recorded and/or collected, any identification issues	**No limitation**
	Two hundred and forty-two (242) taxa from 54 families and 153 genera were recorded: 22% of the 242 taxa were annual, 78% were perennial, and 84% of the species list was identified from specimens with reproductive material. A specimen from each of the taxa recorded was collected, and sometimes multiple specimens, as 412 specimens were collected from the Survey Area. Two hundred and ninety-seven (297) species were listed in the NatureMap search results for the road centreline buffered by 2.5 km. The proportion of flora recorded in the Survey Area is therefore comparable with the search results. Seven taxa could not be confirmed beyond genus (*Amphipogon* sp. Indet.*, Eremaea* sp. Indet.*, Haloragis* sp. Indet.*, Thysanotus* ? *manglesianus, Thysanotus* ? *vernalis* (P3)*, Typha* sp. Indet. and *Xanthorrhoea* ? sp. Lesueur). Two taxa could not be confirmed beyond family (Aizoaceae sp. Indet. and Poaceae sp. Indet.). Five taxa have not been included in the counts as they are likely to be one of the taxa already in the species list (*Banksia* ? *sphaerocarpa, Cassytha aurea, Corynotheca micrantha, Melaleuca* ? *viminea* and *Sonchus* sp. Indet.). Other than *Thysanotus* ? *vernalis*, these unconfirmed species are not likely to be conservation significant species if they were confirmed to be the queried species. Based on this information the proportion of the flora collected and identified based on sampling, survey time, area surveyed, and the intensity of survey effort was good. Only a small proportion of the fauna were identified, however, this was not a limitation of the fauna survey as the primary objective was habitat assessment.
Was the appropriate area fully surveyed (effort and extent)	**No limitation**
	A flora and vegetation reconnaissance survey and a targeted fauna survey was carried out over the Survey Area. Four botanists carried out the flora and vegetation survey over three days. Traverses were walked along both sides of Jurien East Road. By walking along the

Limitation	Comment
	boundary of the maintenance strip with the native vegetation, a band of vegetation up to 5 m wide on both sides of the boundary was surveyed – and this included all of the vegetation within the PCZ. The botanists also assessed 18 quadrats and two relevés within the Survey Area. Plants of known and suspected conservation significance were targeted. When found they were counted, and their locations recorded on a GPS. When known or suspected conservation significant species were found, the vegetation in the wider area around the plants was also searched. A representative proportion of the Survey Area was traversed for the fauna survey, as the primary objective was habitat assessment.
Access restrictions within the survey area	**No limitation** There were no access problems. The Survey Area is within the Jurien East Road reserve and the whole of the reserve was accessible from Jurien East Road.
Survey timing, rainfall, season of survey	**No limitation** The botanical survey was conducted in October 2019 (spring). The spring survey was timed to coincide with flowering times of threatened flora (particularly annual species) with records within 10 km of the Survey Area. Rainfall at Jurien Bay over the four months before the survey was 40.4 mm less than the long-term average for those four months and the vegetation could have been in below average condition in October 2019; however, approximately 22% of the species recorded were annual species and approximately 84% of the flora taxa recorded were either flowering or fruiting (or both) when the survey was carried out. The fauna survey was undertaken in January 2020 (summer) when Carnaby's Cockatoo is likely to be present in areas of non-breeding habitat. Both cockatoos and evidence of cockatoo foraging signs were recorded in the Survey Area.
Disturbances (fire, flood, accidental human intervention etc.)	**No limitation** No disturbances were evident or noted by the ecologists while carrying out the survey. No floods, severe storms or fires had occurred in the weeks or months before the survey was carried out. An existing road maintenance area occurs within the Survey Area and this area has been routinely disturbed.

9 CONCLUSIONS

9.1 FLORA AND VEGETATION

- Two hundred and forty-two (242) taxa from 153 genera and 54 families were recorded in the Survey Area. Species richness for the Survey Area is relatively low compared with species richness for two other local survey areas. NatureMap indicates that the Survey Area is in an area of low to moderate species richness.
- No threatened species, one confirmed priority flora species (*Banksia dallanneyi* subsp. *pollosta* (P3)) and one potentially significant flora species, *Thysanotus ? vernalis* (? P3), were located in the Survey Area.
- These taxa will not be directly impacted by the proposed works because the plants are not in the PCZ.
- No declared plant species was located in the Survey Area, but 44 weed species were located. Weeds were densest along and close to the existing road edges and also in lower and generally wetter and shadier areas.
- Clearing in the PCZ will not bring the level of total clearing of the vegetation system associations of the Survey Area to below the threshold level of 30% in the Swan Coastal Plain and Geraldton Sandplains (and relevant subregions), in the Shire of Dandaragan or in the local area (within 10 km of the road centreline). Post clearing, the remaining percentage of the vegetation system associations of the Survey Area will be between

35.71% and 93.84% respectively, while in the Shire of Dandaragan they will be between 66.8% and 92.8% respectively. The greatest reduction in the remaining extent to the vegetation associations and system associations by bioregion, subregion and Shire would be 0.01%. In the local area, native vegetation extent would decrease from 63.08% to 63.07% if all 5.25 ha of intact native vegetation were to be cleared.

- Eleven vegetation types were mapped in the Survey Area: *Banksia* Low Open Forest to Low Woodland (*B***LOFLWL**); *Eucalyptus* Tall Open Forest (*E***TOF**); *Eucalyptus* Tall Open Mallee Forest (*E***TOMF**); two types of Mixed Low Open Shrubland (**MLOSL** (1) and **MLOSL** (2)); Mixed Open Shrubland (**MOSL** (1)); *Melaleuca* Open Shrubland (*M***OSL** (2)); Mixed Shrubland (MSL); *Melaleuca* Tall Shrubland (*M***TSL** (1)); Mixed Tall Shrubland (**MTSL** (2)); and, *Tecticornia* Low Sparse Samphire Shrubland (*T***LSSSL**). Each is similar to vegetation mapped in the surrounding areas and regionally. Approximately 4.58 ha of intact native vegetation will be cleared for the proposed road works (8.65% of that in the Survey Area).
- The condition of all intact vegetation in the PCZ was rated as 70.5% Good and 29.5% Very Good. These ratings reflect the high cover and density of weeds close to the road, track entrances and drain edges along much of the road.

9.2 Fauna

- Carnaby's Cockatoo (Threatened, Endangered) was recorded in the Survey Area and evidence of foraging was ubiquitous in the *Banksia* woodlands and shrublands of the Survey Area and on *Eucalyptus todtiana*.
- The Survey Area contains high value / quality foraging habitat with important food plants (vegetation types *B***LOFLWL**, **MSL** and *E***TOMF**) in the form of Banksia woodlands and shrublands.
- Carnaby's Cockatoo are not known to breed within 12 km of the Survey Area. The Survey Area contains potential (rather than known) breeding habitat for Carnaby's Cockatoo (vegetation type *E***TOF**). No trees with hollows of sufficient size to support breeding were noted in the PCZ; however, five trees fitting the DBH criterion for potential breeding habitat were located. The foraging habitat is unlikely to be supporting breeding birds (based on current available data) but it is likely to be important for birds in the non-breeding season as they move towards the coast to forage.
- A likely Carnaby's Cockatoo roost site was identified in Flooded Gum and other tall eucalypts near a farm dam and seasonally wet area adjacent to the Survey Area. This Flooded Gum woodland extends into the Survey Area (*E***TOF**) and is likely to be part of this roost site.
- Clearing of more than 1 ha of high value foraging habitat and / or any part of a vegetation community known to contain breeding habitat and / or a known night roosting site is considered to be a high risk of significant impact to Carnaby's Cockatoo. After minimising vegetation clearing in the PCZ, approximately 3.58 ha (in total) of the three high value foraging habitat vegetation types (*B***LOFLWL, MSL and** *E***TOMF**) will be cleared for the road works i.e. 10.1% of Carnaby's Cockatoo foraging vegetation in the Survey Area. While five *Eucalyptus rudis* trees with a DBH ≥ 50 cm occur within the 20 m wide PCZ where *E***TOF** is mapped, the Shire will not remove these trees. They will also not prune any branches from the taller trees but will prune some juvenile trees and shrubs in the shrub layer.
- The habitats of the Survey Area are not likely to support significant numbers of Migratory fauna species previously recorded in the Survey Area (Glossy Ibis and Wood Sandpiper). Neither are they likely to be important for the Specially Protected Fauna species (Peregrine falcon) located previously in the local area.
- Four priority fauna species have been recorded previously in the local area – Woolybush Bee (P3), Western Brush Wallaby, Graceful Sunmoth and Hooded Plover (all P4). Hooded Plovers are only likely to occur on the coast in this region, while the three other species potentially occur.

9.3 Ecological communities and other Significant Areas

- Some of the Survey Area falls in an area indicated as a potential Endangered TEC protected by the EPBC Act – the Banksia Woodlands of the Swan Coastal Plain ecological community. This TEC is not protected by the BC Act in WA.

- Vegetation types *B***LOFLWL** and *E***TOMF** are similar to vegetation communities that form the nationally protected, EPBC listed and Endangered TEC - Banksia Woodlands of the Swan Coastal Plain. Based on an assessment of the key diagnostic characteristics, the TEC is present in the Swan Coastal Plain section of the Survey Area.
- After minimising vegetation clearing in the PCZ, approximately 3.53 ha of *B***LOFLWL** and *E***TOMF** will need to be cleared for the proposed road works. A patch size analysis was carried out on the *B***LOFLWL** in the PCZ (the *E***TOMF** is only mapped in the Geraldton Sandplains bioregion, which is not a key diagnostic for the TEC), and 3.29 ha of *B***LOFLWL** that meets the patch size and condition criteria will be cleared in the PCZ (however, that includes areas of Good condition *B***LOFLWL** that do not meet the size criterion, but that cannot be easily separated from the Very Good condition *B***LOFLWL**).
- The Banksia woodlands of the Swan Coastal Plain TEC is listed as a P3(iii) PEC for the Midwest region - Banksia dominated woodlands of the Swan Coastal Plain IBRA region.
- A section of the Survey Area lies adjacent to the boundary for Conservation Park R48717 (to the south) and another section is adjacent to the boundary for Drovers Cave National Park (to the north). A water reserve and two other Class C reserves are also adjacent to the Survey Area.
- A long, thin section of an ESA extends into the northern side of the Survey Area; however, this is associated with Drovers Cave National Park and its boundary ends at the boundary of the road reserve.
- The Survey Area lies in a Schedule 1 area - the Swan Coastal Plain and Geraldton Sandplains bioregions.
- Areas mapped as Geomorphic Wetlands (palusplain and sumpland) intersect the Survey Area; however, none is classified as a conservation category geomorphic wetland – one is a multiple use management category wetland (with few remaining important attributes and functions).

9.4 Phytophthora Dieback

- A positive sample for *Phytophthora arenaria* has been recorded in the Survey Area. Vegetation association 1030, which comprises approximately 1% of the current native vegetation extent in the Survey Area, is highly susceptible to Phytophthora Dieback and associations 1026 and 1029 are moderately susceptible (and collectively cover 99% of the Survey Area). Up to 2008 most of the Survey Area was classified as moderate confidence uninfested.

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11 MAPS

Location Map

- Karatha
- Newman
- Wiluna
- Geraldton
- Kalgoorlie
- Perth

Localities (Geoscience Australia, 20020101)

Road Network (Main Roads, 20190516)

The Survey Area

maia

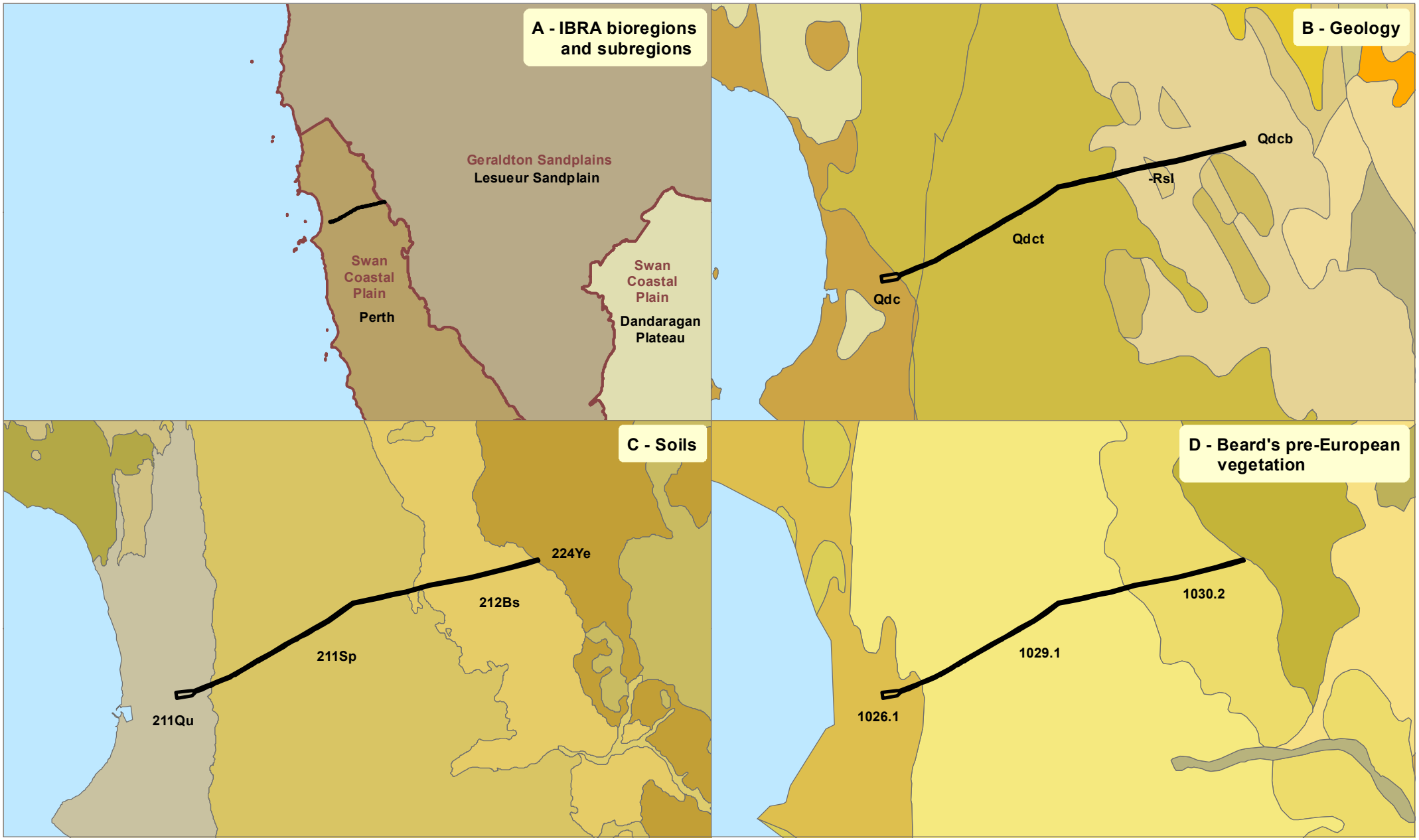
N

0 1

Kilometres

Datum: GDA 1994, MGA 50

Map: 1	
Prepared for: SofD	
Drawn by: RH	
Date: 15/07/2020	
Version: 3	**Size:** A4



Location Map

• Karatha
• Newman
• Wiluna
• Geraldton
• Kalgoorlie
• Perth

Survey Area

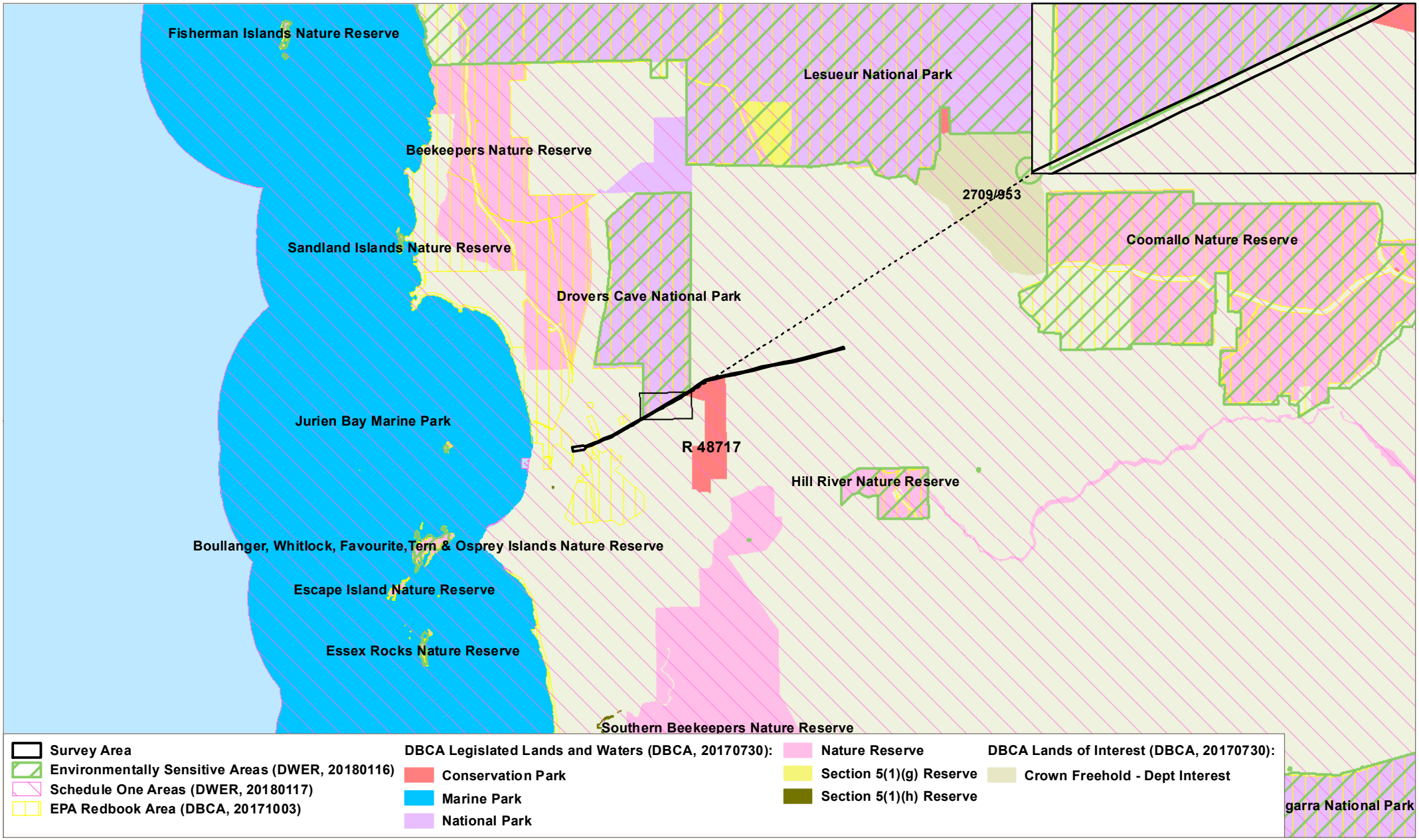
IBRA Bioregions and Subregions, Geology, Soil Landscape Units and Beard's Pre-European Vegetation (Vegetation System Associations)

maia

N

Datum: GDA 1994, MGA 50

Map: 2
Prepared for: SofD
Drawn by: RH
Date: 6/01/2020
Version: 1 **Size:** A4



Protected and Significant Areas

maia

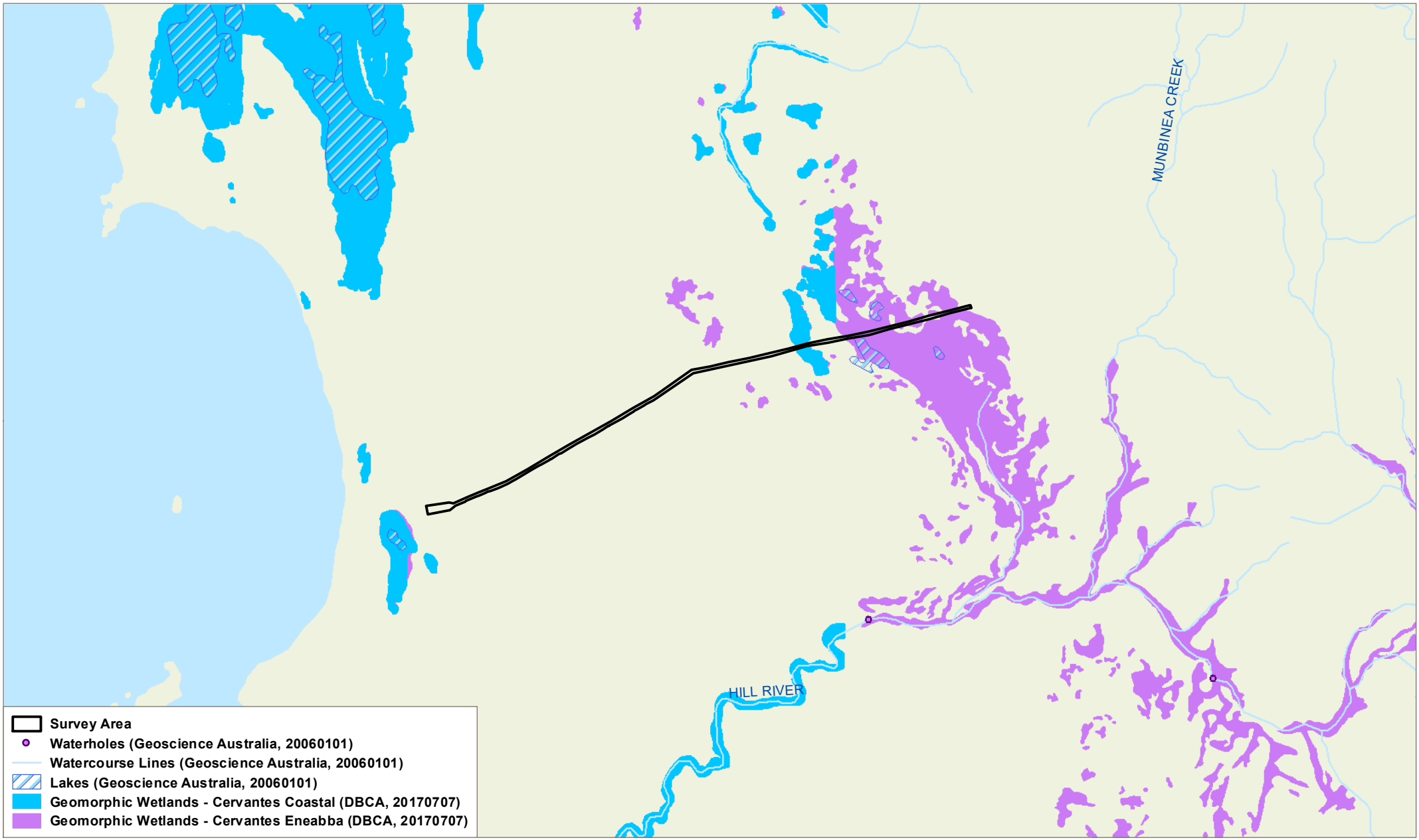
N

0 4.25

Kilometres

Datum: GDA 1994, MGA 50

Map: 3
Prepared for: SofD
Drawn by: RH
Date: 6/01/2020
Version: 1 **Size:** A4



Location Map

Watercourses and Wetlands

maia

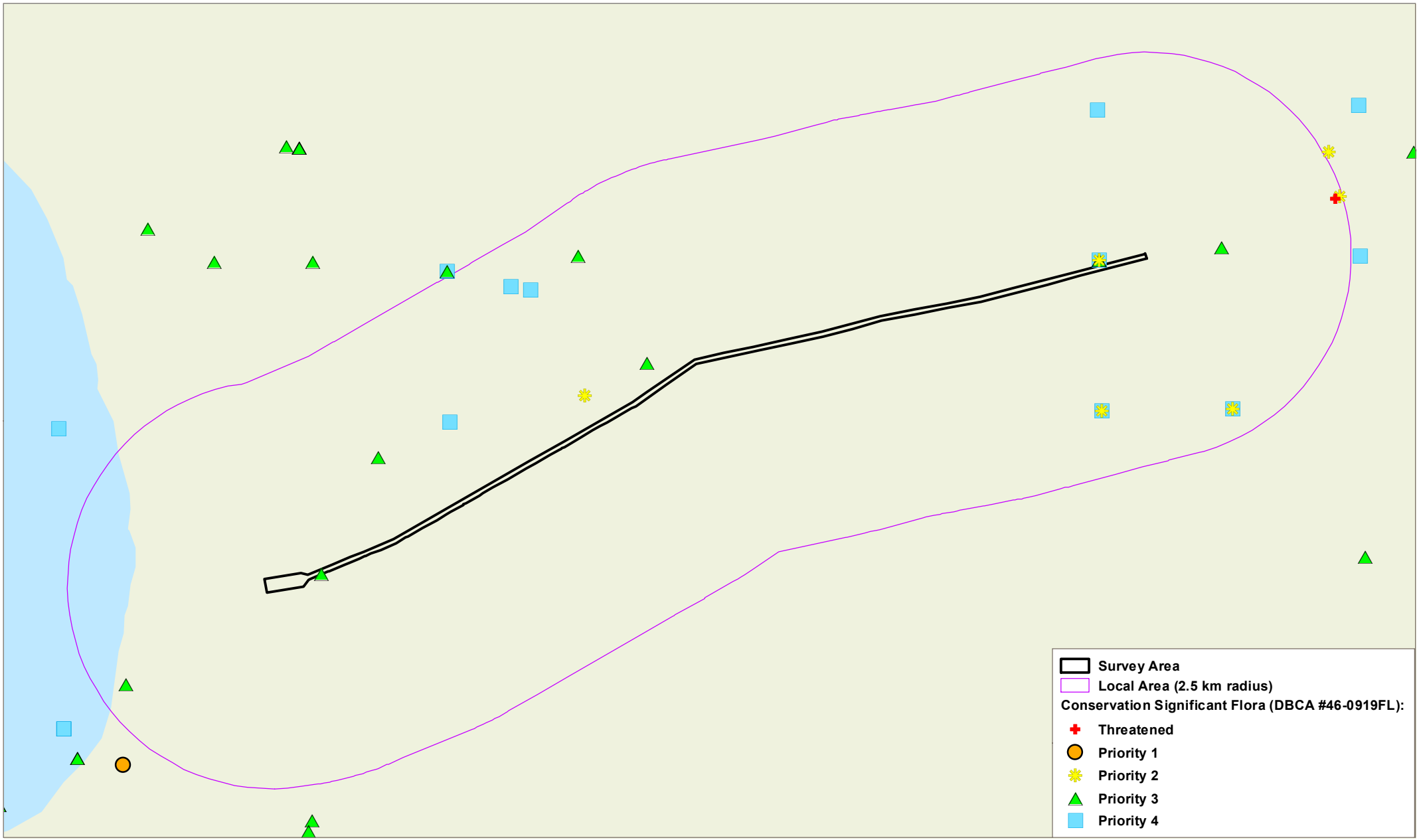
N

0 2

Kilometres

Datum: GDA 1994, MGA 50

Map: 4
Prepared for: SofD
Drawn by: RH
Date: 6/01/2020
Version: 1 **Size:** A4



Location Map

Conservation Significant Flora - DBCA (search reference #46-0919FL)

maia

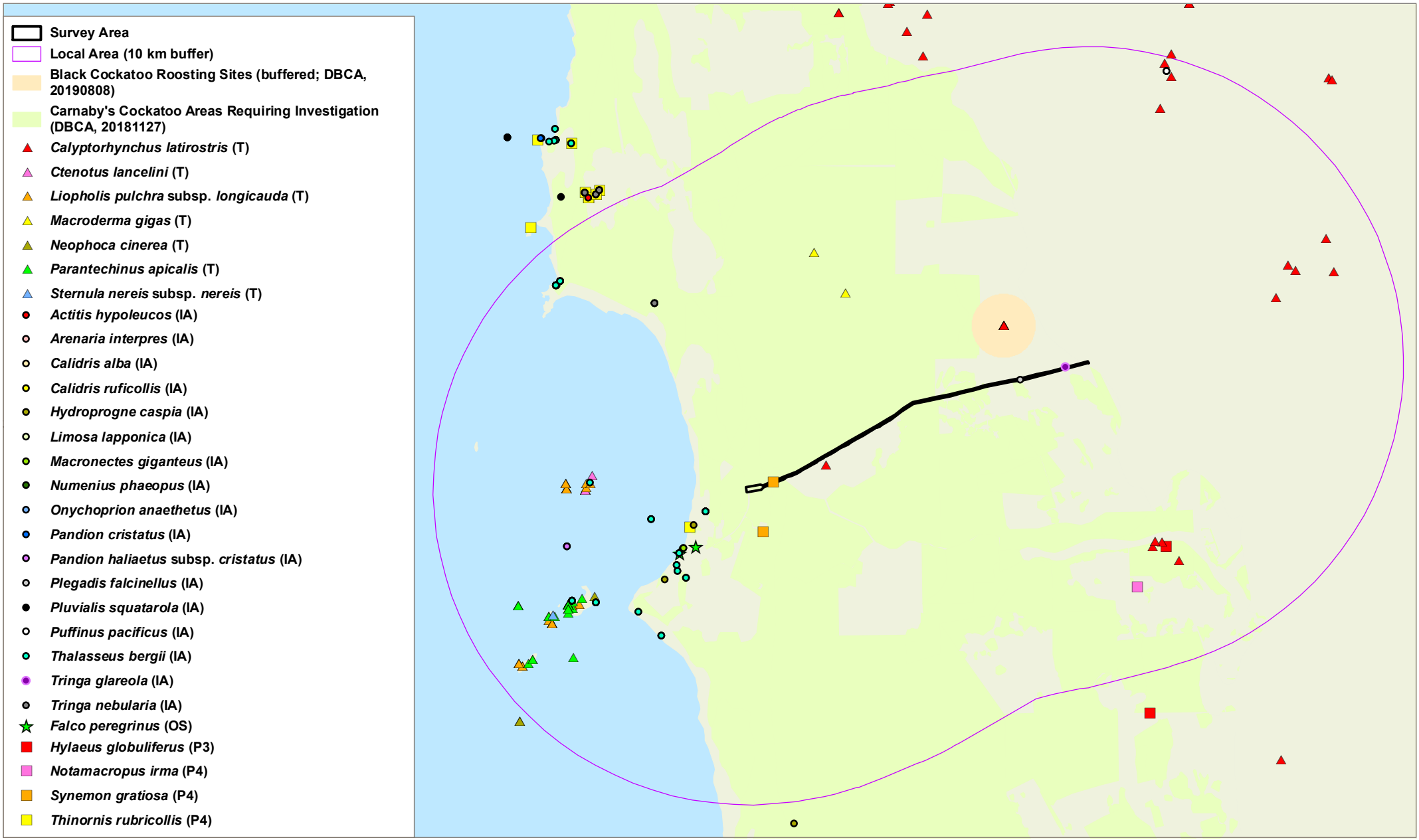
N

0 1.25

Kilometres

Datum: GDA 1994, MGA 50

Map: 5
Prepared for: SofD
Drawn by: RH
Date: 6/01/2020
Version: 1 **Size:** A4



Conservation Significant Fauna - DBCA and NatureMap

maia

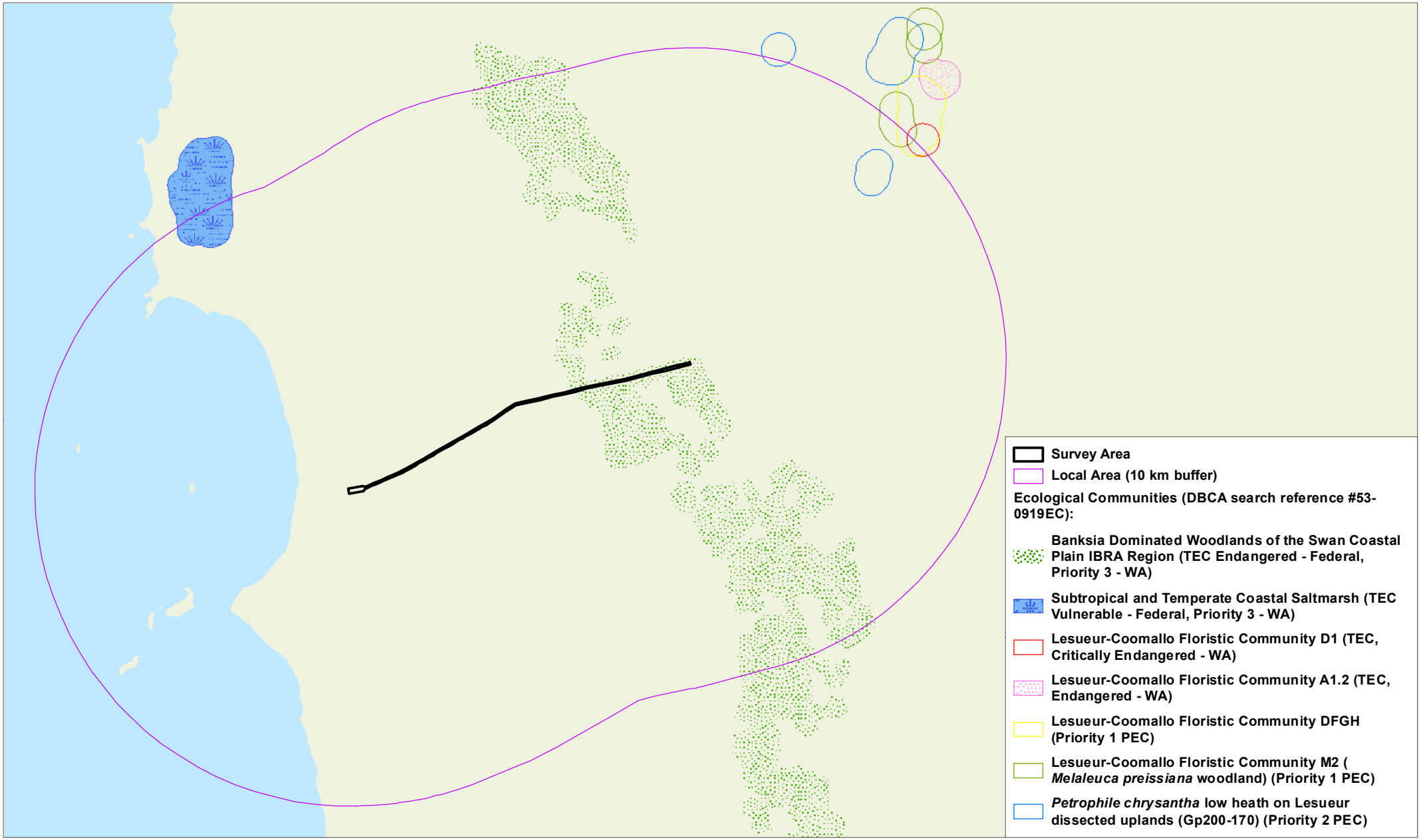
N

0 3.5

Kilometres

Datum: GDA 1994, MGA 50

Map: 6
Prepared for: SofD
Drawn by: RH
Date: 16/03/2020
Version: 1 **Size:** A4



Threatened and Priority Ecological Communities (DBCA search reference #53-0919EC)

maia

N

0 3.5

Kilometres

Datum: GDA 1994, MGA 50

Map: 7
Prepared for: SofD
Drawn by: RH
Date: 6/11/2020
Version: 1 **Size:** A4

Location Map

Sites and Traverses

N

0 1

Kilometres

Datum: GDA 1994, MGA 50

Map: 8	
Prepared for: SofD	
Drawn by: RH	
Date: 9/03/2020	
Version: 1	**Size:** A4

Cockleshell Gully Rd

Munbinea Rd

Jurien East Rd

Cambewarra Dr

Indian Ocean Dr

Memorial Dr

Canover Rd

Survey Area

Proposed Clearing Zone

Conservation Significant Flora:

▲ ***Banksia dallanneyi* subsp. *pollosta* (P3)**

● ***Thysanotus ?vernalis* (potential P3)**

Location Map

Karatha
Newman
Wiluna
Geraldton
Kalgoorlie
Perth

Road Network (Main Roads, 20190516)

Conservation Significant Flora (Survey Results)

maia

N

0 1

Kilometres

Datum: GDA 1994, MGA 50

Map: 9
Prepared for: SofD
Drawn by: RH
Date: 15/07/2020
Version: 3 **Size:** A4

Location Map

Road Network (Main Roads, 20190516)

Conservation Significant Fauna (Survey Results)

maia

N

0 1

Kilometres

Datum: GDA 1994, MGA 50

Map: 10
Prepared for: SofD
Drawn by: RH
Date: 15/07/2020
Version: 3 **Size:** A4

Vegetation Types (Maia):

- ***B*LOFLWL** Low Open Forest to Low Woodland of *Banksia prionotes*, +/- *B. menziesii* and / or *B. attenuata* with a mixed Shrubland mainly of *Scholtzia laxiflora*, *Banksia sphaerocarpa* var. *sphaerocarpa* and *Hibbertia sericosepala* and a Sparse Sedgeland to Isolated Sedges of *Mesomelaena tetragona*
- ***E*TOF** Tall Open Forest of *Eucalyptus rudis* subsp. *rudis* with a Low Woodland of *Melaleuca rhaphiophylla* and a Tall Open Shrubland of *Melaleuca rhaphiophylla* and *Acacia cyclops*
- ***E*TOMF** Tall Open Mallee Forest of *Eucalyptus todtiana* with a Tall Sparse Shrubland of *Adenanthos cygnorum* subsp. *cygnorum* and a Tussock Grassland of **Ehrharta calycina*
- **MLOSL (1)** Mixed Low Open Shrubland mainly of *Melaleuca leuropoma* and *Acacia lasiocarpa* var. *lasiocarpa* with a Sparse Tussock Grassland of **Vulpia bromoides* and **Lolium perenne* x *rigidum*
- **MLOSL (2)** Mixed Low Open Shrubland of *Gastrolobium oxylobioides*, *Hibbertia sericosepala* and *Daviesia incrassata* subsp. *incrassata* with a Low Open Sedgeland of *Desmocladus asper* and Isolated Shrubs of *Allocasuarina humilis* and *Calothamnus quadrifidus* subsp. *quadrifidus*
- **MOSL (1)** Mixed Open Shrubland mainly of *Eremaea beaufortioides* var. *beaufortioides*, *Calothamnus quadrifidus* subsp. *quadrifidus* and *Melaleuca leuropoma* with an Open Tussock Grassland of *Austrostipa elegantissima* and **Ehrharta calycina* and a Low Sparse Shrubland of *Acacia dilatata*
- ***M*OSL (2)** Open Shrubland of *Melaleuca viminea* subsp. *viminea* with an Open Sedgeland of *Typha* sp. Indet
- **MSL** Mixed Shrubland mainly of *Banksia sessilis* var. *cygnorum*, *Hakea trifurcata* and *Melaleuca cardiophylla* and a mixed Open Low Shrubland mainly of *Labichea cassioides*, *Hibbertia sericosepala* and *Petrophile axillaris*
- ***M*TSL (1)** Tall Shrubland of *Melaleuca rhaphiophylla* with a Low Woodland of *M. preissiana* and an Open Tussock Grassland of *Chloris gayana*, *Eragrostis curvula* and *Sporobolus virginicus*
- **MTSL (2)** Mixed Tall Shrubland of *Acacia rostellifera*, *Melaleuca huegelii* and +/- *Spyridium globulosum* with an Open Tussock Grassland of **Lolium perenne* x *rigidum*
- ***T*LSSSL** Low Sparse Samphire Shrubland of *Tecticornia indica* subsp. *bidens*, *T. pergranulata* subsp. *pergranulata* with a Sparse Tussock Grassland of **Lolium perenne* x *rigidum* and Isolated Shrubs of *Melaleuca acutifolia*
- **Disturbed**
- **Cleared**

- **Survey Area**
- **Proposed Clearing Zone**
- **Chainages (0.1 km)**
- **Centreline**
- **Carnaby's Cockatoo (CC) - Sighting (Maia)**

Carnaby's Cockatoo Sightings, Foraging and Roosting (Western Wildlife):

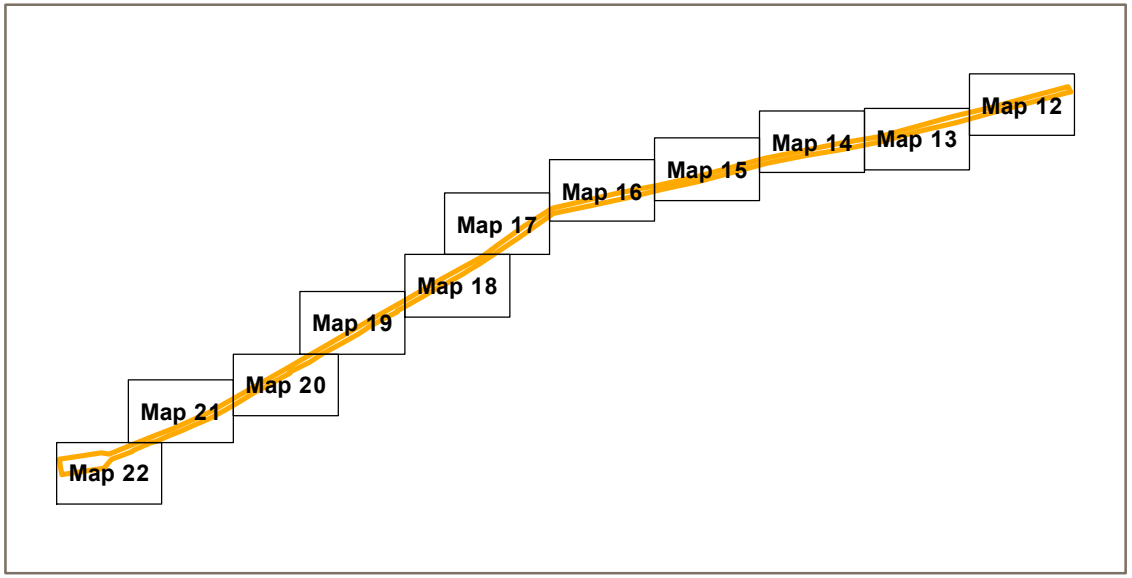
- **Birds foraging in Bansksia woodland**
- **Birds roosting and foraging in tall Eucalypts near farm dam and seasonally wet area**
- **Foraging signs on *Banksia attenuata***
- **Foraging signs on *Banksia menziesii***
- **Foraging signs on *Banksia prionotes***
- **Foraging signs on *Banksia sessillis* (old)**
- **Feather**

Carnaby's Cockatoo - Potential Trees (Maia):

- ***Eucalyptus rudis* subsp. *rudis* (ER1 to ER7)**

Conservation Significant Flora (Maia):

- ***Banksia dallanneyi* subsp. *pollosta* (P3)**
- ***Thysanotus ?vernalis* (potential P3)**



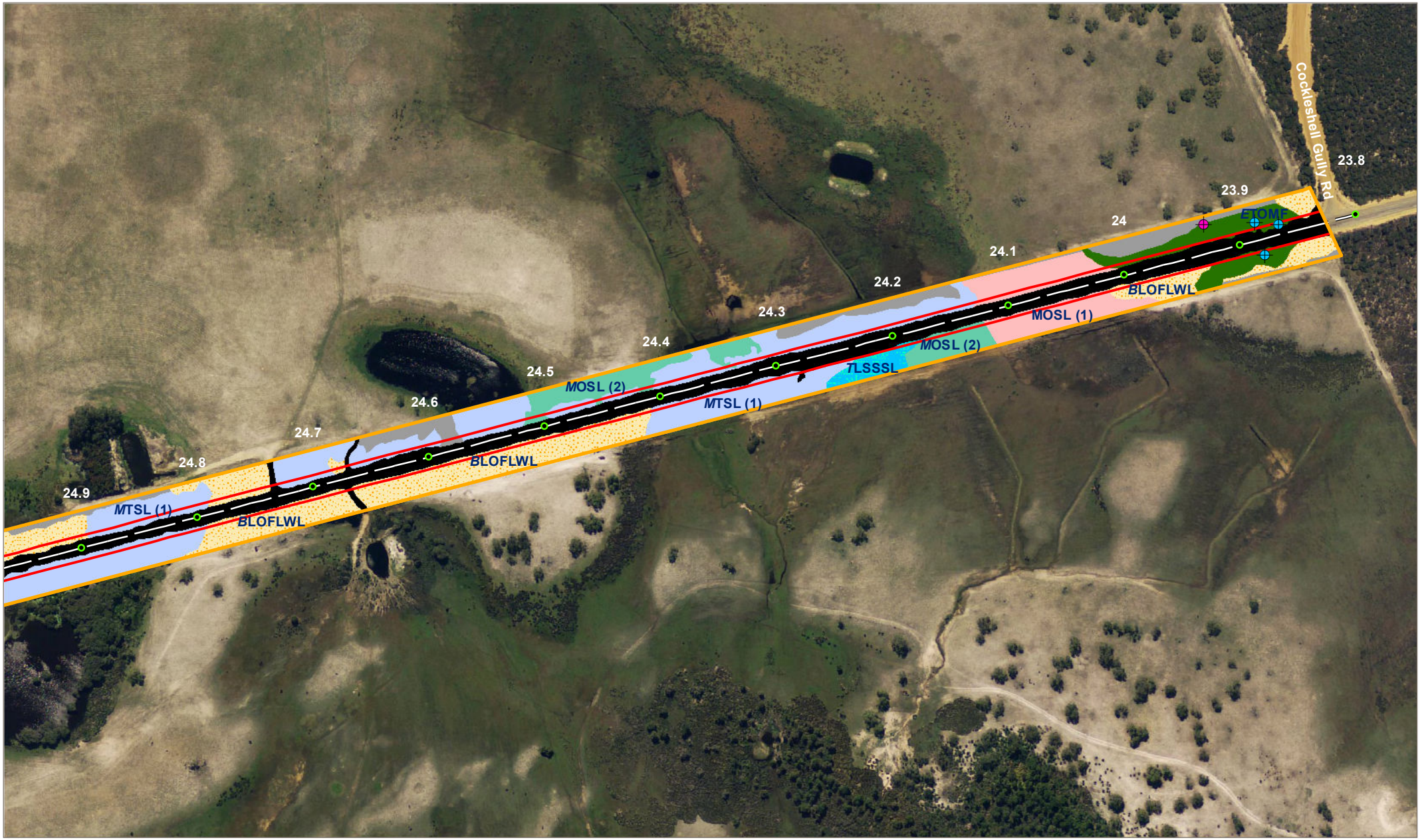
Legend items
Map 12 - Map 22

maia

N

Datum: GDA94

Map: 11
Prepared for: SofD
Drawn by: RH
Date: 10/03/2020
Version: 1 **Size:** A4



Location Map

- Karatha
- Newman
- Wiluna
- Geraldton
- Kalgoorlie
- Perth

Chainage 23.8 km to 24.9 km

maia

N

0 100

Metres

Datum: GDA 1994, MGA 50

Map: 12	
Prepared for: Maia	
Drawn by: RH	
Date: 5/05/2020	
Version: 2	**Size:** A4

Location Map

- Karatha
- Newman
- Wiluna
- Geraldton
- Kalgoorlie
- Perth

Chainage 24.9 km to 26.1 km

maia

N

0 100

Metres

Datum: GDA 1994, MGA 50

Map:	13
Prepared for:	Maia
Drawn by:	RH
Date:	5/05/2020
Version:	2 **Size:** A4

Location Map

- Karatha
- Newman
- Wiluna
- Geraldton
- Kalgoorlie
- Perth

Chainage 26.1 km to 27.2 km

maia

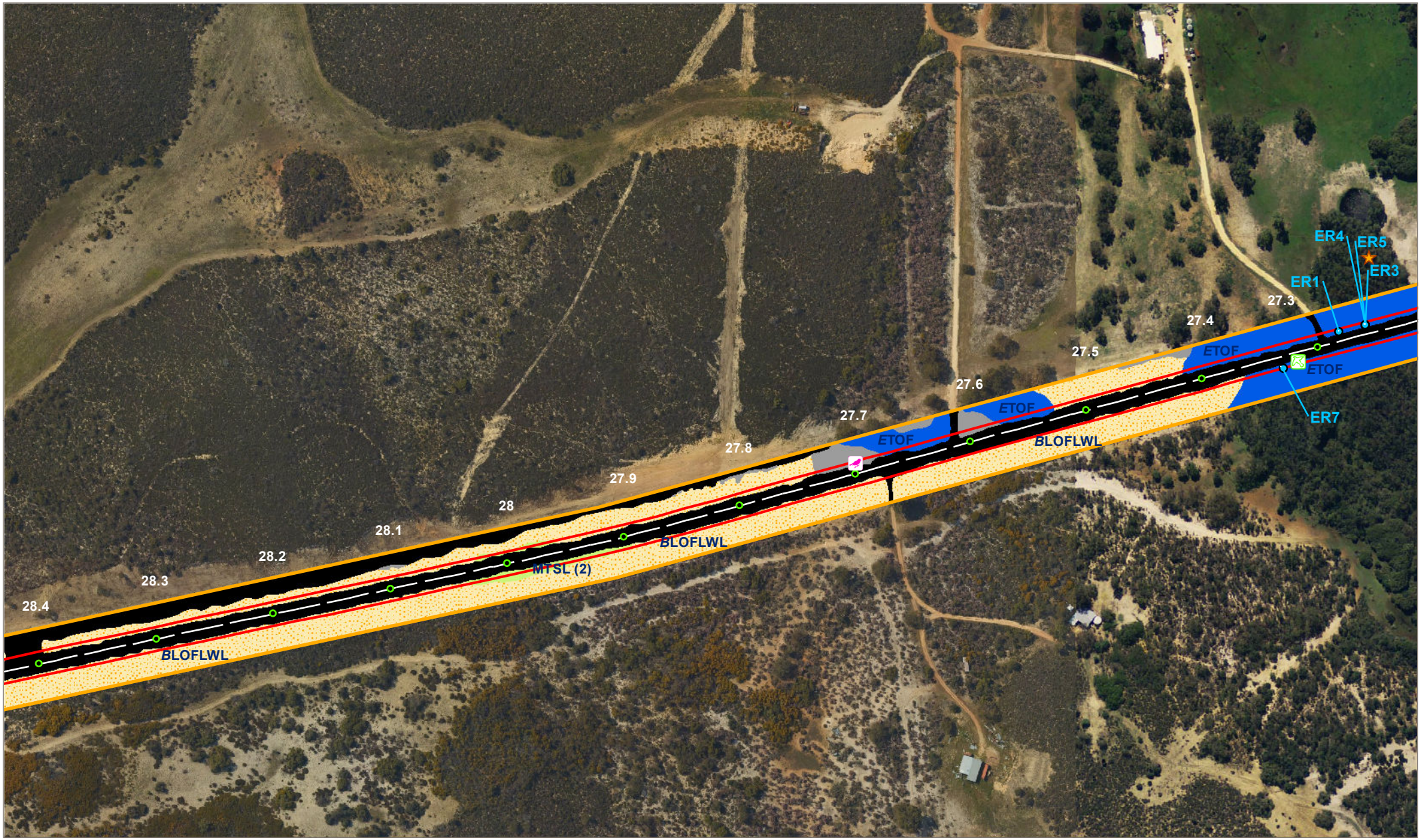
N

0 100

Metres

Datum: GDA 1994, MGA 50

Map: 14
Prepared for: Maia
Drawn by: RH
Date: 5/05/2020
Version: 2 **Size:** A4



Location Map

- Karatha
- Newman
- Wiluna
- Geraldton
- Kalgoorlie
- Perth

Chainage 27.2 km to 28.4 km

maia

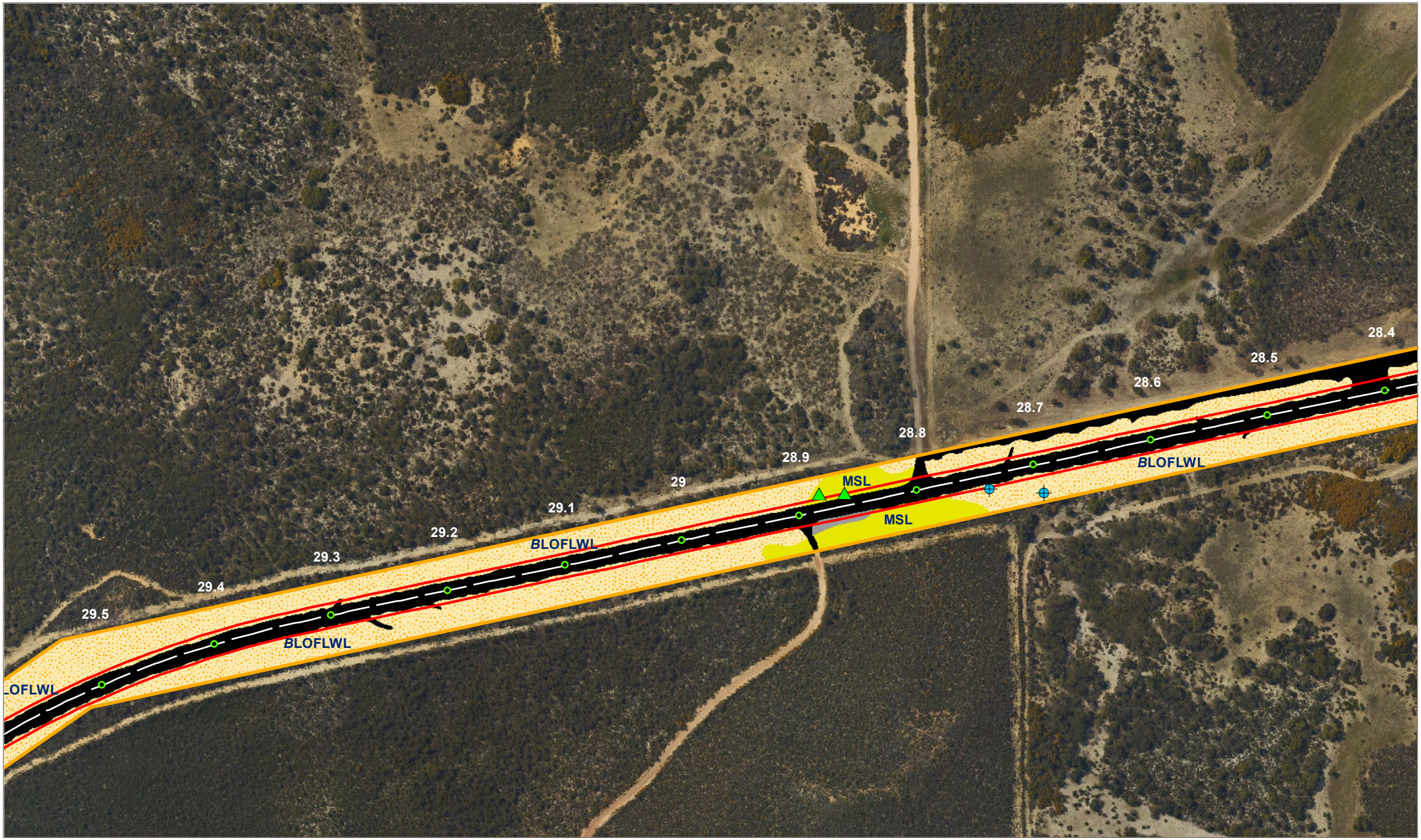
N

0 100

Metres

Datum: GDA 1994, MGA 50

Map: 15
Prepared for: Maia
Drawn by: RH
Date: 5/05/2020
Version: 2 **Size:** A4



Location Map

- Karatha
- Newman
- Wiluna
- Geraldton
- Kalgoorlie
- Perth

Chainage 28.4 km to 29.5 km

maia

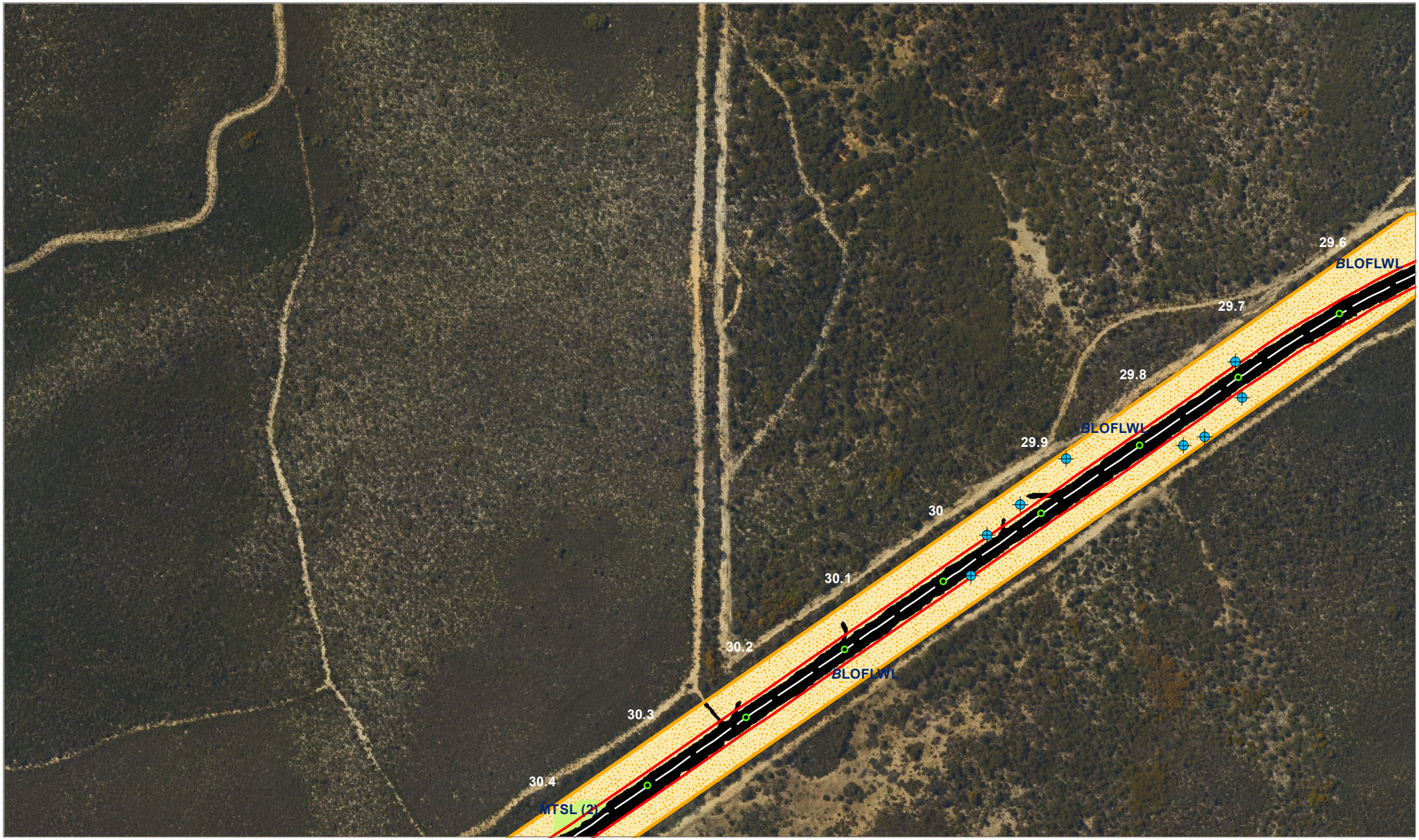
N

0 100

Metres

Datum: GDA 1994, MGA 50

Map: 16
Prepared for: Maia
Drawn by: RH
Date: 5/05/2020
Version: 2 **Size:** A4



Location Map

- Karatha
- Newman
- Wiluna
- Geraldton
- Kalgoorlie
- Perth

Chainage 29.5 km to 30.3 km

maia

N

0 100

Metres

Datum: GDA 1994, MGA 50

Map: 17
Prepared for: Maia
Drawn by: RH
Date: 5/05/2020
Version: 2 **Size:** A4

Location Map

- Karatha
- Newman
- Wiluna
- Geraldton
- Kalgoorlie
- Perth

Chainage 30.3 km to 31.3 km

maia

N

0 100

Metres

Datum: GDA 1994, MGA 50

Map:	18
Prepared for:	Maia
Drawn by:	RH
Date:	5/05/2020
Version:	2 **Size:** A4

Location Map

- Karratha
- Newman
- Wiluna
- Geraldton
- Kalgoorlie
- Perth

Chainage 31.3 km to 32.4 km

maia

N

0 100

Metres

Datum: GDA 1994, MGA 50

Map:	19
Prepared for:	Maia
Drawn by:	RH
Date:	5/05/2020
Version:	2 **Size:** A4

Location Map

- Karatha
- Newman
- Wiluna
- Geraldton
- Kalgoorlie
- Perth

Chainage 32.4 km to 33.5 km

maia

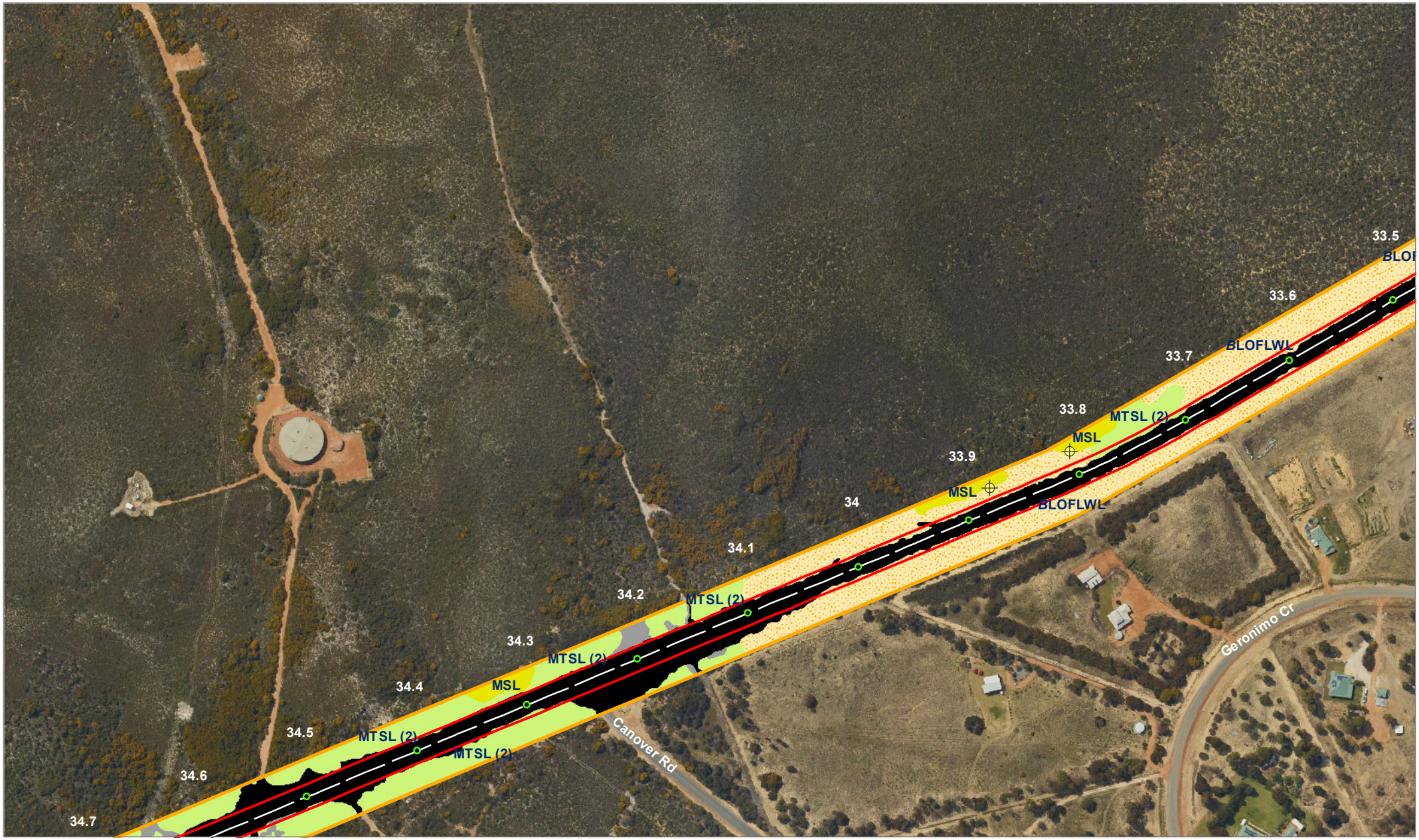
N

0 100

Metres

Datum: GDA 1994, MGA 50

Map: 20
Prepared for: Maia
Drawn by: RH
Date: 5/05/2020
Version: 2 **Size:** A4



Location Map

- Karatha
- Newman
- Wiluna
- Geraldton
- Kalgoorlie
- Perth

Chainage 33.5 km to 34.5 km

maia

N

0 100

Metres

Datum: GDA 1994, MGA 50

Map:	21
Prepared for:	Maia
Drawn by:	RH
Date:	5/05/2020
Version:	2 **Size:** A4

Location Map

- Karatha
- Newman
- Wiluna
- Geraldton
- Kalgoorlie
- Perth

Chainage 34.5 km to 35.5 km

maia

N

0 100

Metres

Datum: GDA 1994, MGA 50

Map:	22
Prepared for:	Maia
Drawn by:	RH
Date:	15/07/2020
Version:	3 **Size:** A4

Location Map

- Karatha
- Newman
- Wiluna
- Geraldton
- Kalgoorlie
- Perth

Vegetation Condition -
Chainage 23.8 km to 24.9 km

maia

N

0 100

Metres

Datum: GDA 1994, MGA 50

Map: 23	
Prepared for: Maia	
Drawn by: RH	
Date: 5/05/2020	
Version: 2	**Size:** A4

Location Map

Vegetation Condition -
Chainage 24.9 km to 26.1 km

maia

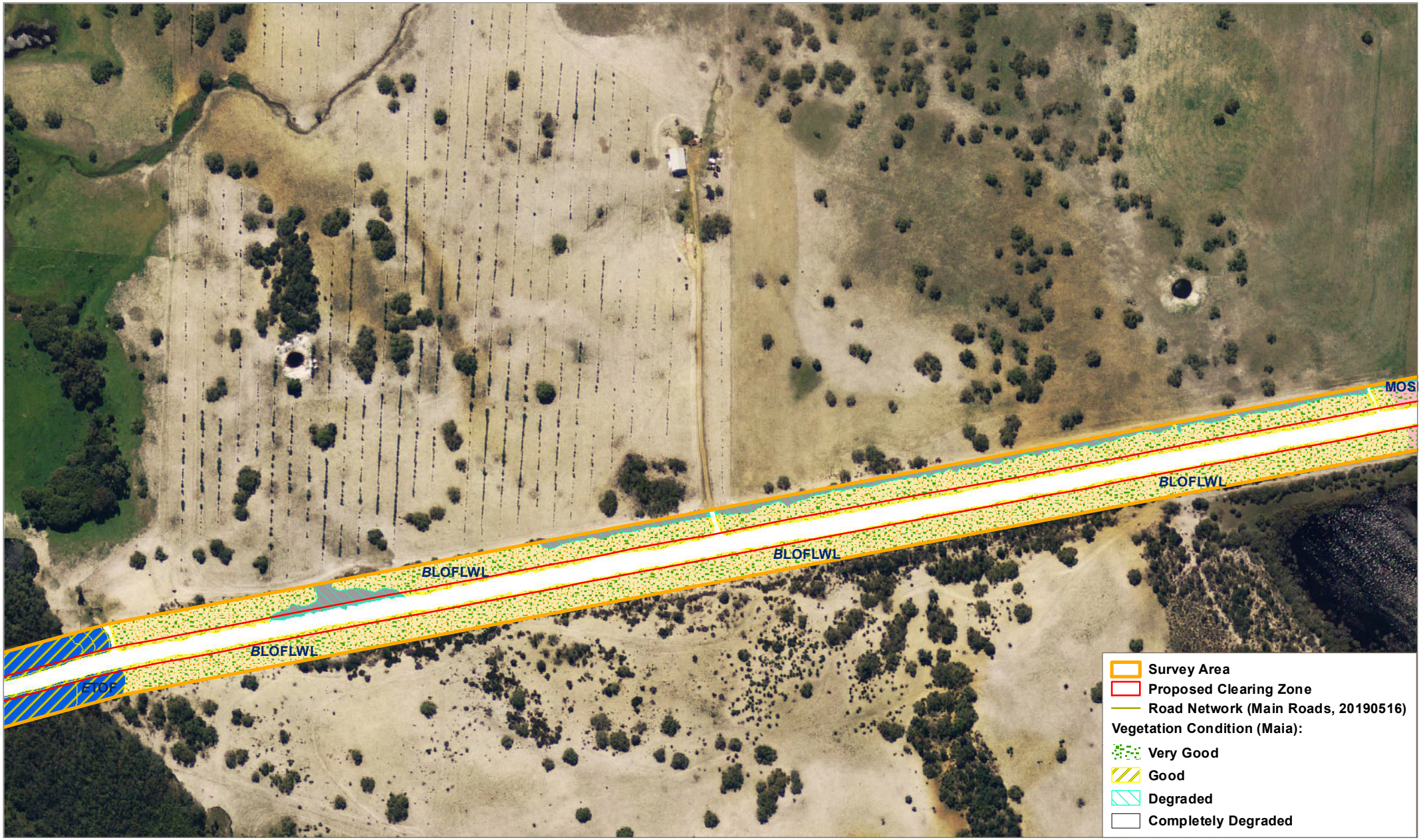
N

0 100

Metres

Datum: GDA 1994, MGA 50

Map: 24
Prepared for: Maia
Drawn by: RH
Date: 5/05/2020
Version: 2 **Size:** A4



Location Map

- Karatha
- Newman
- Wiluna
- Geraldton
- Kalgoorlie
- Perth

Vegetation Condition -
Chainage 26.1 km to 27.2 km

maia

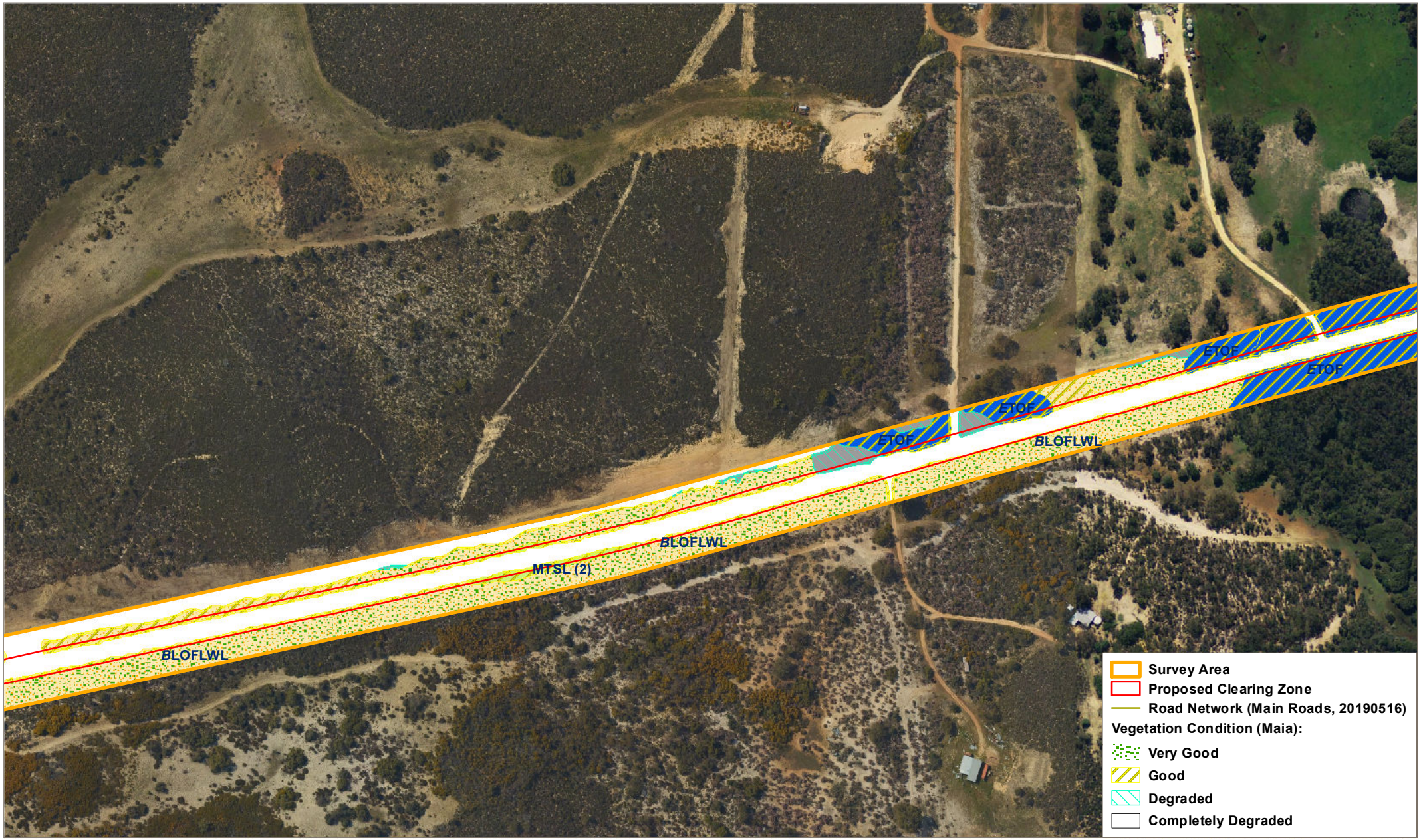
N

0 100

Metres

Datum: GDA 1994, MGA 50

Map: 25
Prepared for: Maia
Drawn by: RH
Date: 5/05/2020
Version: 2 **Size:** A4



Location Map

- Karatha
- Newman
- Wiluna
- Geraldton
- Kalgoorlie
- Perth

Vegetation Condition -
Chainage 27.2 km to 28.4 km

maia

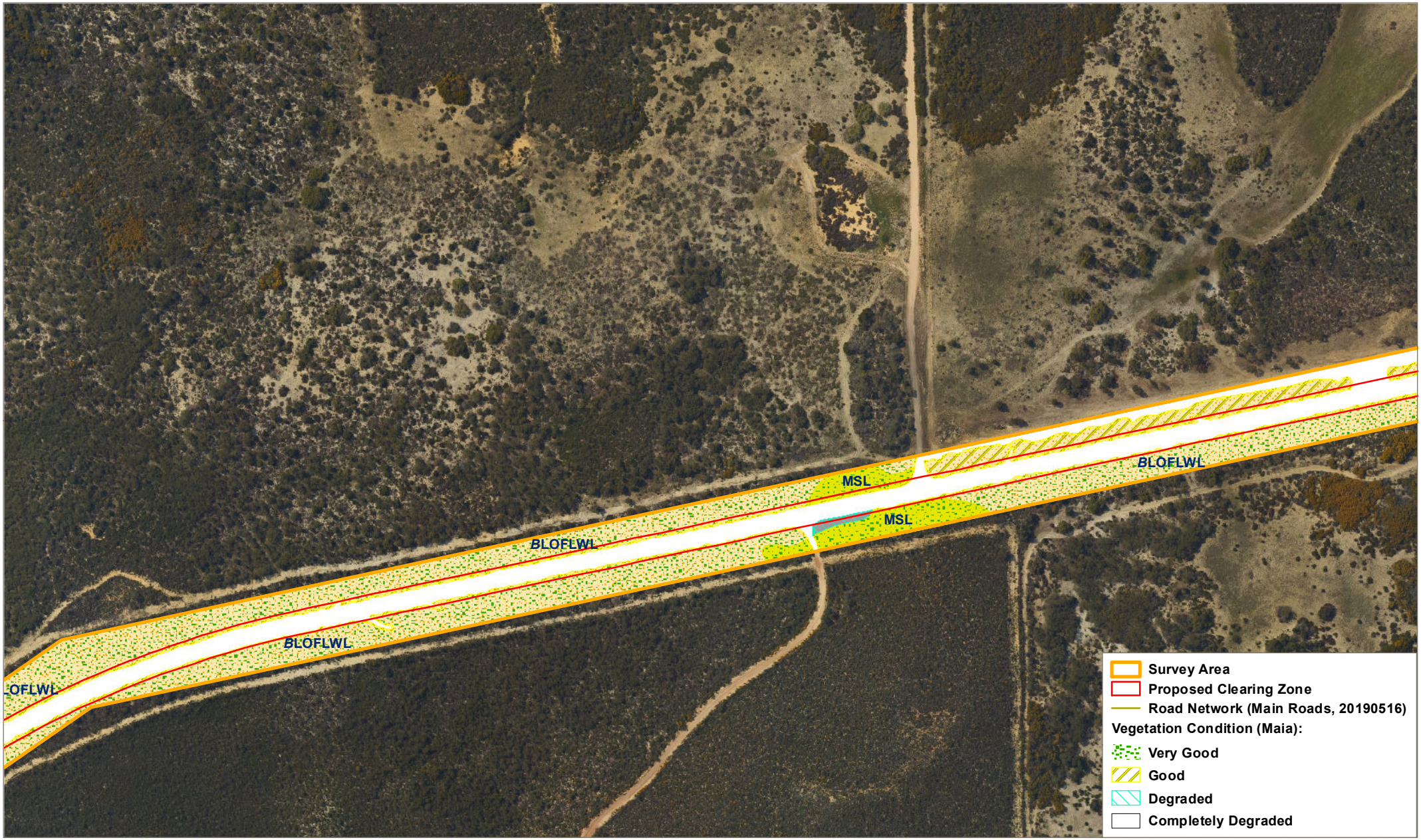
N

0 100

Metres

Datum: GDA 1994, MGA 50

Map: 26
Prepared for: Maia
Drawn by: RH
Date: 5/05/2020
Version: 2 **Size:** A4



Vegetation Condition -
Chainage 28.4 km to 29.5 km

maia

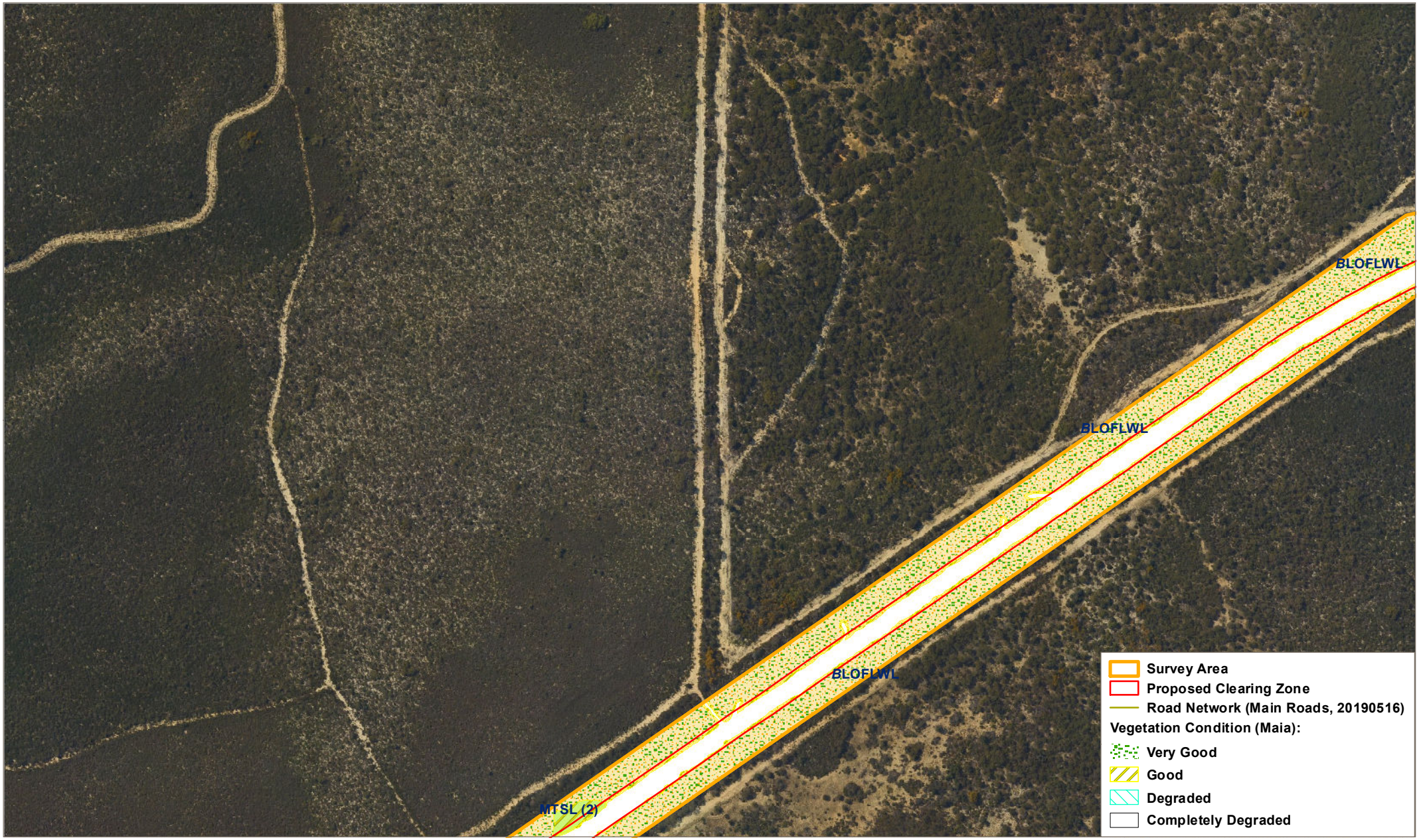
N

0 100

Metres

Datum: GDA 1994, MGA 50

Map: 27
Prepared for: Maia
Drawn by: RH
Date: 5/05/2020
Version: 2 **Size:** A4



Location Map

Vegetation Condition -
Chainage 29.5 km to 30.3 km

maia

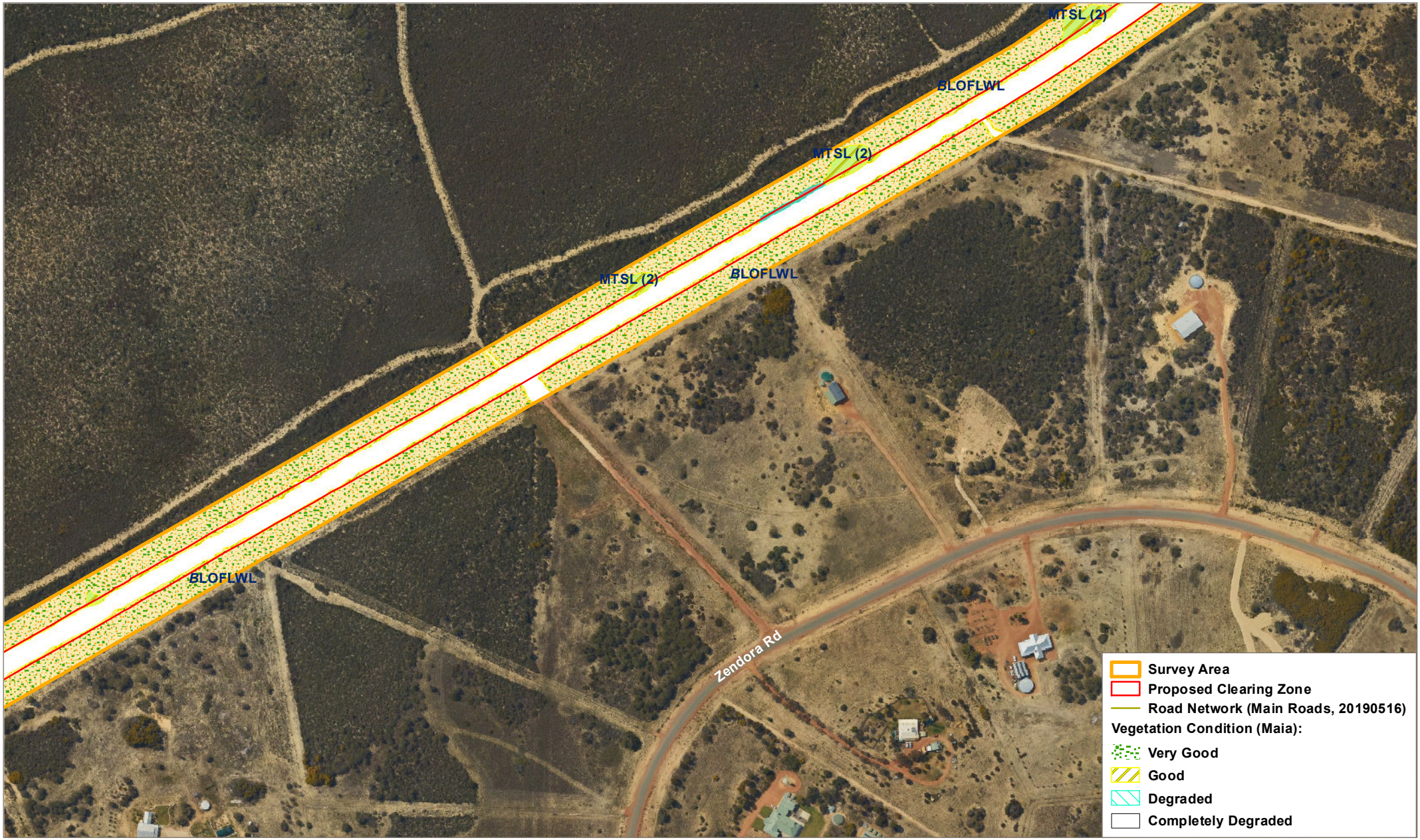
N

0 100

Metres

Datum: GDA 1994, MGA 50

Map: 28
Prepared for: Maia
Drawn by: RH
Date: 5/05/2020
Version: 2 **Size:** A4



Location Map

Vegetation Condition -
Chainage 30.3 km to 31.3 km

maia

N

0 100

Metres

Datum: GDA 1994, MGA 50

Map: 29
Prepared for: Maia
Drawn by: RH
Date: 5/05/2020
Version: 2 **Size:** A4

Location Map

Vegetation Condition -
Chainage 31.3 km to 32.4 km

maia

N

0 100

Metres

Datum: GDA 1994, MGA 50

Map: 30
Prepared for: Maia
Drawn by: RH
Date: 5/05/2020
Version: 2 **Size:** A4

Location Map

Vegetation Condition -
Chainage 32.4 km to 33.5 km

maia

N

0 100

Metres

Datum: GDA 1994, MGA 50

Map: 31
Prepared for: Maia
Drawn by: RH
Date: 5/05/2020
Version: 2 **Size:** A4

Location Map

- Karatha
- Newman
- Wiluna
- Geraldton
- Kalgoorlie
- Perth

Vegetation Condition -
Chainage 33.5 km to 34.5 km

maia

N

0 100

Metres

Datum: GDA 1994, MGA 50

Map: 32
Prepared for: Maia
Drawn by: RH
Date: 5/05/2020
Version: 2 **Size:** A4

Location Map

Vegetation Condition -
Chainage 34.5 km to 35.5 km

maia

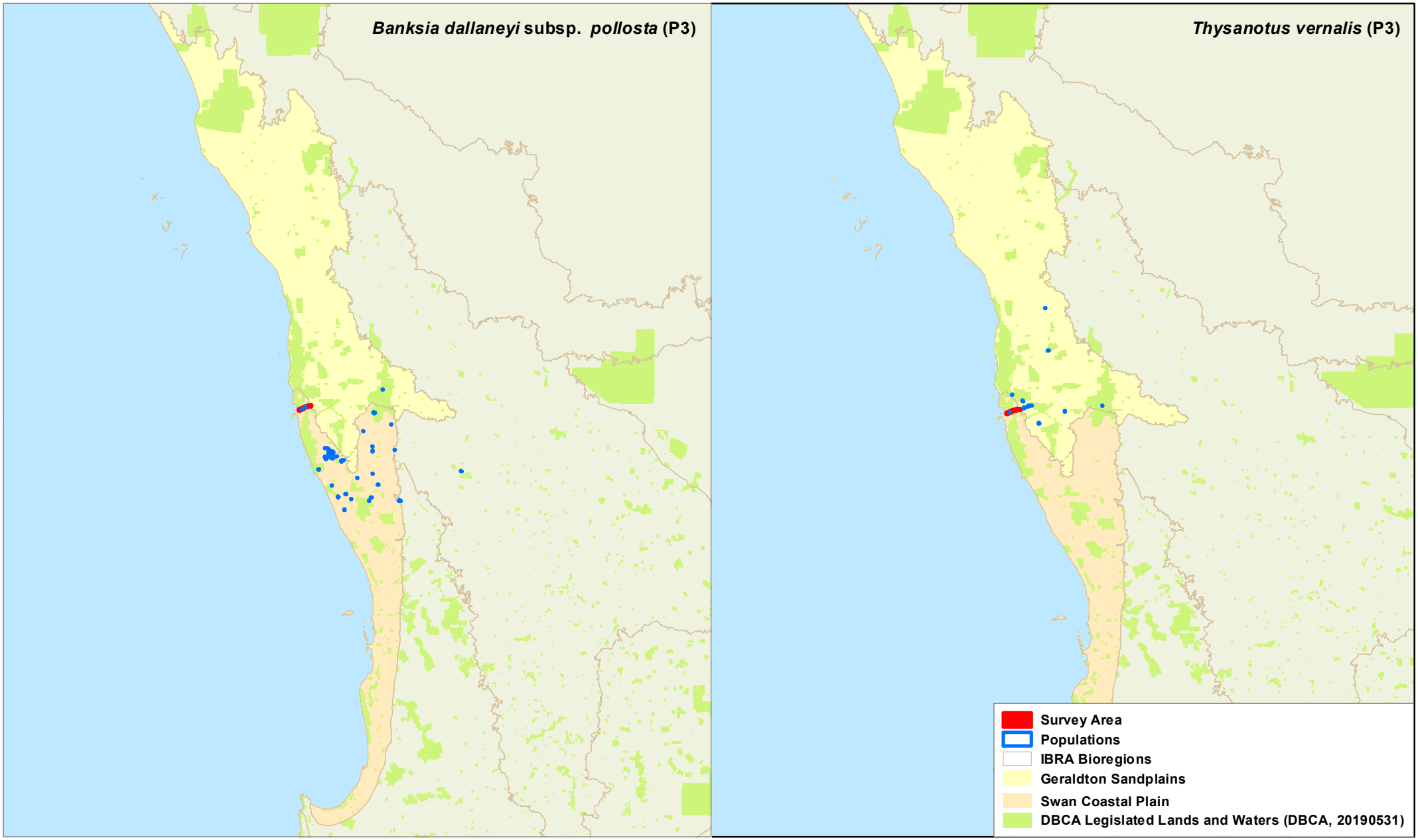
N

0 100

Metres

Datum: GDA 1994, MGA 50

Map: 33
Prepared for: Maia
Drawn by: RH
Date: 15/07/2020
Version: 3 **Size:** A4



Location Map

Distribution of Conservation Significant Flora in WA

maia

N

0 50

Kilometres

Datum: GDA 1994, MGA 50

Map: 34
Prepared for: SofD
Drawn by: RH
Date: 15/07/2020
Version: 2 **Size:** A4

APPENDIX 1: CONSERVATION SIGNIFICANCE; FLORA, FAUNA, ECOLOGICAL COMMUNITIES

Threatened Flora

Some flora species can be protected by Australian Government legislation (*Environment Protection and Biodiversity Conservation Act 1999*, EPBC Act) or by WA legislation (*Biodiversity Conservation Act 2016*, BC Act) (DotEE, 2019b; GoWA, 2016). Species specially protected by these acts are referred to as threatened species and can be listed as critically endangered, endangered, or vulnerable.

On 1 January 2019, the BC Act and *Biodiversity Conservation Regulations 2018* replaced both the *Wildlife Conservation Act 1950* and the *Sandalwood Act 1929* and their associated regulations (DBCA, 2019b; GoWA, 2016 and 2018). The new BC Act and regulations provide greater protection for threatened species and ecological communities.

Priority Flora

Possible threatened species that do not meet survey criteria, or are otherwise data deficient, are added to the Priority Flora List under Priorities (P) 1, 2, 3. These three categories are ranked in order of priority for survey and evaluation of conservation status so that consideration can be given to their declaration as threatened flora. Species that are adequately known, are rare but not threatened, or meet criteria for near threatened, or that have been recently removed from the threatened species list for other than taxonomic reasons, are placed in Priority 4 and require regular monitoring (DBCA, 2019c; Smith & Jones, 2018).

Threatened Fauna

Threatened Fauna are those listed as such under the EPBC Act or BC Act and can be listed as critically endangered, endangered, or vulnerable.

Migratory Fauna

Migratory Fauna are those listed as such under the EPBC Act or the BC Act.

Specially Protected Fauna

Specially Protected Fauna are those listed as such under the BC Act and may be either other specially protected fauna (OS) or conservation dependent fauna (CD).

Priority Fauna

Possible threatened species that do not meet survey criteria, or are otherwise data deficient, are added to the Priority Fauna List under Priorities (P) 1, 2, 3. These three categories are ranked in order of priority for survey and evaluation of conservation status so that consideration can be given to their declaration as threatened fauna. Species that are adequately known, are rare but not threatened, or meet criteria for near threatened, or that have been recently removed from the threatened species list for other than taxonomic reasons, are placed in Priority 4. These species require regular monitoring (DBCA, 2019c).

Threatened Ecological Communities

Some ecological communities are protected by Australian Government legislation (the EPBC Act) based on the perceived levels of threat to the community or species population at a national level. They are listed as threatened

ecological communities – TECs – and can be listed as Critically Endangered, Endangered or Vulnerable (DAWE, 2019c). The communities are listed by state on the DAWE website (DAWE, 2019c; DAWE, 2019d).

In WA, the Minister for Environment previously listed ecological communities as threatened through a non-statutory process if the community was presumed to be totally destroyed or at risk of becoming totally destroyed. The BC Act provides for the statutory listing of TECs by the Minister. The new legislation also describes statutory processes for preparing recovery plans for TECs, the registration of their critical habitat, and penalties for unauthorised modification of TECs. These TECs are listed as presumed totally destroyed, critically endangered, endangered, or vulnerable (DBCA, 2019d).

Priority Ecological Communities

Ecological communities with insufficient information available to be considered a TEC, or which are rare but not currently threatened are placed on a priority list and are referred to as priority ecological communities (PECs; DBCA, 2020a). Definitions, categories and criteria for threatened and priority ecological communities can be found on the DBCA's website (DEC, 2013).

APPENDIX 2: SEARCH RESULTS

Table 20: Database search results - conservation significant flora

Species	Conservation Code	PMST	NM	TPFL	WAHERB
Andersonia gracilis	T (EPBC EN, BC - VU)	•			
Anigozanthos viridis subsp. *terraspectans*	T (EPBC - VU, BC - VU)	•			
Caladenia hoffmanii	T (EPBC EN, BC EN)	•			
Drakaea elastica	T (EPBC EN, BC - CR)	•			
Eucalyptus impensa	T (EPBC EN, BC - CR)	•			
Eucalyptus leprophloia	T (EPBC EN, BC EN)	•			
Eucalyptus suberea	T (EPBC - VU, BC - VU)	•			
Eucalyptus x *balanites*	T (EPBC EN, BC - CR)	•			
Grevillea batrachioides	T (EPBC EN, BC - CR)	•			
Grevillea humifusa	T (EPBC EN, BC - CR)	•			
Hakea megalosperma	T (EPBC - VU, BC - VU)	•			
Hemiandra gardneri	T (EPBC EN, BC - CR)	•			
Paracaleana dixonii	T (EPBC EN, BC - VU)	•			
Tetratheca nephelioides	T (EPBC EN, BC - CR)	•			
Thelymitra stellata	T (EPBC EN, BC EN)	•	•	•	
***Dampiera* sp. Jurien (G. Lullfitz s.n. 10/7/1986)**	P2		•		•
Lepyrodia curvescens	P2		•		•
Scholtzia calcicola	P2		•		•
Synaphea lesueurensis	P2		•		•
Banksia fraseri* var. *crebra	P3		•		•
Guichenotia alba	P3		•		•
Haemodorum loratum	P3		•	•	•
Hensmania stoniella	P3		•		•
Stylidium maritimum	P3		•		•
Thryptomene sp. Lancelin (M.E. Trudgen 14000)	P3		•		•
Grevillea olivacea	P4		•		•
Stylidium inversiflorum	P4		•		•
Xanthosia tomentosa	P4		•		•

Note: PMST = EPBC Act Protected Matters Search Tool (DAWE, 2019a; search reference PMST 3TSOTP); NM = NatureMap search (DBCA, 2007-); TPFL = DBCA Threatened and Priority Flora List (search reference #46-0919FL); WAHERB = DBCA Western Australian Herbarium (search reference #46-0919FL); T = Threatened, P2 – P4 = Priority 2 to Priority 4 species, EPBC = species listed under the Commonwealth's EPBC Act, BC = species listed under the Western Australian BC Act, CR = Critically Endangered, EN = Endangered, VU = Vulnerable; green = species or species habitat likely to occur within the 2.5 km buffered search area, blue = may occur within area. Species in bold in Column 1 indicates species that could potentially occur in the Survey Area based on current known locations and habitats.

Table 21: Database search results - conservation significant fauna

Rank	Breeding known to occur within area	Species or species habitat known to occur within area	Species or species habitat likely to occur within area	Species or species habitat may occur within area	Foraging, feeding, or related behaviour known to occur within area	Translocated population known to occur within area
Threatened (PMST search results, [3] = some fauna are listed in both NatureMap and PMST search results, [2] = Threatened and Migratory fauna species)						
CR			*Calidris ferruginea* (Curlew Sandpiper)[2]	*Limosa lapponica menzbieri* (Northern Siberian Bar-tailed Godwit), *Numenius madagascariensis* (Eastern Curlew)[2]		
E		*Calidrus canutus* (Red Knot)[2], *Calyptorhynchus latirostris* (Carnaby's Black Cockatoo)[3], *Parantechinus apicalis* (Dibbler)[3]	*Rostratula australis* (Australian Painted Snipe)	*Diomedea amsterdamensis* (Amsterdam Albatross)[2], *Macronectes giganteus* (Southern Giant Petrel)[2],[3]	*Diomedea sanfordi* (Northern Royal Albatross)[2]	
V		*Neophoca cinerea* (Australian Sea-lion)[3], *Liopholis pulchra longicauda* (Jurien Bay Skink)[3]	*Leipoa ocellata* (Malleefowl), *Dasyurus geoffroii* (Chuditch)	*Anous tenuirostris melanops* (Australian Lesser Noddy), *Limosa lapponica baueri* (Bar-tailed Godwit (baueri)), *Macronectes halli* (Northern Giant Petrel)[2], *Phoebetria fusca* (Sooty Albatross)[2], *Pterodroma mollis* (Soft-plumaged Petrel), *Thalassarche cauta cauta* (Shy Albatross)[2], *Thalassarche impavida* (Campbell Albatross)[2], *Thalassarche melanophris* (Black-browed Albatross)[2]	*Diomedea epomophora* (Southern Royal Albatross)[2], *Diomedea exulans* (Wandering Albatross)[2], *Sternula nereis nereis* (Australian Fairy Tern)[3], *Thalassarche carteri* (Indian Yellow-nosed Albatross)[2], *Thalassarche cauta steadi* (White-capped Albatross)[2]	*Ctenotus lancelini* (Lancelin Island Skink)[3]
NatureMap only	*Macroderma gigas* (Ghost Bat)[3]					

Rank	Breeding known to occur within area	Species or species habitat known to occur within area	Species or species habitat likely to occur within area	Species or species habitat may occur within area	Foraging, feeding, or related behaviour known to occur within area	Translocated population known to occur within area
Migratory						
PMST search	*Ardenna pacifica* (Wedge-tailed Shearwater), *Hydroprogne caspia* (Caspian Tern)[3], *Onychoprion anaethetus* (Bridled Tern)[3], *Pandion haliaetus* (Osprey)[3], *Thalasseus bergii* (Crested Tern)[3]	*Actitis hypoleucos* (Common Sandpiper)[3], *Limosa lapponica* (Bar-tailed Godwit)[3]	*Anous stolidus* (Common Noddy), *Apus pacificus* (Fork-tailed Swift), *Tringa nebularia* (Common Greenshank)[3]	*Motacillea cinerea* (Grey Wagtail), *Calidris acuminata* (Sharp-tailed Shearwater), *Calidiris melanotos* (Pectoral Sandpiper)	*Ardenna carneipes* (Flesh-footed Shearwater), *Sterna dougallii* (Roseate Tern).	
NatureMap only (not recorded in PMST)	*Arenaria interpres* (Ruddy Turnstone)[3], *Calidris alba* (Sanderling)[3], *Calidris ruficollis* (Red-necked Stint)[3], *Numenius phaeopus* (Whimbrel)[3], *Pandion cristatus* (Eastern Osprey)[3], *Plegadis falcinellus* (Glossy Ibis)[3], *Pluvialis squatarola* (Grey Plover)[3], *Puffinus pacificus* (Wedge-tailed Shearwater)[3], *Tringa glareola* (Wood Sandpiper)[3]					
Other Specially Protected Fauna						
Falco peregrinus (Peregrine Falcon)[3]						
Priority Fauna						
Hylaeus globuliferus (Woolybush Bee)[3] (P3), *Notamacropus irma* (Western Brush Wallaby)[3] (P4), *Synemon gratiosa* (Graceful Sunmoth)[3] (P4), *Thinornis rubricollis* (Hooded Plover)[3] (P4)						

Note: PMST = EPBC Act Protected Matters Search Tool (DotEE, 2019a; search reference PMST O0OEEU); NM = NatureMap search (DBCA, 2007-); [2] = Threatened and Migratory Fauna species; [3] = recorded in NatureMap search (DBCA, 2007-); CR = Critically Endangered, EN = Endangered, VU = Vulnerable; P3 = Priority 3, P4 = Priority 4 species.

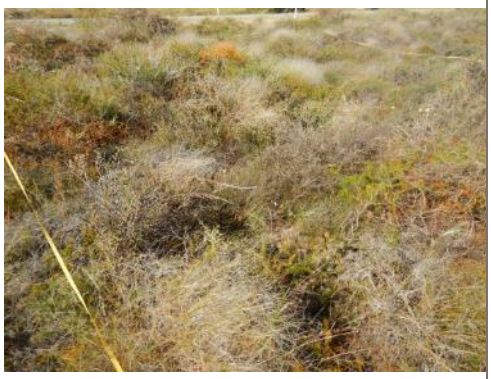
APPENDIX 3: QUADRAT AND RELEVÉ INFORMATION

Note, in this table: P3 = Priority 3 species, ? P3 = potential Priority 3 species, * = environmental weed, REn = regional endemic, REx = range extension, sp. = species, subsp. = subspecies, var. = variety, sp. Indet. = species indeterminate, could not be identified.

Table 22: Quadrat and relevé information

Quadrat: Q28	Described by: CC and MP	Date: 15/10/2019	Photo:
Location (GDA94):	MGA50 324092 mE 6652111 mN		
Habitat:	Sandplain		
Soil:	Grey fine sand loose soil (5%)		
Rocks:	No rocks		
Mapped as:	*E***TOMF**		
Vegetation Type:	Open Mallee Forest of *Eucalyptus todtiana* with a Tussock Grassland of *Ehrharta calycina**, Sparse Tall Shrubland to Isolated Mid Shrubs of *Adenanthos cygnorum* subsp. *cygnorum*		
Vegetation Condition:	Good		
Disturbances:	Weeds		
Fire Age:	Not evident		
Species:	*Adenanthos cygnorum* subsp. *cygnorum*, ***Alexgeorgea subterranea* (REn),** *Banksia prionotes*, ****Briza maxima, *Bromus diandrus, *Bromus hordeaceus, *Ehrharta calycina, *Eragrostis curvula,*** *Eucalyptus todtiana, Lomandra hastilis, Melaleuca leiopyxis, Microtis media* subsp. *media*, *Regelia ciliata, Reichardia tingitana, Stirlingia latifolia, Thysanotus ?manglesianus*		

Quadrat: Q29	Described by: CC and MP	Date: 17/10/2019	Photo:
Location (GDA94):	MGA50 322106 mE 6651588 mN		
Habitat:	Outcrop		
Soil:	Grey fine sand, loose soil (5%)		
Rocks:	Laterite boulders (30%), stones (10%), gravel (20%)		
Mapped as:	**MLOSL** (2)		
Vegetation Type:	Open Low Shrubland of *Gastrolobium oxylobioides* and *Hibbertia sericosepala* with Isolated Mid Shrubs of *Allocasuarina humilis* and *Calothamnus quadrifidus* subsp. *quadrifidus*, Isolated Tussock Grasses of *Neurachne alopecuroidea* and *Austrostipa elegantissima* and Isolated Sedges of *Lepidosperma leptostachyum*, *Ecdeiocolea monostachya* and *Desmocladus asper*		
Vegetation Condition:	Good		
Disturbances:	Weeds		
Fire Age:	Not evident		
Species:	*Acacia acuaria, Acacia dilatata, Acacia lasiocarpa* var. *lasiocarpa*, *Adenanthos cygnorum* subsp. *cygnorum*, *Allocasuarina humilis, Austrostipa elegantissima,* ****Avena barbata, *Briza maxima, *Briza minor, *Bromus diandrus,*** *Burchardia congesta, Calothamnus quadrifidus* subsp. *quadrifidus*, *Calothamnus sanguineus, Cassytha aurea* var. *aurea*, *Dampiera spicigera, Daviesia incrassata* subsp. *incrassata*, *Desmocladus asper, Dianella revoluta* var. *divaricata*, *Ecdeiocolea monostachya,* ****Ehrharta calycina,*** *Gastrolobium oxylobioides, Hakea incrassata, Hibbertia aurea, Hibbertia sericosepala, Hyalosperma cotula, Hypocalymma xanthopetalum, Jacksonia hakeoides, Lepidosperma leptostachyum,** ***Lolium perenne x rigidum,*** *Lyginia barbata,* ****Lysimachia arvensis,*** *Mesomelaena tetragona, Neurachne alopecuroidea,* ****Pentameris airoides,*** *Podolepis gracilis, Podotheca gnaphalioides, Reichardia tingitana, Scaevola repens* subsp. Northern Sandplains (R.J. Cranfield & P.J. Spencer 8445), ****Sonchus oleraceus,*** *Trachymene pilosa,* ****Ursinia anthemoides* subsp. *anthemoides,*** *Xanthorrhoea* ? sp. Lesueurensis, *Xanthosia huegelii*		

Quadrat:	Q30	Described by:	CC and MP		Date:	15/10/2019	Photo:
Location (GDA94):		MGA50	322192	mE	6651646	mN	
Habitat:		Sandplain					
Soil:		Grey-white fine sand loose soil (5%)					
Rocks:		No rocks					
Mapped as:		M**OSL** (1)					
Vegetation Type:		Open Mid Shrubland of *Eremaea beaufortioides* var. *beaufortioides* and *Calothamnus quadrifidus* subsp. *quadrifidus* with an Open Tussock Grassland of *Austrostipa elegantissima* and *Ehrharta calycina**, Sparse Low Shrubland of *Acacia dilatata* and Sparse Sedgeland of *Mesomelaena tetragona*					
Vegetation Condition:		Very Good					
Disturbances:		Weeds					
Fire Age:		Not evident					
Species:		*Acacia dilatata, Allocasuarina microstachya, Austrostipa elegantissima,* ****Avena barbata,*** *Burchardia congesta, Calothamnus quadrifidus* subsp. *quadrifidus*, *Caustis dioica, Conostylis aculeata* subsp. *breviflora*, *Dampiera spicigera, Desmocladus lateriflorus,* ****Ehrharta calycina,*** *Eremaea beaufortioides* var. *beaufortioides*, *Hakea incrassata, Hyalosperma cotula, Hypocalymma xanthopetalum,* ****Hypochaeris glabra, *Lysimachia arvensis,*** *Melaleuca leuropoma, Mesomelaena tetragona, Opercularia vaginata, Pimelea angustifolia, Podolepis gracilis, Ptilotus manglesii, Rytidosperma acerosum, Scaevola repens* subsp. Northern Sandplains (R.J. Cranfield & P.J. Spencer 8445), *Scholtzia umbellifera,* ****Sonchus oleraceus,*** *Trachymene pilosa,* ****Ursinia anthemoides*** **subsp.** ***anthemoides***					

Quadrat:	Q31	Described by:	CC and MP		Date:	15/10/2019	Photo:
Location (GDA94):		MGA50	320819	mE	6651336	mN	
Habitat:		Minor depression					
Soil:		Dark brown loam loose soil (3%)					
Rocks:		No rocks					
Mapped as:		*E***TOF**					
Vegetation Type:		Closed Tussock Grassland of *Lolium perenne* x *rigidum** and *Ehrharta calycina** with an Open Tall Forest of *Eucalyptus rudis* subsp. *rudis*, Low Woodland and Open Tall Shrubland of *Melaleuca rhaphiophylla* and Sparse Mid Shrubland of *Acacia cyclops*					
Vegetation Condition:		Good					
Disturbances:		Weeds					
Fire Age:		Not evident					
Species:		*Acacia cyclops,* ****Bromus diandrus, *Ehrharta calycina,*** *Eucalyptus rudis* subsp. *rudis*, ****Lolium perenne* x *rigidum*,*** *Melaleuca rhaphiophylla,* ****Rumex crispus, *Solanum nigrum***					

Quadrat:	Q32	Described by:	CC and MP		Date:	15/10/2019	Photo:
Location (GDA94):		MGA50	320284	mE	6651194	mN	
Habitat:		Hill (gentle hillslope)					
Soil:		Grey-brown fine sand loose soil (20%)					
Rocks:		Laterite surface plates (2%)					
Mapped as:		*B***LOFLWL**					
Vegetation Type:		Open Tall Shrubland of *Scholtzia umbellifera* with an Open Low Woodland of *Banksia prionotes* and *Banksia menziesii*, Sparse Mid Shrubland of *Scholtzia umbellifera*, *Hibbertia sericosepala* and *Adenanthos cygnorum* subsp. *cygnorum* and Sparse Low Shrubland of *Hibbertia sericosepala* and *Acacia lasiocarpa* var. *lasiocarpa*					
Vegetation Condition:		Very Good					
Disturbances:		Weeds					
Fire Age:		Not evident					
Species:		*Acacia lasiocarpa* var. *lasiocarpa*, *Acacia pulchella* var. *glaberrima*, *Adenanthos cygnorum* subsp. *cygnorum*, *Amphipogon* sp. Indet, *Anigozanthos manglesii, Arnocrinum preissii, Banksia menziesii, Banksia prionotes, Bossiaea eriocarpa,* ****Briza maxima,*** *Calytrix strigosa, Cassytha racemosa, Conostylis aculeata* subsp. *spinuligera*, *Conostylis candicans* subsp. *calcicola*, *Corynotheca micrantha, Desmocladus asper, Dianella revoluta* var. *divaricata*, ****Ehrharta calycina,*** *Hibbertia hypericoides, Hibbertia sericosepala, Hybanthus calycinus, Hypocalymma xanthopetalum, Lechenaultia linarioides, Lepidobolus preissianus* subsp. *preissianus*, *Lepidosperma scabrum, Mesomelaena tetragona, Scholtzia umbellifera, Trachymene pilosa,* ****Wahlenbergia capensis,*** *Xanthosia huegelii*					

Quadrat:	Q33	Described by:	CC and MP		Date:	15/10/2019	Photo:
Location (GDA94):		MGA50	319006	mE	6650906	mN	
Habitat:		Low rolling hill (very gentle upperslope)					
Soil:		Brown sandy-loam loose soil (>1%)					
Rocks:		No rocks					
Mapped as:		*B***LOFLWL**					
Vegetation Type:		Low Woodland of *Banksia prionotes* with a Sparse Tall Shrubland of *Xanthorrhoea preissii*, Sparse Mid Shrubland of *Allocasuarina humilis*, *Eremaea beaufortioides* var. *beaufortioides* and *Banksia sphaerocarpa* var. *sphaerocarpa* and Sparse Sedgeland of *Mesomelaena tetragona*					
Vegetation Condition:		Very Good					
Disturbances:		Wind damage					
Fire Age:		Not evident					
Species:		*Allocasuarina humilis, Austrostipa compressa, Austrostipa elegantissima, Banksia* ?*sphaerocarpa*, *Banksia prionotes, Banksia sphaerocarpa* var. *sphaerocarpa*, *Calectasia narragara, Cassytha glabella, Conostylis aculeata* subsp. *spinuligera*, *Conostylis teretifolia* subsp. *teretifolia*, *Cryptandra intermedia, Drosera omissa, Drosera pallida, Eremaea asterocarpa* subsp. *asterocarpa*, *Eremaea beaufortioides* var. *beaufortioides*, *Eremaea pauciflora* var. *lonchophylla*, *Gompholobium tomentosum, Hypocalymma xanthopetalum, Johnsonia pubescens* subsp. *pubescens*, *Lepidosperma scabrum, Levenhookia stipitata, Lyginia barbata, Melaleuca leuropoma, Mesomelaena tetragona, Patersonia occidentalis* var. *occidentalis*, *Persoonia comata, Petrophile linearis, Pterostylis vittata, Scaevola canescens, Stylidium crossocephalum, Stylidium cygnorum, Thysanotus thyrsoideus, Trachymene pilosa, Xanthorrhoea preissii, Xanthosia huegelii*					

Quadrat:	Q34	Described by:	CC and MP		Date:	15/10/2019	Photo:
Location (GDA94):		MGA50	318179	mE	6650552	mN	
Habitat:		Minor depression					
Soil:		Yellow fine sand loose soil (10%)					
Rocks:		No rocks					
Mapped as:		*B***LOFLWL**					
Vegetation Type:		Low Woodland of *Banksia prionotes* with a Sparse Tall Shrubland of *Adenanthos cygnorum* subsp. *cygnorum*, *Acacia cyclops* and *Banksia sessilis* var. *cygnorum*, Sparse Mid Shrubland of *Eremaea pauciflora* var. *lonchophylla* and Isolated Low Shrubs of *Synaphea spinulosa* subsp. *spinulosa*					
Vegetation Condition:		Very Good					
Disturbances:		Weeds					
Fire Age:		Not evident					
Species:		*Acacia cyclops, Adenanthos cygnorum* subsp. *cygnorum*, *Allocasuarina humilis, Austrostipa elegantissima, ***Avena barbata,** Banksia prionotes, Banksia sessilis* var. *cygnorum*, *****Briza maxima, *Bromus diandrus,** Conostylis candicans* subsp. *candicans*, *Desmocladus asper, ***Ehrharta calycina,** Eremaea pauciflora* var. *lonchophylla*, *Hemiphora bartlingii, Hypocalymma xanthopetalum, ***Hypochaeris glabra,** Jacksonia nutans, ***Lysimachia arvensis,** Mesomelaena tetragona, Podotheca gnaphalioides, Reichardia tingitana, Schoenus grandiflorus, Synaphea spinulosa* subsp. *spinulosa*, *Thysanotus dichotomus, Trachymene pilosa, ***Ursinia anthemoides*** **subsp. *anthemoides***					

Quadrat:	Q35	Described by:	CC and MP		Date:	16/10/2019	Photo:
Location (GDA94):		MGA50	317821	mE	6650320	mN	
Habitat:		Hill (gentle north-east facing upperslope)					
Soil:		Brown-white fine sand loose soil (5%)					
Rocks:		No rocks					
Mapped as:		*B***LOFLWL**					
Vegetation Type:		Open Low Forest of *Banksia prionotes* with an Open Mid Shrubland of *Banksia sphaerocarpa* var. *sphaerocarpa*, *Scholtzia umbellifera* and *Hibbertia sericosepala*, Sparse Low Shrubland of *Hibbertia sericosepala*, Sparse Sedgeland of *Mesomelaena tetragona* and Isolated Tussock Grasses of *Austrostipa elegantissima*					
Vegetation Condition:		Excellent					
Disturbances:		Weeds					
Fire Age:		Not evident					
Species:		*Allocasuarina humilis, Asteridea pulverulenta, Austrostipa compressa, Austrostipa elegantissima, Austrostipa* sp. Indet, *Banksia prionotes, Banksia sphaerocarpa* var. *sphaerocarpa*, *****Bromus hordeaceus,** Burchardia congesta, Conostylis candicans* subsp. *calcicola*, *Desmocladus asper, Desmocladus flexuosus, Gompholobium tomentosum, Hibbertia sericosepala, Hypocalymma xanthopetalum, Jacksonia nutans, Lyginia barbata, Melaleuca leiopyxis, Melaleuca leuropoma, Mesomelaena tetragona, Scaevola canescens, Scholtzia umbellifera, ***Sonchus oleraceu*,** Trachymene pilosa, Xanthosia huegelii*					

Quadrat: Q36	Described by:	CC and MP		Date:	16/10/2019	Photo:
Location (GDA94):	MGA50	316811	mE	6649737	mN	
Habitat:	Low rolling hill (gentle upperslope)					
Soil:	Yellow fine sand loose soil (20%)					
Rocks:	No rocks					
Mapped as:	*B***LOFLWL**					
Vegetation Type:	Open Low Forest of *Banksia prionotes* with a Sparse Mid Shrubland of *Banksia sphaerocarpa* var. *sphaerocarpa*, Isolated Low Shrubs of *Gompholobium tomentosum* and *Hypocalymma xanthopetalum*, Isolated Tussock Grasses of *Austrostipa elegantissima* and Isolated Sedges of *Mesomelaena tetragona*					
Vegetation Condition:	Very Good					
Disturbances:	Weeds					
Fire Age:	Not evident					
Species:	*Acacia cyclops, Allocasuarina humilis, Austrostipa elegantissima,* ****Avena barbata,*** *Banksia prionotes, Banksia sessilis* var. *cygnorum*, *Banksia sphaerocarpa* var. *sphaerocarpa*, *Burchardia congesta, Calothamnus quadrifidus* subsp. *quadrifidus*, *Conospermum stoechadis* subsp. *stoechadis*, *Conostylis candicans* subsp. *calcicola*, *Daucus glochidiatus, Desmocladus asper, Desmocladus flexuosus, Dianella revoluta* var. *divaricata*, ****Ehrharta calycina,*** *Eremaea pauciflora* var. *lonchophylla*, *Eremaea* sp. Indet., *Gompholobium tomentosum, Hibbertia sericosepala, Hypocalymma xanthopetalum,* ****Hypochaeris glabra,*** *Lechenaultia linarioides, Mesomelaena tetragona,* ****Pelargonium capitatum,*** *Reichardia tingitana, Scholtzia umbellifera,* ****Sonchus oleraceus,*** *Stenanthemum notiale* subsp. *notiale*, *Trachymene pilosa,* ****Ursinia anthemoides*** **subsp. *anthemoides***					

Quadrat: Q37	Described by:	CC and MP		Date:	16/10/2019	Photo:
Location (GDA94):	MGA50	315924	mE	6649232	mN	
Habitat:	Hill / dune (gentle midslope)					
Soil:	Yellow-white fine sand loose soil (10%)					
Rocks:	Limestone boulders (5%)					
Mapped as:	M**SL**					
Vegetation Type:	Open Mid Shrubland of *Banksia sessilis* var. *cygnorum* and *Melaleuca cardiophylla* with a Sparse Low Shrubland of *Hibbertia sericosepala* and *Petrophile brevifolia* subsp. *brevifolia*					
Vegetation Condition:	Very Good					
Disturbances:	Weeds					
Fire Age:	Old (more than 5 years)					
Species:	*Acacia lasiocarpa* var. *lasiocarpa*, *Allocasuarina humilis, Banksia sessilis* var. *cygnorum*, ****Bromus diandrus,*** *Burchardia congesta, Calothamnus quadrifidus* subsp. *quadrifidus*, *Conospermum stoechadis* subsp. *stoechadis*, *Desmocladus flexuosus,* ***Grevillea preissii*** **subsp. *glabrilimba* (REn),** *Hakea trifurcata, Hibbertia racemosa, Hibbertia sericosepala, Hypocalymma xanthopetalum, Labichea cassioides, Lyginia barbata,* ****Lysimachia arvensis,*** *Melaleuca cardiophylla, Mesomelaena tetragona,* ***Olearia revoluta*** **(REx),** *Petrophile axillaris,* ***Petrophile brevifolia*** **subsp. *brevifolia* (REx),** *Podotheca gnaphalioides, Scaevola canescens, Stylidium crossocephalum, Tetraria octandra,* ***Thysanotus* ? *vernalis* (?P3),** *Trachymene pilosa,* ****Ursinia anthemoides*** **subsp. *anthemoides*, **Vulpia bromoides***					

Quadrat: Q38	Described by:	CC and MP		Date:	16/10/2019	Photo:
Location (GDA94):	MGA50	315176	mE	6648795	mN	
Habitat:	Sand dune (gentle east facing midslope)					
Soil:	Yellow-white fine sand loose soil (20%)					
Rocks:	No rocks					
Mapped as:	*B***LOFLWL**					
Vegetation Type:	Open Mid Shrubland of *Eremaea pauciflora* var. *lonchophylla* and *Melaleuca leuropoma* with an Open Low Woodland of *Banksia prionotes* and *Banksia attenuata*, Sparse Low Shrubland of *Hibbertia sericosepala* and Sparse Sedgeland of *Mesomelaena tetragona*					
Vegetation Condition:	Very Good					
Disturbances:	Weeds					
Fire Age:	Not evident					
Species:	*Acacia cyclops, Acacia lasiocarpa* var. *lasiocarpa*, *Austrostipa elegantissima, Austrostipa flavescens, Banksia attenuata, Banksia menziesii, Banksia prionotes,* ****Briza maxima *Bromus diandrus,*** *Calothamnus quadrifidus* subsp. *quadrifidus*, *Conostylis candicans* subsp. *calcicola, Corynotheca micrantha, Daucus glochidiatus, Desmocladus asper, Desmocladus flexuosus, Dianella revoluta* var. *divaricata*, ****Ehrharta calycina,*** *Eremaea pauciflora* var. *lonchophylla*, *Gompholobium tomentosum, Hibbertia sericosepala,* ****Hypochaeris glabra,*** *Isotropis cuneifolia* subsp. *cuneifolia*, *Lyginia barbata,* ****Lysimachia arvensis,*** *Melaleuca leiopyxis, Melaleuca leuropoma, Mesomelaena tetragona,* ***Petrophile brevifolia*** **subsp. *brevifolia* (REx),** *Petrophile macrostachya, Reichardia tingitana, Scaevola canescens, Scholtzia umbellifera, Synaphea spinulosa* subsp. *spinulosa*, *Trachymene pilosa,* ****Ursinia anthemoides*** **subsp. *anthemoides***					

Quadrat:	Q39	Described by:	CC and MP	Date:	17/10/2019	Photo:
Location (GDA94):		MGA50	323638 mE	6652030 mN		
Habitat:		Seasonally inundated wetland				
Soil:		Dark brown loam loose soil (50%)				
Rocks:		No rocks				
Mapped as:		*M***OSL** (2)				
Vegetation Association:		Open Mid Shrubland of *Melaleuca viminea* subsp. *viminea* with Open Sedgeland of *Typha* sp. Indet.				
Vegetation Condition:		Very Good				
Disturbances:		Weeds				
Fire Age:		Not evident				
Species:		***Atriplex prostrata**** **(REx),** *Austrostipa elegantissima,* ****Briza minor,*** *Cassytha racemosa,* ****Cyperus congestus,*** *Ficinia nodosa, Melaleuca viminea* subsp. *viminea*, *Sporobolus virginicus,* ****Symphyotrichum squamatum,*** *Typha* sp. Indet.				

Quadrat:	Q40	Described by:	SH and RH	Date:	16/10/2019	Photo:
Location (GDA94):		MGA50	313946 mE	6648255 mN		
Habitat:		Swale				
Soil:		White fine sand loose soil (100%)				
Rocks:		None				
Mapped as:		M**TSL** (2)				
Vegetation Type:		Closed Tussock Grassland of *Lolium perenne* x *rigidum** and *Lysimachia arvensis** with a Mid to Low Shrubland of *Spyridium globulosum* and *Melaleuca huegelii*				
Vegetation Condition:		Very Good				
Disturbances:		Weeds				
Fire Age:		Not evident				
Species:		*Acacia lasiocarpa* var. *lasiocarpa*, *Acacia rostellifera, Austrostipa elegantissima,* ****Avena barbata, *Bromus diandrus,*** *Cassytha racemosa, Clematis linearifolia,* ****Ehrharta longiflora,*** *Gahnia trifida, Gompholobium tomentosum, Haloragis* sp. Indet., *Hardenbergia comptoniana,* ****Lolium perenne* x *rigidum*,*** *Lomandra maritima,* ****Lysimachia arvensis,*** *Melaleuca huegelii, Myoporum insulare, Opercularia vaginata,* Poaceae sp. Indet., ****Romulea rosea, *Sonchus* sp. Indet.,*** *Spyridium globulosum, Stenanthemum notiale* subsp. *notiale*, *Templetonia retusa, Tricoryne elatior*				

Quadrat:	Q41	Described by:	SH and RH	Date:	15/10/2019	Photo:
Location (GDA94):		MGA50	313526 mE	6648069 mN		
Habitat:		Swale				
Soil:		White fine sand loose soil (100%)				
Rocks:		No rocks				
Mapped as:		**MLOSL** (1)				
Vegetation Type:		Open Low Shrubland of *Melaleuca leuropoma* and *Acacia lasiocarpa* var. *lasiocarpa* with a Sparse Tussock Grassland of *Vulpia bromoides** and *Lolium perenne* x *rigidum**				
Vegetation Condition:		Good				
Disturbances:		Weeds				
Fire Age:		Not evident				
Species:		*Acacia cyclops, Acacia lasiocarpa* var. *lasiocarpa*, *Acanthocarpus preissii, Austrostipa flavescens, Brachyscome pusilla,* ****Bromus diandrus,*** *Conostylis candicans* subsp. *calcicola*, *Crassula colorata* var. *acuminata*, ****Crassula glomerata,*** *Desmocladus asper, Lepidosperma calcicola,* ****Lolium perenne* x *rigidum*,*** *Lomandra maritima, Melaleuca leuropoma, Olearia axillaris, Opercularia spermacocea, Phyllanthus calycinus, Podotheca angustifolia, Ptilotus stirlingii* subsp. *stirlingii, Reichardia tingitana, Roepera similis,* ****Romulea rosea,*** *Trachymene pilosa,* ****Vulpia bromoides***				

Quadrat:	Q42	Described by:	SH and RH		Date:	15/10/2019	Photo:
Location (GDA94):		MGA50	313713	mE	6648196	mN	
Habitat:		Sand dune (gentle hilltop)					
Soil:		White fine sand loose soil (100%)					
Rocks:		No rocks					
Mapped as:		M**TSL** (2)					
Vegetation Type:		Tall Shrubland of *Acacia rostellifera* and *Melaleuca huegelii* with an Open Tussock Grassland of *Lolium perenne* x *rigidum**					
Vegetation Condition:		Good					
Disturbances:		Weeds					
Fire Age:		Not evident					
Species:		*Acacia rostellifera*, ***Bromus diandrus,** Clematis linearifolia, Desmocladus asper, ***Ehrharta longiflora, *Lolium perenne* x ***rigidum,** Lomandra maritima, Melaleuca huegelii, Myoporum insulare, Opercularia echinocephala, ***Sonchus* sp. Indet.,** *Spyridium globulosum*					

Quadrat:	Q43	Described by:	CC, MP and RH		Date:	17/10/2019	Photo:
Location (GDA94):		MGA50	323795	mE	6652026	mN	
Habitat:		Saline plain (edge of wetland)					
Soil:		Grey-yellow sandy-loam surface crust (70%)					
Rocks:		No rocks					
Mapped as:		*T***LSSSL**					
Vegetation Type:		Sparse Samphire Shrubland of *Tecticornia indica* subsp. *bidens* and *Tecticornia pergranulata* subsp. *pergranulata* with a Sparse Tussock Grassland of *Lolium perenne* x *rigidum** and Isolated Mid Shrubs of *Melaleuca acutifolia*					
Vegetation Condition:		Good					
Disturbances:		Weeds					
Fire Age:		Not evident					
Species:		Aizoaceae sp. Indet., ***Briza maxima, *Briza minor, *Centaurium erythraea,** *Centrolepis polygyna*, ***Cotula coronopifolia, *Ehrharta longiflora,** *Gnephosis tenuissima*, ***Hordeum leporinum, *Hypochaeris glabra, Isolepis hookeriana* (REx), *Juncus bufonius, *Lolium perenne* x ***rigidum*, *Lysimachia arvensis,** *Melaleuca acutifolia*, *Platysace* sp. Indet., *Pogonolepis stricta*, ***Romulea rosea,** *Tecticornia indica* subsp. *bidens*, *Tecticornia pergranulata* subsp. *pergranulata*, *Triglochin mucronata*					

Quadrat:	Q44	Described by:	CC and MP		Date:	17/10/2019	Photo:
Location (GDA94):		MGA50	320513	mE	6651253	mN	
Habitat:		Sandplain					
Soil:		Brown sandy-loam loose soil (20%)					
Rocks:		No rocks					
Mapped as:		*B***LOFLWL**					
Vegetation Type:		Open Low Forest of *Banksia menziesii* and *Banksia prionotes* with a Tall Shrubland of *Scholtzia laxiflora*					
Vegetation Condition:		Very Good					
Disturbances:		Weeds					
Fire Age:		Not evident					
Species:		*Acacia lasiocarpa* var. *lasiocarpa*, *Acacia pulchella* var. *glaberrima*, *Amphipogon* sp. Indet., *Banksia menziesii, Banksia prionotes, ***Briza maxima,** *Conostylis candicans* subsp. *calcicola*, *Conostylis candicans* subsp. *candicans*, *Corynotheca micrantha* var. *micrantha*, ***Ehrharta calycina,** *Gompholobium tomentosum, Hypocalymma xanthopetalum, Jacksonia hakeoides, Lepidosperma scabrum, Leucopogon conostephioides, Lyginia barbata, Melaleuca leiopyxis, Mesomelaena tetragona,* ***Petrophile brevifolia* subsp. *brevifolia* (REx),** *Pterostylis vittata, Schoenus grandiflorus, Scholtzia laxiflora, Trachymene pilosa, ***Ursinia anthemoides* subsp. *anthemoides***					

Quadrat:	Q45	Described by:	CC and MP		Date:	17/10/2019	Photo:
Location (GDA94):		MGA50	316420	mE	6649516	mN	
Habitat:		Sand dune (gentle north facing upperslope)					
Soil:		White fine sand loose soil (10%)					
Rocks:		Limestone surface plates (2%)					
Mapped as:		M**SL**					
Vegetation Type:		Mid Shrubland of *Banksia sessilis* var. *cygnorum* and *Hakea trifurcata* with an Open Low Shrubland of *Labichea cassioides* and Open Sedgeland of *Desmocladus flexuosus*					
Vegetation Condition:		Excellent					
Disturbances:		Weeds					
Fire Age:		Not evident					
Species:		***Avena barbata,** *Banksia sessilis* var. *cygnorum*, ***Bromus diandrus,** *Calothamnus quadrifidus* subsp. *quadrifidus*, *Conostylis candicans* subsp. *calcicola*, *Desmocladus flexuosus*, ***Grevillea preissii* subsp. *glabrilimba* (REn),** *Hakea lissocarpha, Hakea trifurcata, Hibbertia sericosepala, Labichea cassioides, ***Lysimachia arvensis,** *Melaleuca* ? *viminea*, *Melaleuca leuropoma, Petrophile axillaris, Scholtzia laxiflora, Trachymene pilosa, ***Ursinia anthemoides* subsp. *anthemoides***					

Relevé:	R46/JER-T01	Described by:	CC, MP and RH		Date:	17/10/2019	Photo:
Location (GDA94):		MGA50	32286	mE	6651799	mN	
Habitat:		Seasonally inundated wetland					
Soil:		Brown loam loose soil (5%)					
Rocks:		Laterite gravel (5%)					
Mapped as:		*M***TSL** (1)					
Vegetation Type:		Tall Shrubland of *Melaleuca rhaphiophylla* with a Low Woodland of *Melaleuca preissiana*, Open Tussock Grassland of *Lolium perenne* x *rigidum** and *Chloris gayana** and a Sparse Sedgeland of *Gahnia trifida* and *Typha* sp. Indet.					
Vegetation Condition:		Good					
Disturbances:		Weeds					
Fire Age:		Not evident					
Species:		*Acacia lasiocalyx, Baumea juncea, ***Bromus hordeaceus,** *Cassytha racemosa, ***Chloris gayana, *Cyperus congestus, *Eragrostis curvula,** *Gahnia trifida, Hakea varia, ***Lolium perenne* x *rigidum***, *Melaleuca incana* subsp. *incana*, *Melaleuca preissiana, Melaleuca rhaphiophylla, Melaleuca viminea* subsp. *viminea*, ***Ornithopus sativus,** *Sporobolus virginicus, Stylidium rigidulum, Typha* sp. Indet., *Viminaria juncea*					

Relevé:	R47/JER-T02	Described by:	CC, MP and RH		Date:	17/10/2019	Photo:
Location (GDA94):		MGA50	32348	mE	6651967	mN	
Habitat:		Seasonally inundated wetland					
Soil:		Dark brown loam loose soil (20%)					
Rocks:		No rocks					
Mapped as:		*M***TSL** (1)					
Vegetation Type:		Low Woodland to Open Tall Shrubland of *Melaleuca preissiana* with an Open Tussock Grassland of *Sporobolus virginicus* and Open Sedgeland of *Baumea juncea*					
Vegetation Condition:		Good					
Disturbances:		Weeds					
Fire Age:		Not evident					
Species:		*Acacia lasiocalyx, ***Avena barbata,** *Baumea juncea, ***Briza maxima, *Bromus diandrus, *Bromus hordeaceus,** *Callitris pyramidalis, ***Chloris gayana, *Cyperus congestus,** *Dianella revoluta* var. *divaricata*, ***Ehrharta calycina, *Eragrostis curvula,** *Ficinia nodosa, ***Gladiolus caryophyllaceus,** *Juncus pallidus, Lobelia anceps, ***Lolium perenne* x *rigidum*, *Lysimachia arvensis,** *Melaleuca preissiana, ***Oenothera drummondii* subsp. *drummondii*, *Paspalum dilatatum,** *Reichardia tingitana, ***Solanum nigrum, *Sonchus asper, *Sonchus oleraceus,** *Sporobolus virginicus, Spyridium globulosum, ***Symphyotrichum squamatum,** *Typha* sp. Indet., *Viminaria juncea*					

APPENDIX 4: FLORA SPECIES LIST

Table 23: Flora species list

Family	Taxa	FlFr	Quadrat	Relevé	OppColl
Aizoaceae	Aizoaceae sp. Indet.		•		
Amaranthaceae	*Ptilotus manglesii*	Fl	•		•
Amaranthaceae	*Ptilotus stirlingii* subsp. *stirlingii*	Fl	•		
Anarthriaceae	*Lyginia barbata*	FlFr	•		
Apiaceae	*Daucus glochidiatus*	Fr	•		
Apiaceae	*Platysace* sp. Indet.		•		
Apiaceae	*Xanthosia huegelii*	Fl	•		
Araliaceae	*Trachymene pilosa*	FlFr	•		
Asparagaceae	*Acanthocarpus preissii*	Fl	•		
Asparagaceae	*Lomandra hastilis*	Fr	•		
Asparagaceae	*Lomandra maritima*		•		
Asparagaceae	*Thysanotus arbuscula*	FlFr			•
Asparagaceae	*Thysanotus arenarius*	Fl			•
Asparagaceae	*Thysanotus asper*	Fl			•
Asparagaceae	*Thysanotus dichotomus*		•		
Asparagaceae	*Thysanotus manglesianus*				•
Asparagaceae	*Thysanotus* ? *manglesianus*		•		
Asparagaceae	*Thysanotus thyrsoideus*	Fr	•		
Asparagaceae	*Thysanotus triandrus*	Fl			•
Asparagaceae	***Thysanotus* ? *vernalis* (?P3)**		•		
Asteraceae	****Arctotheca calendula***	Fl			•
Asteraceae	*Asteridea pulverulenta*	Fl	•		
Asteraceae	*Brachyscome pusilla*	Fl	•		
Asteraceae	****Centaurea melitensis***	Fl			•
Asteraceae	****Cotula coronopifolia****	FlFr	•		
Asteraceae	****Gazania linearis***	Fl			•
Asteraceae	*Gnephosis tenuissima*	Fl	•		
Asteraceae	*Hyalosperma cotula*	Fl	•		
Asteraceae	****Hypochaeris glabra***	FlFr	•		
Asteraceae	*Olearia axillaris*		•		
Asteraceae	***Olearia revoluta* (REx)**		•		
Asteraceae	*Podolepis gracilis*	Fl	•		
Asteraceae	*Podotheca angustifolia*	Fl	•		
Asteraceae	*Podotheca gnaphalioides*	Fl	•		•
Asteraceae	*Pogonolepis stricta*	Fl	•		
Asteraceae	*Reichardia tingitana*	FlFr	•	•	•
Asteraceae	****Sonchus asper***			•	
Asteraceae	****Sonchus oleraceus***	FlFr	•	•	•
Asteraceae	****Sonchus* sp. Indet.**		•		
Asteraceae	****Symphyotrichum squamatum***	FlFr	•	•	
Asteraceae	****Ursinia anthemoides* subsp. *anthemoides***	Fl	•		•
Brassicaceae	****Raphanus raphanistrum***	Fr			•
Campanulaceae	*Lobelia anceps*	Fl		•	
Campanulaceae	****Wahlenbergia capensis***	Fr	•		
Casuarinaceae	*Allocasuarina humilis*	Fr	•		•
Casuarinaceae	*Allocasuarina microstachya*	Fl	•		•
Centrolepidaceae	*Centrolepis polygyna*	Fr	•		

Family	Taxa	FlFr	Quadrat	Relevé	OppColl
Chenopodiaceae	***Atriplex prostrata* (REx)**	Fr	•		
Chenopodiaceae	*Tecticornia indica* subsp. *bidens*	Fl	•		
Chenopodiaceae	*Tecticornia pergranulata* subsp. *pergranulata*		•		
Colchicaceae	*Burchardia congesta*	Fr	•		
Crassulaceae	*Crassula colorata* var. *acuminata*	Fl	•		
Crassulaceae	***Crassula glomerata***	Fr	•		
Cupressaceae	*Callitris preissii*	Fr			•
Cupressaceae	*Callitris pyramidalis*	Fr		•	
Cyperaceae	*Baumea juncea*	Fr		•	
Cyperaceae	*Caustis dioica*		•		
Cyperaceae	***Cyperus congestus***	Fl	•	•	
Cyperaceae	*Ficinia nodosa*	Fr	•	•	
Cyperaceae	*Gahnia trifida*	Fr	•	•	
Cyperaceae	***Isolepis hookeriana* (REx)**	Fl	•		
Cyperaceae	*Lepidosperma calcicola*	Fr	•		
Cyperaceae	*Lepidosperma leptostachyum*		•		
Cyperaceae	*Lepidosperma scabrum*	Fr	•		
Cyperaceae	*Mesomelaena tetragona*	Fr	•		
Cyperaceae	*Schoenus grandiflorus*	Fr	•		•
Cyperaceae	*Tetraria octandra*	Fl	•		
Dasypogonaceae	*Calectasia narragara*	Fl	•		
Dasypogonaceae	*Dasypogon obliquifolius*	Fl			•
Dilleniaceae	*Hibbertia aurea*	Fr	•		
Dilleniaceae	*Hibbertia hypericoides*	Fl	•		
Dilleniaceae	*Hibbertia racemosa*	Fl	•		
Dilleniaceae	*Hibbertia sericosepala*	Fl	•		
Droseraceae	*Drosera omissa*	Fl	•		
Droseraceae	*Drosera pallida*	Fl	•		
Ecdeiocoleaceae	*Ecdeiocolea monostachya*	Fr	•		
Ericaceae	*Leucopogon conostephioides*		•		
Euphorbiaceae	*Adriana quadripartita*	Fr			•
Fabaceae	*Acacia acuaria*		•		
Fabaceae	*Acacia auronitens*	Fr			•
Fabaceae	*Acacia cyclops*	FlFr	•		
Fabaceae	*Acacia dilatata*	FlFr	•		•
Fabaceae	*Acacia lasiocalyx*	Fr		•	
Fabaceae	*Acacia lasiocarpa* var. *lasiocarpa*	Fr	•		•
Fabaceae	*Acacia pulchella* var. *glaberrima*	Fr	•		•
Fabaceae	*Acacia rostellifera*	Fl	•		•
Fabaceae	*Acacia stenoptera*	Fr			•
Fabaceae	*Bossiaea eriocarpa*		•		
Fabaceae	*Daviesia divaricata* subsp. *divaricata*	Fr			•
Fabaceae	*Daviesia incrassata* subsp. *incrassata*	Fr	•		
Fabaceae	*Gastrolobium oxylobioides*	Fl	•		
Fabaceae	*Gompholobium tomentosum*	FlFr	•		
Fabaceae	*Hardenbergia comptoniana*	Fl	•		
Fabaceae	*Isotropis cuneifolia* subsp. *cuneifolia*	Fr	•		
Fabaceae	*Jacksonia hakeoides*	Fr	•		•
Fabaceae	*Jacksonia nutans*		•		
Fabaceae	*Labichea cassioides*	Fl	•		

Family	Taxa	FlFr	Quadrat	Relevé	OppColl
Fabaceae	***Lupinus luteus* (REx)**	Fr			•
Fabaceae	***Medicago laciniata***	Fr			•
Fabaceae	***Ornithopus sativus***	Fr		•	
Fabaceae	*Templetonia retusa*		•		
Fabaceae	***Trifolium lappaceum***	Fr			•
Fabaceae	*Viminaria juncea*	Fl		•	
Gentianaceae	***Centaurium erythraea***	Fl	•		
Geraniaceae	***Pelargonium capitatum***	FlFr	•		•
Goodeniaceae	*Dampiera spicigera*	Fl	•		
Goodeniaceae	*Lechenaultia floribunda*	Fl			•
Goodeniaceae	*Lechenaultia linarioides*	Fl	•		•
Goodeniaceae	*Scaevola anchusifolia*	Fl			•
Goodeniaceae	*Scaevola canescens*	Fl	•		
Goodeniaceae	*Scaevola repens* subsp. Northern Sandplains (R.J. Cranfield & P.J. Spencer 8445)		•		
Goodeniaceae	*Scaevola repens* var. *angustifolia*	Fl			•
Goodeniaceae	*Scaevola thesioides* subsp. *thesioides*	Fl			•
Haemodoraceae	*Anigozanthos manglesii*	Fl	•		
Haemodoraceae	*Conostylis aculeata* subsp. *breviflora*	Fl	•		
Haemodoraceae	*Conostylis aculeata* subsp. *spinuligera*	Fl	•		
Haemodoraceae	*Conostylis candicans* subsp. *calcicola*	Fl	•		
Haemodoraceae	*Conostylis candicans* subsp. *candicans*	Fl	•		
Haemodoraceae	*Conostylis teretifolia* subsp. *teretifolia*		•		
Haloragaceae	*Haloragis* sp. Indet.		•		
Hemerocallidaceae	*Arnocrinum preissii*	Fl	•		
Hemerocallidaceae	*Corynotheca micrantha*		•		
Hemerocallidaceae	*Corynotheca micrantha* var. *micrantha*	Fl	•		
Hemerocallidaceae	*Dianella revoluta* var. *divaricata*	Fl	•	•	
Hemerocallidaceae	*Johnsonia pubescens* subsp. *pubescens*	Fr	•		
Hemerocallidaceae	*Tricoryne elatior*	Fl	•		
Hemerocallidaceae	*Tricoryne* sp. Eneabba (E.A. Griffin 1200)	Fl			•
Iridaceae	***Gladiolus caryophyllaceus***	Fr		•	•
Iridaceae	*Patersonia occidentalis* var. *occidentalis*	Fl	•		•
Iridaceae	***Romulea rosea***	Fr	•		
Juncaceae	***Juncus bufonius***	FlFr	•		
Juncaceae	*Juncus pallidus*	FlFr		•	•
Juncaginaceae	*Triglochin mucronata*		•		
Lamiaceae	*Hemiandra glabra*	FlFr			•
Lamiaceae	*Hemiphora bartlingii*	Fl	•		•
Lauraceae	*Cassytha aurea*	Fr			•
Lauraceae	*Cassytha aurea* var. *aurea*	Fr	•		
Lauraceae	*Cassytha glabella*	Fr	•		
Lauraceae	*Cassytha racemosa*	Fr	•	•	
Myrtaceae	*Calothamnus quadrifidus* subsp. *quadrifidus*	FlFr	•		
Myrtaceae	*Calothamnus sanguineus*	Fr	•		
Myrtaceae	*Calytrix strigosa*	Fl	•		
Myrtaceae	*Chamelaucium uncinatum*	Fl			•
Myrtaceae	*Eremaea asterocarpa* subsp. *asterocarpa*	Fl	•		
Myrtaceae	*Eremaea beaufortioides* var. *beaufortioides*	FlFr	•		•
Myrtaceae	*Eremaea pauciflora* var. *lonchophylla*	FlFr	•		

Family	Taxa	FlFr	Quadrat	Relevé	OppColl
Myrtaceae	*Eremaea* sp. Indet.		•		
Myrtaceae	*Eucalyptus rudis* subsp. *rudis*	FlFr	•		•
Myrtaceae	*Eucalyptus todtiana*	Fr	•		
Myrtaceae	***Eucalyptus utilis* (REx)**	Fr			•
Myrtaceae	*Hypocalymma xanthopetalum*	Fl	•		
Myrtaceae	*Melaleuca acutifolia*	Fr	•		
Myrtaceae	*Melaleuca cardiophylla*	Fr	•		
Myrtaceae	*Melaleuca huegelii*	Fr	•		
Myrtaceae	*Melaleuca incana* subsp. *incana*	FlFr		•	
Myrtaceae	*Melaleuca leiopyxis*	Fr	•		
Myrtaceae	*Melaleuca leuropoma*	FlFr	•		
Myrtaceae	*Melaleuca preissiana*	Fr		•	
Myrtaceae	*Melaleuca rhaphiophylla*	FlFr	•	•	
Myrtaceae	*Melaleuca viminea* subsp. *viminea*	Fr	•	•	
Myrtaceae	*Melaleuca* ? *viminea*		•		
Myrtaceae	*Regelia ciliata*	FlFr	•		
Myrtaceae	*Scholtzia laxiflora*	Fl	•		
Myrtaceae	*Scholtzia umbellifera*	Fl	•		
Myrtaceae	*Verticordia densiflora* var. *densiflora*	Fl			•
Myrtaceae	*Verticordia pennigera*				•
Onagraceae	****Oenothera drummondii* subsp. *drummondii***			•	•
Onagraceae	****Oenothera stricta***	Fl			•
Orchidaceae	*Microtis media* subsp. *media*	Fr	•		
Orchidaceae	*Pterostylis vittata*	Fr	•		
Phyllanthaceae	*Phyllanthus calycinus*	Fl	•		
Poaceae	*Amphipogon* sp. Indet.		•		
Poaceae	*Austrostipa compressa*	Fr	•		
Poaceae	*Austrostipa elegantissima*	Fr	•		
Poaceae	*Austrostipa flavescens*	Fr	•		
Poaceae	*Austrostipa* sp. Indet.		•		
Poaceae	****Avena barbata***	Fr	•	•	•
Poaceae	****Briza maxima***	Fr	•	•	•
Poaceae	****Briza minor***	Fr	•		•
Poaceae	*Bromus arenarius*	Fl			•
Poaceae	****Bromus diandrus***	Fr	•	•	
Poaceae	****Bromus hordeaceus***	Fr	•	•	
Poaceae	****Chloris gayana***	Fr		•	
Poaceae	****Cynodon dactylon***				•
Poaceae	****Ehrharta calycina***	Fr	•	•	
Poaceae	****Ehrharta longiflora***	Fr	•		
Poaceae	****Eragrostis curvula***	Fr	•	•	•
Poaceae	****Hordeum leporinum***	Fr	•		
Poaceae	****Lagurus ovatus***	Fl			•
Poaceae	****Lolium perenne* x *rigidum***	Fr	•	•	•
Poaceae	*Neurachne alopecuroidea*	Fr	•		
Poaceae	****Paspalum dilatatum***	Fr		•	
Poaceae	****Pentameris airoides***	Fr	•		
Poaceae	Poaceae sp. Indet.		•		
Poaceae	*Rytidosperma acerosum*	Fr	•		
Poaceae	*Sporobolus virginicus*		•	•	

Family	Taxa	FlFr	Quadrat	Relevé	OppColl
Poaceae	***Vulpia bromoides***	Fr	•		
Polygonaceae	*Muehlenbeckia adpressa*	Fl			•
Polygonaceae	***Rumex crispus***	Fr	•		
Primulaceae	***Lysimachia arvensis***	FlFr	•	•	
Proteaceae	*Adenanthos cygnorum* subsp. *cygnorum*	Fl	•		
Proteaceae	*Banksia attenuata*	Fl	•		
Proteaceae	*Banksia dallanneyi* subsp. *media*	Fl			•
Proteaceae	***Banksia dallanneyi* subsp. *pollosta* (P3)**	Fl			•
Proteaceae	*Banksia menziesii*	FlFr	•		
Proteaceae	*Banksia prionotes*	FlFr	•		
Proteaceae	*Banksia sessilis* var. *cygnorum*	Fl	•		
Proteaceae	*Banksia sphaerocarpa* var. *sphaerocarpa*	Fl	•		
Proteaceae	*Banksia* ? *sphaerocarpa*		•		
Proteaceae	*Conospermum stoechadis* subsp. *stoechadis*	Fl	•		
Proteaceae	***Grevillea preissii* subsp. *glabrilimba* (REn)**	Fr	•		
Proteaceae	*Hakea incrassata*		•		
Proteaceae	*Hakea lissocarpha*	Fr	•		
Proteaceae	*Hakea trifurcata*	Fr	•		
Proteaceae	*Hakea varia*	Fl		•	•
Proteaceae	*Persoonia comata*		•		
Proteaceae	*Petrophile axillaris*	Fl	•		•
Proteaceae	***Petrophile brevifolia* subsp. *brevifolia* (REx)**	Fl	•		
Proteaceae	*Petrophile linearis*	FlFr	•		•
Proteaceae	*Petrophile macrostachya*	Fl	•		•
Proteaceae	*Stirlingia latifolia*	Fl	•		
Proteaceae	*Synaphea spinulosa* subsp. *spinulosa*	Fl	•		•
Ranunculaceae	*Clematis linearifolia*	Fl	•		
Restionaceae	***Alexgeorgea subterranea* (REn)**		•		
Restionaceae	*Desmocladus asper*		•		
Restionaceae	*Desmocladus flexuosus*		•		
Restionaceae	*Desmocladus lateriflorus*		•		
Restionaceae	*Lepidobolus preissianus* subsp. *preissianus*	Fl	•		
Rhamnaceae	*Cryptandra intermedia*	Fl	•		
Rhamnaceae	*Spyridium globulosum*	Fl	•	•	
Rhamnaceae	*Stenanthemum notiale* subsp. *notiale*	FlFr	•		•
Rubiaceae	*Opercularia echinocephala*	Fl	•		
Rubiaceae	*Opercularia spermacocea*		•		
Rubiaceae	*Opercularia vaginata*	Fr	•		
Scrophulariaceae	*Myoporum insulare*	Fl	•		
Solanaceae	*Anthocercis littorea*	Fl			•
Solanaceae	***Solanum nigrum***	FlFr	•	•	
Stylidiaceae	*Levenhookia stipitata*	Fl	•		
Stylidiaceae	*Stylidium crossocephalum*	Fl	•		
Stylidiaceae	*Stylidium cygnorum*	Fl	•		
Stylidiaceae	*Stylidium rigidulum*	Fl		•	
Thymelaeaceae	*Pimelea angustifolia*	Fl	•		
Typhaceae	*Typha* sp. Indet.	Fr	•	•	
Violaceae	*Hybanthus calycinus*	Fl	•		
Xanthorrhoeaceae	*Xanthorrhoea* ? sp. Lesueur	Fl	•		
Xanthorrhoeaceae	*Xanthorrhoea preissii*		•		

Family	Taxa	FlFr	Quadrat	Relevé	OppColl
Zygophyllaceae	*Roepera similis*	Fr	•		

Note: P3 = Priority 3 species, ?P3 = potential Priority 3 species, * = environmental weed, REn = regional endemic, REx = range extension, sp. = species, subsp. = subspecies, var. = variety, sp. Indet. = species indeterminate (could not be identified to species), Fl = flowering, Fr = fruiting, OppColl = opportunistic collection.

APPENDIX 5: CONSERVATION SIGNIFICANT FLORA - PHOTOGRAPHS

Table 24: Photographs of confirmed and potential priority flora species recorded in the Survey Area

***Banksia dallaneyi* subsp. *pollosta* (P3) (confirmed)**	
	
***Thysanotus vernalis* (P3) (potential)**	
	

APPENDIX 6: POTENTIAL CARNABY'S COCKATOO BREEDING TREES

Table 25: Tree data for potential Carnaby's Cockatoo breeding trees in the Jurien East Road 20 m wide PCZ

<table>
<tr><th colspan="5">Carnaby's Cockatoo tree data</th></tr>
<tr><th>Species</th><th>Tree reference number</th><th>Easting (mE)</th><th>Northing (mN)</th><th>Photograph</th></tr>
<tr><td rowspan="9">Eucalyptus rudis subsp. rudis</td><td rowspan="9">ER1</td><td>320817</td><td>6651358</td><td rowspan="9">  </td></tr>
<tr><td>Trunk within PCZ</td><td>Canopy overhangs PCZ</td></tr>
<tr><td>Yes</td><td>Yes</td></tr>
<tr><td>Distance from front of trunk to current bitumen Centreline (m)</td><td>DBH (cm)</td></tr>
<tr><td>9.60</td><td>51.90</td></tr>
<tr><td>Hollow comments</td><td>Tree health</td></tr>
<tr><td>No visible hollows</td><td>Very Good</td></tr>
</table>

Species	Tree reference number	Easting (mE)	Northing (mN)	Photograph
Eucalyptus rudis subsp. *rudis*	ER3	320839	6651364	
		Trunk within PCZ	**Canopy overhangs PCZ**	
		Yes	Yes	
		Distance from front of trunk to current bitumen centreline (m)	**DBH (cm)**	
		9.95	58.00	
		Hollow comments	**Tree health**	
		No visible hollows	Very Good	

Species	Tree reference number	Easting (mE)	Northing (mN)	Photograph
Eucalyptus rudis subsp. *rudis*	ER4	320839	6651364	
		Trunk within PCZ	**Canopy overhangs PCZ**	
		Yes	Yes	
		Distance from front of trunk to current bitumen centreline (m)	**DBH (cm)**	
		9.95	74.20	
		Hollow comments	**Tree health**	
		No visible hollows	Very Good	

Species	Tree reference number	Easting (mE)	Northing (mN)	Photograph
Eucalyptus rudis subsp. *rudis*	ER5	320839	6651364	
		Trunk within PCZ	**Canopy overhangs PCZ**	
		Yes	Yes	
		Distance from front of trunk to current bitumen centreline (m)	**DBH (cm)**	
		9.95	59.90	
		Hollow comments	**Tree health**	
		No visible hollows	Very Good	

Species	Tree reference number	Easting (mE)	Northing (mN)	Photograph
Eucalyptus rudis subsp. *rudis*	ER7	320771	6651328	
		Trunk within PCZ	**Canopy overhangs PCZ**	
		Yes	Yes	
		Distance from front of trunk to current bitumen centreline (m)	**DBH (cm)**	
		8.45	55.40	
		Hollow comments	**Tree health**	
		No visible hollows	Very Good	

APPENDIX 7: SITE BY SPECIES MATRIX

Table 26: Site by species matrix

	*E*TOMF	MLOSL (2)	MOSL (1)	*E*TOF	*B*LOFLWL					MSL	BLOFLWL	*M*OSL (2)	*M*TSL (2)	MLOSL (1)	*M*TSL (2)	*T*LSSSL	BLOFLWL	MSL	*M*TSL (1)	
Taxa	Q28	Q29	Q30	Q31	Q32	Q33	Q34	Q35	Q36	Q37	Q38	Q39	Q40	Q41	Q42	Q43	Q44	Q45	R46¥	R47¥
Acacia acuaria		0.1																		
Acacia cyclops				2			2		0.1		1			0.1						
Acacia dilatata		0.1	2																	
Acacia lasiocalyx																			2	1
Acacia lasiocarpa var. *lasiocarpa*		1			2					0.1	1		0.1	2			0.1			
Acacia pulchella var. *glaberrima*					0.1												1			
Acacia rostellifera													1		3					
Acanthocarpus preissii														1						
Adenanthos cygnorum subsp. *cygnorum*	2	0.1			2		2													
Aizoaceae sp. Indet.																0.1				
***Alexgeorgea subterranea* (REn)**	1																			
Allocasuarina humilis		1				1	1	0.1	1	0.1										
Allocasuarina microstachya			1																	
Amphipogon sp. Indet.					1												0.1			
Anigozanthos manglesii					0.1															
Arnocrinum preissii					0.1															
Asteridea pulverulenta								0.1												
****Atriplex prostrata* (REx)**												1								
Austrostipa compressa						0.1		0.1												
Austrostipa elegantissima		2	3			1	1	1	1		1	0.1	1							

	*E*TOMF	MLOSL (2)	MOSL (1)	*E*TOF	*B*LOFLWL					MSL	BLOFLWL	*M*OSL (2)	*M*TSL (2)	MLOSL (1)	*M*TSL (2)	*T*LSSSL	BLOFLWL	MSL	*M*TSL (1)	
Taxa	Q28	Q29	Q30	Q31	Q32	Q33	Q34	Q35	Q36	Q37	Q38	Q39	Q40	Q41	Q42	Q43	Q44	Q45	R46¥	R47¥
Austrostipa flavescens											1			1						
Austrostipa sp. Indet.								1												
Avena barbata		1	1				2		1				2					0.1		1
Banksia ?sphaerocarpa						0.1														
Banksia attenuata											2									
Banksia menziesii					1						1						4			
Banksia prionotes	1				2	3	3	4	4		2						2			
Banksia sessilis var. *cygnorum*							1		1	2								4		
Banksia sphaerocarpa var. *sphaerocarpa*						2		3	2											
Baumea juncea																			2	2
Bossiaea eriocarpa					0.1															
Brachyscome pusilla														1						
Briza maxima	1	1			1		1				0.1					1	1			1
Briza minor		1										0.1				0.1				
Bromus diandrus	0.1	1		1			1			1	0.1		1	1	1			0.1		1
Bromus hordeaceus	1							0.1											1	1
Burchardia congesta		0.1	1					1	0.1	0.1										
Calectasia narragara						0.1														
Callitris pyramidalis																				0.1
Calothamnus quadrifidus subsp. *quadrifidus*		1	3						0.1	1	2							1		
Calothamnus sanguineus		0.1																		
Calytrix strigosa					0.1															
Cassytha aurea var. *aurea*		2																		
Cassytha glabella						0.1														
Cassytha racemosa					1							1	1						2	
Caustis dioica			1																	

	*E*TOMF	MLOSL (2)	MOSL (1)	*E*TOF	*B*LOFLWL					MSL	BLOFLWL	*M*OSL (2)	*M*TSL (2)	MLOSL (1)	*M*TSL (2)	*T*LSSSL	BLOFLWL	MSL	*M*TSL (1)	
Taxa	Q28	Q29	Q30	Q31	Q32	Q33	Q34	Q35	Q36	Q37	Q38	Q39	Q40	Q41	Q42	Q43	Q44	Q45	R46¥	R47¥
Centaurium erythraea																0.1				
Centrolepis polygyna																1				
Chloris gayana																			2	2
Clematis linearifolia													1		1					
Conospermum stoechadis subsp. *stoechadis*									1	1										
Conostylis aculeata subsp. *breviflora*			0.1																	
Conostylis aculeata subsp. *spinuligera*					0.1	0.1														
Conostylis candicans subsp. *calcicola*					0.1			1	1		1			1			0.1	1		
Conostylis candicans subsp. *candicans*							1										0.1			
Conostylis teretifolia subsp. *teretifolia*						0.1														
Corynotheca micrantha					0.1						1									
Corynotheca micrantha var. *micrantha*																	1			
Cotula coronopifolia																1				
Crassula colorata var. *acuminata*														0.1						
Crassula glomerata														0.1						
Cryptandra intermedia						0.1														
Cyperus congestus												0.1							1	0.1
Dampiera spicigera		1	0.1																	
Daucus glochidiatus									0.1		0.1									
Daviesia incrassata subsp. *incrassata*		3																		
Desmocladus asper		3			0.1		0.1	1	0.1		1			1	1					
Desmocladus flexuosus								1	1	2	0.1							3		
Desmocladus lateriflorus			1																	

	*E*TOMF	MLOSL (2)	MOSL (1)	*E*TOF	*B*LOFLWL					MSL	BLOFLWL	*M*OSL (2)	*M*TSL (2)	MLOSL (1)	*M*TSL (2)	*T*LSSSL	BLOFLWL	MSL	*M*TSL (1)	
Taxa	Q28	Q29	Q30	Q31	Q32	Q33	Q34	Q35	Q36	Q37	Q38	Q39	Q40	Q41	Q42	Q43	Q44	Q45	R46¥	R47¥
Dianella revoluta var. *divaricata*		0.1			1				0.1		0.1									0.1
Drosera omissa						1														
Drosera pallida						0.1														
Ecdeiocolea monostachya		0.1																		
***Ehrharta calycina**	1	1	3	5	1		1		1		0.1						1			2
***Ehrharta longiflora**													1		1	0.1				
***Eragrostis curvula**	1																		2	1
Eremaea asterocarpa subsp. *asterocarpa*						0.1														
Eremaea beaufortioides var. *beaufortioides*			3			2														
Eremaea pauciflora var. *lonchophylla*						1	2		1		3									
Eremaea sp. Indet.									0.1											
Eucalyptus rudis subsp. *rudis*				4																
Eucalyptus todtiana	4																			
Ficinia nodosa												0.1								2
Gahnia trifida													0.1						3	
Gastrolobium oxylobioides		3																		
***Gladiolus caryophyllaceus**																				0.1
Gnephosis tenuissima																0.1				
Gompholobium tomentosum						0.1		0.1	1		1		0.1				1			
***Grevillea preissii* subsp. *glabrilimba* (REn)**										0.1								0.1		
Hakea incrassata		1	1																	
Hakea lissocarpha																		0.1		
Hakea trifurcata										1								3		
Hakea varia																			2	
Haloragis sp. Indet.													0.1							

	*E*TOMF	MLOSL (2)	MOSL (1)	*E*TOF	*B*LOFLWL					MSL	BLOFLWL	*M*OSL (2)	*M*TSL (2)	MLOSL (1)	*M*TSL (2)	*T*LSSSL	BLOFLWL	MSL	*M*TSL (1)	
Taxa	Q28	Q29	Q30	Q31	Q32	Q33	Q34	Q35	Q36	Q37	Q38	Q39	Q40	Q41	Q42	Q43	Q44	Q45	R46¥	R47¥
Hardenbergia comptoniana													0.1							
Hemiphora bartlingii							1													
Hibbertia aurea		1																		
Hibbertia hypericoides					1															
Hibbertia racemosa										0.1										
Hibbertia sericosepala		2			2			2	1	2	2							1		
Hordeum leporinum																1				
Hyalosperma cotula		1	1																	
Hybanthus calycinus					0.1															
Hypocalymma xanthopetalum		0.1	0.1		1	0.1	1	1	1	1							0.1			
Hypochaeris glabra			0.1				1		1		0.1					1				
***Isolepis hookeriana* (REx)**																0.1				
Isotropis cuneifolia subsp. *cuneifolia*											1									
Jacksonia hakeoides		0.1															0.1			
Jacksonia nutans							0.1	1												
Johnsonia pubescens subsp. *pubescens*						0.1														
Juncus bufonius																0.1				
Juncus pallidus																				1
Labichea cassioides										1								3		
Lechenaultia linarioides					0.1				1											
Lepidobolus preissianus subsp. *preissianus*					1															
Lepidosperma calcicola														1						
Lepidosperma leptostachyum		1																		
Lepidosperma scabrum					0.1	0.1											1			

	*E*TOMF	MLOSL (2)	MOSL (1)	*E*TOF	*B*LOFLWL					MSL	BLOFLWL	*M*OSL (2)	*M*TSL (2)	MLOSL (1)	*M*TSL (2)	*T*LSSSL	BLOFLWL	MSL	*M*TSL (1)	
Taxa	Q28	Q29	Q30	Q31	Q32	Q33	Q34	Q35	Q36	Q37	Q38	Q39	Q40	Q41	Q42	Q43	Q44	Q45	R46¥	R47¥
Leucopogon conostephioides																	0.1			
Levenhookia stipitata						0.1														
Lobelia anceps																				1
***Lolium perenne x rigidum**		1		2									3	1	1	2			2	1
Lomandra hastilis	1																			
Lomandra maritima													0.1	0.1	0.1					
Lyginia barbata		1				1		1		0.1	1						1			
***Lysimachia arvensis**		1	0.1				1			0.1	1		3			0.1		0.1		0.1
Melaleuca ?viminea																		0.1		
Melaleuca acutifolia																1				
Melaleuca cardiophylla										3										
Melaleuca huegelii													3		3					
Melaleuca incana subsp. *incana*																			1	
Melaleuca leiopyxis	0.1							1			1						0.1			
Melaleuca leuropoma			2			1		1			1			3				1		
Melaleuca preissiana																			3	3
Melaleuca rhaphiophylla				3															4	
Melaleuca viminea subsp. *viminea*												3							1	
Mesomelaena tetragona		1	2		1	2	1	2	1	1	1						1			
Microtis media subsp. *media*	0.1																			
Myoporum insulare													0.1		0.1					
Neurachne alopecuroidea		1																		
Oenothera drummondii* subsp. *drummondii																				1
Olearia axillaris														0.1						
***Olearia revoluta* (REx)**										0.1										

	*E*TOMF	MLOSL (2)	MOSL (1)	*E*TOF	*B*LOFLWL					MSL	BLOFLWL	*M*OSL (2)	*M*TSL (2)	MLOSL (1)	*M*TSL (2)	*T*LSSSL	BLOFLWL	MSL	*M*TSL (1)	
Taxa	**Q28**	**Q29**	**Q30**	**Q31**	**Q32**	**Q33**	**Q34**	**Q35**	**Q36**	**Q37**	**Q38**	**Q39**	**Q40**	**Q41**	**Q42**	**Q43**	**Q44**	**Q45**	**R46¥**	**R47¥**
Opercularia echinocephala															1					
Opercularia spermacocea														1						
Opercularia vaginata			0.1										0.1							
***Ornithopus sativus**																			1	
***Paspalum dilatatum**																				1
Patersonia occidentalis var. *occidentalis*						2														
***Pelargonium capitatum**									0.1											
***Pentameris airoides**		0.1																		
Persoonia comata						0.1														
Petrophile axillaris										1								0.1		
***Petrophile brevifolia* subsp. *brevifolia* (REx)**										1	1						1			
Petrophile linearis						0.1														
Petrophile macrostachya											1									
Phyllanthus calycinus														0.1						
Pimelea angustifolia			0.1																	
Platysace sp. Indet.																0.1				
Poaceae sp. Indet.													0.1							
Podolepis gracilis		1	1																	
Podotheca angustifolia														1						
Podotheca gnaphalioides		1					1			0.1										
Pogonolepis stricta																1				
Pterostylis vittata						0.1											0.1			
Ptilotus manglesii			0.1																	
Ptilotus stirlingii subsp. *stirlingii*														0.1						
Regelia ciliata	1																			

	*E*TOMF	MLOSL (2)	MOSL (1)	*E*TOF	*B*LOFLWL					MSL	BLOFLWL	*M*OSL (2)	*M*TSL (2)	MLOSL (1)	*M*TSL (2)	*T*LSSSL	BLOFLWL	MSL	*M*TSL (1)	
Taxa	Q28	Q29	Q30	Q31	Q32	Q33	Q34	Q35	Q36	Q37	Q38	Q39	Q40	Q41	Q42	Q43	Q44	Q45	R46¥	R47¥
Reichardia tingitana	1	1					1		1		0.1			0.1						0.1
Roepera similis														1						
***Romulea rosea**													1	0.1		0.1				
***Rumex crispus**				1																
Rytidosperma acerosum			1																	
Scaevola canescens						0.1		1		0.1	1									
Scaevola repens subsp. Northern Sandplains (R.J. Cranfield & P.J. Spencer 8445)		0.1	0.1																	
Schoenus grandiflorus							0.1										1			
Scholtzia laxiflora																	4	2		
Scholtzia umbellifera			1		3			2	2		1									
***Solanum nigrum**				0.1																0.1
***Sonchus asper**																				0.1
***Sonchus oleraceus**		1	1					0.1	1											1
***Sonchus* sp. Indet.**													0.1		0.1					
Sporobolus virginicus												1							2	3
Spyridium globulosum													2		1					0.1
Stenanthemum notiale subsp. *notiale*									0.1				0.1							
Stirlingia latifolia	1																			
Stylidium crossocephalum						0.1				0.1										
Stylidium cygnorum						0.1														
Stylidium rigidulum																			1	
***Symphyotrichum squamatum**												0.1								1
Synaphea spinulosa subsp. *spinulosa*							1				1									
Tecticornia indica subsp. *bidens*																1				

	*E*TOMF	MLOSL (2)	MOSL (1)	*E*TOF	*B*LOFLWL					MSL	BLOFLWL	*M*OSL (2)	*M*TSL (2)	MLOSL (1)	*M*TSL (2)	*T*LSSSL	BLOFLWL	MSL	*M*TSL (1)	
Taxa	**Q28**	**Q29**	**Q30**	**Q31**	**Q32**	**Q33**	**Q34**	**Q35**	**Q36**	**Q37**	**Q38**	**Q39**	**Q40**	**Q41**	**Q42**	**Q43**	**Q44**	**Q45**	**R46¥**	**R47¥**
Tecticornia pergranulata subsp. *pergranulata*																1				
Templetonia retusa													0.1							
Tetraria octandra										1										
Thysanotus ? *manglesianus*	1																			
***Thysanotus* ? *vernalis* (?P3)**										0.1										
Thysanotus dichotomus							0.1													
Thysanotus thyrsoideus						0.1														
Trachymene pilosa		1	1		0.1	1	1	1	2	1	1			1			0.1	0.1		
Tricoryne elatior													0.1							
Triglochin mucronata																1				
Typha sp. Indet.												3							2	1
Ursinia anthemoides* subsp. *anthemoides		2	1				1		2	2	1						2	2		
Viminaria juncea																			0.1	0.1
Vulpia bromoides										1				1						
Wahlenbergia capensis					0.1															
Xanthorrhoea ? sp. Lesueur		0.1																		
Xanthorrhoea preissii						2														
Xanthosia huegelii		1			0.1	0.1		1												

Note: ¥ = R46 and R47 = JER-T01 and JER-T02 respectively, P3 = Priority 3 species, ? P3 = potential Priority 3 species, * = environmental weed, REn = regional endemic, REx = range extension, sp. = species, subsp. = subspecies, var. = variety, sp. Indet = species indeterminate / could not be identified from material collected. A number in a cell indicates a cover code.

APPENDIX 8: VEGETATION CONDITION SCALE

Table 27: Vegetation condition scale (EPA, 2016a)

Vegetation condition	South West and Interzone Botanical Provinces
Pristine	Pristine or nearly so, no obvious signs of damage caused by human activities since European settlement.
Excellent	Vegetation structure intact, disturbance affecting individual species and weeds are non-aggressive species. Damage to trees caused by fire, the presence of non-aggressive weeds and occasional vehicle tracks.
Very Good	Vegetation structure altered, obvious signs of disturbance. Disturbance to vegetation structure caused by repeated fires, the presence of some more aggressive weeds, dieback, logging and grazing.
Good	Vegetation structure significantly altered by very obvious signs of multiple disturbances. Retains basic vegetation structure or ability to regenerate it. Disturbance to vegetation structure caused by very frequent fires, the presence of very aggressive weeds, partial clearing, dieback and grazing.
Poor	
Degraded	Basic vegetation structure severely impacted by disturbance. Scope for regeneration but not to a state approaching good condition without intensive management. Disturbance to vegetation structure caused by very frequent fires, the presence of very aggressive weeds at high density, partial clearing, dieback and grazing.
Completely Degraded	The structure of the vegetation is no longer intact and the area is completely or almost completely without native species. These areas are often described as 'parkland cleared' with the flora comprising weed or crop species with isolated native trees and shrubs.

APPENDIX 9: BANKSIA WOODLAND PATCHES

Table 28: Banksia woodland patch size and condition analysis – Survey Area

SLK	Patch area over both sides of the road in the Survey Area	Vegetation type	Banksia woodlands of the Swan Coastal Plain ecological community?
23.8 to 24.05	0.65 ha	***B*LOFLWL** and ***E*TOMF**	**No**. This section of the Survey Area is in the Geraldton Sandplains bioregion.
24.4 to 24.85	One patch; 0.65 ha is Very Good, 0.40 ha Good. Combined patch size of 1.05 ha.	***B*LOFLWL**	**No**. The Very Good and Good patch sizes do not meet the minimum patch sizes for either condition.
24.85 to 26.09	Four discrete patches separated by between 93 m and 495 m. Patch sizes are: 0.54 ha (all Good); 0.48 ha (VG 0.45 ha, G 0.03 ha); 0.46 ha (VG 0.37 ha, G 0.08 ha); 0.16 ha (VG 0.15 ha, G 0.01).	***B*LOFLWL**	**No**. The combined area of both Very Good and Good in each of the four patches is less than the minimum patch size requirement for either condition.
26.09 to 27.2	One large patch: 4.21 ha is Very Good; 0.32 ha Good; and 0.42 ha Disturbed. Combined patch size of 4.95 ha.	***B*LOFLWL**	**Yes**. Meets the Very Good condition minimum patch size but not the Good condition patch size. However, the Very Good and Good cannot be separated (the Good is mostly the road facing edge of each polygon where weeds are denser).
27.3 to 28.8	One large patch: 3.57 ha Very Good; 1.20 ha Good; and 0.17 ha Disturbed. Combined patch size 4.94 ha.	***B*LOFLWL**	**Yes**. Meets the Very Good condition minimum patch size but not the Good condition. However, the Very Good and Good cannot be separated (the Good is mostly the road facing edge of each polygon where weeds are denser).
28.8 to 32.85	One large patch: 15.10 ha Very Good; 1.23 ha Good; and 0.13 ha Disturbed. Combined patch size of 16.46 ha.	***B*LOFLWL**	**Yes**. Meets the Very Good condition minimum patch size but not the Good condition. However, the Very Good and Good cannot be separated (the Good is mostly the road facing edge of each polygon where weeds are denser).
32.85 to 34.15	One large patch: 4.36 ha Very Good; and 0.44 ha Good. Combined patch size of 4.80 ha.	***B*LOFLWL**	**Yes**. Meets the Very Good condition minimum patch size but not the Good condition. However, the Very Good and Good cannot be separated (the Good is mostly the road facing edge of each polygon where weeds are denser).

Note: The combined patch size includes the Banksia woodland vegetation on both sides of the road – but it does not include the area of road and road shoulder i.e. completely cleared areas.

Table 29: Banksia woodlands of the Swan Coastal Plain ecological community – patch size, condition and impact

	Survey Area patches (ha)				Area of patches in PCZ (ha)			
SLK	Total	By condition			Total	By condition		
		Very Good	Good	Disturbed		Very Good	Good	Disturbed
26.09 to 27.2	4.95	4.21	0.32	0.42	0.58	0.24	0.31	0.03
27.3 to 28.8	4.94	3.57	1.2	0.17	0.64	0.19	0.43	0.02
28.8 to 32.85	16.46	15.1	1.23	0.13	1.62	0.58	1.01	0.03
32.85 to 34.15	4.8	4.36	0.44	0	0.45	0.14	0.31	0
Total	31.15	27.24	3.19	0.72	3.29	1.15	2.06	0.08

	Impact (%)			
Area	Overall	Very Good	Good	Disturbed
Study Area overall	10.56	3.69	6.61	0.26
PCZ	-	34.95	62.61	2.43

Note: Areas of disturbed vegetation (when < 30 m wide) have been included in the calculations as per DotEE, 2016.

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