Tonkin Highway Extension (Thomas Road to South western Highway)

Reconnaissance Flora and Vegetation Survey

MAIN ROADS WESTERN AUSTRALIA

DECEMBER 2019

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Tonkin Highway Extension (Thomas Road to South western Highway) Reconnaissance Vegetation Survey

Prepared for: Main Roads Western Australia

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Cover Photograph: *Corymbia calophylla* woodland over *Xanthorrhoea preissii* and sedgeland in Survey Area, May 2019 (Photo: Woodman Environmental

DOCUMENT REVISION AND STATUS

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A	Draft Report	GW/LF	CG	11/08/2019	EJ	28/08/2019
B	Draft report with client comments and revised to address expanded survey area	GW/LF	CG	29/10/2019	EJ	10/12/2019
0	Final Report	GW/LF	GW	12/12/2019		

DISCLAIMER

TABLE OF CONTENTS

FIGURES

TABLES

PLATES

APPENDICES

EXECUTIVE SUMMARY

Main Roads is proposing to extend Tonkin Highway from Thomas Road in Oakford to South Western Highway in Mundijong (The Proposal).

To inform the environmental impact assessment (EIA) process, Main Roads commissioned Woodman Environmental Consulting Pty Ltd (Woodman Environmental) to conduct a reconnaissance survey of the project area. The overall objectives of the assessment were to conduct a Desktop literature review, to provide information on restricted flora and vegetation that is known from, or may potentially occur in the Study Area and to complete a Reconnaissance field survey.

The Desktop Study indicated 12 Threatened Ecological Communities (TECs), two Priority Ecological Communities (PECs), 20 Priority taxa and 21 listed Threatened taxa (two listed only at State level) have been recorded within the local area (Desktop Study Area).

The Study Area has been highly modified due to clearing and other associated impacts. This includes very high levels of introduced taxa which have impacted on the condition of the remnant vegetation.

During the field survey three significant flora; *Babingtonia urbana* (P3), *Synaphea* sp. Serpentine (G.R. Brand 103) (T, critically endangered under the *Environment Protection Biodiversity Conservation Act 1999*) and *Tetraria australiensis* (T, vulnerable under the *Environment Protection Biodiversity Conservation Act 1999*) were recorded and it is possible that there are further locations and individuals of both these taxa within the areas they were recorded in the Study Area.

The majority of the vegetation recorded in the Study Area was degraded to some degree with 13 units identified as intact vegetation, 16 units comprising highly disturbed vegetation or remnant trees and a further 6 units comprising planted vegetation. Five of the 13 intact vegetation types mapped within the Study Area have potential correlations with TECs known to occur within the vicinity.

1. INTRODUCTION

1.1 Project Overview

Main Roads is proposing to extend Tonkin Highway from Thomas Road in Oakford to South Western Highway in Mundijong (The Proposal). The preliminary concept includes:

- approximately 14 kilometres of four lane dual carriageway from Thomas Road to South Western Highway;
- construction/upgrades of intersections at Thomas Road, Orton Road, Mundijong Road and South Western Highway; and
- a grade separated interchange at Bishop Road catering for the Perth to Bunbury rail line and any future freight rail realignment at Mundijong.

The Proposal is designed to alleviate pressure on the existing transport network, to reduce travel times for private and freight traffic and improve safety and connectivity between current and future residential, business and employment precincts.

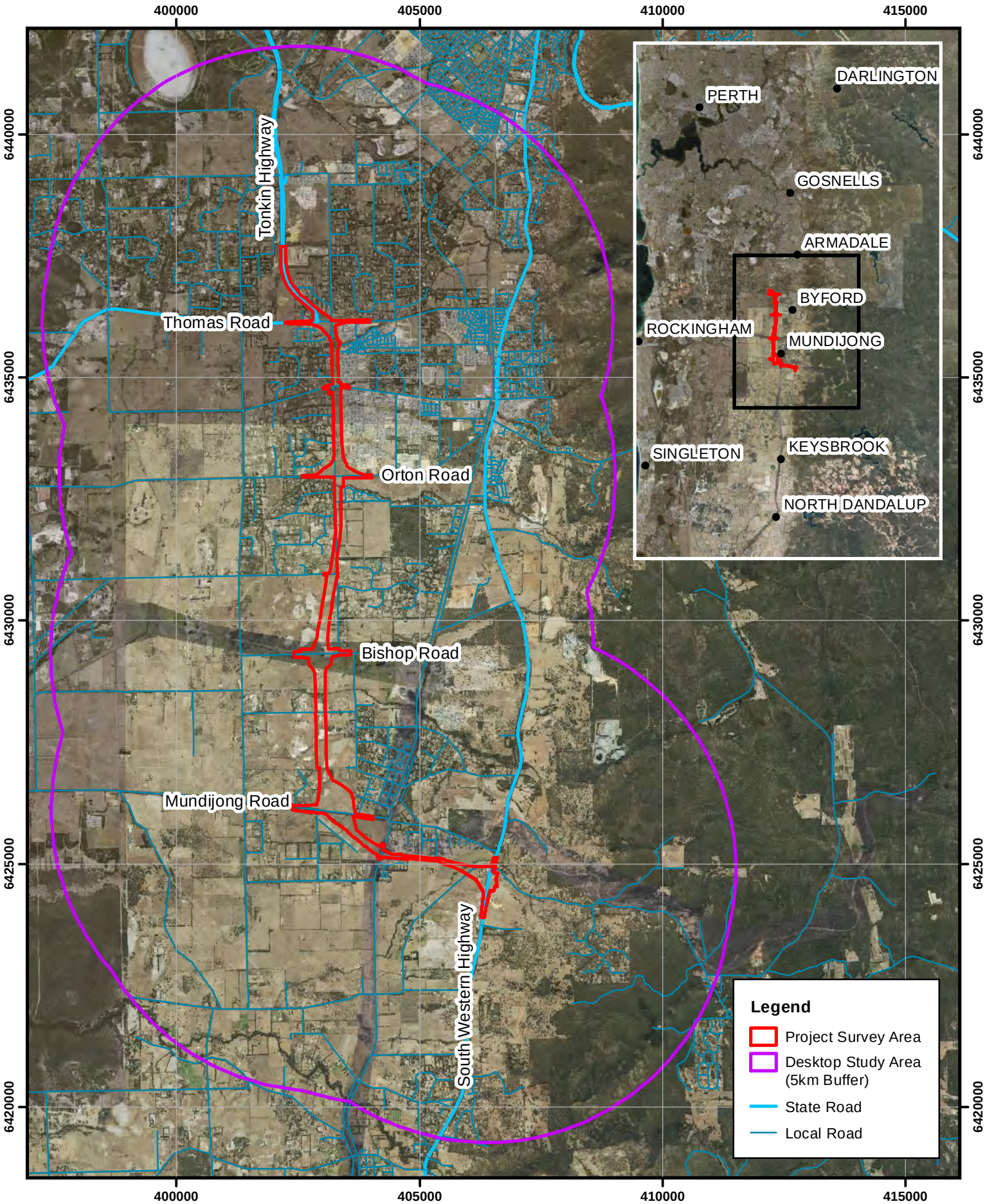
The Project forms the second portion of the project "Construction and use of the Tonkin Highway Extension from Mills Road West, Gosnells to South Western Highway, Mundijong". The project was referred to the EPA and assessed at PER level. A decision was made to approve the works under Ministerial Statement 595 on the 12th of June 2002.

Main Roads commissioned Woodman Environmental Consulting Pty Ltd (Woodman Environmental) to conduct a reconnaissance survey of the remaining un-developed portion of the project area. The main objective of the survey was to describe the main vegetation units present within the potential disturbance areas to inform Referral of the project under the Commonwealth *Environment Protection Biodiversity Conservation Act 1999* (EPBC Act).

1.2 Study Area Definition

Main Roads has provided the Project Study Area (the Study Area), as shown on Figure 1. The Study Area is located approximately 40 km south of Perth City, near Byford and Mundijong in the Shire of Serpentine-Jarrahdale. The Study Area is 491 ha in size and is located in the SWA-2 IBRA subregion, which has been highly modified due to clearing and other associated impacts.

For the purposes of elements of the Desktop Study for the Project, including interrogation of databases and searches for relevant literature, a Desktop Study Area has also been defined; as per Main Roads requirements, the Desktop Study Area considers the Study Area with a 5 km buffer, as shown on Figure 1.



Study Area and Desktop Study Area Location	Author: Leah Firth	N
	WEC Ref: MR19-22-01	
WOODMAN ENVIRONMENTAL	Filename: MR19-22-01-f01.mxd	**Figure**
	Scale: 1:100,000 (A4)	1
	Projection: GDA 1994 MGA Zone 50	
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1.3 Aim and Objectives

The aim of the survey is to provide relevant biological information to support the EIA process. The reconnaissance survey of the Study Area was conducted as per the Scope of Works (SoW) as provided by Main Roads (Appendix A).

The overall objectives of the assessment were to conduct a:

- desktop literature review (background research) - to provide information on restricted flora and vegetation that is known from, or may potentially occur in the Study Area; and
- reconnaissance field survey - to verify the information obtained from the desktop study and characterise the dominant flora and vegetation units present, and enable clarification as to whether the survey area may support significant flora and vegetation.

The survey and reporting works comply with the following documents:

- Technical Guidance – Flora and Vegetation Surveys for Environmental Impact Assessment (EPA 2016a);
- Environmental Factor Guideline – Flora and Vegetation (EPA 2016b).

2. BACKGROUND

2.1 Climate

The Study Area is located within the Swan Coastal Plain subregion (Drummond Botanical Subdistrict) of the South-West Forest region as classified by Beard (1990). The climate is classified as warm Mediterranean, with rainfall received mainly during May – September with 5 – 6 dry months per year (Beard 1990).

Figure 2 displays monthly precipitation totals and average maximum temperature for the preceding twelve months up until the field survey date (June 2018 to May 2019), as well as long-term average monthly maximum temperature (1965-2019) for Karnet and average monthly precipitation (1905-2019) recorded for Serpentine (all months shown), which are the nearest meteorological stations to the Study Area (Bureau of Meteorology 2019).

The precipitation in the twelve months preceding the survey was 721 mm, which was below the long term average of 904 mm.

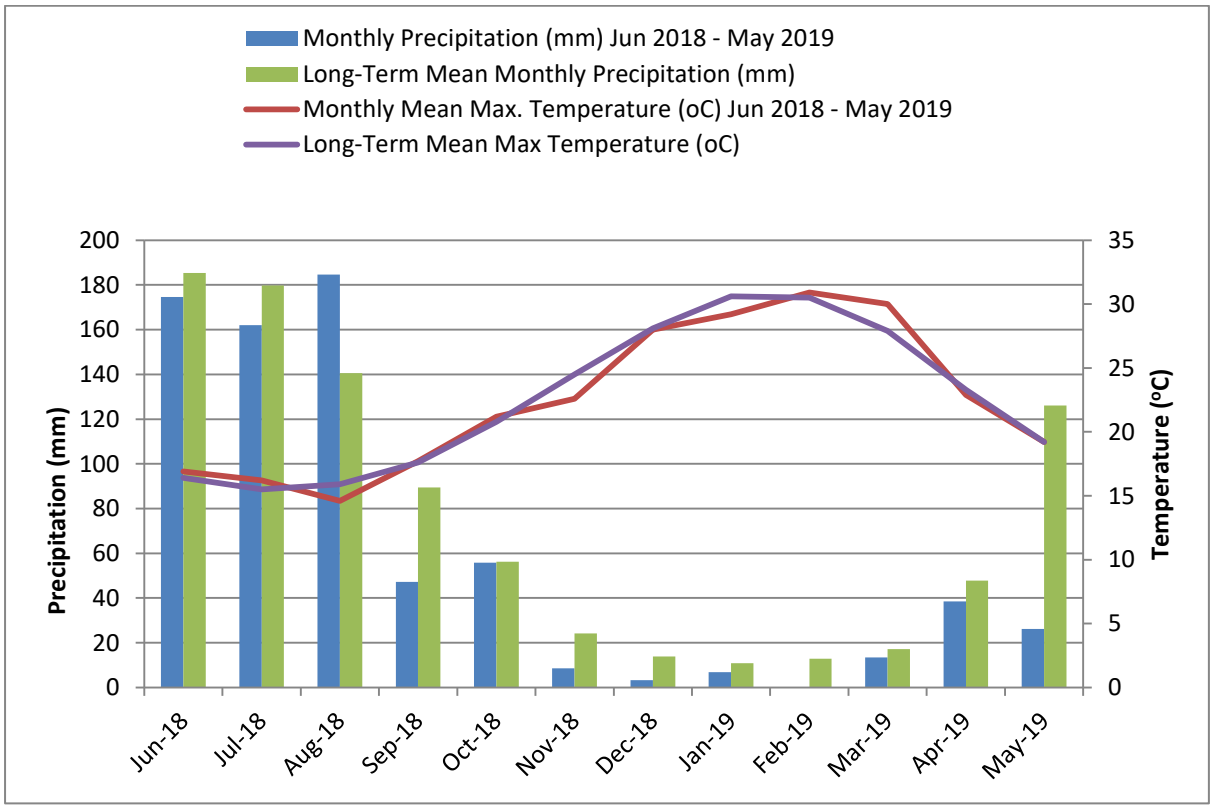


Figure 2: **Average Daily Maximum Temperature and Total Precipitation for June 2018 to May 2019, and Long-Term Average Monthly Maximum Temperature and Precipitation, for Serpentine (Precipitation) and Karnet (Temperature) weather stations (Bureau of Meteorology 2019)**

2.2 Geology, Landforms and Soils

The Study Area is located in the Swan Coastal Plain subregion as defined by Beard (1981; 1990); which is equivalent to the Swan Coastal Plain Interim Biogeographic Regionalisation for Australia (IBRA) region and SWA-2 IBRA subregion (Commonwealth of Australia 2012). The Swan Coastal Plain subregion consists of a coastal plain of low-lying, often swampy areas and sandhills (generally referred to as the Swan Coastal Plain), with soils consisting of sands or swamp deposits as well as dissected country rising to the duricrusted Dandaragan Plateau on Mesozoics consisting of mainly yellow sandy soils. The geology of the region is Mesozoic to recent sediments of the Perth Basin (Beard 1990).

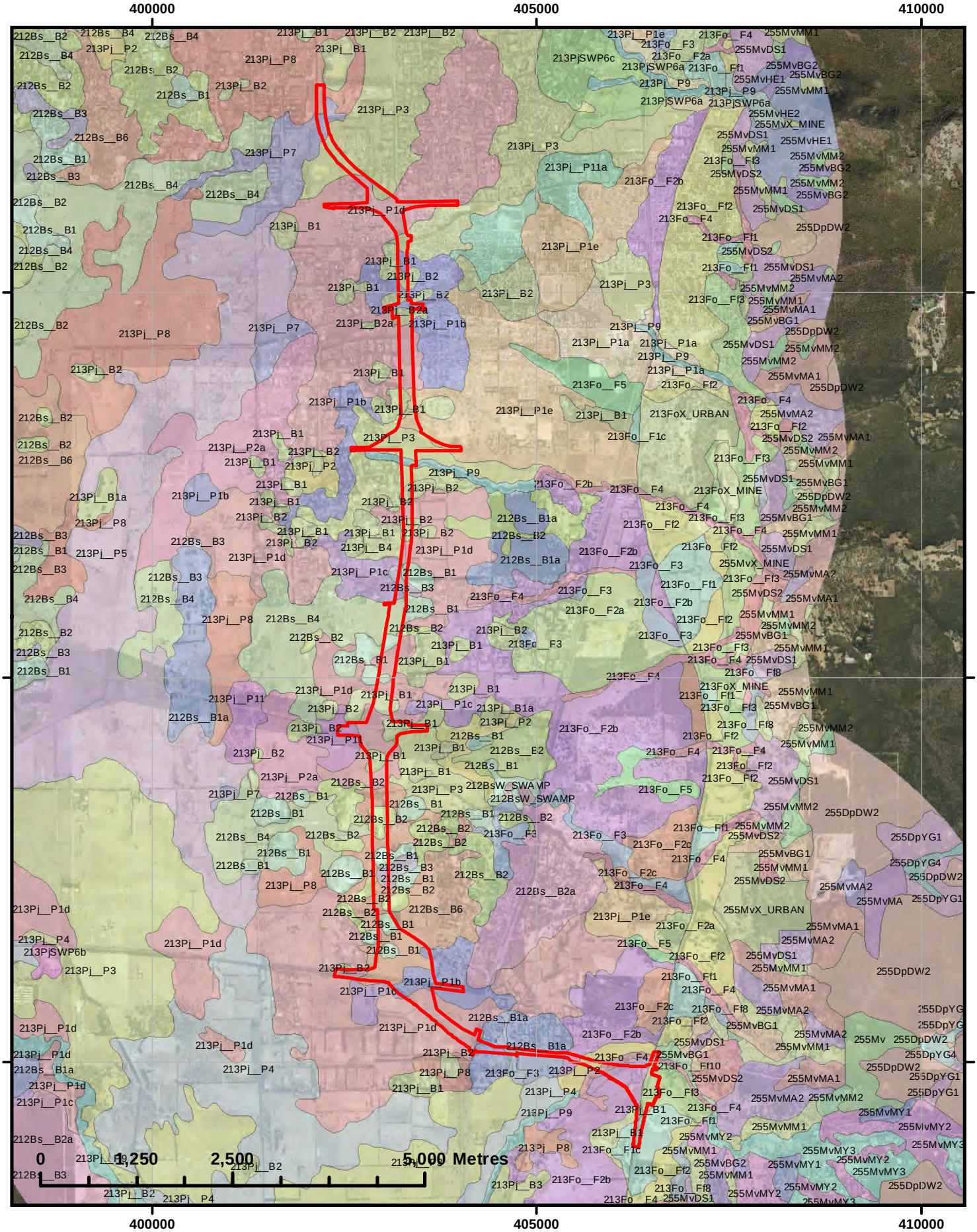
The Study Area occurs within the Bassendean and the Pinjarra Soil-Landscape Zones of the Swan Province. The Bassendean Zone is described as consisting of Mid-Pleistocene Bassendean sand and fixed dunes inland from the coastal dune zone, with non-calcareous sands and podsolised soils with low-lying wet areas. The Pinjarra Zone is characterised by alluvial deposits (early Pleistocene to Recent) between the Bassendean Dunes Zone and the Darling Scarp with colluvial and shelf deposits adjacent to the Darling Scarp in clayey to sandy alluvial soils with wet areas (Purdie *et al.* 2004).

Twenty soil-landscape units are mapped within the Study Area as summarised in Table 1 and presented in Figure 3 (Department of Primary Industries and Development (DPIRD) (2019a))
.

Table 1: Soil Landscape Units of the Study Area (Department of Primary Industries and Development 2019a)

Unit Name	Unit Symbol	Description
Bassendean B1 Phase	212Bs__B1	Extremely low to very low relief dunes, undulating sandplain and discrete sand rises with deep bleached grey sands sometimes with a pale yellow B horizon or a weak iron-organic hardpan at depths generally greater than 2 m; banksia dominant.
Bassendean B1a Phase	212Bs__B1a	Extremely low to very low relief dunes, undulating sandplain and discrete sand rises with deep bleached grey sands with an intensely coloured yellow B horizon occurring within 1 m of the surface; marri and jarrah dominant.
Bassendean B2 Phase	212Bs__B2	Flat to very gently undulating sandplain with well to moderately well drained deep bleached grey sands with a pale yellow B horizon or a weak iron-organic hardpan 1-2 m.
Bassendean B2a Phase	212Bs__B2a	Flat to very gently undulating sandplain with well to moderately well drained deep bleached grey sands with an intensely coloured yellow B horizon usually well within 1 m of the surface.
Bassendean B3 Phase	212Bs__B3	Closed depressions and poorly defined stream channels with moderately deep, poorly to very poorly drained bleached sands with an iron-organic pan, or clay subsoil. Surfaces are dark grey sand or sandy loam.
Bassendean B4 Phase	212Bs__B4	Broad poorly drained sandplain with deep grey siliceous sands or bleached sands, underlain at depths generally greater than 1.5 m by clay or less frequently a strong iron-organic hardpan.
Bassendean B6 Phase	212Bs__B6	Sandplain and broad extremely low rises with imperfectly drained deep or very deep grey siliceous sands.
Forrestfield F2b Phase	213Fo__F2b	Low slopes and foot slopes up to 5-10% with well drained moderately deep to deep, gravelly acidic yellow duplex soils and rare laterite.
Forrestfield F3 Phase	213Fo__F3	1-3% foot slopes with deep, imperfectly drained yellow and, less commonly, acidic grey duplex soils.
Forrestfield F4 Phase	213Fo__F4	Incised stream channels within gentle slopes with deep acidic yellow duplex soils and sandy alluvial gradational brown earths.
Forrestfield (D Range) F3 Phase	213Fo__Ff3	Foot and low slopes <10%. Well drained gravelly yellow or red duplex soils with sandy loam to loam topsoil. Woodland of E. wandoo and E. marginata.
Pinjarra, B1 Phase	213Pj__B1	Extremely low to very low relief dunes, undulating sandplain and discrete sand rises with deep bleached grey sands sometimes with a pale yellow B horizon or a weak iron-organic hardpan at depths generally greater than 2 m; banksia dominant.
Pinjarra, B2 Phase	213Pj__B2	Flat to very gently undulating sandplain with well to moderately well drained deep bleached grey sands with a pale yellow B horizon or a weak iron-organic hardpan 1-2 m.
Pinjarra, B2a Phase	213Pj__B2a	Flat to very gently undulating sandplain with well to moderately well drained deep bleached grey sands with an intensely coloured yellow B horizon usually well within 1 m of the surface.
Pinjarra, P1b Phase	213Pj__P1b	Flat to very gently undulating plain with deep acidic mottled yellow duplex (or ineffective duplex) soils. Moderately deep pale sand to loamy sand over clay: imperfectly drained and moderately susceptible to salinity in limited areas.
Pinjarra, P1c Phase	213Pj__P1c	Flat to very gently undulating plain with deep acidic mottled yellow duplex (or ineffective duplex) soils. Deep pale brown to yellowish sand to sandy loam over clay; imperfectly drained and moderately susceptible to salinity in limited areas.

Unit Name	Unit Symbol	Description
Pinjarra, P1d Phase	213Pj__P1d	Flat to very gently undulating plain with deep acidic mottled yellow duplex (or ineffective duplex) soils. Shallow pale sand to sandy loam over clay; imperfect to poorly drained and moderately susceptible to salinity.
Pinjarra, P1e Phase	213Pj__P1e	Flat to very gently undulating plain with deep acidic mottled yellow duplex (or ineffective duplex) soils. Shallow pale sand to sandy loam over very gravelly clay; moderately well drained.
Pinjarra, P2 Phase	213Pj__P2	Flat to very gently undulating plain with deep alkaline mottled yellow duplex soils which generally consist of shallow pale sand to sandy loam over clay.
Pinjarra, P3 Phase	213Pj__P3	Flat to very gently undulating plain with deep, imperfect to poorly drained acidic gradational yellow or grey-brown earths and mottled yellow duplex soils, with loam to clay loam surface horizons.
Pinjarra, P9 Phase	213Pj__P9	Shallowly incised stream channels of minor creeks and rivers with deep acidic mottled yellow duplex soils.



Soil Landscape Units of the Desktop Study Area	Author: Leah Firth	
	WEC Ref: MR19-22-01	
WOODMAN ENVIRONMENTAL	Filename: MR19-22-01-f03.mxd	**Figure**
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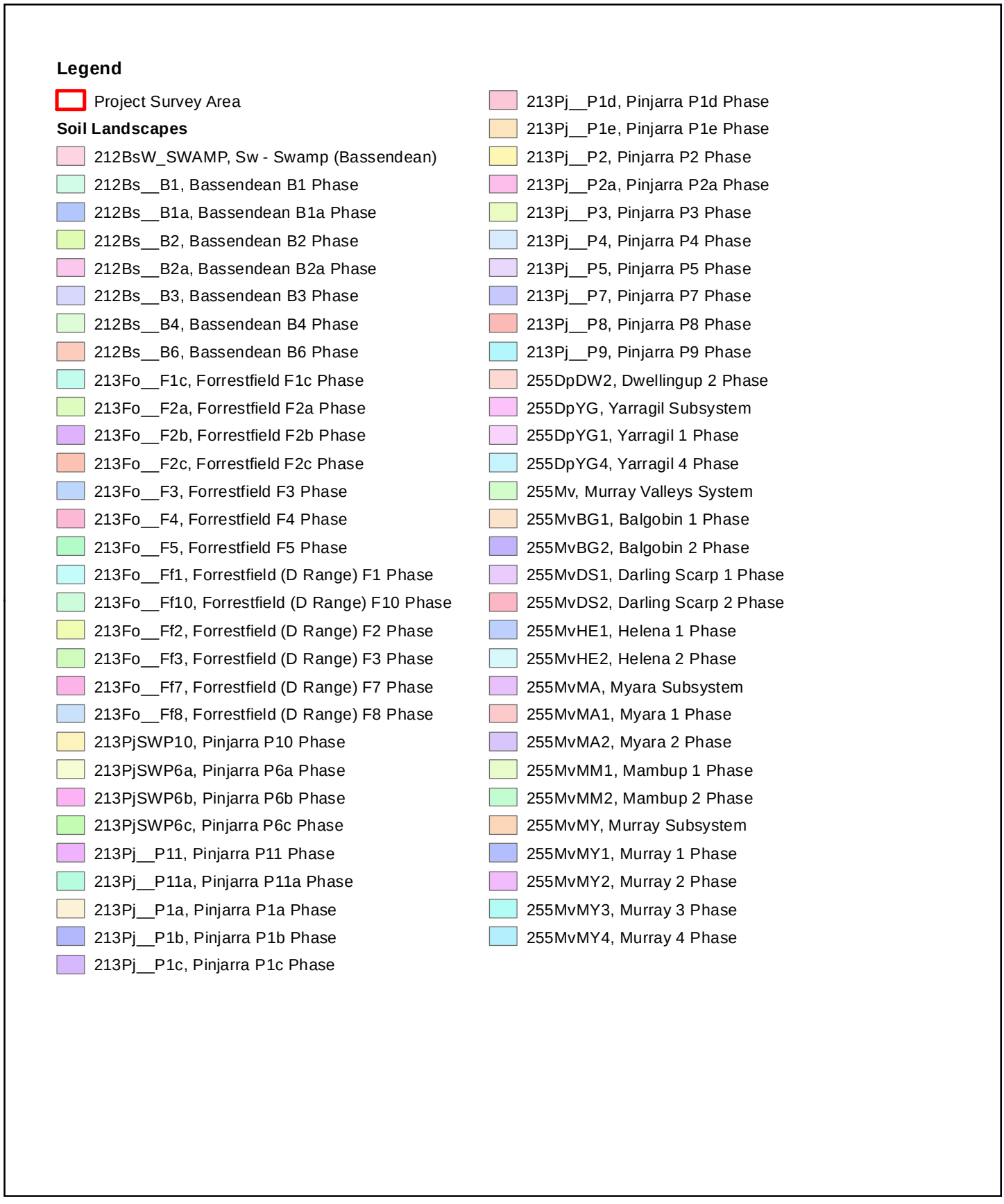

Soil Landscape Units of the Desktop Study Area Legend	Author: Leah Firth	N
	WEC Ref: MR19-22-01	
WOODMAN ENVIRONMENTAL	Filename: MR19-22-01-f03.mxd	**Figure**
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	Projection: GDA 1994 MGA Zone 50	
This map should only be used in conjunction with WEC report MR19-22-01.	Revision: 0 - 12 December 2019	

3. METHODS

3.1 Desktop Study

Prior to commencement of the field survey, a review of all publicly available flora and vegetation data relevant to the Study Area was undertaken. This included obtaining and reviewing copies of reports of previous biological surveys carried out within the vicinity of the Study Area (where available) and interrogation of relevant databases and other sources as listed in Table 2.

Table 2: Searches Undertaken for the Desktop Study Area

Source	Search Attributes	Search Purpose
DBCA Threatened and Priority Ecological Communities Database (data provided by Main Roads)	Database interrogated using Desktop Study Area boundary	Obtain records of DBCA-classified TECs and/or DBCA-classified PECs within the Desktop Study Area
DBCA TEC and PEC lists	Review of current DBCA TEC and PEC lists (DBCA 2018a, 2019b)	Identify whether there are any additional DBCA listed TECs or PECs which could occur within the Desktop Study Area
DBCA Significant Flora Databases (WA Herbarium specimen database and Threatened and Priority Flora (TPFL) database) (data provided by Main Roads)	Database interrogated using Desktop Study Area boundary	Obtain records of listed significant flora within the Desktop Study Area
DoEE Species Profile and Threats (SPRAT) Database (interrogated using the Protected Matters Search Tool (DoEE 2019))	Database interrogated using approximate Desktop Study Area boundary (exact boundary cannot be used); search performed prior to survey, updated 31/7/19	Identify Matters of National Environmental Significance (MNES), including Threatened flora and TECs, listed under the EPBC Act, that occur or have the potential to occur within the Desktop Study Area
DBCA NatureMap (WA Herbarium and TPFL records) (DBCA 2007-)	Database interrogated using approximate Desktop Study Area boundary (exact boundary cannot be used); search performed prior to survey, updated 31/7/19	Obtain records of listed significant flora and introduced flora within the Desktop Study Area
2019 Statewide Vegetation Statistics incorporating the CAR Reserve Analysis (Government of Western Australia 2019a)	Study Area Vegetation System Associations – current extent, data current March 2019	Identify extent of Vegetation System Associations within the Study Area
2018 South West Vegetation Complex Statistics (Government of Western Australia 2019b)	Study Area Vegetation Complexes – current extent, data current March 2019.	Identify extent of Vegetation Complexes within the Study Area

3.1.1 Personnel and Licensing

Table 3 lists the personnel involved in both fieldwork and plant identifications for the survey. The lead field surveyor, and the project taxonomist have extensive previous experience (>10 years) in conducting flora surveys and plant identifications in the SWA-2 IBRA subregion. All plant material was collected under the scientific licences pursuant to the

Biodiversity Conservation Act 2016 (BC Act), Regulation 62 of the *Biodiversity Conservation Regulations 2018* as listed in Table 3.

Table 3: Personnel and Licensing Information

Personnel	Role	Flora Collecting Permit (BC Act)
Greg Woodman	Project Manager and Field survey (lead)	FB62000053 TFL 19-1819
Leah Firth	Field survey assistant	FB62000055
David Coultas	Plant identifications	N/A

3.1.2 Aerial Photography Interpretation and Survey Design

Initial interpretation of ortho-rectified aerial photography at a scale of 1:5,000 was conducted to determine preliminary vegetation patterns present within the Study Area, with releves allocated based on these patterns.

3.1.3 Field Survey Methods

The field survey of the Study Area was conducted on the 24th May 2019, with follow up inspection conducted on 17th October 2019.

The Study Area was accessed by vehicle using existing roads and access tracks, and via foot transects. The reconnaissance survey involved on–ground inspection of vegetated areas (as defined through initial aerial photography interpretation) within the Study Area, with data being collected through the use of releves. The following information was recorded within 10m radius of non-permanent releves:

- Releve number, date, surveyor
- GPS location
- Soil type, colour
- Topography
- Listing of dominant vascular plant taxa within the limits of the releve area and approximate percentage foliage covers of each taxon
- Listing of all other vascular plant taxa within the limits of the releve area
- Vegetation Condition as per EPA (2016a) (Appendix B).

The dominant taxa only were recorded to allow description of the plant community. This report does not include a full census of plant taxa in each community. Targeted survey for significant flora taxa was not undertaken as part of the survey.

All traverses in the Study Area are presented as track logs on maps in Appendix C.

3.1.4 Plant Collection and Identification

Specimens of any unknown taxa that were collected were pressed for later identification at the WA Herbarium by Senior Botanist, David Coultas. External experts of particular families or genera were consulted for any specimens considered to be difficult to identify or of taxonomic interest.

Taxon nomenclature generally follows FloraBase (WA Herbarium 1998-) with all names checked against the current DBCA Max Database to ensure their validity. The conservation status of each taxon was checked against FloraBase, which provides the most up-to-date information regarding the conservation status of flora taxa in Western Australia.

3.1.5 Vegetation Unit Definition, Mapping and Description

Vegetation Units (VUs) were defined and described using the structural vegetation classification technique, as outlined in EPA (2016a). This classification uses vegetation structure and dominant species to describe differences between VUs, with information provided on height of strata, folia cover and dominant species (EPA 2016a).

VU descriptions have been adapted from the National Vegetation Information System (NVIS) Australian Vegetation Attribute Manual Version 6.0 (ESCAVI 2003), as stipulated by EPA (2016a). This model follows nationally-agreed guidelines to describe and represent VUs, so that comparable and consistent data are produced nation-wide.

Releve data and site descriptions were compared with descriptions of listed conservation significant vegetation types to determine the likelihood of the vegetation being representative of TECs or PECs present on the Swan Coastal Plain. More definitive classification analyses were not possible utilising the releve data. The releve data and site descriptions were also used compared to published information regarding habitat preferences of conservation significant flora species to determine the potential presence of habitat known to support Threatened flora that potentially occurs in the area.

3.1.6 Vegetation Condition Mapping

Vegetation condition was described using the vegetation condition scale presented in EPA (2016a) (see Appendix B). Notes on vegetation condition were taken during the field survey during foot traverses undertaken within the Study Area. Vegetation condition category polygon boundaries were developed using this information, and were digitised using GIS software as for VU polygon boundaries. Condition ratings were not applied to cleared land.

3.1.7 Significant Flora and Vegetation

3.1.7.1 Significant Flora

As per EPA (2016b), flora taxa may be significant for a range of reasons, including, but not limited to the following:

- Being identified as a Threatened or Priority species (formally listed significant taxa – includes taxa listed under both State and Commonwealth legislation, and classified as Priority by DBCA);
- Locally endemic or associated with a restricted habitat type (e.g. surface water or groundwater dependent ecosystems);
- New species or anomalous features that indicate a potential new species;
- Representative of the range of a species (particularly, at the extremes of range, recently discovered range extensions, or isolated outliers of the main range);
- Unusual species, including restricted subspecies, varieties or naturally occurring hybrids;

- Relictual status, being representative of taxonomic groups that no longer occur widely in the broader landscape.

Significant taxa opportunistically recorded within the Study Area are discussed in Section 5.1.2.2 with reference to the above categories. The likelihood of occurrence of all other significant flora species in the Study Area were categorised using the following:

Low: Taxon was not recorded within the Study Area during the survey, and suitable habitat is not present.

Unlikely: Taxon was not recorded within the Study Area during the survey, and suitable habitat for the taxon was not observed or otherwise mapped in the Study Area.

Possible: Taxon was not recorded or otherwise known from the Study Area; suitable habitat to support the taxon was observed or otherwise mapped in the Study Area.

Known: Taxon was either recorded within the Study Area during this survey, or was otherwise previously known to occur within the Study Area through previous records.

3.1.7.2 Significant Vegetation

As per EPA (2016b), vegetation may be significant for a range of reasons, including, but not limited to the following:

- Being identified as a TEC or PEC (formally listed significant vegetation – includes vegetation listed under Commonwealth legislation, endorsed as a TEC by the WA Government, or classified as a PEC by DBCA);
- Having restricted distribution;
- Degree of historical impact from threatened processes;
- A role as a refuge;
- Providing an important function required to maintain ecological integrity of a significant ecosystem.

With regard to TECs and PECs listed in Western Australia that occur in the Swan Coastal Plain region, the vegetation of the Study Area was qualitatively compared to the descriptions of such TECs and PECs to determine whether any vegetation may represent a TEC or PEC (DBCA 2018a; 2019b).

With regard to TECs listed under the EPBC Act, the vegetation of the Study Area was assessed against the appropriate listing and conservation advice for any TECs likely to occur in the Study Area.

4. LIMITATIONS OF SURVEY

4.1 Flora and Vegetation

Table 4 presents the limitations of the flora and vegetation survey of the Study Area in accordance with EPA (2016a), as applicable to Reconnaissance Survey.

Table 4: Table of Limitations

Limitation	Limitation of Survey	Comment
Effort and Extent	No	Reconnaissance Survey undertaken across entire Study Area. Releves were completed across the sites to determine broad vegetation type boundaries.
Competency /experience of the team carrying out the survey	No	Lead Surveyor has extensive experience (>10 years) in conducting similar assessments on the Swan Coastal Plain. Personnel conducting plant identifications have had >10 years' experience in plant identification in the Swan Coastal Plain.
Proportion of flora identified, recorded and/or collected	Minor	Only dominant species were recorded. Data suitable to describe vegetation units and identify where the potential exists for conservation significant vegetation and/or flora to be present.
Sources of information e.g. previously available information (whether historic or recent) as distinct from new data	No	Reasonable contextual information for the Study Area was available prior to the survey. Sources of information used included government databases (DBCA), which are known to have been extensively populated with data from numerous surveys conducted in the general vicinity of the Study Area, as well as numerous general sources pertaining to the climate, geomorphology, flora and vegetation of the Swan Coastal Plain, and several surveys conducted in the local area, including some that overlapped the Study Area.
Timing/weather/season/cycle	Minor	Although the survey was not conducted within what is considered to be the usual appropriate season for survey in the Swan Coastal Plain bioregion (spring), dominant taxa were able to be identified to allow for broad vegetation type mapping.
Disturbances (e.g. fire, flood, accidental human intervention etc.), which affected results of survey	Minor	The vegetation in the study area is highly disturbed due to clearing, weeds etc. This made the resolution of Vegetation Units somewhat difficult in the field in some instances.
Remoteness and/or access problems	Minor	Some landowners denied access to properties within the Study Area. However all areas of intact vegetation could be adequately surveyed with no-access areas containing only highly degraded remnants or were observable from fence lines.

5. RESULTS

5.1 Desktop Study

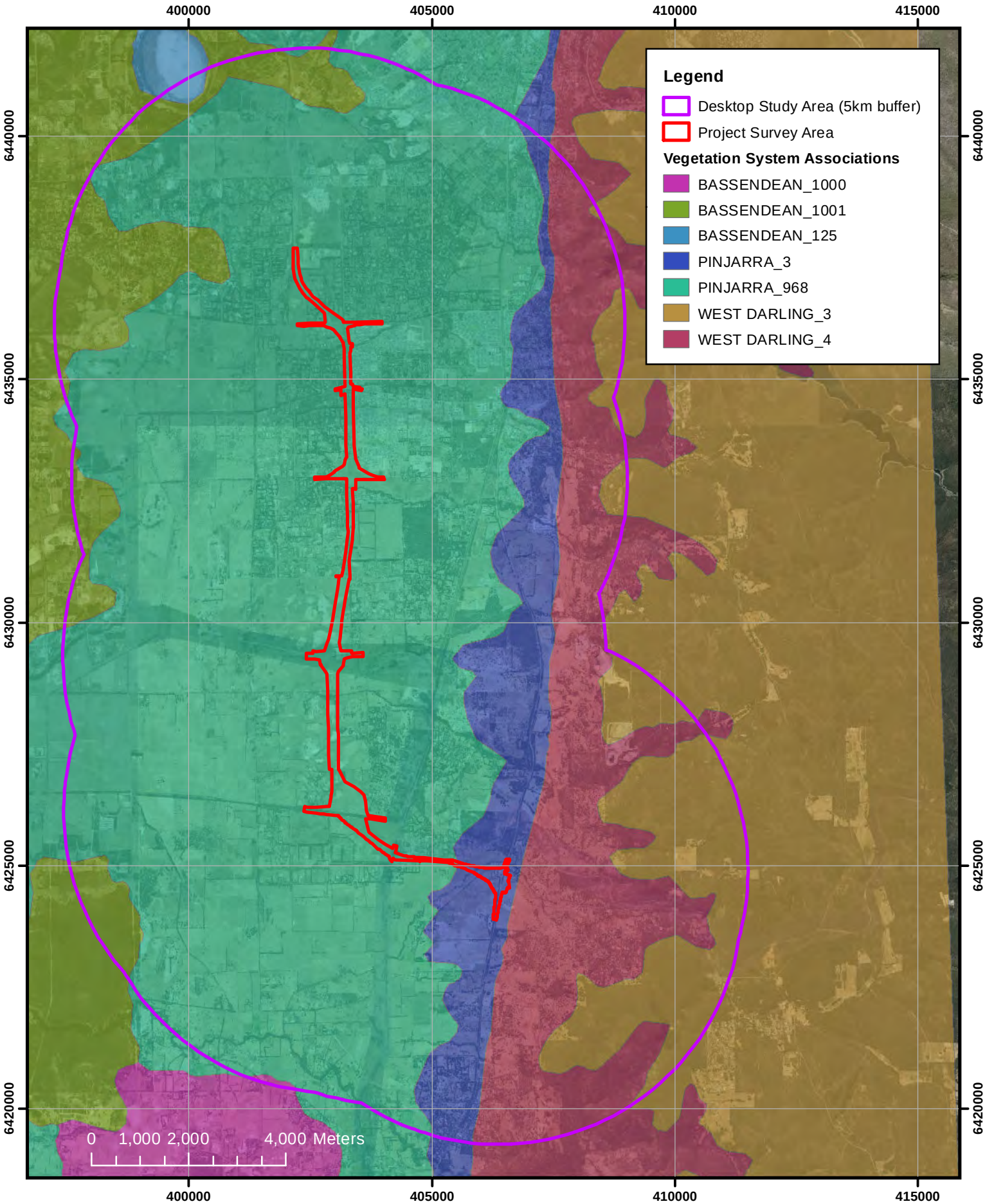
5.1.1 Regional Vegetation

As previously mentioned, the Study Area is located in the Swan Coastal Plain IBRA region, and specifically within the SWA2 IBRA subregion (Commonwealth of Australia 2012). Beard (1981) mapped vegetation of the Swan area (including the Study Area) related to physiognomy, at a scale of 1:1,000,000. The vegetation mapping by Beard (1981) was used by Shepherd *et al.* (2002) to describe vegetation system associations, at a scale of 1:250,000.

Two vegetation system associations occur in the Study Area, as summarised in Table 5 and presented on Figure 4. Table 5 also presents the current extent of each vegetation system association in relation to its pre-European extent (Government of Western Australia 2019a), and the percentage of the current extent of each vegetation system association currently protected for conservation. The Pinjarra_968 and Pinjarra_3 vegetation system associations both have less than 12% of their pre-European extent remaining, with a very small proportion (1.19% and 1.53% respectively) of the remaining extant area protected for conservation.

Table 5: Vegetation System Associations Occurring in the Study Area

Vegetation System Association	Description	Current Extent (ha)	Percentage of Pre-European Extent Remaining	Percentage of Current Extent Protected for Conservation
Pinjarra_968	Medium woodland; jarrah, marri & wandoo	8,996	6.61	1.19
Pinjarra_3	Medium forest; jarrah-marri	1,587	11.55	1.53



Vegetation System Associations of the Desktop Study Area

Author: Leah Firth

WEC Ref: MR19-22-01

WOODMAN ENVIRONMENTAL

Filename: MR19-22-01-f04.mxd

Scale: 1:100,000 (A4)

Projection: GDA 1994 MGA Zone 50

Revision: 0 - 12 December 2019

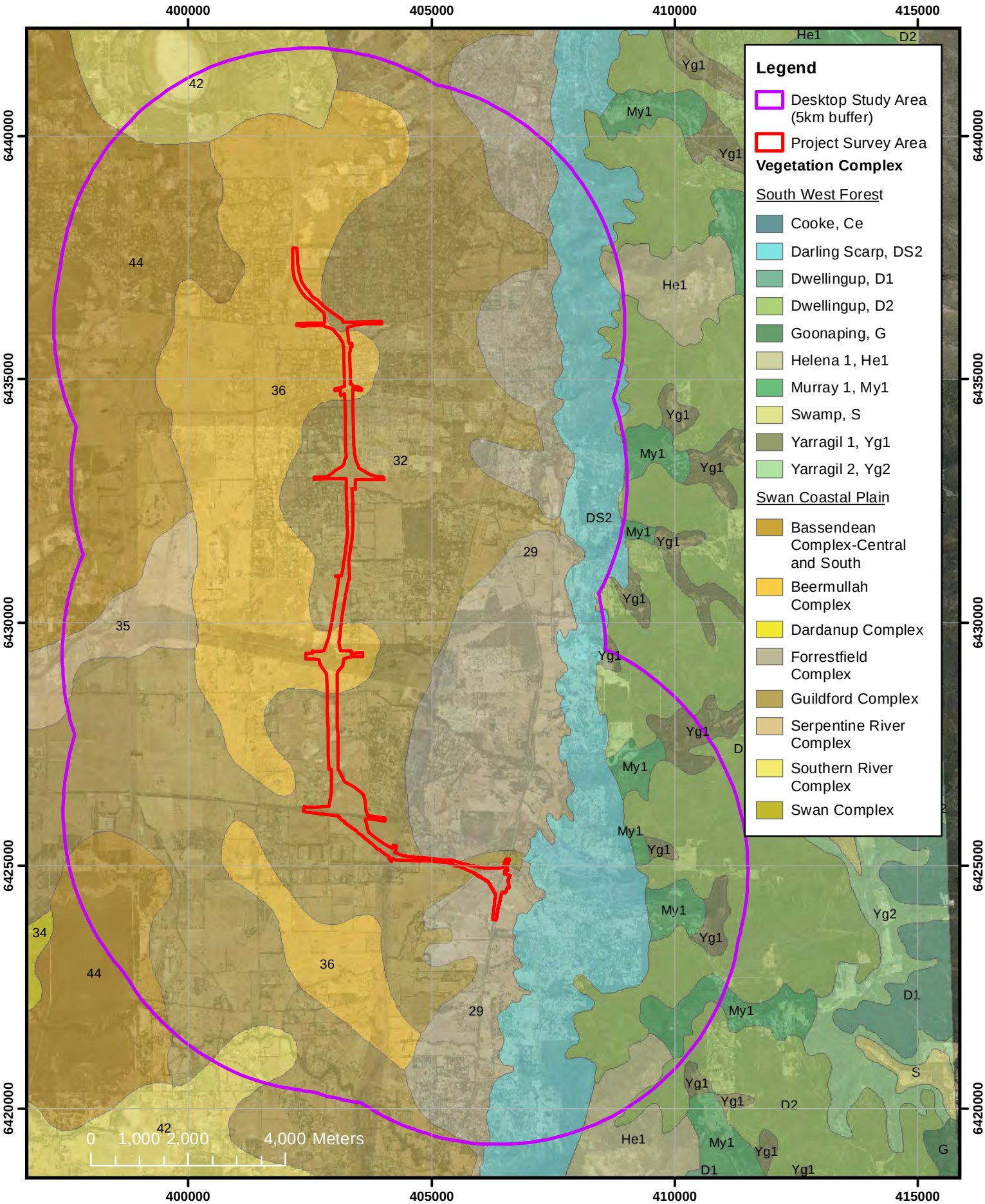
Figure 4

This map should only be used in conjunction with WEC report MR19-22-01.

Vegetation within the Perth Metropolitan area has been described by Heddle *et al.* (1980) as vegetation complexes. Three vegetation complexes occur in the Study Area, as summarised in Table 6 and presented on Figure 5. Table 6 also presents the current extent of each vegetation complex in relation to its pre-European extent (Government of Western Australia 2019b), and the percentage of the current extent of each vegetation system association currently protected for conservation. The Guildford, Beermullah and Forrestfield vegetation complexes have less than 13% of their pre-European extent remaining, with a very small proportion (0.26%, 2.13 and 1.37% respectively) of the remaining extent protected for conservation.

Table 6: Vegetation Complexes Occurring in the Study Area

Vegetation Complex	Description	Current Extent (ha)	Percentage of Pre-European Extent Remaining	Percentage of Current Extent Protected for Conservation
Guildford Complex (32)	A mixture of open forest to tall open forest of *Corymbia calophylla* (Marri) - *Eucalyptus wandoo* (Wandoo) - *Eucalyptus marginata* (Jarrah) and woodland of *Eucalyptus wandoo* (Wandoo) (with rare occurrences of *Eucalyptus lane-poolei* (Salmon White Gum)). Minor components include *Eucalyptus rudis* (Flooded Gum) - *Melaleuca rhaphiophylla* (Swamp Paperbark).	4,607	5.09	0.26
Beermullah Complex (36)	Mixture of low open forest of *Casuarina obesa* (Swamp Sheoak) and open woodland of *Corymbia calophylla* (Marri) - *Eucalyptus wandoo* (Wandoo) - *Eucalyptus marginata* (Jarrah). Minor components include closed scrub of Melaleuca species and occurrence of *Actinostrobus pyramidalis* (Swamp Cypress).	447	6.67	2.13
Forrestfield Complex (29)	Vegetation ranges from open forest of *Corymbia calophylla* (Marri) - *Eucalyptus wandoo* (Wandoo) - *Eucalyptus marginata* (Jarrah) to open forest of *Eucalyptus marginata* (Jarrah) - *Corymbia calophylla* (Marri) - *Allocasuarina fraseriana* (Sheoak) - Banksia species. Fringing woodland of *Eucalyptus rudis* (Flooded Gum) in the gullies that dissect this landform.	2,803	12.29	1.37



Vegetation Complexes of the Desktop Study Area	Author: Leah Firth	N
	WEC Ref: MR19-22-01	
WOODMAN ENVIRONMENTAL	Filename: MR19-22-01-f05.mxd	**Figure**
	Scale: 1:100,000 (A4)	5
	Projection: GDA 1994 MGA Zone 50	
This map should only be used in conjunction with WEC report MR19-22-01.	Revision: 0 - 12 December 2019	

5.1.2 Local Flora and Vegetation Surveys

A number of flora and vegetation surveys which are publically available, have been undertaken within 5 kms of the Desktop Study Area as outlined in Table 7.

Six TECs, two listed Threatened taxa and four Priority taxa have been recorded within the local area during the surveys as presented in Table 7. Since 2012 one of the Priority taxa recorded has been delisted (*Calothamnus rupestris* (P4)). These surveys indicate a high probability of TECs, Threatened and Priority taxa within the Study Area.

Surveys conducted prior to 2014 were undertaken to meet the requirements of a Level 2 Survey, which consisted of background research/desktop study and reconnaissance survey, followed by either a detailed or comprehensive survey. The level of survey required was determined from Table 2 of the Environmental Protection Authority's Guidance Statement No. 51 (EPA 2004). Since 2014 the Environmental Protection Authority have released new advice ('Technical Guidance for Flora and Vegetation Surveys for Environmental Impact Assessment' (EPA 2016a)), which supersedes Guidance Statement No 51. The original Level 2 Survey has been replaced by a Detailed Survey.

Table 2: Summary of Flora and Vegetation Surveys Previously Conducted in the local area

Report Title and Author	Scope	Key Findings (Flora and Vegetation only)
Mundijong Road Spring Flora Survey – Main Roads WA by Eco Logical (2019)	Detailed and Targeted Survey – 8.9 hectares of road reserve.	• Recorded 97 taxa from 34 families and 78 genera. • 8 quadrats (10 x 10 m) and transects (5-20 m apart). • Field survey was conducted in spring. • Two EPBC Act listed threatened species were recorded; *Synaphea* sp. Serpentine (G.R. Brand 103) and *Synaphea* sp. Pinjarra Plain (A. S. George 17182) • No priority taxa recorded. • Recorded 27 introduced taxa. • Four vegetation communities mapped within survey area. • Relationship to TECs and PECs was inconclusive due to degraded condition of vegetation. However there was some similarity with the 'Clay Pans of the Swan Coastal Plain TEC'.
Bungendore Park Targeted Flora Survey – City of Armadale by Spectrum Ecology (2018)	Targeted Survey – 84 x 5m2 sites.	• No Threatened or Priority taxa recorded. • All 84 sites inspected. No quadrats due to the small size of sites. • Field survey was conducted in spring.
Abernethy Road, Byford Flora, Vegetation and Fauna Report – Shire of Serpentine Jarrahdale by 360 Environmental (2014)	Level 2 Flora and Vegetation Assessment (now a Detailed Survey) – 20.5 hectares.	• Recorded 58 taxa from 26 families and 50 genera. • Three releves completed. No quadrats were done due to highly disturbed condition of vegetation. • Field survey was conducted in spring. • No threatened or priority taxa were recorded. • Recorded 20 introduced taxa. • Four floristic community types recorded. However statistical analysis was not undertaken as quadrats were not done due to the highly disturbed state of the vegetation. • Two potential TECs were recorded; Herb rich shrublands in clay pans (SCP 8) and *Corymbia calophylla-Kingia australis* woodlands on heavy soils (SCP 3a).

Report Title and Author	Scope	Key Findings (Flora and Vegetation only)
Report for Rail Reserves in the Shire of Serpentine Jarrahdale: Spring Flora and Vegetation Survey and Fauna and Habitat Assessment – Public Transport Authority by GHD (2012)	Level 2 Flora and Vegetation Assessment (now a Detailed Survey) – 230 hectares.	• Recorded 394 taxa from 65 families and 197 genera • 16 quadrats (10 x 10 m) and six releves. • Field survey was conducted in spring. • One threatened taxa recorded but identification not confirmed; *Synaphea stenoloba* or possibly *Synaphea* sp. Serpentine. • Four priority taxa recorded; *Grevillea bipinnatifida* subsp. *pagna* (P1), *Synaphea odocoileops* (P1), *Johnsonia pubescens* subsp. *cygnorum* (P2) and *Calothamnus rupestris* (P4) – delisted since 2012. • Recorded 58 introduced taxa. • 13 vegetation types mapped. • Five TECs or vegetation closely associated with a TEC were identified; Communities of Tumulus Springs (Organic Mound Springs, SCP), *Banksia attenuata* and/or *Eucalyptus marginata* woodlands of the eastern side of the Swan Coastal Plain (SCP 20b), *Corymbia calophylla – Kingia australis* woodlands on heavy soils Swan Coastal Plain (SCP 3a), *Corymbia calophylla – Xanthorrhoea preissii* woodlands on heavy soils Swan Coastal Plain (SCP 3c) and Shrublands on dry clay flats (SCP 10a).
Provision of Domestic Supply King Rd/Mundijong Rd Environmental Assessment – Western Power by Woodman Environmental (2006)	Inspection of area to be impacted by installation of private power pole and associated trench.	• No native taxa recorded at the site. • Site dominated by pasture and introduced taxa.

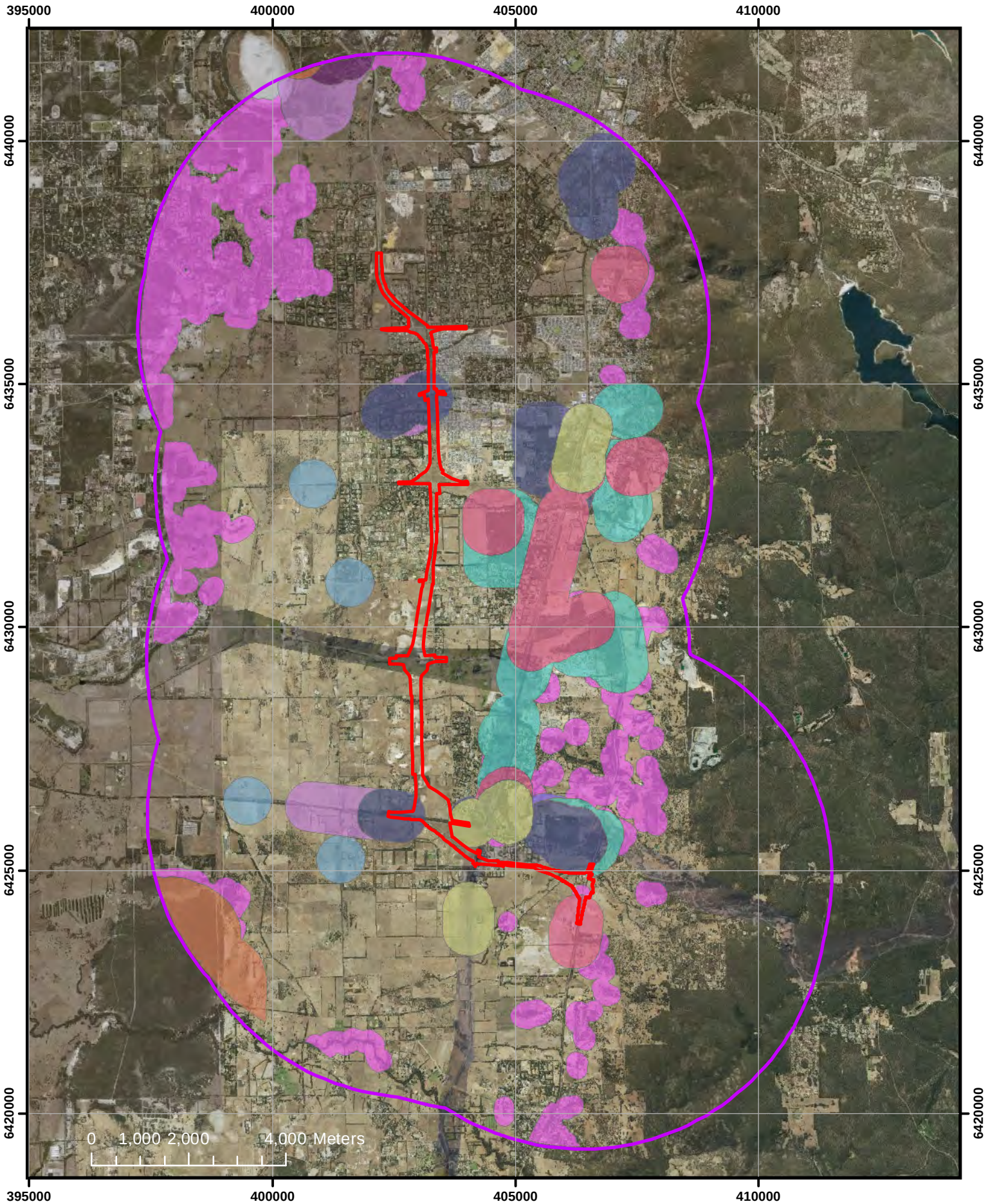
5.1.3 Significant Vegetation

The interrogation of the DBCA TEC and PEC Database (data provided by Main Roads as per Section 3.1.1) and DoEE's SPRAT Database returned a total of fourteen significant communities that have records in the Desktop Study Area. Two of the communities are listed as PECs in Western Australia with the remaining communities listed as TECs under either state and/or federal legislation. Table 8 provides a summary of these communities. Six of these communities and/or their buffer polygon are currently known to occur within the Study Area itself, highlighted in pink in Table 8. The locations of significant vegetation are presented on Figure 6. 'Herb rich shrublands in Clay Pans (SCP08)' and 'Shrublands on dry clay flats (SCP10a)' are components of the 'Clay Pans of the Swan Coastal Plain' EPBC Act listed TEC.

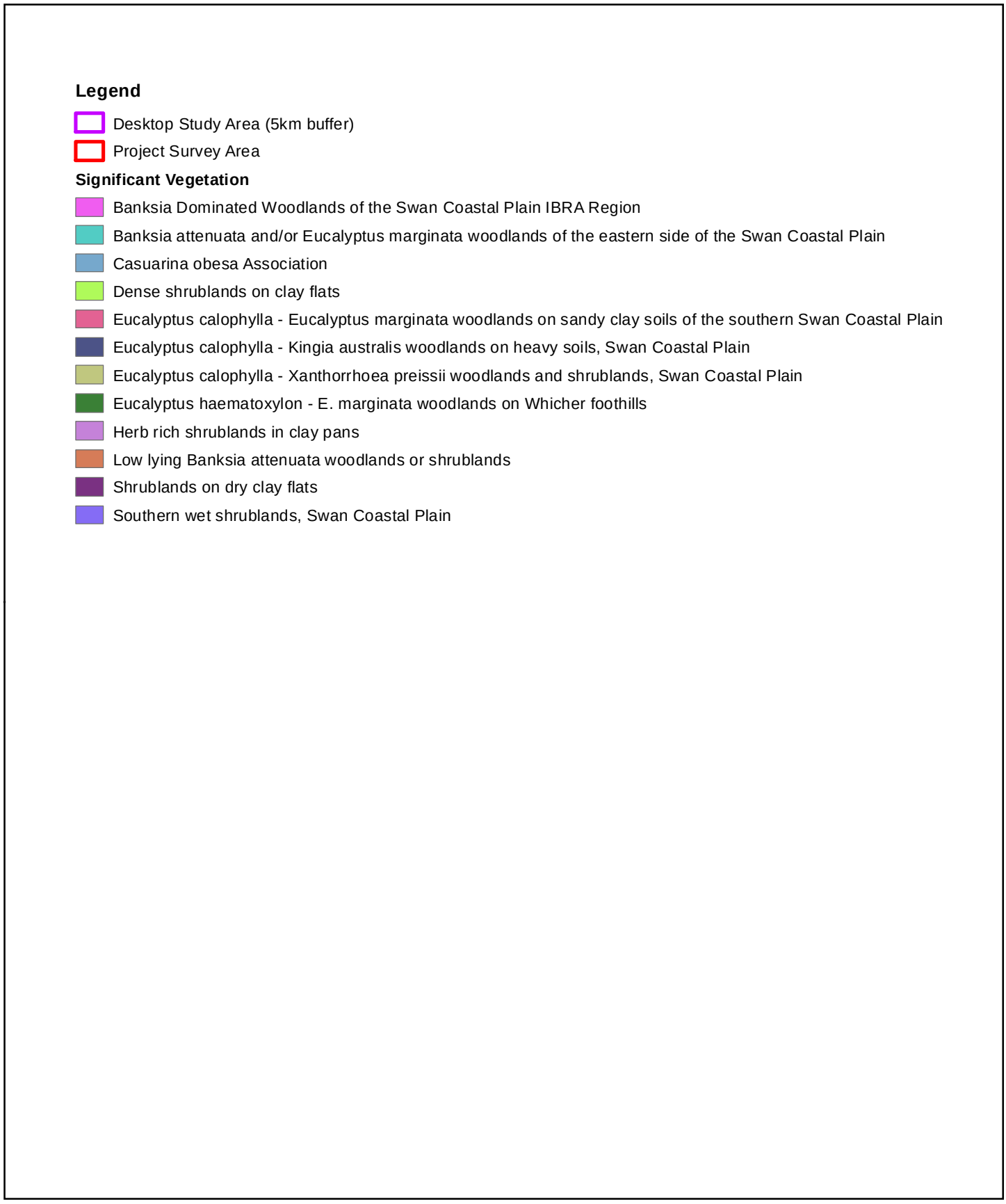
Table 8: Significant Vegetation Known from Within the Desktop Study Area

Community	Conservation Status (W.A.)	EPBC Act Ranking	Source
Banksia attenuata and/or *Eucalyptus marginata* woodlands of the eastern side of the Swan Coastal Plain (SCP20b)	TEC (Endangered)	Endangered	DBCA
Banksia Dominated Woodlands of the Swan Coastal Plain IBRA Region	PEC (P3)	Endangered	DoEE, DBCA
Casuarina obesa association	PEC (P1)	-	DBCA
Clay Pans of the Swan Coastal Plain	-	Critically Endangered	DoEE
Corymbia calophylla – Eucalyptus marginata woodlands on sandy clay soils of the southern Swan Coastal Plain (SCP3a)	TEC (Vulnerable)	-	DBCA
Corymbia calophylla – Kingia australis Woodlands on heavy soils of the Swan Coastal Plain (SCP3a)	TEC (Critically Endangered)	Endangered	DoEE, DBCA
Corymbia calophylla – Xanthorrhoea preissii woodlands and shrublands of the Swan Coastal Plain (SCP3c)	TEC (Critically Endangered)	Endangered	DoEE, DBCA
Dense shrublands on clay flats	TEC (Vulnerable)	Critically Endangered	DBCA
Eucalyptus haematoxylon - E. marginata woodlands on Whicher foothills (SCP1a)	PEC (P3)	-	DBCA
Herb rich shrublands in clay pans (SCP08)	TEC (Vulnerable)	Critically Endangered	DBCA
Low lying *Banksia attenuata* woodlands or shrublands (SCP21c)	PEC (P3)	Endangered	DBCA
Shrublands on dry clay flats (SCP10a)	TEC (Endangered)	Critically Endangered	DBCA
Southern wet shrublands, Swan Coastal Plain (SCP02)	TEC (Endangered)	-	DBCA
Tuart (*Eucalyptus gomphocephala*) Woodlands and Forests of the Swan Coastal Plain ecological community	PEC (P3)	Critically Endangered	DoEE

*Sources are:
DBCA – DBCA's TEC and PEC Database, data provided by Main Roads and Naturemap (see Section 3.1.1);
DoEE – Department of Energy and Environment MNES database



Existing Significant Vegetation Records of the Desktop Study Area	Author: Leah Firth	
	WEC Ref: MR19-22-01	
WOODMAN ENVIRONMENTAL	Filename: MR19-22-01-f06.mxd	**Figure**
	Scale: 1:100,000 (A4)	6.1
	Projection: GDA 1994 MGA Zone 50	
This map should only be used in conjunction with WEC report MR19-22-01.	Revision: 0 - 12 December 2019	



Existing Significant Vegetation Records of the Desktop Study Area - Legend

Author: Leah Firth

WEC Ref: MR19-22-01

WOODMAN ENVIRONMENTAL

Filename: MR19-22-01-f06-02.mxd

Scale: 1:100,000 (A4)

Projection: GDA 1994 MGA Zone 50

Revision: 0 - 12 December 2019

Figure

6.2

This map should only be used in conjunction with WEC report MR19-22-01.

5.1.4 Significant Flora

The interrogation of the DBCA WA Herbarium specimen Database and TPFL Database (data provided by Main Roads as per Section 3.1.1) returned a total of 28 significant vascular flora taxa that have records in the Desktop Study Area.

A search of these databases using NatureMap (DBCA 2007-) was also undertaken as part of the Desktop Study, to check for any recently added records and confirm the records returned from the DBCA WA Herbarium specimen Database and TPFL Database search. Two additional taxa were returned.

The search of the DoEE SPRAT Database (DoEE 2019) with regard to MNES listed under the EPBC Act identified 18 flora taxa listed as Threatened species, or habitat for Threatened species, that is likely to occur in the Desktop Study Area (Table 9). The full results of the DoEE Database search are presented in Appendix D.

A list of significant flora taxa known from within the Desktop Study Area is presented in Table 9 and on Figure 7. This list has been compiled from the results of searches of DBCA's Threatened Flora Databases and DoEE's SPRAT Database. Three of these taxa are known to occur in the Study Area (*Tetraria australiensis* (T); *Synaphea* sp. Serpentine (G.R. Brand 103) (T) and *Babingtonia urbana* (P3)).

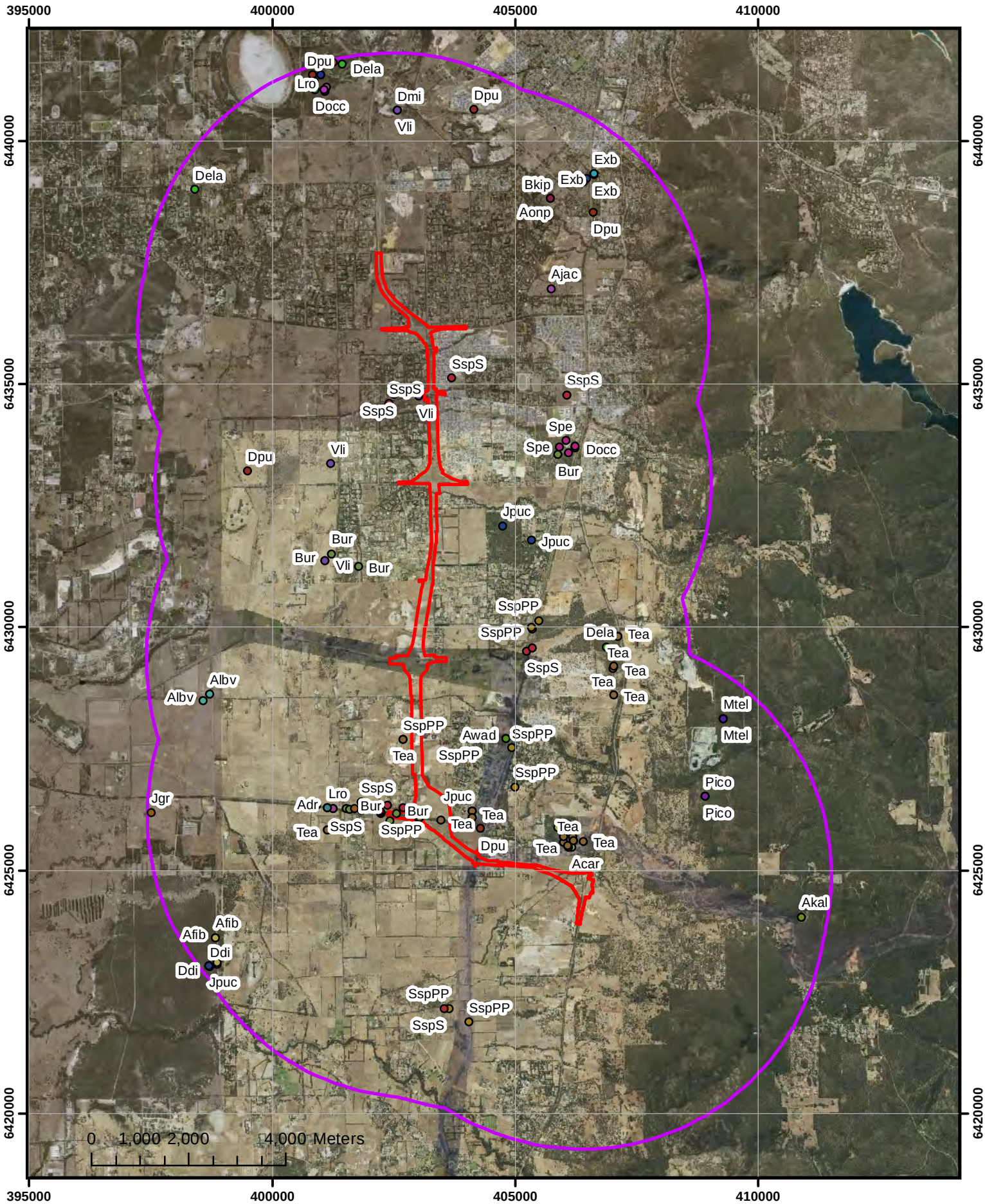
Table 9: Significant Flora Taxa Known from Within the Desktop Study Area

Taxon	Status	Source *	Flowering Period (WA Herbarium 1998-)	Habitat (WA Herbarium 1998-)
Acacia lasiocarpa var. bracteolata long peduncle variant (G.J. Keighery 5026)	P1	DBCA	May or August	Grey or black sand over clay. Swampy areas, winter wet lowlands.
Acacia oncinophylla subsp. *patulifolia*	P4	DBCA	March to April or September to December	Granite, occasionally on laterite. Brown loam.
Andersonia gracilis	T, Endangered	DBCA, DoEE	August to November	White/grey sand, sandy clay, gravelly loam. Winter-wet areas, near swamps.
Angianthus drummondii	P3	DBCA	October to December	Grey or brown clay soils, ironstone. Seasonally wet flats.
Anthocercis gracilis	T, Vulnerable	DBCA, DoEE	September to October	Sandy or loamy soils. Granite outcrops.
Austrostipa jacobsiana	T	DBCA	November	Grey/white sand.
Babingtonia urbana	P3	DBCA	October to March	Wetlands
Banksia kippistiana var. *paenepeccata*	P3	DBCA	September to November	Lateritic gravelly soils.
Caladenia huegelii	T, Endangered	DBCA, DoEE	August to October	Grey or brown sand, clay loam.
Calectasia cyanea	T	DBCA	July to November	White, grey or yellow sand, gravel. Often over limestone.

Taxon	Status	Source *	Flowering Period (WA Herbarium 1998-)	Habitat (WA Herbarium 1998-)
Diuris micrantha	T, Vulnerable	DBCA, DoEE	September to October	Brown loamy clay. Winter-wet swamps, in shallow water.
Diuris purdiei	T, Endangered	DBCA, DoEE	September to October	Grey-black sand, moist. Winter-wet swamps.
Dillwynia dillwynioides	P3	DBCA	August - December	Sandy soils. Winter-wet depressions.
Drakaea elastica	T, Endangered	DBCA, DoEE	October to November	White or grey sand. Low-lying situations adjoining winter-wet swamps.
Drakaea micrantha	T, Vulnerable	DBCA, DoEE	September to November	White-grey sand.
Drosera occidentalis	P4	DBCA	October to November	Swampy or damp flats, sandy floodplain.
Eleocharis keigheryi	T, Vulnerable	DBCA, DoEE	August to November	Clay, sandy loam. Emergent in freshwater: creeks, claypans.
Eucalyptus x balanites	T, Endangered	DBCA, DoEE	October to December or January to February	Sandy soils with lateritic gravel.
Grevillea curviloba subsp. *incurva*	T, Endangered	DBCA, DoEE	August to October	Grey/white or brown sand, sandy loam. Winter-wet heath.
Jacksonia gracillima	P3	DBCA	September to November	Grey sand, winter-wet areas.
Johnsonia pubescens subsp. *cygnorum*	P2	DBCA	September-October	Grey-white-yellow sand. Flats, seasonally-wet sites.
Lasiopetalum pterocarpum	T, Endangered	DBCA, DoEE	September to November	Dark red-brown loam or clayey sand over granite. On sloping banks near creeklines.
Lepidosperma rostratum	T, Endangered	DBCA, DoEE	June to July, September to December	Peaty sand, clay. Seasonally wet swamps.
Levenhookia pulcherrima	P2	DBCA	September to November	White/ grey sand.
Meionectes tenuifolia	P3	DBCA	October to December	Wetlands, swamps.
Millotia tenuifolia var. laevis	P2	DBCA	September to October	Granite or laterite soils, yellow sand.
Ornduffia submersa	P4	DBCA	September to November	Wetlands
Parsonsia diaphanophleba	P4	DBCA	April to June	Alluvial soils. Along rivers.
Pithocarpa corymbulosa	P3	DBCA	January to April	Gravelly or sandy loam. Amongst granite outcrops.
Schoenus capillifolius	P3	DBCA	October to November	Brown mud. Claypans.

Taxon	Status	Source *	Flowering Period (WA Herbarium 1998-)	Habitat (WA Herbarium 1998-)
Schoenus pennisetis	P3	DBCA	August to November	Grey or peaty sand, sandy clay. Swamps, winter-wet depressions.
Schoenus sp. Waroona (G.J. Keighery 12235)	P3	DBCA	October to November	Clay or sandy clay. Winter-wet flats.
Stylidium aceratum	P3	DBCA	October to November	Sandy soils. Swamp heathland.
Synaphea sp. Fairbridge Farm (D. Papenfus 696)	T, Critically Endangered	DBCA, DoEE	September to October	Grey clayey sand or sandy with lateritic pebbles. Near winter-wet flats.
Synaphea sp. Pinjarra Plain (A.S. George 17182)	T	DBCA	September to November	Grey sandy loam or brown clayey loam, laterite. Flats, seasonally wet areas, wet depressions or drains.
Synaphea sp. Serpentine (G.R. Brand 103)	T, Critically Endangered	DBCA, DoEE	September to October	Brown loam or sand. Seasonally wet areas.
Tetraria australiensis	T, Vulnerable	DBCA, DoEE	September to December	Brown sandy loam or grey sand. Winter damp areas.
Thelymitra dedmaniarum	T, Endangered	DBCA, DoEE	November to January	Grey loam. Granite.
Thelymitra stellata	T, Endangered	DBCA, DoEE	October to November	Sand, gravel, lateritic loam.
Verticordia lindleyi subsp. *lindleyi*	P4	DBCA	October to May	Sand, sandy clay. Winter-wet depressions.
Verticordia plumosa var. *ananeotes*	T, Endangered	DBCA, DoEE	November to January	White/grey sand or sandy clay. Winter-wet flats.

*Sources are:
DBCA – DBCA's Significant Flora Databases, data provided by Main Roads and Naturemap (see Section 3.1.1);
DoEE – Department of Environment and Energy MNES database search



Existing Significant Flora Records of the Desktop Study Area	Author: Leah Firth WEC Ref: MR19-22-01	N
WOODMAN ENVIRONMENTAL This map should only be used in conjunction with WEC report MR19-22-01.	Filename: MR19-22-01-f07.mxd Scale: 1:100,000 (A4) Projection: GDA 1994 MGA Zone 50 Revision: 0 - 12 December 2019	**Figure** 7.1

Legend

Desktop Study Area (5 km buffer)

Project Survey Area

Significant Flora

- Acar, *Amanita carneiphylla* (P3)
- Adr, *Angianthus drummondii* (P3)
- Afib, *Amanita fibrillopes* (P3)
- Ajac, *Austrostipa jacobsiana* (T)
- Akal, *Amanita kalamundae* (P3)
- Albv, *Acacia lasiocarpa* var. bracteolata long peduncle variant (G.J. Keighery 5026) (P1)
- Aonp, *Acacia oncinophylla* subsp. *patulifolia* (P4)
- Awad, *Amanita wadjukiorum* (P3)
- Bkip, *Banksia kippistiana* var. *paenepeccata* (P3)
- Bur, *Babingtonia urbana* (P3)
- Cca, *Centrolepis caespitosa*
- Ddi, *Dillwynia dillwynioides* (P3)
- Dela, *Drakaea elastica* (T)
- Dmi, *Drakaea micrantha* (T)
- Docc, *Drosera occidentalis* (P4)
- Dpu, *Diuris purdiei* (T)
- Exb, *Eucalyptus x balanites* (T)
- Jgr, *Jacksonia gracillima* (P3)
- Jpuc, *Johnsonia pubescens* subsp. *cygnorum* (P2)
- Lro, *Lepidosperma rostratum* (T)
- Mte, *Meionectes tenuifolia* (P3)
- Mtel, *Millotia tenuifolia* var. *laevis* (P2)
- Osu, *Ornduffia submersa* (P4)
- Pdia, *Parsonsia diaphanophleba* (P4)
- Pico, *Pithocarpa corymbulosa* (P3)
- Sac, *Stylidium aceratum* (P3)
- Sca, *Schoenus capillifolius* (P3)
- Spe, *Schoenus pennisetis* (P3)
- SspPP, *Synaphea* sp. Pinjarra Plain (A.S. George 17182) (T)
- SspS, *Synaphea* sp. Serpentine (G.R. Brand 103) (T)
- SspW, *Schoenus* sp. Waroona (G.J. Keighery 12235) (P3)
- Tea, *Tetraria australiensis* (T)
- Vli, *Verticordia lindleyi* subsp. *lindleyi* (P4)

Existing Significant Flora Records of the Desktop Study Area - Legend	Author: Leah Firth WEC Ref: MR19-22-01	N
WOODMAN ENVIRONMENTAL This map should only be used in conjunction with WEC report MR19-22-01.	Filename: MR19-22-01-f07-2.mxd Scale: 1:100,000 (A4) Projection: GDA 1994 MGA Zone 50 Revision: 0 - 12 December 2019	**Figure** 7.2

5.1.5 Introduced Flora

A search of the WA Herbarium specimen Database for records of introduced taxa within the Desktop Study Area was performed using NatureMap. A total of 130 introduced taxa that have records in the Desktop Study Area were returned. In addition to this a search of the DoEE SPRAT Database with regard to MNES listed under the EPBC Act was conducted. An additional 15 introduced taxa with habitat likely to occur within the area were returned, however none of these have been recorded in the Desktop Study Area. Thirteen Declared Pests listed under the BAM Act (Department of Primary Industries and Regional Development (DPIRD) 2019b) and eleven listed Weeds of National Significance (WoNS) (Australian Weeds Committee (AWC) 2019) were returned by the search.

A list of introduced flora taxa known from within the Desktop Study Area is presented in Table 10. This has been compiled from WA Herbarium specimen data, DoEE's SPRAT Database, and from local flora surveys (Section 5.1.5).

Table 10: Introduced Flora Taxa Known from Within the Desktop Study Area or Habitat Likely to Occur Within the Area

Taxon	Common Name	Source*	Comments
Aira caryophyllea	Silvery Hairgrass	DBCA	
Aira cupaniana	Silvery Hairgrass	DBCA	
Aizoon pubescens		DBCA	
Anredera cordifolia	Madeira Vine	DoEE	WoNS
Arctotheca calendula	Cape Weed	DBCA	
Asclepias curassavica	Redhead Cottonbush	DBCA	
Asparagus asparagoides	Bridal Creeper	DBCA, DoEE	Declared Pest, WoNS
Avellinia michelii		DBCA	
Avena barbata	Bearded Oat	DBCA	
Avena sativa	Common Oat	DBCA	
Babiana angustifolia		DBCA	
Bellardia trixago	Bellardia	DBCA	
Bellardia viscosa		DBCA	
Brachiaria mutica	Para Grass	DoEE	
Brachychiton populneus	Kurrajong	DBCA	
Brachypodium distachyon	False Brome	DBCA	
Briza maxima	Blowfly Grass	DBCA	
Briza minor	Shivery Grass	DBCA	
Bromus diandrus	Great Brome	DBCA	
Callitriche stagnalis	Common Starwort	DBCA	
Casuarina glauca	Swamp Sheoak	DBCA	
Cenchrus ciliaris	Buffel Grass	DoEE	
Centaurium erythraea	Common Centaury	DBCA	
Cerastium glomeratum	Mouse Ear Chickweed	DBCA	
Chamaecytisus palmensis	Tagasaste	DBCA	
Chloris gayana	Rhodes Grass	DBCA	
Chrysanthemoides monilifera	Boneseed	DoEE	Declared Pes
Chrysanthemoides monilifera subsp. *monilifera*	Boneseed	DBCA, DoEE	Declared Pest, WoNS
Cicendia filiformis	Slender Cicendia	DBCA	

Taxon	Common Name	Source*	Comments
Cichorium intybus	Chicory	DBCA	
Cotula coronopifolia	Waterbuttons	DBCA	
Crassula alata		DBCA	
Crassula natans var. *minus*	Floating Pigmyweed	DBCA	
Crepis foetida	Foetid Hawksbeard	DBCA	
Crepis foetida subsp. *foetida*	Stinking Hawksbeard	DBCA	
Cuscuta epithymum	Lesser Dodder	DBCA	
Cynodon dactylon	Couch	DBCA	
Cyperus congestus	Dense Flat-sedge	DBCA	
Cyperus tenellus	Tiny Flatsedge	DBCA	
Disa bracteata	South African Orchid	DBCA	
Dischisma capitatum	Woolly-headed Dischisma	DBCA	
Dittrichia graveolens	Stinkwort	DBCA	
Ehrharta calycina	Perennial Veldt Grass	DBCA	
Ehrharta longiflora	Annual Veldt Grass	DBCA	
Eragrostis curvula	African Lovegrass	DBCA	
Erodium botrys	Long Storksbill	DBCA	
Euphorbia maculata	Spotted Spurge	DBCA	
Euphorbia prostrata	Prostrate Sandmat	DBCA	
Freesia alba x leichtlinii	Freesia	DBCA	
Fumaria capreolata	Whiteflower Fumitory	DBCA	
Galium divaricatum	Lamarck's bedstraw	DBCA	
Gastridium phleoides	Nitgrass	DBCA	
Genista sp. X Genista monspessulana	Broom	DoEE	WoNS
Gladiolus angustus	Long Tubed Painted Lady	DBCA	
Gladiolus caryophyllaceus	Wild Gladiolus	DBCA	
Gomphocarpus fruticosus	Narrowleaf Cottonbush	DBCA	Declared Pest
Hainardia cylindrica	Common Barbgrass	DBCA	
Holcus lanatus	Yorkshire Fog	DBCA	
Hordeum marinum	Sea Barley	DBCA	
Hypochaeris glabra	Smooth Catsear	DBCA	
Isolepis hystrix		DBCA	
Juncus bufonius	Toad Rush	DBCA	
Juncus capitatus	Capitate Rush	DBCA	
Juncus microcephalus		DBCA	
Lachenalia aloides	Cape Cowslip	DBCA	
Lantana camara	Lantana	DoEE	Declared Pest, WoNS
Linum trigynum	French Flax	DBCA	
Logfia gallica	Daggerleaf cottonrose	DBCA	
Lolium perenne	Perennial Ryegrass	DBCA	
Lolium rigidum	Wimmera Ryegrass	DBCA	
Lotus angustissimus	Narrowleaf Trefoil	DBCA	
Lotus subbiflorus	Hairy Bird's-foot Trefoil	DBCA	
Lycium ferocissimum	African Boxthorn	DoEE	WoNS
Lysimachia arvensis	Pimpernel	DBCA	
Lysimachia minima	Chaffweed	DBCA	
Melaleuca armillaris subsp. *armillaris*	Giant Honey-Myrtle	DBCA	

Taxon	Common Name	Source*	Comments
Melinis repens	Natal Grass	DBCA	
Misopates orontium	Lesser Snapdragon	DBCA	
Monopsis debilis		DBCA	
Monopsis debilis var. *depressa*		DBCA	
Moraea flaccida	One-leaf Cape Tulip	DBCA	Declared Pest
Oenothera affinis	Longflower Evening Primrose	DBCA	
Oenothera mollissima	Primrose	DBCA	
Oenothera stricta subsp. *stricta*	Primrose	DBCA	
Olea europaea	Olive	DoEE	
Ornithopus compressus	Yellow Serradella	DBCA	
Ornithopus pinnatus	Slender Serradella	DBCA	
Oxalis glabra	Finger Leaf	DBCA	
Oxalis pes-caprae	Soursob	DBCA	
Panicum capillare	Witchgrass	DBCA	
Parentucellia latifolia	Common Bartsia	DBCA	
Pentameris airoides subsp. *airoides*	False Hairgrass	DBCA	
Phleum pratense	Timothy Grass	DBCA	
Phyllopodium cordatum		DBCA	
Pinus radiata	Radiata Pine	DoEE	
Poa annua	Winter Grass	DBCA	
Polygonum aviculare	Wireweed	DBCA	
Polypogon monspeliensis	Annual Beardgrass	DBCA	
Ranunculus trilobus	Buttercup	DBCA	
Romulea rosea	Guildford Grass	DBCA	
Rubus fruticosus aggregate	Blackberry	DoEE	WoNS
Rubus ulmifolius	Blackberry	DBCA	Declared Pest
Rumex acetosella	Sorrel	DBCA	Declared Pest
Salix sp.	Willows	DoEE	Declared Pest, WoNS
Salvinia molesta	Salvinia	DoEE	WoNS
Schinus molle	Chilean Pepper Tree	DBCA	
Setaria verticillata	Whorled Pigeon Grass	DBCA	
Silene gallica	French Catchfly	DBCA	
Solanum elaeagnifolium	Silver Nightshade	DoEE	Declared Pest, WoNS
Solanum linnaeanum	Apple of Sodom	DBCA	Declared Pest
Solanum nigrum	Black Berry Nightshade	DBCA	
Sonchus asper	Rough Sowthistle	DBCA	
Sonchus oleraceus	Common Sowthistle	DBCA	
Sparaxis bulbifera	Harlequin Flower	DBCA	
Spergula arvensis	Corn Spurry	DBCA	
Stellaria media	Chickweed	DBCA	
Symphyotrichum squamatum	Bushy Starwort	DBCA	
Tagetes erecta	Marigold	DBCA	
Tamarix aphylla	Athel Pine	DoEE	Declared Pest, WoNS
Trifolium angustifolium	Narrowleaf Clover	DBCA	
Trifolium arvense	Hare's Foot Clover	DBCA	
Trifolium campestre	Hop Clover	DBCA	
Trifolium campestre var. *campestre*	Hop Clover	DBCA	

Taxon	Common Name	Source*	Comments
Trifolium cernuum	Drooping Flower Clover	DBCA	
Trifolium dubium	Suckling Clover	DBCA	
Trifolium incarnatum var. *incarnatum*	Crimson Clover	DBCA	
Trifolium subterraneum	Subterranean Clover	DBCA	
Ursinia anthemoides	Ursinia	DBCA	
Ursinia anthemoides subsp. *anthemoides*	Ursinia	DBCA	
Vellereophyton dealbatum	White Cudweed	DBCA	
Verbascum virgatum	Twiggy Mullein	DBCA	
Vicia hirsuta	Hairy Vetch	DBCA	
Vicia sativa subsp. *sativa*	Garden Vetch	DBCA	
Vulpia bromoides	Squirrel Tail Fescue	DBCA	
Vulpia myuros	Rat's Tail Fescue	DBCA	
Vulpia myuros forma *myuros*	Rat's Tail Fescue	DBCA	
Wahlenbergia capensis	Cape Bluebell	DBCA	
Washingtonia filifera	California Palm	DBCA	
Watsonia borbonica	Cape Bugle-Lily	DBCA	
Watsonia marginata	Fragrant Bugle-Lily	DBCA	
Watsonia meriana	Bulbil Watsonia	DBCA	
Watsonia meriana var. *bulbillifera*	Bulbil Watsonia	DBCA	
Watsonia meriana var. *meriana*	Bulbil Watsonia	DBCA	
Zantedeschia aethiopica	Arum Lily	DBCA	Declared Pest

*Sources are:
DBCA – WA Herbarium Specimen Database, data provided by Naturemap (see Section 3.1.1);
DoEE – MNES Database (see Section 3.1.1)

5.2 Field Survey Results

5.2.1 Significant Flora Taxa

Three significant flora taxa were recorded during this survey of the Study Area including two threatened flora taxa and one priority taxon. These were from known populations within the Mundijong Road Reserve (Figure 7). No counts of these taxa were undertaken during this survey. A summary of information for each taxon is provided below.

No other populations of significant flora taxa are known from the Study Area through the desktop review.

***Babingtonia urbana* (P3)**
Babingtonia urbana (P3) is a spreading shrub with erect slender stems, growing to 0.4–0.7 m high (Rye 2015). This taxon has a known range in Western Australia of approximately 200 km, extending from near Badgingarra National Park south to its southern extent at Mundijong (DBCA 2007). *Babingtonia urbana* is associated with wetlands on the Swan Coastal Plain. This taxon is known from 28 records (DBCA 2007-).

***Synaphea* sp. Serpentine** (G.R. Brand 103) **(T / Critically Endangered (EPBC Act))**
Synaphea sp. Serpentine (G.R. Brand 103) (T) is an erect compact shrub up to 0.5 m high (WA Herbarium 1998-). This taxon has a known range in Western Australia of approximately 150 km, extending from Byford in the north to 18km south of Bunbury. This taxon is known from 57 records (DBCA 2007-).

***Tetraria australiensis* (T / Vulnerable (EPBC Act))**
Tetraria australiensis (T) is a rhizomatous, tufted perennial, grass-like or herb (sedge), growing to 1 m high (WA Herbarium 1998-). This taxon has a known range in Western Australia of approximately 200 km, from the northern extent at Kenwick (Perth Metropolitan Area) to 10 km south of Busselton. This taxon is known from 67 records (DBCA 2007-).

5.2.1.1 Likelihood of Occurrence of Further Significant Flora Taxa

As detailed in Section 5.1. 4, a total of 41 significant flora taxa were identified as occurring within the Desktop Study Area prior to survey. Of these, three were recorded within the Study Area by this survey, as detailed in Section 5.2.2. Of the remaining 38 taxa, some of these were not identifiable during the survey period because the survey period did not coincide with the taxon's flowering period. Table 11 presents an assessment of the likelihood of these taxa being present within the Study Area.

Table 11: Likelihood of Significant Flora Taxa Occurring Within the Study Area

Taxon	Status	Habitat (WA Herbarium 1998-)	Likelihood of Occurrence
Acacia lasiocarpa var. bracteolata long peduncle variant (G.J. Keighery 5026)	P1	Grey or black sand over clay. Swampy areas, winter wet lowlands.	Low Habitat not observed
Acacia oncinophylla subsp. *patulifolia*	P4	Granite, occasionally on laterite. Brown loam.	Unlikely Habitat not present
Andersonia gracilis	T (Endangered)	White/grey sand, sandy clay, gravelly loam. Winter-wet areas, near swamps.	Possible
Angianthus drummondii	P3	Grey or brown clay soils, ironstone. Seasonally wet flats.	Unlikely Habitat not present
Anthocercis gracilis	T (Vulnerable)	Sandy or loamy soils. Granite outcrops.	Unlikely Habitat not present
Austrostipa jacobsiana	T	Grey/white sand.	Possible
Babingtonia urbana	P3	Wetlands	**Known**
Banksia kippistiana var. *paenepeccata*	P3	Lateritic gravelly soils.	Unlikely Habitat not present

Taxon	Status	Habitat (WA Herbarium 1998-)	Likelihood of Occurrence
Caladenia huegelii	T (Endangered)	Grey or brown sand, clay loam.	Possible
Calectasia cyanea	T	White, grey or yellow sand, gravel. Often over limestone.	Possible
Diuris micrantha	T (Vulnerable)	Brown loamy clay. Winter-wet swamps, in shallow water.	Low Habitat not observed
Diuris purdiei	T (Endangered)	Grey-black sand, moist. Winter-wet swamps.	Low Habitat not observed
Dillwynia dillwynioides	P3	Sandy soils. Winter-wet depressions.	Possible
Drakaea elastica	T (Endangered)	White or grey sand. Low-lying situations adjoining winter-wet swamps.	Low Habitat not observed
Drakaea micrantha	T (Vulnerable)	White-grey sand.	Possible
Drosera occidentalis	P4	Swampy or damp flats, sandy floodplain.	Possible
Eleocharis keigheryi	T (Vulnerable)	Clay, sandy loam. Emergent in freshwater: creeks, claypans.	Low Habitat not observed
Eucalyptus x balanites	T (Endangered)	Sandy soils with lateritic gravel.	Unlikely Habitat not present
Grevillea curviloba subsp. *incurva*	T (Endangered)	Grey/white or brown sand, sandy loam. Winter-wet heath.	Low Habitat not observed
Jacksonia gracillima	P3	Grey sand, winter-wet areas.	Possible
Johnsonia pubescens subsp. *cygnorum*	P2	Grey-white-yellow sand. Flats, seasonally-wet sites.	Possible
Lasiopetalum pterocarpum	T (Endangered)	Dark red-brown loam or clayey sand over granite. On sloping banks near creeklines.	Unlikely Habitat not present
Lepidosperma rostratum	T (Endangered)	Peaty sand, clay. Seasonally wet swamps.	Unlikely Habitat not present
Levenhookia pulcherrima	P2	White/ grey sand.	Possible
Meionectes tenuifolia	P3	Wetlands, swamps.	Unlikely Habitat not present
Millotia tenuifolia var. laevis	P2	Granite or laterite soils, yellow sand.	Unlikely Habitat not present
Ornduffia submersa	P4	Wetlands	Unlikely Habitat not present
Parsonsia diaphanophleba	P4	Alluvial soils. Along rivers.	Unlikely Habitat not present
Pithocarpa corymbulosa	P3	Gravelly or sandy loam. Amongst granite outcrops.	Unlikely Habitat not present
Schoenus capillifolius	P3	Brown mud. Claypans.	Unlikely Habitat not present
Schoenus pennisetis	P3	Grey or peaty sand, sandy clay. Swamps, winter-wet depressions.	Possible
Schoenus sp. Waroona (G.J. Keighery 12235)	P3	Clay or sandy clay. Winter-wet flats.	Unlikely Habitat not present

Taxon	Status	Habitat (WA Herbarium 1998-)	Likelihood of Occurrence
Stylidium aceratum	P3	Sandy soils. Swamp heathland.	Possible
Synaphea sp. Fairbridge Farm (D. Papenfus 696)	T (Critically Endangered)	Grey clayey sand or sandy with lateritic pebbles. Near winter-wet flats.	Possible
Synaphea sp. Pinjarra Plain (A.S. George 17182)	T	Grey sandy loam or brown clayey loam, laterite. Flats, seasonally wet areas, wet depressions or drains.	Possible
Synaphea sp. Serpentine (G.R. Brand 103)	T (Critically Endangered)	Brown loam or sand. Seasonally wet areas.	**Known**
Tetraria australiensis	T (Vulnerable)	Brown sandy loam or grey sand. Winter damp areas.	**Known**
Thelymitra dedmaniarum	T (Endangered)	Grey loam. Granite.	Unlikely Habitat not present
Thelymitra stellata	T (Endangered)	Sand, gravel, lateritic loam.	Unlikely Habitat not present
Verticordia lindleyi subsp. *lindleyi*	P4	Sand, sandy clay. Winter-wet depressions.	Possible
Verticordia plumosa var. *ananeotes*	T (Endangered)	White/grey sand or sandy clay. Winter-wet flats.	Possible

5.2.2 Introduced Taxa

Introduced taxa were only opportunistically recorded during this reconnaissance survey for the purposes of describing vegetation and not identified to species level. There were numerous pasture and grass weeds observed throughout the sites.

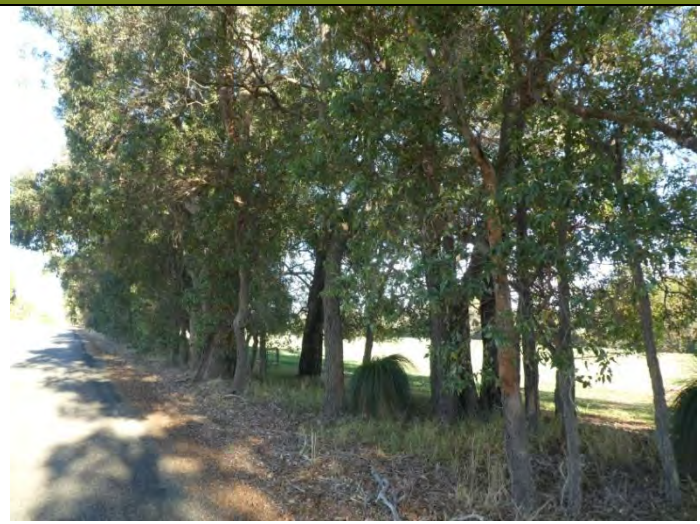
5.2.3 Vegetation Units

Thirteen Vegetation Units (VUs) were identified as intact vegetation and described using the structural vegetation classification technique, as outlined in EPA (2016a). A further 16 units comprising highly disturbed vegetation or remnant indigenous trees. All such mapping is presented in Appendix E, with descriptions presented in Table 12.

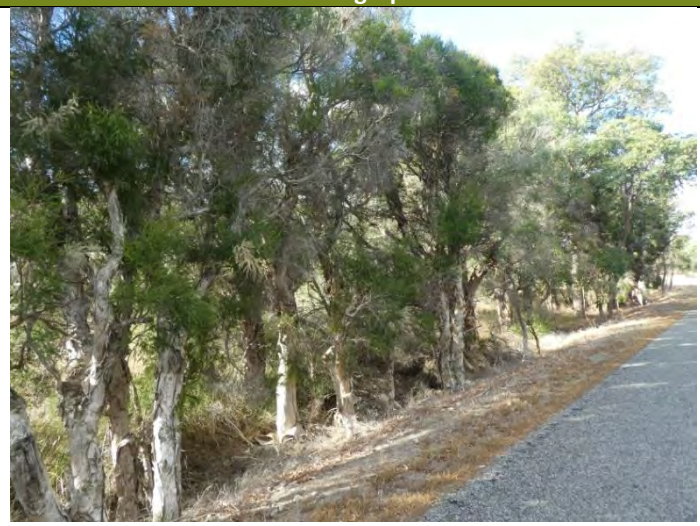
5.2.4 Other Areas Described

Areas where natural vegetation has been completely and apparently permanently removed, with no original native taxa remaining, have been mapped as ‘cleared land’ (C); this includes roads (and associated infrastructure including culverts) and tracks. Other units in this category include five units comprising planted vegetation where a mix of indigenous and introduced taxa have been planted as either revegetation or shelter belts on private property. The VUs described in the Study Area are summarised in Table 12 and presented on maps in Appendix E.

Table 12: Summary of Vegetation Types Mapped in the Study Area

Vegetation Unit	Description	Photograph
INTACT VEGETATION		
W1	Mid woodland of *Corymbia calophylla* over mid open shrubland of *Xanthorrhoea preissii* with occasional *Kingia australis* and various shrub species over introduced grasses and pasture weeds on grey sandy loams on mid to lower slopes Figures E5, E13 of Appendix E	 **Plate 1: Vegetation Unit W1 (Photo: Woodman Environmental)**

Vegetation Unit	Description	Photograph
W2	Mid woodland of *Corymbia calophylla* and *Melaleuca preissiana* over mid open shrubland of *Xanthorrhoea preissii* and *Jacksonia sternbergiana* over a low open shrubland of mixed species on grey sand on flats Figure E12 of Appendix E	 **Plate 2: Vegetation Unit W2 (Photo: Woodman Environmental)**
W3	Mid woodland of *Corymbia calophylla* over mid open shrubland of *Xanthorrhoea preissii* and mixed species over a mid sedgeland of *Mesomelaena tetragona* and *Tetraria octandra* on grey sandy loam on flats Figures E2, E4, E9, E10 of Appendix E	 **Plate 3: Vegetation Unit W3 (Photo: Woodman Environmental)**

Vegetation Unit	Description	Photograph
W4	Mid woodland of *Corymbia calophylla*, *Melaleuca preissiana* and *M. rhaphiophylla* over a mid sedgeland of *Lepidosperma longitudinale* on grey sandy loam in a swale Figure E8 of Appendix E	 **Plate 4: Vegetation Unit W4 (Photo: Woodman Environmental)**
W5	Low woodland of *Melaleuca preissiana* over mid open shrubland of *Regelia ciliata* and *Hakea varia* over low open shrubland of *Banksia nivea* subsp. *nivea* over introduced grasses on brown sandy loam in a basin Figures E4, E8 of Appendix E	 **Plate 5: Vegetation Unit W5 (Photo: Woodman Environmental)**

Vegetation Unit	Description	Photograph
W6	Low woodland of *Banksia attenuata* and *B. menziesii* over a tall open shrubland of *Jacksonia furcellata* and *Kunzea glabrescens* over a sparse mid shrubland of *Melaleuca* ?*trichophylla* over introduced grasses on grey sand on a low dune Figure E8 of Appendix E	 **Plate 6: Vegetation Unit W6 (Photo: Woodman Environmental)**
F1	Mid closed forest of *Eucalyptus rudis* and *Melaleuca preissiana* over mid sparse shrubland of *Xanthorrhoea preissii* and *M. lateritia* on brown sandy loam on flats and in drainage lines Figures E4, E5, E8, E13 of Appendix E	 **Plate 7: Vegetation Unit F1 (Photo: Woodman Environmental)**

Vegetation Unit	Description	Photograph
F2	Mid closed forest of *Eucalyptus marginata* and *Corymbia calophylla* over a low woodland of *Allocasuarina fraseriana* and *Banksia grandis* over mid open shrubland of *Xanthorrhoea preissii* and *Hakea lissocarpha* on sandy gravels on a mid-slope Figure E13 of Appendix E	 **Plate 8: Vegetation Unit F2 (Photo: Woodman Environmental)**
S1	Mid shrubland of mixed species with isolated mid shrubs of *Xanthorrhoea preissii* and *Kingia australis* over mid sedgeland of *Mesomelaena tetragona* and *Tetraria octandra* on brown sandy loam on flats Figures E9 of Appendix E	 **Plate 9: Vegetation Unit S1 (Photo: Woodman Environmental)**

Vegetation Unit	Description	Photograph
S2	Tall open shrubland of *Hakea varia*, *Jacksonia sternbergiana*, *Xanthorrhoea preissii and Kingia australis* over a mid-open shrubland of mixed species dominated by *Hypocalymma angustifolium*, *Allocasuarina microstachya*, *Verticordia densiflora* subsp. *densiflora* and *Banksia dallanneyi* over mid sedgeland of *Mesomelaena tetragona*, *Schoenus rigens* and *Tetraria octandra* on light brown sandy loam to clay on flats Figure E9 of Appendix E	 **Plate 10: Vegetation Unit S2 (Photo: Woodman Environmental)**
S3	Mid open shrubland of *Hakea incrassata* and *Allocasuarina microstachya* over a mid-closed sedgeland of *Desmocladus lateriflorus* on brown sandy loam in a shallow basin Figure E9 of Appendix E	 **Plate 11: Vegetation Unit S3 (Photo: Woodman Environmental)**

Vegetation Unit	Description	Photograph
S4	Tall shrubland of *Melaleuca viminea* subsp. *viminea*, *Viminaria juncea* and *Jacksonia sternbergiana* over introduced grasses and *Watsonia meriana* ssp. *bulbillifera* on brown sand on flats Figure E5 of Appendix E	 **Plate 12: Vegetation Unit S4 (Photo: Woodman Environmental)**
T1	Tall closed shrubland of *Melaleuca osullivanii* and *Hakea varia* over low sedgeland of *Leptocarpus canus* and *Schoenus rigens* on brown sandy loam on flats Figure E9 of Appendix E	 **Plate 13: Vegetation Unit T1 (Photo: Woodman Environmental)**

Vegetation Unit	Description	Photograph
	Disturbed Areas	
MV	Highly modified areas of native vegetation as a result of earthworks or clearing comprising an open woodland of *Corymbia calophylla* over a tall mixed shrubland of *Melaleuca osullivanii*, *M. viminea* subsp. *viminea*, *Xanthorrhoea preissii* and *Kingia australis* over a shrubland of *Verticordia densiflora* subsp. *densiflora*, *Synaphea petiolaris* subsp. *petiolaris* over a sedgeland of *Mesomelaena tetragona* and introduced grasses on brown sandy loam on flats Figure E9 of Appendix E	 **Plate 14: Vegetation Unit MV (Photo: Woodman Environmental)**
AS	Individual or stands of *Acacia saligna* over pasture weeds on grey sands on cleared palusplains Figure E4 of Appendix E	No Photograph Available
BI	Individual or stands of *Banksia ilicifolia* over pasture weeds on grey sandy soils on low rises Figure E8 of Appendix E	No Photograph Available
CC	Individual or stands of *Corymbia calophylla* over pasture weeds on various soils and topographical positions Figures E2, E4, E5, E6, E7, E8, E9, E10, E11, E13 of Appendix E	No Photograph Available
CO	Individual or stands of *Casuarina obesa* over pasture weeds on grey sands on cleared palusplains and in roadside drains Figures E2, E8, E9 of Appendix E	No Photograph Available
EG	Individual or stands of planted *Eucalyptus gomphocephala* over pasture	No Photograph Available

Vegetation Unit	Description	Photograph
	weeds on grey sands on cleared palusplains and in roadside drains Figure E9 of Appendix E	
EM	Individual or stands of *Eucalyptus marginata* over pasture weeds on grey sandy soils on low rises Figures E12, E13 of Appendix E	No Photograph Available
ER	Individual or stands of *Eucalyptus rudis* over pasture weeds on grey sands on cleared palusplains and in roadside drains Figures E2, E5, E7, E8, E13 of Appendix E	No Photograph Available
ER/CC	Mixed stand of *Eucalyptus rudis* and *Corymbia calophylla* over pasture weeds on grey sands on cleared palusplains and in roadside drains Figures E5, E7 of Appendix E	No Photograph Available
ER/EC	Mixed stand of *Eucalyptus rudis* and *Corymbia calophylla* over pasture weeds on grey sands on cleared palusplains and in roadside drains Figures E2, E3, E4 of Appendix E	No Photograph Available
ER/MP	Mixed stand of *Eucalyptus rudis* and *Melaleuca preissiana* over pasture weeds on grey sands on cleared palusplains and in roadside drains Figures E8, E9 of Appendix E	No Photograph Available
ER/MR	Mixed stand of *Eucalyptus rudis* and *Melaleuca rhaphiophylla* over pasture weeds on grey sands on cleared palusplains and in roadside drains Figure E8 of Appendix E	No Photograph Available
ER/CO/MP/MR	Mixed stand of *Eucalyptus rudis, Casuarina obesa, Melaleuca preissiana* and *Melaleuca rhaphiophylla* over pasture weeds on grey sands on cleared palusplains and in roadside drains Figures E8, E9 of Appendix E	No Photograph Available
EW	Individual or stands of *Eucalyptus wandoo* over pasture weeds on grey sands on cleared land	No Photograph Available

Vegetation Unit	Description	Photograph
	Figures E9, E13 of Appendix E	
MP	Individual or stands of *Melaleuca preissiana* over pasture weeds on grey sands on cleared palusplains and in roadside drains Figures E5, E7, E8, E9 of Appendix E	No Photograph Available
TO	Dense rushland of **Typha orientalis* growing in a minor creek Figure E2 of Appendix E	No Photograph Available
Revegetated Areas		
IE	Areas planted with Non-indigenous *Eucalyptus* species over pasture weeds Figures E2, E3, E4, E5, E7, E8, E9, E12, E13 of Appendix E	No Photograph Available
RV1	Revegetated road reserve with *Casuarina obesa*, introduced *Eucalyptus* species and the occasional *Corymbia calophylla* and *Eucalyptus rudis* over *Melaleuca rhaphiophylla* and *M. teretifolia* over pasture weeds Figures E1, E2 of Appendix E	No Photograph Available
RV2	Revegetated land with *Corymbia calophylla* and *Eucalyptus rudis* over *Melaleuca rhaphiophylla* and mixed shrub species over pasture weeds Figure E4 of Appendix E	No Photograph Available
RV3	Revegetated road reserve dominated by *Corymbia calophylla* with occasional *Eucalyptus marginata*, *E. wandoo*, *E. rudis*, *E. accedens* and *E. lane poolei* over *Acacia saligna*, *A. pulchella*, *Xanthorrhoea preissii* and various indigenous and non-indigenous shrub species over pasture weeds Figure E13 of Appendix E	No Photograph Available

Vegetation Unit	Description	Photograph
Mixed Plantation	Shelter belt plantings composed of introduced *Eucalyptus* species along with *E. rudis*, *E. gomphocephala*, *E. wandoo*, *Corymbia calophylla*, *Melaleuca rhaphiophylla*, *M. preissiana*, *M. teretifolia*, *Allocasuarina fraseriana*, *Acacia saligna* and *Callistemon phoeniceus*	 **Plate 15: Vegetation Unit Mixed Plantation (Photo: Woodman Environmental)**
PR?	Individual or stands of *Pinus?radiata* over pasture weeds on grey sands on cleared land	No Photograph Available
Other Areas		
C	Cleared	

5.2.5 Significant Vegetation

Of the VUs described and mapped in the Study Area, it is considered that five could potentially represent both state and federally listed TECs (Table 13). Detailed analysis of vegetation utilising appropriate classification analysis of quadrat data nor patch assessments according to Commonwealth guidance were undertaken.

Table 13: Vegetation Units with potential to be representative of a Threatened Ecological Community

Community	Conservation Status (W.A.)	EPBC Act Ranking	Potential Vegetation Unit
Banksia Dominated Woodlands of the Swan Coastal Plain ecological community	PEC (P3)	Endangered	W6
Clay Pans of the Swan Coastal Plain	-	Critically Endangered	S1, S2, S3
Corymbia calophylla – Xanthorrhoea preissii woodlands and shrublands of the Swan Coastal Plain (SCP3c)	TEC (Critically Endangered)	Endangered	W3
Dense shrublands on clay flats (SCP 09)	TEC (Vulnerable)	Critically Endangered	S1, S2, S3
Herb rich shrublands in clay pans (SCP08)	TEC (Vulnerable)	Critically Endangered	S1, S2, S3

5.2.6 Vegetation Condition

Vegetation condition mapping polygons are displayed on maps in Appendix F. The condition of the majority of the vegetation in the Study Area was rated Degraded. The area has been significantly disturbed by clearing and introduced taxa have altered most of the vegetation. Small areas of Good and Very Good condition vegetation persist primarily along Mundijong Road and these areas are considered to be floristically rich, reflecting the high α and β diversity recognised as characteristic of the southern Swan Coastal Plain (Gibson *et al*. 1994).

The condition of VUs may influence whether any of the potential EPBC Act TECs listed in Table 12 are present. Vegetation unit W6 for example was recorded in a narrow degraded road verge and therefore it is likely this VU will not meet the diagnostic requirements of the Commonwealth listed TEC.

6. DISCUSSION AND CONCLUSIONS

Although the Study Area is relatively small in size, it is considered that the area is relatively diverse in terms of taxon richness. The long narrow shape of the Study Area has resulted in it crossing through numerous soil and vegetation complexes. The Study Area has been highly modified due to clearing and other associated impacts which have impacted on the condition of the remnant vegetation.

Three significant flora (*Babingtonia urbana* (P3), *Synaphea* sp. Serpentine (G.R. Brand 103) (T/ Critically Endangered (EPBC Act)) and *Tetraria australiensis* (T Vulnerable (EPBC Act))) were recorded and it is possible that there are further locations and individuals of these taxa

within the Study Area. A comparison of the habitats present against preferred habitat requirements of other conservation significant flora taxa known from the region indicates that additional conservation significant flora taxa are likely to be present, particularly in areas of good or better condition vegetation.

Five of the 13 intact vegetation units mapped within the Study Area potentially represent TECs known to occur within the vicinity however detailed TEC mapping was not undertaken as part of the survey.

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Appendix A: Scope of Works

This survey was undertaken as per the following SoW provided by Main Roads WA, as listed below:

Desktop Assessment

- Complete a desktop assessment of the study area prior to the field survey work to identify all biological features and constraints, which may be in, or nearby the project area. Desktop assessment to include presentation and review of data from the Department of the Environment and Energy's (DoEE) Protected Matters Search Tool, DBCA's *NatureMap* and *FloraBase*, Main Roads supplied database searches from DBCA's Species & Communities Branch (threatened and priority flora/ TEC & PEC)
- Review relevant environmental reports as provided by Main Roads and/or relevant to the project area and ecological values
- Identify significant flora, vegetation/ecological communities, , soil/land system, groundwater and surface water values and potential sensitivity to impact
- Identify broad pre-European vegetation type(s) (Beard various); and Mattiske & Havel (1998), Heddle et al (1980) and the recent extension of vegetation complex mapping to landform boundaries within the Swan Coastal Plain landform and forested region of south-west Western Australia (Webb (DBCA) 2016) for southwest and Swan Coastal Plain areas; the Albany Regional Vegetation Survey (Sandiford & Barrett 2010) for Albany area.

Field Survey

- While conducting the Survey, vehicles are not to drive over areas of exposed sand. The survey area contains a number of Aboriginal Heritage sites, with artefacts which could be impacted by driving over areas of exposed sand. Walking over these areas is acceptable.
- Conduct a field survey (to be done by an environmental specialist in accordance with regulatory expectation for years of experience in the relevant bioregion) to verify / ground truth the desktop assessment findings through targeted and comprehensive survey (refer to relevant EPA published flora and fauna Technical Guides & guidance for Matters of National Environmental Significance (MNES) species where available)
- Undertake vegetation community/type mapping to a scale appropriate for the bioregion and described according to the National Vegetation Information System (NVIS) structure and floristics. NVIS (ESCAVI 2003) is the current nationally adopted classification system and should be used for vegetation description. Mapping at a scale of 1:10,000 using NVIS sub-association level (L5) for structural descriptions (NHT 2003)
- Where TEC or PECs occur within or in the vicinity of the survey area, map areas where the TEC/PEC potentially exists.
- Track logs from GPS are to be recorded during the field survey to attest to time and effort expended
- Undertake vegetation condition mapping using EPA (2016) condition scale
- Targeted survey for rare and priority flora based on desktop likelihood of occurrence and habitat availability. When populations are identified, survey and map extent of populations to determine number and habitat area for each population. Shapefiles shall be provided with point data indicating the number of plants identified at each point. If more than 100, the edges of the population boundary can be mapped and provided as a

shapefile to Main Roads. If the population extends outside the survey area, the survey will map the extent of the population.

- Provide number of individual plants and total number of populations in WA, for any threatened and priority flora, where such data is available. All threatened flora to be mapped with a **differential GPS**
- Map wetland habitat and riparian habitat if present. Provide on maps and as shapefiles

Department of Biodiversity, Conservation and Attractions

- All conservation significant flora shall have a specimen taken and lodged with the WA Herbarium. WAHerb accession number to be provided in final report
  - For each species of conservation significant flora, a DBCA Threatened & Priority Flora report form (https://www.dpaw.wa.gov.au/plants-and-animals/threatened-species-and-communities/threatened-plants?view=categories&id=108) is to be completed and submitted to DBCA Species & Communities Branch. A copy shall be appended to the final report
  - For each occurrence of TEC or PEC, a DBCA TEC/PEC report form (https://www.dpaw.wa.gov.au/plants-and-animals/threatened-species-and-communities/wa-s-threatened-ecological-communities) is to be completed and submitted to DBCA Species & Communities Branch. A copy shall be appended to the final report

Data

- Raw survey data (results) are to be provided at **Rev A Report Stage** and include quadrat data (Excel format), GIS data of all biological survey components including but not limited to flora records, DBH trees, ecological community and condition mapping, and track logs for survey effort
- At Project completion (Rev 0/final report) data in electronic format final data is to be provided. The data is to be provided in a format that satisfies Main Roads data standards, as supplied.

Appendix B: Vegetation Condition Scale for the South-West and Interzone Botanical Provinces (EPA 2016a)

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

Appendix C: GPS track lots from reconnaissance survey

401500 402000 402500

6438500 6438000 6437500 6437000

Legend

- Project Survey Area
- Track Logs

0 125 250 500 Meters

WOODMAN ENVIRONMENTAL

N

This map should only be used in conjunction with WEC project MR19-22-01.

Tonkin Highway Reconnaissance Survey Track Log

Revision: 0 - 12 December 2019 Scale: 1:5,000 (A3)

Author: Leah Firth

WEC Ref: MR19-22-01

Filename: MR19-22-01-AppC

Projection: GDA 1994 MGA Zone 50

Appendix

C1

402500 403000 403500

6436500 6436000 6435500

402500 403000 403500

WOODMAN ENVIRONMENTAL

N

This map should only be used in conjunction with WEC project MR19-22-01.

Tonkin Highway Reconnaissance Survey Track Log	Author: Leah Firth	**Appendix** C2
	WEC Ref: MR19-22-01	
	Filename: MR19-22-01-AppC	
Revision: 0 - 12 December 2019 Scale: 1:5,000 (A3)	Projection: GDA 1994 MGA Zone 50	

404000

404500

6436500

6436000

6435500

404000

404500

WOODMAN ENVIRONMENTAL

This map should only be used in conjunction with WEC project MR19-22-01.

N

Tonkin Highway Reconnaissance Survey Track Log

Revision: 0 - 12 December 2019 Scale: 1:5,000 (A3)

Author: Leah Firth

WEC Ref: MR19-22-01

Filename: MR19-22-01-AppC

Projection: GDA 1994 MGA Zone 50

Appendix

C3

402500 403000 403500

6435000 6434500 6434000 6433500

WOODMAN ENVIRONMENTAL

N

This map should only be used in conjunction with WEC project MR19-22-01.

Tonkin Highway Reconnaissance Survey Track Log

Revision: 0 - 12 December 2019 Scale: 1:5,000 (A3)

Author: Leah Firth

WEC Ref: MR19-22-01

Filename: MR19-22-01-AppC

Projection: GDA 1994 MGA Zone 50

Appendix

C4

402500 403000 403500

6433000 6432500 6432000 6431500

WOODMAN ENVIRONMENTAL

This map should only be used in conjunction with WEC project MR19-22-01.

N

Tonkin Highway Reconnaissance Survey Track Log	Author: Leah Firth	**Appendix** C5
	WEC Ref: MR19-22-01	
	Filename: MR19-22-01-AppC	
Revision: 0 - 12 December 2019 Scale: 1:5,000 (A3)	Projection: GDA 1994 MGA Zone 50	

404000 404500

6433000 6433000

6432500 6432500

6432000 6432000

6431500 6431500

404000 404500

Legend

Project Survey Area

Track Logs

0 125 250 500 Meters

WOODMAN ENVIRONMENTAL

N

This map should only be used in conjunction with WEC project MR19-22-01.

Tonkin Highway Reconnaissance Survey Track Log	Author: Leah Firth	**Appendix** C6
	WEC Ref: MR19-22-01	
	Filename: MR19-22-01-AppC	
Revision: 0 - 12 December 2019 Scale: 1:5,000 (A3)	Projection: GDA 1994 MGA Zone 50	

402500 403000 403500

6431000 6430500 6430000

Legend

- Project Survey Area
- Track Logs

0 125 250 500 Meters

N

WOODMAN ENVIRONMENTAL

This map should only be used in conjunction with WEC project MR19-22-01.

Tonkin Highway Reconnaissance Survey Track Log	Author: Leah Firth	**Appendix** C7
	WEC Ref: MR19-22-01	
	Filename: MR19-22-01-AppC	
Revision: 0 - 12 December 2019 Scale: 1:5,000 (A3)	Projection: GDA 1994 MGA Zone 50	

402500 403000 403500

6429500 6429000 6428500 6428000

Legend

- Project Survey Area
- Track Logs

0 125 250 500 Meters

WOODMAN ENVIRONMENTAL

N

This map should only be used in conjunction with WEC project MR19-22-01.

Tonkin Highway Reconnaissance Survey Track Log	Author: Leah Firth	**Appendix** C8
	WEC Ref: MR19-22-01	
	Filename: MR19-22-01-AppC	
Revision: 0 - 12 December 2019 Scale: 1:5,000 (A3)	Projection: GDA 1994 MGA Zone 50	

402500 403000 403500

6427500 6427000 6426500 6426000

Legend

- Project Survey Area
- Track Logs

0 125 250 500 Meters

N

WOODMAN ENVIRONMENTAL

This map should only be used in conjunction with WEC project MR19-22-01.

Tonkin Highway Reconnaissance Survey Track Log	Author: Leah Firth	**Appendix** C9
	WEC Ref: MR19-22-01	
	Filename: MR19-22-01-AppC	
Revision: 0 - 12 December 2019 Scale: 1:5,000 (A3)	Projection: GDA 1994 MGA Zone 50	

404000 404500 405000

6427500 6427000 6426500 6426000

Legend

- Project Survey Area
- Track Logs

0 125 250 500 Meters

WOODMAN ENVIRONMENTAL

N

This map should only be used in conjunction with WEC project MR19-22-01.

Tonkin Highway Reconnaissance Survey Track Log	Author: Leah Firth	**Appendix** C10
	WEC Ref: MR19-22-01	
	Filename: MR19-22-01-AppC	
Revision: 0 - 12 December 2019 Scale: 1:5,000 (A3)	Projection: GDA 1994 MGA Zone 50	

403000 403500

6425500 6425500

6425000 6425000

6424500 6424500

6424000 6424000

403000 403500

Legend

Project Survey Area

Track Logs

0 125 250 500 Meters

WOODMAN ENVIRONMENTAL

This map should only be used in conjunction with WEC project MR19-22-01.

N

Tonkin Highway Reconnaissance Survey Track Log

Author: Leah Firth

WEC Ref: MR19-22-01

Filename: MR19-22-01-AppC

Revision: 0 - 12 December 2019 Scale: 1:5,000 (A3)

Projection: GDA 1994 MGA Zone 50

Appendix

C11

404000 404500 405000

6425500 6425000 6424500 6424000

Legend

- Project Survey Area
- Track Logs

0 125 250 500 Meters

WOODMAN ENVIRONMENTAL

N

This map should only be used in conjunction with WEC project MR19-22-01.

Tonkin Highway Reconnaissance Survey Track Log

Author: Leah Firth

WEC Ref: MR19-22-01

Filename: MR19-22-01-AppC

Revision: 0 - 12 December 2019 Scale: 1:5,000 (A3)

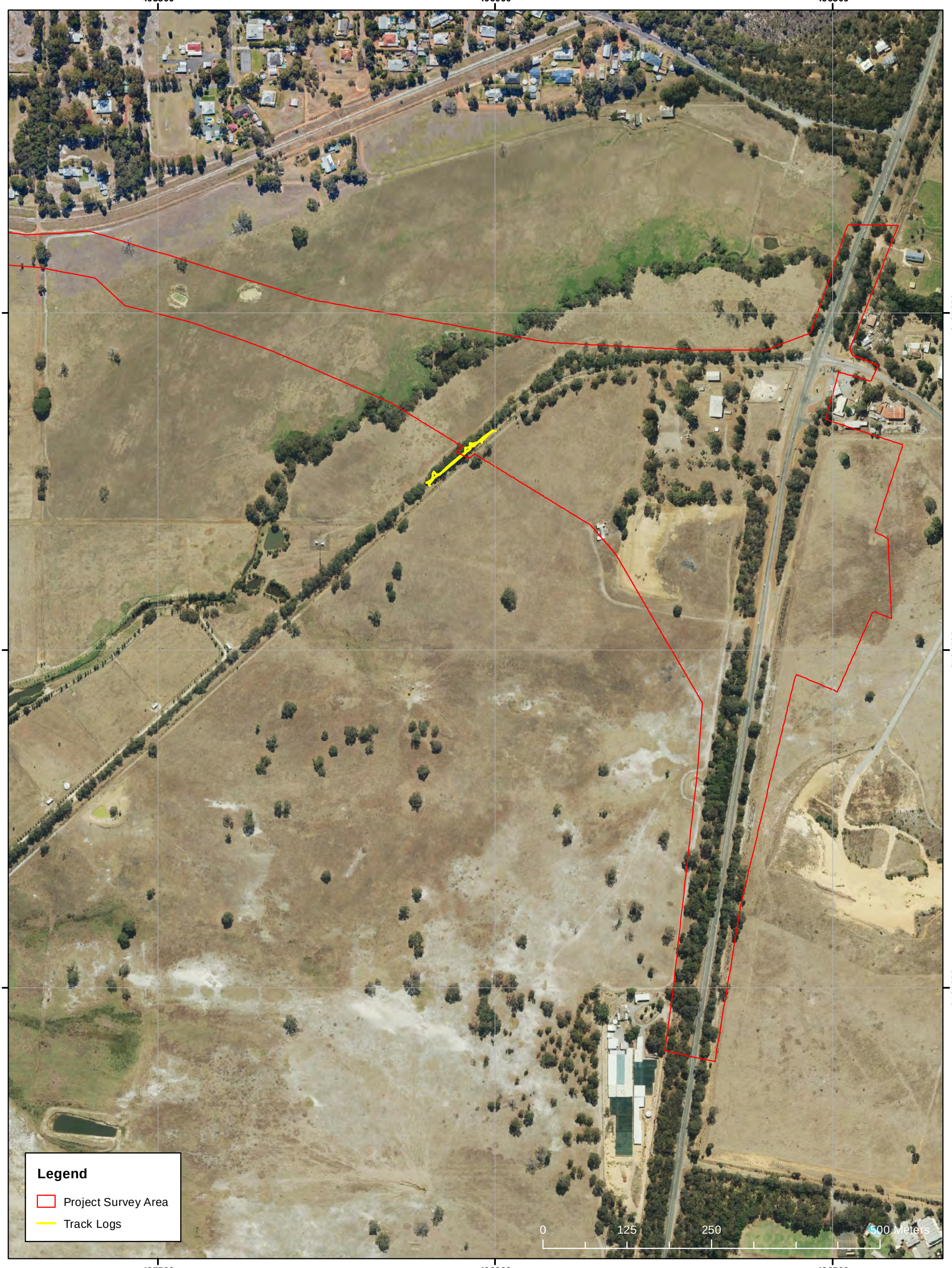
Projection: GDA 1994 MGA Zone 50

Appendix

C12

405500 406000 406500

6425000 6424500 6424000



405500 406000 406500

WOODMAN ENVIRONMENTAL

N

This map should only be used in conjunction with WEC project MR19-22-01.

Tonkin Highway Reconnaissance Survey Track Log	Author: Leah Firth	**Appendix** C13
	WEC Ref: MR19-22-01	
	Filename: MR19-22-01-AppC	
Revision: 0 - 12 December 2019 Scale: 1:5,000 (A3)	Projection: GDA 1994 MGA Zone 50	

Appendix D: Results of Search of the Department of the Environment and Energy Species Profile and Threats (SPRAT) Database (DoEE 2019

Australian Government
Department of the Environment and Energy

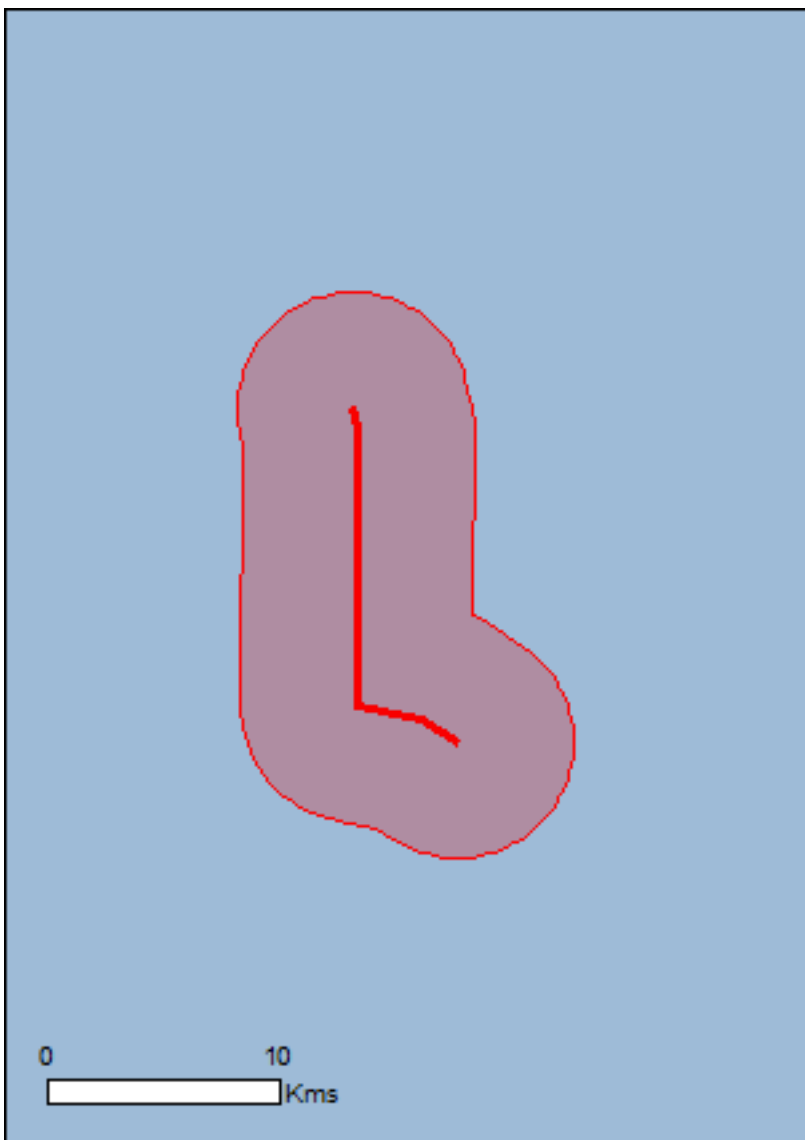
EPBC Act Protected Matters Report

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

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

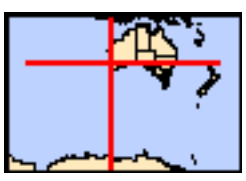
Information is available about Environment Assessments and the EPBC Act including significance guidelines, forms and application process details.

Report created: 31/07/19 15:47:04



Coordinates

Buffer: 5.0Km



Summary

Matters of National Environmental Significance

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

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance:	2
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	None
Listed Threatened Ecological Communities:	5
Listed Threatened Species:	33
Listed Migratory Species:	19

Other Matters Protected by the EPBC Act

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

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

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

Commonwealth Land:	1
Commonwealth Heritage Places:	None
Listed Marine Species:	28
Whales and Other Cetaceans:	None
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	None

Extra Information

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

State and Territory Reserves:	7
Regional Forest Agreements:	1
Invasive Species:	40
Nationally Important Wetlands:	1
Key Ecological Features (Marine)	None

Details

Matters of National Environmental Significance

Wetlands of International Importance (Ramsar) [Resource Information]

Name	Proximity
Forrestdale and thomsons lakes	Within Ramsar site
Peel-yalgorup system	30 - 40km upstream

Listed Threatened Ecological Communities [Resource Information]

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

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

Listed Threatened Species [Resource Information]

Name	Status	Type of Presence
Birds		
Botaurus poiciloptilus		
Australasian Bittern [1001]	Endangered	Species or species habitat known to occur within area
Calidris ferruginea		
Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area
Calyptorhynchus banksii naso		
Forest Red-tailed Black-Cockatoo, Karrak [67034]	Vulnerable	Species or species habitat known to occur within area
Calyptorhynchus baudinii		
Baudin's Cockatoo, Long-billed Black-Cockatoo [769]	Endangered	Roosting known to occur within area
Calyptorhynchus latirostris		
Carnaby's Cockatoo, Short-billed Black-Cockatoo [59523]	Endangered	Species or species habitat known to occur within area
Leipoa ocellata		
Malleefowl [934]	Vulnerable	Species or species habitat likely to occur within area
Numenius madagascariensis		
Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Rostratula australis		
Australian Painted-snipe, Australian Painted Snipe [77037]	Endangered	Species or species habitat may occur within

Name	Status	Type of Presence
		area
Insects		
[Leioproctus douglasiellus](#) a short-tongued bee [66756]	Critically Endangered	Species or species habitat known to occur within area
[Neopasiphae simplicior](#) A native bee [66821]	Critically Endangered	Species or species habitat likely to occur within area
Mammals		
[Bettongia penicillata ogilbyi](#) Woylie [66844]	Endangered	Species or species habitat known to occur within area
[Dasyurus geoffroii](#) Chuditch, Western Quoll [330]	Vulnerable	Species or species habitat known to occur within area
[Pseudocheirus occidentalis](#) Western Ringtail Possum, Ngwayir, Womp, Woder, Ngoor, Ngoolangit [25911]	Critically Endangered	Species or species habitat likely to occur within area
[Setonix brachyurus](#) Quokka [229]	Vulnerable	Species or species habitat likely to occur within area
Other		
[Westralunio carteri](#) Carter's Freshwater Mussel, Freshwater Mussel [86266]	Vulnerable	Species or species habitat known to occur within area
Plants		
[Andersonia gracilis](#) Slender Andersonia [14470]	Endangered	Species or species habitat may occur within area
[Anthocercis gracilis](#) Slender Tailflower [11103]	Vulnerable	Species or species habitat may occur within area
[Caladenia huegelii](#) King Spider-orchid, Grand Spider-orchid, Rusty Spider-orchid [7309]	Endangered	Species or species habitat likely to occur within area
[Diuris micrantha](#) Dwarf Bee-orchid [55082]	Vulnerable	Species or species habitat likely to occur within area
[Diuris purdiei](#) Purdie's Donkey-orchid [12950]	Endangered	Species or species habitat known to occur within area
[Drakaea elastica](#) Glossy-leafed Hammer Orchid, Glossy-leaved Hammer Orchid, Warty Hammer Orchid [16753]	Endangered	Species or species habitat known to occur within area
[Drakaea micrantha](#) Dwarf Hammer-orchid [56755]	Vulnerable	Species or species habitat likely to occur within area
[Eleocharis keigheryi](#) Keighery's Eleocharis [64893]	Vulnerable	Species or species habitat may occur within area
[Eucalyptus x balanites](#) Cadda Road Mallee, Cadda Mallee [87816]	Endangered	Species or species habitat known to occur within area
[Grevillea curviloba subsp. incurva](#) Narrow curved-leaf Grevillea [64909]	Endangered	Species or species habitat may occur within area

Name	Status	Type of Presence
Lasiopetalum pterocarpum Wing-fruited Lasiopetalum [64922]	Endangered	Species or species habitat likely to occur within area
Lepidosperma rostratum Beaked Lepidosperma [14152]	Endangered	Species or species habitat likely to occur within area
Synaphea sp. Fairbridge Farm (D. Papenfus 696) Selena's Synaphea [82881]	Critically Endangered	Species or species habitat likely to occur within area
Synaphea sp. Serpentine (G.R. Brand 103) [86879]	Critically Endangered	Species or species habitat known to occur within area
Tetraria australiensis Southern Tetraria [10137]	Vulnerable	Species or species habitat likely to occur within area
Thelymitra dedmaniarum Cinnamon Sun Orchid [65105]	Endangered	Species or species habitat may occur within area
Thelymitra stellata Star Sun-orchid [7060]	Endangered	Species or species habitat likely to occur within area
Verticordia plumosa var. ananeotes Tufted Plumed Featherflower [23871]	Endangered	Species or species habitat may occur within area

Listed Migratory Species [Resource Information]

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

Name	Threatened	Type of Presence
Migratory Marine Birds		
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Migratory Terrestrial Species		
Motacilla cinerea Grey Wagtail [642]		Species or species habitat may occur within area
Migratory Wetlands Species		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat likely to occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Roosting known to occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat known to occur within area
Calidris ruficollis Red-necked Stint [860]		Roosting known to occur within area
Calidris subminuta Long-toed Stint [861]		Roosting known to occur within area
Charadrius dubius Little Ringed Plover [896]		Roosting known to occur within area

Name	Threatened	Type of Presence
Gallinago megala		
Swinhoe's Snipe [864]		Roosting likely to occur within area
Gallinago stenura		
Pin-tailed Snipe [841]		Roosting likely to occur within area
Limosa limosa		
Black-tailed Godwit [845]		Roosting known to occur within area
Numenius madagascariensis		
Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Numenius minutus		
Little Curlew, Little Whimbrel [848]		Roosting likely to occur within area
Pandion haliaetus		
Osprey [952]		Species or species habitat known to occur within area
Philomachus pugnax		
Ruff (Reeve) [850]		Roosting known to occur within area
Tringa glareola		
Wood Sandpiper [829]		Roosting known to occur within area
Tringa nebularia		
Common Greenshank, Greenshank [832]		Species or species habitat known to occur within area
Tringa stagnatilis		
Marsh Sandpiper, Little Greenshank [833]		Roosting known to occur within area

Other Matters Protected by the EPBC Act

Commonwealth Land [Resource Information]

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

Name
Commonwealth Land -

Listed Marine Species [Resource Information]

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

Name	Threatened	Type of Presence
Birds		
Actitis hypoleucos		
Common Sandpiper [59309]		Species or species habitat likely to occur within area
Apus pacificus		
Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardea alba		
Great Egret, White Egret [59541]		Species or species habitat known to occur within area
Ardea ibis		
Cattle Egret [59542]		Species or species habitat may occur within area
Calidris acuminata		
Sharp-tailed Sandpiper [874]		Roosting known to occur within area
Calidris ferruginea		
Curlew Sandpiper [856]	Critically Endangered	Species or species

Name	Threatened	Type of Presence
		habitat known to occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat known to occur within area
Calidris ruficollis Red-necked Stint [860]		Roosting known to occur within area
Calidris subminuta Long-toed Stint [861]		Roosting known to occur within area
Charadrius dubius Little Ringed Plover [896]		Roosting known to occur within area
Charadrius ruficapillus Red-capped Plover [881]		Roosting known to occur within area
Gallinago megala Swinhoe's Snipe [864]		Roosting likely to occur within area
Gallinago stenura Pin-tailed Snipe [841]		Roosting likely to occur within area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat known to occur within area
Himantopus himantopus Pied Stilt, Black-winged Stilt [870]		Roosting known to occur within area
Limosa limosa Black-tailed Godwit [845]		Roosting known to occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area
Motacilla cinerea Grey Wagtail [642]		Species or species habitat may occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Numenius minutus Little Curlew, Little Whimbrel [848]		Roosting likely to occur within area
Pandion haliaetus Osprey [952]		Species or species habitat known to occur within area
Philomachus pugnax Ruff (Reeve) [850]		Roosting known to occur within area
Recurvirostra novaehollandiae Red-necked Avocet [871]		Roosting known to occur within area
Rostratula benghalensis (sensu lato) Painted Snipe [889]	Endangered*	Species or species habitat may occur within area
Thinornis rubricollis Hooded Plover [59510]		Species or species habitat may occur within area
Tringa glareola Wood Sandpiper [829]		Roosting known to occur within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species

Name	Threatened	Type of Presence
		habitat known to occur within area
Tringa stagnatilis Marsh Sandpiper, Little Greenshank [833]		Roosting known to occur within area

Extra Information

State and Territory Reserves [Resource Information]

Name	State
Cardup	WA
Forrestdale Lake	WA
Gooralong	WA
Serpentine	WA
Unnamed WA42044	WA
Unnamed WA46818	WA
Watkins Road	WA

Regional Forest Agreements [Resource Information]

Note that all areas with completed RFAs have been included.

Name	State
South West WA RFA	Western Australia

Invasive Species [Resource Information]

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

Name	Status	Type of Presence
Birds		
Acridotheres tristis Common Myna, Indian Myna [387]		Species or species habitat likely to occur within area
Anas platyrhynchos Mallard [974]		Species or species habitat likely to occur within area
Carduelis carduelis European Goldfinch [403]		Species or species habitat likely to occur within area
Columba livia Rock Pigeon, Rock Dove, Domestic Pigeon [803]		Species or species habitat likely to occur within area
Passer domesticus House Sparrow [405]		Species or species habitat likely to occur within area
Passer montanus Eurasian Tree Sparrow [406]		Species or species habitat likely to occur within area
Streptopelia chinensis Spotted Turtle-Dove [780]		Species or species habitat likely to occur within area

Name	Status	Type of Presence
Streptopelia senegalensis Laughing Turtle-dove, Laughing Dove [781]		Species or species habitat likely to occur within area
Sturnus vulgaris Common Starling [389]		Species or species habitat likely to occur within area
Turdus merula Common Blackbird, Eurasian Blackbird [596]		Species or species habitat likely to occur within area
Mammals		
Bos taurus Domestic Cattle [16]		Species or species habitat likely to occur within area
Canis lupus familiaris Domestic Dog [82654]		Species or species habitat likely to occur within area
Capra hircus Goat [2]		Species or species habitat likely to occur within area
Felis catus Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
Funambulus pennantii Northern Palm Squirrel, Five-striped Palm Squirrel [129]		Species or species habitat likely to occur within area
Mus musculus House Mouse [120]		Species or species habitat likely to occur within area
Oryctolagus cuniculus Rabbit, European Rabbit [128]		Species or species habitat likely to occur within area
Rattus norvegicus Brown Rat, Norway Rat [83]		Species or species habitat likely to occur within area
Rattus rattus Black Rat, Ship Rat [84]		Species or species habitat likely to occur within area
Sus scrofa Pig [6]		Species or species habitat likely to occur within area
Vulpes vulpes Red Fox, Fox [18]		Species or species habitat likely to occur within area
Plants		
Anredera cordifolia Madeira Vine, Jalap, Lamb's-tail, Mignonette Vine, Anredera, Gulf Madeiravine, Heartleaf Madeiravine, Potato Vine [2643]		Species or species habitat likely to occur within area
Asparagus asparagoides Bridal Creeper, Bridal Veil Creeper, Smilax, Florist's Smilax, Smilax Asparagus [22473]		Species or species habitat likely to occur within area
Brachiaria mutica Para Grass [5879]		Species or species habitat may occur within area
Cenchrus ciliaris Buffel-grass, Black Buffel-grass [20213]		Species or species habitat may occur within

Name	Status	Type of Presence
		area
Chrysanthemoides monilifera Bitou Bush, Boneseed [18983]		Species or species habitat may occur within area
Chrysanthemoides monilifera subsp. monilifera Boneseed [16905]		Species or species habitat likely to occur within area
Genista linifolia Flax-leaved Broom, Mediterranean Broom, Flax Broom [2800]		Species or species habitat likely to occur within area
Genista monspessulana Montpellier Broom, Cape Broom, Canary Broom, Common Broom, French Broom, Soft Broom [20126]		Species or species habitat likely to occur within area
Genista sp. X Genista monspessulana Broom [67538]		Species or species habitat may occur within area
Lantana camara Lantana, Common Lantana, Kamara Lantana, Large-leaf Lantana, Pink Flowered Lantana, Red Flowered Lantana, Red-Flowered Sage, White Sage, Wild Sage [10892]		Species or species habitat likely to occur within area
Lycium ferocissimum African Boxthorn, Boxthorn [19235]		Species or species habitat likely to occur within area
Olea europaea Olive, Common Olive [9160]		Species or species habitat may occur within area
Pinus radiata Radiata Pine Monterey Pine, Insignis Pine, Wilding Pine [20780]		Species or species habitat may occur within area
Rubus fruticosus aggregate Blackberry, European Blackberry [68406]		Species or species habitat likely to occur within area
Salix spp. except S.babylonica, S.x calodendron & S.x reichardtii Willows except Weeping Willow, Pussy Willow and Sterile Pussy Willow [68497]		Species or species habitat likely to occur within area
Salvinia molesta Salvinia, Giant Salvinia, Aquarium Watermoss, Kariba Weed [13665]		Species or species habitat likely to occur within area
Solanum elaeagnifolium Silver Nightshade, Silver-leaved Nightshade, White Horse Nettle, Silver-leaf Nightshade, Tomato Weed, White Nightshade, Bull-nettle, Prairie-berry, Satansbos, Silver-leaf Bitter-apple, Silverleaf-nettle, Trompillo [12323]		Species or species habitat likely to occur within area
Tamarix aphylla Athel Pine, Athel Tree, Tamarisk, Athel Tamarisk, Athel Tamarix, Desert Tamarisk, Flowering Cypress, Salt Cedar [16018]		Species or species habitat likely to occur within area
Reptiles		
Hemidactylus frenatus Asian House Gecko [1708]		Species or species habitat likely to occur within area

Nationally Important Wetlands	[Resource Information]
Name	State
Gibbs Road Swamp System	WA

Caveat

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

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

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

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

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

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

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

- migratory and
- marine

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

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

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

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

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

Coordinates

-32.200455 115.970199,-32.207137 115.972259,-32.298016 115.971572,-32.302079 115.996978,-32.309914 116.010711

Acknowledgements

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

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

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

Please feel free to provide feedback via the Contact Us page.

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Appendix E: Vegetation Units Mapping of the Study Area

Figures: E1 - E13

401500 402000 402500

6438500 6438000 6437500 6437000

C RV1 0 125 250 500 Meters

WOODMAN ENVIRONMENTAL

N

This map should only be used in conjunction with WEC project MR19-22-01.

Tonkin Highway Reconnaissance Survey
Detailed Vegetation Units

Revision: 0 - 12 December 2019 Scale: 1:5,000 (A3)

Author: Leah Firth

WEC Ref: MR19-22-01

Filename: MR19-22-01-AppE

Projection: GDA 1994 MGA Zone 50

Appendix

E1

402500 403000 403500

6436500 6436000 6435500

C RV1 RV1 IE RV1 IE RV1 CO CO CO CO C CC CC CC ER/EC CC ER IE IE CC IE IE W3 CC CC CC TO CC CC W3 CC CC CC CC CC CC

0 125 250 500 Meters

402500 403000 403500

WOODMAN ENVIRONMENTAL This map should only be used in conjunction with WEC project MR19-22-01.	**Tonkin Highway Reconnaissance Survey** **Detailed Vegetation Units**	Author: Leah Firth	**Appendix**
		WEC Ref: MR19-22-01	
		Filename: MR19-22-01-AppE	E2
	Revision: 0 - 12 December 2019 Scale: 1:5,000 (A3)	Projection: GDA 1994 MGA Zone 50	

404000

404500

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6435500

ER/EC

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IE

IE

0 125 250 500 Meters

N

WOODMAN ENVIRONMENTAL

This map should only be used in conjunction with WEC project MR19-22-01.

Tonkin Highway Reconnaissance Survey
Detailed Vegetation Units

Revision: 0 - 12 December 2019 Scale: 1:5,000 (A3)

Author: Leah Firth

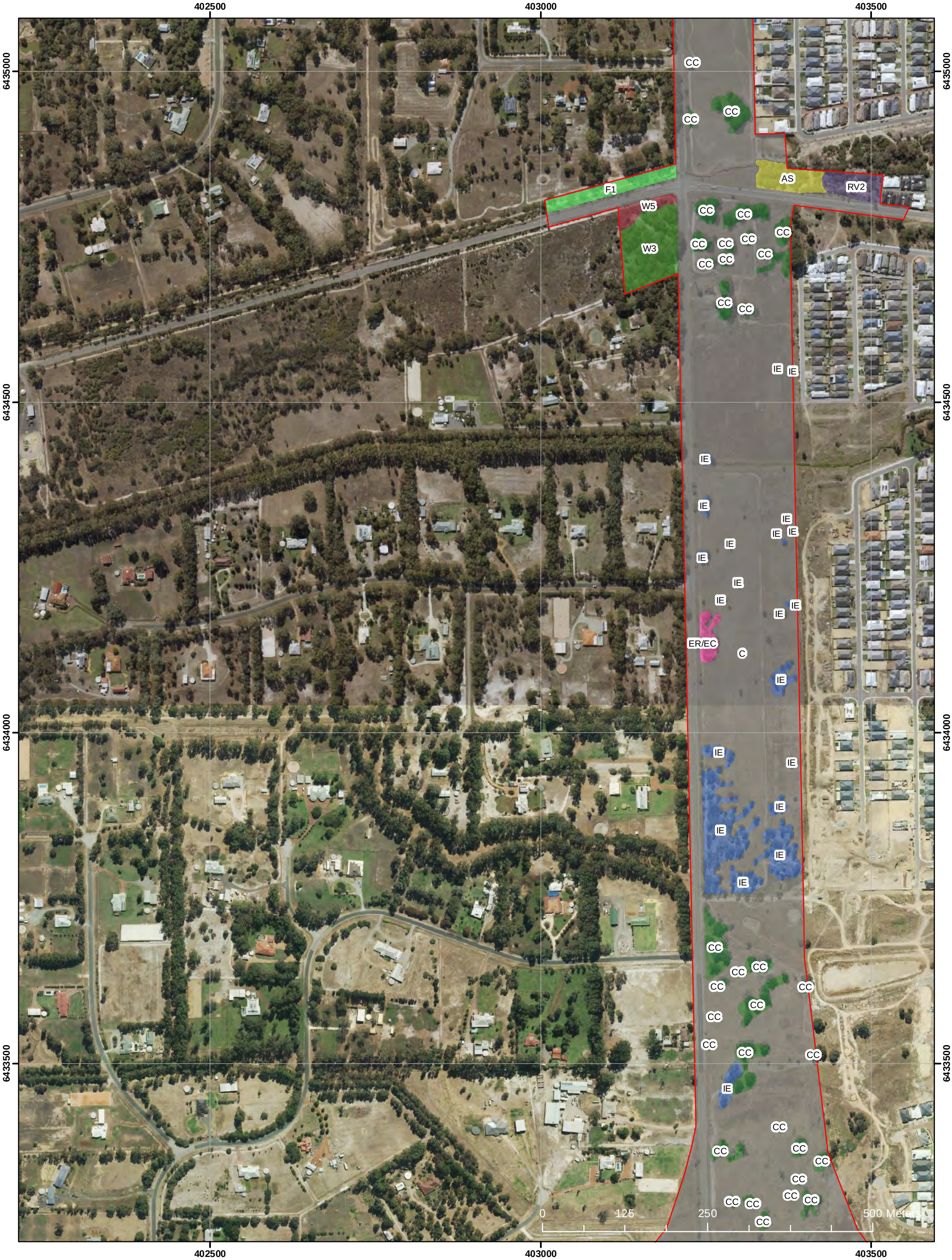
WEC Ref: MR19-22-01

Filename: MR19-22-01-AppE

Projection: GDA 1994 MGA Zone 50

Appendix

E3



WOODMAN ENVIRONMENTAL

This map should only be used in conjunction with WEC project MR19-22-01.

N

Tonkin Highway Reconnaissance Survey
Detailed Vegetation Units

Revision: 0 - 12 December 2019 Scale: 1:5,000 (A3)

Author: Leah Firth

WEC Ref: MR19-22-01

Filename: MR19-22-01-AppE

Projection: GDA 1994 MGA Zone 50

Appendix

E4

402500 403000 403500

6433000 6432500 6432000 6431500

W1 F1 W1 S4 MP MP CC CC CC CC

IE F1 IE F1 F1 IE ER C IE ER

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0 125 250 500 Meters

402500 403000 403500

WOODMAN ENVIRONMENTAL

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This map should only be used in conjunction with WEC project MR19-22-01.

Tonkin Highway Reconnaissance Survey
Detailed Vegetation Units

Revision: 0 - 12 December 2019 Scale: 1:5,000 (A3)

Author: Leah Firth

WEC Ref: MR19-22-01

Filename: MR19-22-01-AppE

Projection: GDA 1994 MGA Zone 50

Appendix

E5

404000 404500

6433000 6433000

6432500 6432500

6432000 6432000

6431500 6431500

C

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0 125 250 500 Meters

404000 404500

WOODMAN ENVIRONMENTAL

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This map should only be used in conjunction with WEC project MR19-22-01.

Tonkin Highway Reconnaissance Survey
Detailed Vegetation Units

Revision: 0 - 12 December 2019 Scale: 1:5,000 (A3)

Author: Leah Firth

WEC Ref: MR19-22-01

Filename: MR19-22-01-AppE

Projection: GDA 1994 MGA Zone 50

Appendix

E6

402500 403000 403500

6431000 6430500 6430000

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0 125 250 500 Meters

402500 403000 403500

WOODMAN ENVIRONMENTAL

N

This map should only be used in conjunction with WEC project MR19-22-01.

Tonkin Highway Reconnaissance Survey
Detailed Vegetation Units

Revision: 0 - 12 December 2019 Scale: 1:5,000 (A3)

Author: Leah Firth

WEC Ref: MR19-22-01

Filename: MR19-22-01-AppE

Projection: GDA 1994 MGA Zone 50

Appendix

E7

402500 403000 403500

6429500 6429000 6428500 6428000

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0 125 250 500 Meters

N

WOODMAN ENVIRONMENTAL

This map should only be used in conjunction with WEC project MR19-22-01.

Tonkin Highway Reconnaissance Survey
Detailed Vegetation Units

Revision: 0 - 12 December 2019 Scale: 1:5,000 (A3)

Author: Leah Firth

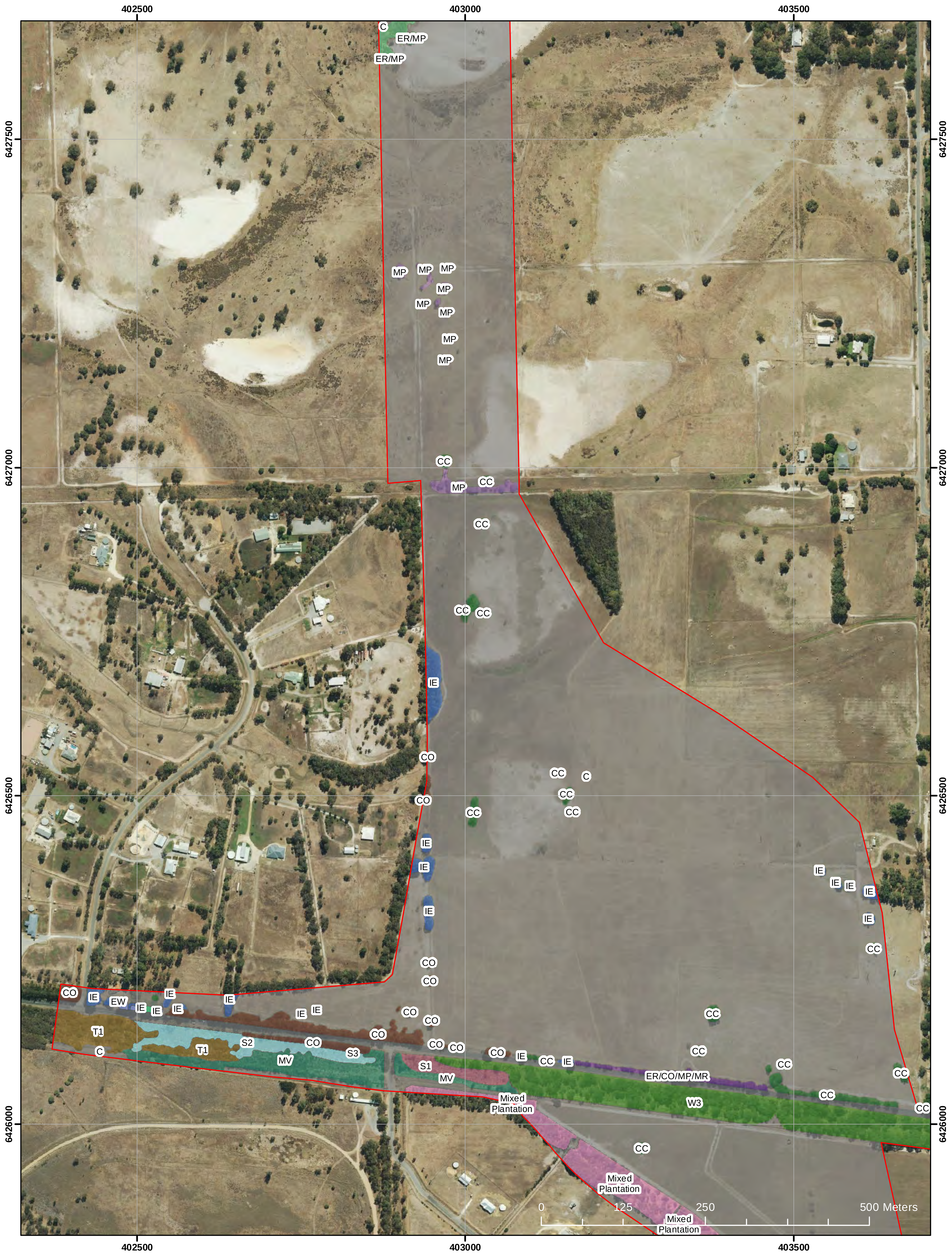
WEC Ref: MR19-22-01

Filename: MR19-22-01-AppE

Projection: GDA 1994 MGA Zone 50

Appendix

E8



WOODMAN ENVIRONMENTAL

This map should only be used in conjunction with WEC project MR19-22-01.

Tonkin Highway Reconnaissance Survey Detailed Vegetation Units	Author: Leah Firth	**Appendix**
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	Filename: MR19-22-01-AppE	
Revision: 0 - 12 December 2019 Scale: 1:5,000 (A3)	Projection: GDA 1994 MGA Zone 50	

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0 125 250 500 Meters

WOODMAN ENVIRONMENTAL

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This map should only be used in conjunction with WEC project MR19-22-01.

Tonkin Highway Reconnaissance Survey
Detailed Vegetation Units

Revision: 0 - 12 December 2019 Scale: 1:5,000 (A3)

Author: Leah Firth

WEC Ref: MR19-22-01

Filename: MR19-22-01-AppE

Projection: GDA 1994 MGA Zone 50

Appendix

E10

403000 403500

6425500 6425500

6425000 6425000

6424500 6424500

6424000 6424000

403000 403500

C Mixed Plantation

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Mixed Plantation

0 125 250 500 Meters

N

WOODMAN ENVIRONMENTAL

This map should only be used in conjunction with WEC project MR19-22-01.

Tonkin Highway Reconnaissance Survey
Detailed Vegetation Units

Revision: 0 - 12 December 2019 Scale: 1:5,000 (A3)

Author: Leah Firth

WEC Ref: MR19-22-01

Filename: MR19-22-01-AppE

Projection: GDA 1994 MGA Zone 50

Appendix

E11

404000 404500 405000

6425500 6425000 6424500 6424000

C
W2
Mixed Plantation
C
W2
IE
EM
IE
C
C
IE
EM
EM
C

0 125 250 500 Meters

404000 404500 405000

WOODMAN ENVIRONMENTAL

This map should only be used in conjunction with WEC project MR19-22-01.

N

Tonkin Highway Reconnaissance Survey
Detailed Vegetation Units

Revision: 0 - 12 December 2019 Scale: 1:5,000 (A3)

Author: Leah Firth

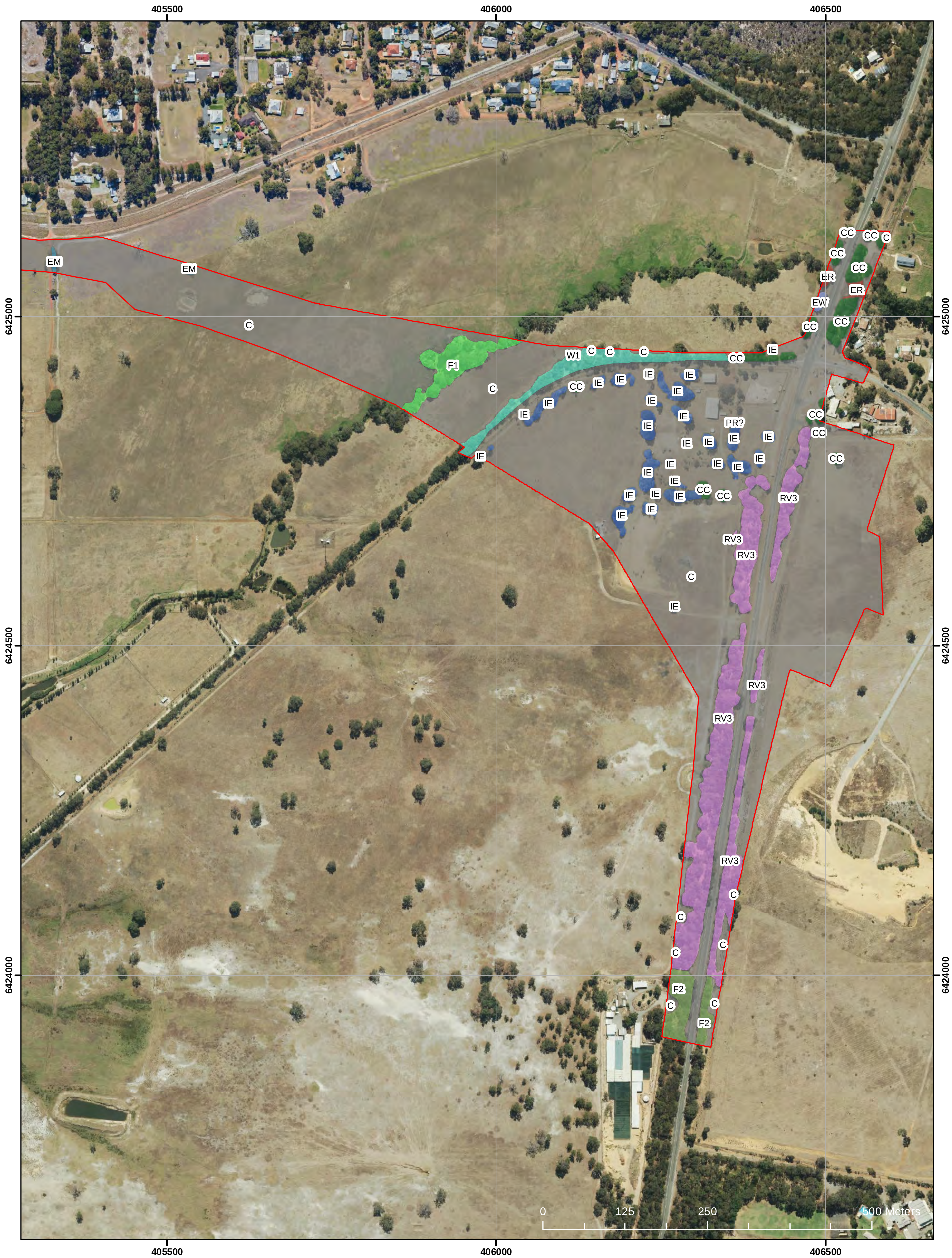
WEC Ref: MR19-22-01

Filename: MR19-22-01-AppE

Projection: GDA 1994 MGA Zone 50

Appendix

E12



WOODMAN ENVIRONMENTAL	Tonkin Highway Reconnaissance Survey Detailed Vegetation Units	Author: Leah Firth	Appendix
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		Filename: MR19-22-01-AppE	
This map should only be used in conjunction with WEC project MR19-22-01.	Revision: 0 - 12 December 2019 Scale: 1:5,000 (A3)	Projection: GDA 1994 MGA Zone 50	

Legend

Project Survey Area

Woodland Forests

W1	Mid woodland of *Corymbia calophylla* over mid open shrubland of *Xanthorrhoea preissii* with occasional *Kingia australis* and various shrub species over introduced grasses and pasture weeds on grey sandy loams on mid to lower slopes
W2	Mid woodland of *Corymbia calophylla* and *Melaleuca preissiana* over mid open shrubland of *Xanthorrhoea preissii* and *Jacksonia sternbergiana* over a low open shrubland of mixed species on grey sand on flats
W3	Mid woodland of *Corymbia calophylla* over mid open shrubland of *Xanthorrhoea preissii* and mixed species over a mid sedgeland of *Mesomelaena tetragona* and *Tetraria octandra* on grey sandy loam on flats
W4	Mid woodland of *Corymbia calophylla*, *Melaleuca preissiana* and *M. rhaphiophylla* over a mid sedgeland of *Lepidosperma longitudinale* on grey sandy loam in a swale
W5	Low woodland of *Melaleuca preissiana* over mid open shrubland of *Regelia ciliata* and *Hakea varia* over low open shrubland of *Banksia nivea* subsp. *nivea* over introduced grasses on brown sandy loam in a basin
W6	Low woodland of *Banksia attenuata* and *B. menziesii* over a tall open shrubland of *Jacksonia furcellata* and *Kunzea glabrescens* over a sparse mid shrubland of *Melaleuca ?trichophylla* over introduced grasses on grey sand on a low dune
F1	Mid closed forest of *Eucalyptus rudis* and *Melaleuca preissiana* over mid sparse shrubland of *Xanthorrhoea preissii* and *M. lateritia* on brown sandy loam on flats and in drainage lines
F2	Mid closed forest of *Eucalyptus marginata* and *Corymbia calophylla* over a low woodland of *Allocasuarina fraseriana* and *Banksia grandis* over mid open shrubland of *Xanthorrhoea preissii* and *Hakea lissocarpha* on sandy gravels on a mid slope

Shrublands and Thickets

S1	Mid shrubland of mixed species with isolated mid shrubs of *Xanthorrhoea preissii* and *Kingia australis* over mid sedgeland of *Mesomelaena tetragona* and *Tetraria octandra* on brown sandy loam on flats
S2	Tall open shrubland of *Hakea varia*, *Jacksonia sternbergiana*, *Xanthorrhoea preissii and Kingia australis* over a mid open shrubland of mixed species dominated by *Hypocalymma angustifolium*, *Allocasuarina microstachya*, *Verticordia densiflora* subsp. *densiflora* and *Banksia dallanneyi* over mid sedgeland of *Mesomelaena tetragona*, *Schoenus rigens* and *Tetraria octandra* on light brown sandy loam to clay on flats
S3	Mid open shrubland of *Hakea incrassata* and *Allocasuarina microstachya* over a mid closed sedgeland of *Desmocladus lateriflorus* on brown sandy loam in a shallow basin
S4	Tall shrubland of *Melaleuca viminea* subsp. *viminea*, *Viminaria juncea* and *Jacksonia sternbergiana* over introduced grasses and *Watsonia meriana* ssp. *bulbillifera* on brown sand on flats
T1	Tall closed shrubland of *Melaleuca osullivanii* and *Hakea varia* over low sedgeland of *Leptocarpus canus* and *Schoenus rigens* on brown sandy loam on flats

Disturbed Areas

MV	Highly modified areas of native vegetation as a result of earthworks or clearing comprising an open woodland of *Corymbia calophylla* over a tall mixed shrubland of *Melaleuca osullivanii*, *M. viminea* subsp. *viminea*, *Xanthorrhoea preissii* and *Kingia australis* over a shrubland of *Verticordia densiflora* subsp. *densiflora*, *Synaphea petiolaris* subsp. *petiolaris* over a sedgeland of *Mesomelaena tetragona* and introduced grasses on brown sandy loam on flats
AS	Individual or stands of *Acacia saligna* over pasture weeds on grey sands on cleared palusplains
BI	Individual or stands of *Banksia ilicifolia* over pasture weeds on grey sandy soils on low rises
C	Cleared Land
CC	Individual or stands of *Corymbia calophylla* over pasture weeds on various soils and topographical positions
CG	Individual or stands of planted *Eucalyptus gomphocephala* over pasture weeds on grey sands on cleared palusplains and in roadside drains
CO	Individual or stands of *Casuarina obesa* over pasture weeds on grey sands on cleared palusplains and in roadside drains
EG	Individual or stands of planted *Eucalyptus gomphocephala* over pasture weeds on grey sands on cleared palusplains and in roadside drains
EM	Individual or stands of *Eucalyptus marginata* over pasture weeds on grey sandy soils on low rises
ER	Individual or stands of *Eucalyptus rudis* over pasture weeds on grey sands on cleared palusplains and in roadside drains
ER/CC	Mixed stand of *Eucalyptus rudis* and *Corymbia calophylla* over pasture weeds on grey sands on cleared palusplains and in roadside drains
ER/CO/MP/MR	Mixed stand of *Eucalyptus rudis, Casuarina obesa, Melaleuca preissiana* and *Melaleuca rhaphiophylla* over pasture weeds on grey sands on cleared palusplains and in roadside drains
ER/EC	Mixed stand of *Eucalyptus rudis* and planted *E. camaldulensis* over pasture weeds on grey sands on cleared palusplains and in roadside drains
ER/MP	Mixed stand of *Eucalyptus rudis* and *Melaleuca preissiana* over pasture weeds on grey sands on cleared palusplains and in roadside drains
ER/MR	Mixed stand of *Eucalyptus rudis* and *Melaleuca rhaphiophylla* over pasture weeds on grey sands on cleared palusplains and in roadside drains
EW	Individual or stands of *Eucalyptus wandoo* over pasture weeds on grey sands on cleared land
MP	Individual or stands of *Melaleuca preissiana* over pasture weeds on grey sands on cleared palusplains and in roadside drains
PR?	Individual or stands of *Pinus?radiata* over pasture weeds on grey sands on cleared land
TO	Dense rushland of **Typha orientalis* growing in a minor

Revegetated Areas

IE	Areas planted with Non-indigenous *Eucalyptus* species over pasture weeds
RV1	Revegetated road reserve with *Casuarina obesa*, introduced *Eucalyptus* species and the occasional *Corymbia calophylla* and *Eucalyptus rudis* over *Melaleuca rhaphiophylla* and *M. teretifolia* over pasture weeds
RV2	Revegetated land with *Corymbia calophylla* and *Eucalyptus rudis* over *Melaleuca rhaphiophylla* and mixed shrub species over pasture weeds
RV3	Revegetated road reserve dominated by *Corymbia calophylla* with occasional *Eucalyptus marginata*, *E. wandoo*, *E. rudis*, *E. accedens* and *E. lane poolei* over *Acacia saligna*, *A. pulchella*, *Xanthorrhoea preissii* and various indigenous and non-indigenous shrub species over pasture weeds
Mixed Plantation	Shelter belt plantings composed of introduced *Eucalyptus* species along with *E. rudis*, *E. gomphocephala*, *E. wandoo*, *Corymbia calophylla*, *Melaleuca rhaphiophylla*, *M. preissiana*, *M. teretifolia*, *Allocasuarina fraseriana*, *Acacia saligna* and *Callistemon phoeniceus*

WOODMAN ENVIRONMENTAL

This map should only be used in conjunction with WEC project MR19-22-01.

N

Tonkin Highway Reconnaissance Survey
Detailed Vegetation Units

Revision: 0 - 12 December 2019 Scale: 1:5,000 (A3)

Author: Leah Firth

WEC Ref: MR19-22-01

Filename: MR19-22-01-AppE-14

Projection: GDA 1994 MGA Zone 50

Appendix

E14

Appendix F: Vegetation Condition Mapping of the Study Area

Figures: F1 - F13

401500 402000 402500

6438500 6438000 6437500 6437000

C C C C C CD CD CD CD C C CD CD C CD

0 125 250 500 Meters

Legend

Project Survey Area

Vegetation Condition

CD Completely Degraded

C Cleared Land

N

WOODMAN ENVIRONMENTAL

This map should only be used in conjunction with WEC project MR19-22-01.

Tonkin Highway Reconnaissance Survey Vegetation Condition

Revision: 0 - 12 December 2019 Scale: 1:5,000 (A3)

Author: Leah Firth

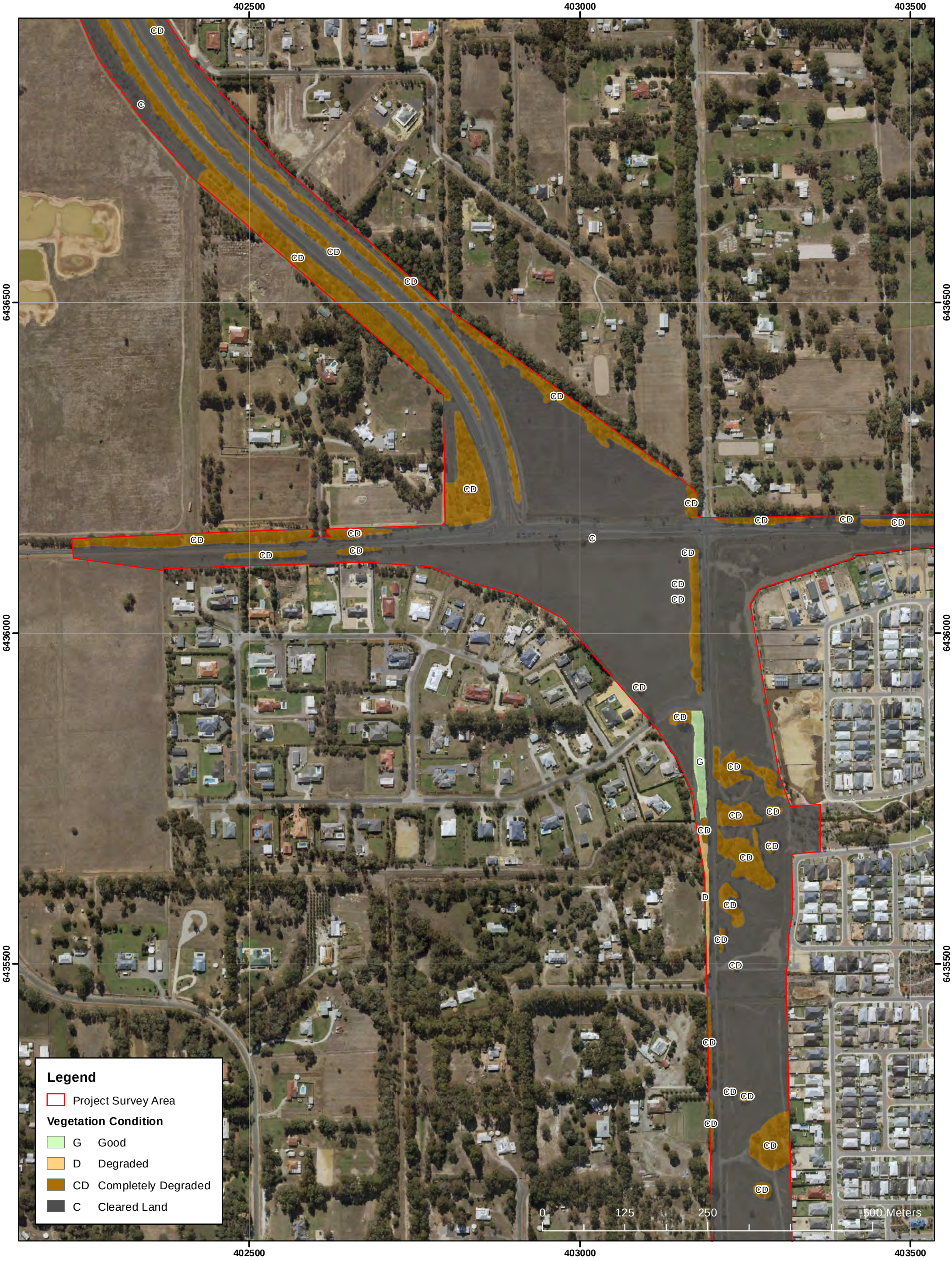
WEC Ref: MR19-22-01

Filename: MR19-22-01-AppF

Projection: GDA 1994 MGA Zone 50

Appendix

F1



WOODMAN ENVIRONMENTAL

This map should only be used in conjunction with WEC project MR19-22-01.

Tonkin Highway Reconnaissance Survey
Vegetation Condition

Revision: 0 - 12 December 2019 Scale: 1:5,000 (A3)

Author: Leah Firth

WEC Ref: MR19-22-01

Filename: MR19-22-01-AppF

Projection: GDA 1994 MGA Zone 50

Appendix

F2

404000 404500

6436500 6436500

CD CD C CD

6436000 6436000

6435500 6435500

404000 404500

Legend

Project Survey Area

Vegetation Condition

CD Completely Degraded

C Cleared Land

0 125 250 500 Meters

WOODMAN ENVIRONMENTAL

This map should only be used in conjunction with WEC project MR19-22-01.

N

Tonkin Highway Reconnaissance Survey
Vegetation Condition

Revision: 0 - 12 December 2019 Scale: 1:5,000 (A3)

Author: Leah Firth

WEC Ref: MR19-22-01

Filename: MR19-22-01-AppF

Projection: GDA 1994 MGA Zone 50

Appendix

F3

WOODMAN ENVIRONMENTAL

This map should only be used in conjunction with WEC project MR19-22-01.

N

Tonkin Highway Reconnaissance Survey
Vegetation Condition

Revision: 0 - 12 December 2019 Scale: 1:5,000 (A3)

Author: Leah Firth

WEC Ref: MR19-22-01

Filename: MR19-22-01-AppF

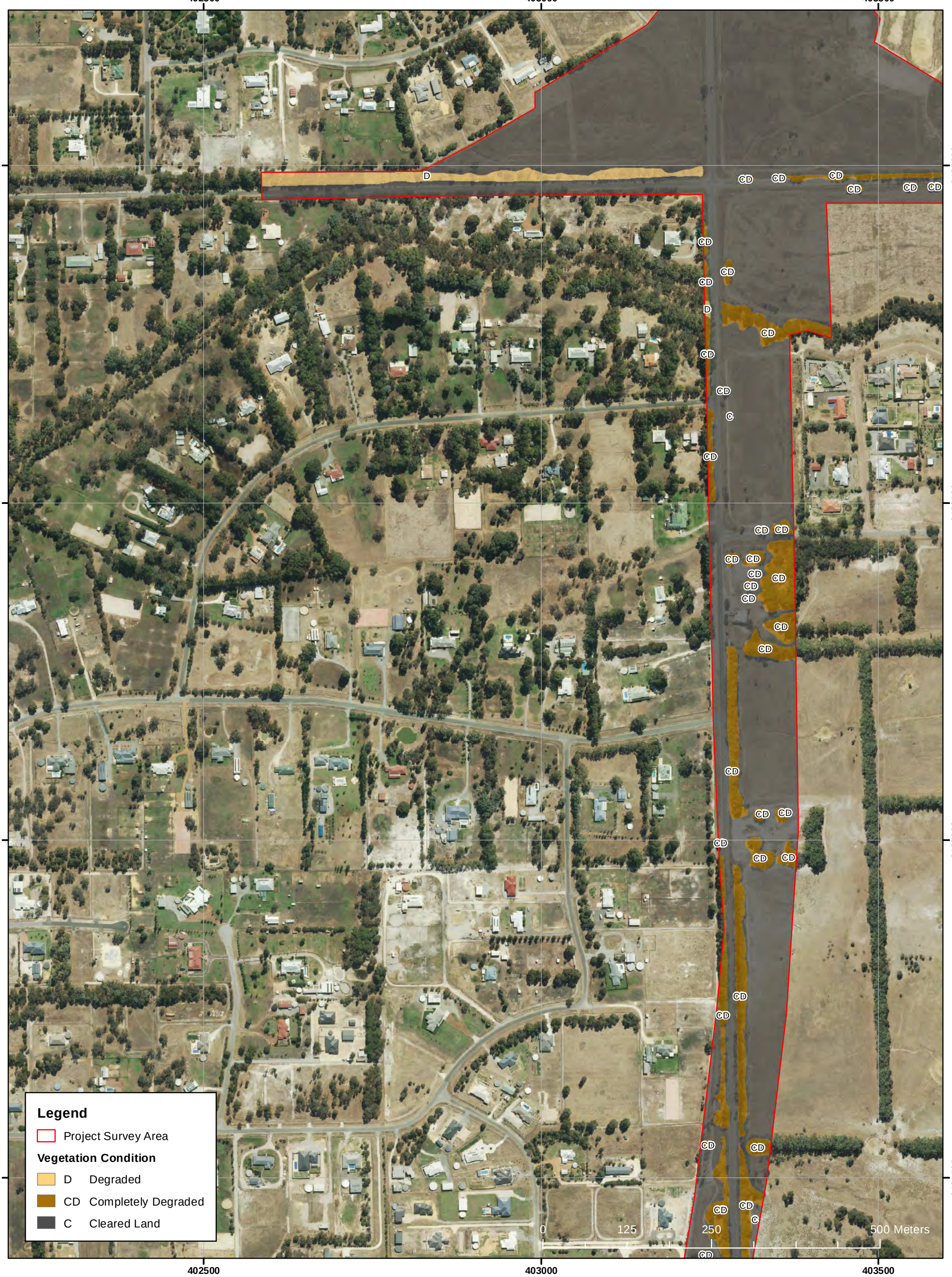
Projection: GDA 1994 MGA Zone 50

Appendix

F4

402500 403000 403500

6433000 6432500 6432000 6431500



Legend

Project Survey Area

Vegetation Condition

- D Degraded
- CD Completely Degraded
- C Cleared Land

WOODMAN ENVIRONMENTAL

N

This map should only be used in conjunction with WEC project MR19-22-01.

Tonkin Highway Reconnaissance Survey
Vegetation Condition

Revision: 0 - 12 December 2019 Scale: 1:5,000 (A3)

Author: Leah Firth

WEC Ref: MR19-22-01

Filename: MR19-22-01-AppF

Projection: GDA 1994 MGA Zone 50

Appendix

F5

404000 404500

6433000 6433000

6432500 6432500

6432000 6432000

6431500 6431500

C

CD CD CD CD CD CD CD CD CD

Legend

Project Survey Area

Vegetation Condition

CD Completely Degraded

C Cleared Land

0 125 250 500 Meters

404000 404500

WOODMAN ENVIRONMENTAL

N

This map should only be used in conjunction with WEC project MR19-22-01.

Tonkin Highway Reconnaissance Survey Vegetation Condition	Author: Leah Firth	**Appendix** F6
	WEC Ref: MR19-22-01	
	Filename: MR19-22-01-AppF	
Revision: 0 - 12 October 2019 Scale: 1:5,000 (A3)	Projection: GDA 1994 MGA Zone 50	

WOODMAN ENVIRONMENTAL This map should only be used in conjunction with WEC project MR19-22-01.	**Tonkin Highway Reconnaissance Survey Vegetation Condition**	Author: Leah Firth	**Appendix** F7
		WEC Ref: MR19-22-01	
		Filename: MR19-22-01-AppF	
	Revision: 0 - 12 December 2019 Scale: 1:5,000 (A3)	Projection: GDA 1994 MGA Zone 50	

402500 403000 403500

6429500 6429000 6428500 6428000

Legend

- Project Survey Area

Vegetation Condition

- D Degraded
- CD Completely Degraded
- C Cleared Land

0 125 250 500 Meters

N

WOODMAN ENVIRONMENTAL

This map should only be used in conjunction with WEC project MR19-22-01.

Tonkin Highway Reconnaissance Survey
Vegetation Condition

Revision: 0 - 12 December 2019 Scale: 1:5,000 (A3)

Author: Leah Firth

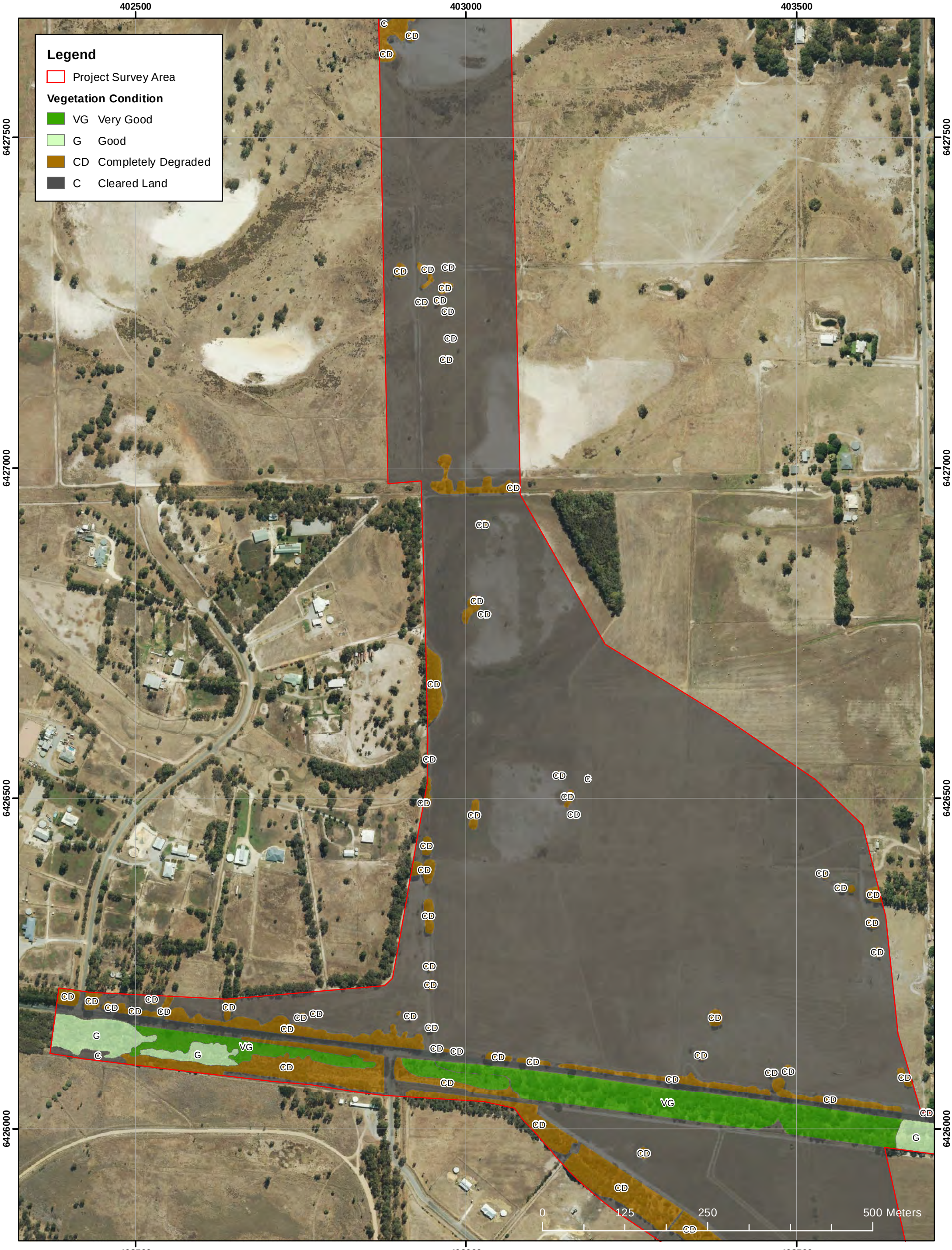
WEC Ref: MR19-22-01

Filename: MR19-22-01-AppF

Projection: GDA 1994 MGA Zone 50

Appendix

F8



WOODMAN ENVIRONMENTAL

This map should only be used in conjunction with WEC project MR19-22-01.

Tonkin Highway Reconnaissance Survey
Vegetation Condition

Revision: 0 - 12 December 2019 Scale: 1:5,000 (A3)

Author: Leah Firth

WEC Ref: MR19-22-01

Filename: MR19-22-01-AppF

Projection: GDA 1994 MGA Zone 50

Appendix

F9

404000 404500 405000

6427500 6427000 6426500 6426000

Legend

Project Survey Area

Vegetation Condition

- VG Very Good
- G Good
- CD Completely Degraded
- C Cleared Land

CD C CD G VG

0 125 250 500 Meters

404000 404500 405000

WOODMAN ENVIRONMENTAL

N

This map should only be used in conjunction with WEC project MR19-22-01.

Tonkin Highway Reconnaissance Survey
Vegetation Condition

Author: Leah Firth

WEC Ref: MR19-22-01

Filename: MR19-22-01-AppF

Revision: 0 - 12 October 2019 Scale: 1:5,000 (A3)

Projection: GDA 1994 MGA Zone 50

Appendix

F10

403000 403500

6425500 6425500

6425000 6425000

6424500 6424500

6424000 6424000

403000 403500

C CD CD CD CD CD C CD CD CD CD CD

Legend

Project Survey Area

Vegetation Condition

CD Completely Degraded

C Cleared Land

0 125 250 500 Meters

WOODMAN ENVIRONMENTAL

N

This map should only be used in conjunction with WEC project MR19-22-01.

Tonkin Highway Reconnaissance Survey
Vegetation Condition

Revision: 0 - 12 December 2019 Scale: 1:5,000 (A3)

Author: Leah Firth

WEC Ref: MR19-22-01

Filename: MR19-22-01-AppF

Projection: GDA 1994 MGA Zone 50

Appendix

F11

404000 404500 405000

6425500 6425000 6424500 6424000

C CD G C G CD CD CD C CD C CD CD C

Legend

Project Survey Area

Vegetation Condition

G Good

CD Completely Degraded

C Cleared Land

0 125 250 500 Meters

WOODMAN ENVIRONMENTAL

N

This map should only be used in conjunction with WEC project MR19-22-01.

Tonkin Highway Reconnaissance Survey
Vegetation Condition

Revision: 0 - 12 December 2019 Scale: 1:5,000 (A3)

Author: Leah Firth

WEC Ref: MR19-22-01

Filename: MR19-22-01-AppF

Projection: GDA 1994 MGA Zone 50

Appendix

F12

405500 406000 406500

6425000 6424500 6424000

Legend

Project Survey Area

Vegetation Condition

G	Good
D	Degraded
CD	Completely Degraded
C	Cleared Land

0 125 250 500 Meters

WOODMAN ENVIRONMENTAL

N

This map should only be used in conjunction with WEC project MR19-22-01.

Tonkin Highway Reconnaissance Survey
Vegetation Condition

Revision: 0 - 12 December 2019 Scale: 1:5,000 (A3)

Author: Leah Firth

WEC Ref: MR19-22-01

Filename: MR19-22-01-AppF

Projection: GDA 1994 MGA Zone 50

Appendix

F13