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Sinosteel Midwest Corporation Limited: Koolanooka South (E70/2433) Reconnaissance and Targeted Flora Survey, September/October 2018




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This document describes the results of a combined reconnaissance and targeted flora survey carried out by Maia Environmental Consultancy (Maia) for Sinosteel Midwest Corporation Limited (SMC) on tenement E70/2433 in September / October 2018. The Survey Area is in the Shire of Morawa, and the Merredin subregion of the Avon Wheatbelt bioregion, Western Australia.

Photographs on front page – left to right: photographs 1, 2 and 4 vegetation of the Survey Area, photograph 3 *Drummondita rubroviridis* (Priority 1 species).

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Acronyms and Abbreviations

AVW	Avon Wheatbelt bioregion
AVW01	Merredin subregion of Avon Wheatbelt bioregion
BAM Act	*Biosecurity and Agriculture Management Act 2007*
BC Act	*Biodiversity Conservation Act 2016*
BIF	Banded iron formation
BoM	Bureau of Meteorology
BVA	Beard vegetation association
CSF	Conservation significant flora
DAFWA	Former Department of Agriculture and Food Western Australia (current DPIRD)
DBCA	Department of Biodiversity Conservation and Attractions
DEC	Former Department of Environment and Conservation (current DBCA)
DMP	Former Department of Mines and Petroleum
DotEE	Department of the Environment and Energy
DPaW	Former Department of Parks and Wildlife (current DBCA)
DPIRD	Department of Primary Industries and Regional Development
DPP	Declared pest plant
DSA	Database search area
DWER	Department of Water and Environmental Regulation
EPA	Environmental Protection Authority
EP Act	*Environmental Protection Act 1986*
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
ESA	Environmentally sensitive area
ESCAVI	Executive Steering Committee for Australian Vegetation Information
Fl, Fr	Flowering, fruiting
GDA94	Geocentric Datum of Australia, 1994
GDE	Groundwater dependent ecosystem
GoWA	Government of Western Australia
GPS	Global Positioning System
ha	Hectare
IBRA	Interim Biogeographic Regionalisation for Australia
IUCN	International Union for Conservation of Nature
km	Kilometre
L-t	Long-term
m	Metre
Maia	Maia Environmental Consultancy Pty Ltd
MGA50	Map Grid of Australia zone 50
mm	Millimetre
MVT	Maia vegetation type

NVIS	National Vegetation Information System
OppColl	Opportunistic collection
P (1-4)	Priority 1 to Priority 4 flora
PEC	Priority ecological community
PMST	Protected Matters Search Tool
RE	Range extension
Reconn.	Reconnaissance survey
SMC	Sinosteel Midwest Corporation Limited
sp.	Species -single
subsp.	Subspecies
T	Threatened flora species
TEC	Threatened ecological community
TFS	Targeted flora survey
TOI	Taxon of interest
TP List	Threatened and Priority Flora list
TPFL	Threatened and Priority Flora database
VA	Vegetation association
var.	Variety
VSA	Vegetation system association
WA	Western Australia
WA Herb/WAH	Western Australian Herbarium
WAOL	Western Australian Organism List
WC Act	*Wildlife Conservation Act 1950*
WoNS	Weed of National Significance
?	Queried species
*****	Indicates an environmental weed species

Summary

Background and Methods

Sinosteel Midwest Corporation Limited plans to carry out an exploration drilling program on E70/2433, which is approximately 25 km south-east of Morawa in the Shire of Morawa in the Avon Wheatbelt region of Western Australia. Maia Environmental Consultancy Pty Ltd was asked to carry out a combined reconnaissance and targeted flora survey over two polygons on tenement E70/2433. The two polygons (with a combined area of 37.6 ha) are collectively referred to as the Survey Area in this report.

A desktop study was carried out before the survey, which was undertaken between September 26 and October 2, 2018 by three botanists. Rainfall over the three months leading up to the survey was above average for the area.

One Threatened species has a record in the desktop search area, *Tecticornia bulbosa*, but the record is 3.9 km from the Survey Area. Nineteen Priority species have records in the desktop search area and five of the 19 species have been recorded previously in a small section of the Survey Area. The Survey Area lies within the boundaries of a threatened ecological community (TEC) the 'Plant Assemblages of the Koolanooka System (banded ironstone formation)' TEC.

Survey Results - Flora

One hundred and thirty-seven species were recorded in the Survey Area from 91 genera and 47 families (63.50% perennial and 36.50% annual), and approximately 87% of the species were identified from plants having flowers or fruit or both flowers and fruit.

No threatened flora species were located in the Survey Area.

Eleven confirmed priority flora species were located in the Survey Area: *Acacia graciliformis*, *Acacia muriculata*, *Dodonaea scurra*, *Drummondita rubroviridis*, *Lepidosperma* sp. Koolanooka (K.R. Newbey 9336), *Millotia dimorpha* (all Priority (P) 1), *Baeckea* sp. Perenjori (J.W. Green 1516) (P2), *Melaleuca barlowii*, *Mirbelia ferricola*, *Persoonia pentasticha* and *Stenanthemum poicilum* (all P3). Plant numbers recorded ranged from two (*Melaleuca barlowii*, P3) to more than 5,000 (*Millotia dimorpha* a small annual herb, P1).

Two taxa of interest were located in the Survey Area - *Beyeria* aff. *minor* and *Labichea* sp. Koolanooka.

No weed species on any of the national weeds lists were located in the Survey Area. One of the 13 weed species located in the Survey Area is listed as a Declared Plant in WA – *Echium plantagineum* (Paterson's Curse).

Survey Results -Vegetation

Five vegetation types plus disturbed areas (tracks and fencelines) were mapped over the Survey Area and vegetation condition was rated as Excellent (87%), Very Good (11%) and Degraded (2%).

Conservation Significance - Flora and Vegetation

Regional and local significance assessments were carried out for the 11 confirmed priority species located in the Survey Area and they are rated as having moderate to high conservation significance when the regional and local scores are combined and *Millotia dimorpha* achieved the highest score.

The regional and local significance of the pre-European vegetation association (631) mapped in the Survey Area is rated as high.

The five vegetation types described for the Survey Area are similar to three of the community types described for the Koolanooka and Perenjori Hills. The local significance of the five vegetation types mapped by Maia in the Survey Area is rated as high.

Ecological Communities and Other Significant Areas

The Survey Area lies within the boundaries of a state-listed threatened ecological community (TEC) - the 'Plant assemblages of the Koolanooka System (banded ironstone formation)' TEC.

None of the vegetation types recorded in the Survey Area contain the key species indicated for the nationally listed Eucalypt Woodlands of the Western Australian Wheatbelt TEC mapped as potentially occurring close to the Survey Area.

None of the vegetation types recorded in the Survey Area is the Eucalypt Woodlands of the Western Australian Wheatbelt PEC (using the Eucalypt Woodlands TEC description as a guide).

The Survey Area lies in an environmentally sensitive area (the Koolanooka System TEC) and a Schedule 1 area (the Avon Wheatbelt, which is one of the non-permitted areas listed in Schedule 1 of the Environmental Protection (Clearing of Vegetation) Regulations 2004).

The Survey Area does not lie within any of the lands managed by DBCA, there are no legislated land or waters in or close to the Survey Area, no EPA Red Book area, and no significant water bodies, rivers or drainage lines.

Recommendations

Vegetation clearing should only be carried out if a native vegetation clearing permit is granted for the exploration program.

Tracks and drill pads should be aligned to minimise direct and potential indirect impact to the confirmed priority flora species located in the Survey Area, particularly P1 and P2 species. Areas that were surveyed and where fewer conservation significant flora (CSF) plants were located should be selected in preference to areas where many CSF plants were recorded.

Direct or indirect impact to the two taxa of interest *Beyeria* aff. *minor* and *Labichea* sp. Koolanooka should be avoided as they have not been located elsewhere.

Direct impact to the vegetation in the Survey Area should be minimised and clearing boundaries clearly defined. The area is a TEC and the vegetation and flora are conservation significant.

Every effort should be made to prevent a) the introduction of new weeds into the area on machinery used for the works and b) the spread of existing weeds into the surrounding area when soil is moved from place to place.

Sinosteel Midwest Corporation Limited: Koolanooka South (E70/2433)

Reconnaissance and Targeted Flora Survey, September/October 2018

1 Introduction

1.1 Scope of Work

Sinosteel Midwest Corporation Limited (SMC) proposes to carry out an exploration drilling program on tenement E70/2433 in the Shire of Morawa, Western Australia (WA).

Maia Environmental Consultancy Pty Ltd (Maia) was contracted by SMC to carry out a combined reconnaissance and targeted flora survey over two polygons on tenement E70/2433. This report presents the results of a brief desktop study carried out before going to site, the results of the field survey and a discussion of the significance of the flora and vegetation of the areas surveyed.

The two areas surveyed are referred to collectively as the Survey Area in this report and they are shown on **Map 10.1, Section 10**.

1.2 Survey Area Location and Size

The Survey Area is approximately 25 kilometres (km) south-east of the town of Morawa (**Map 10.1, Section 10**) and covers 37.6 hectares (ha) (**Table 1.1)**.

Table 1.1: Survey Area

Polygon	Area (ha)
Northern	15.34
Southern	22.23
Survey Area	37.57

2 Background Information and Desktop Assessment

2.1 Rainfall

The closest weather station is Morawa Airport (station number 8296) located approximately 24 km north-west of the Survey Area (Bureau of Meteorology (BoM)). Morawa Airport's long-term mean rainfall and actual rainfall data for 2018 are listed in **Table 2.1** (BoM, 2018a).

Table 2.1: Long-term and 2018 Total Monthly and Annual Rainfall (mm) – Morawa

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Morawa Airport (site number 8296; long-term data collected between 1997 and 2018)													
2018 (mm)	49.4	1.8	5.2	0.0	23.2	54.8	81.8	64.0	2.6				282.8
L-t (mm)	24.2	17.0	17.6	17.7	36.7	38.5	44.7	34.9	22.8				254.1

Note: L-t = long-term mean monthly and January to September rainfall (millimetres (mm)).

Total rainfall recorded at Morawa over the three months before the survey (July, August and September 2018) was 46.0 mm more than the long-term mean total for those three months (148.4 mm compared with long-term mean of 102.4 mm). Total rainfall recorded over the six months before the survey (April to September) was above average (226.4 mm compared with the long-term mean total of 195.3 mm).

BoM's Western Australian rainfall deciles maps for 1 July to 30 September and 1 April to 30 September 2018 (**Figure 2.1**) show that the Survey Area lies in an area that received above average rainfall over the three months and average rainfall over the six months (BoM, 2018b).

Based on these data the condition of the vegetation could have been in average to above average condition in late September early October 2018.

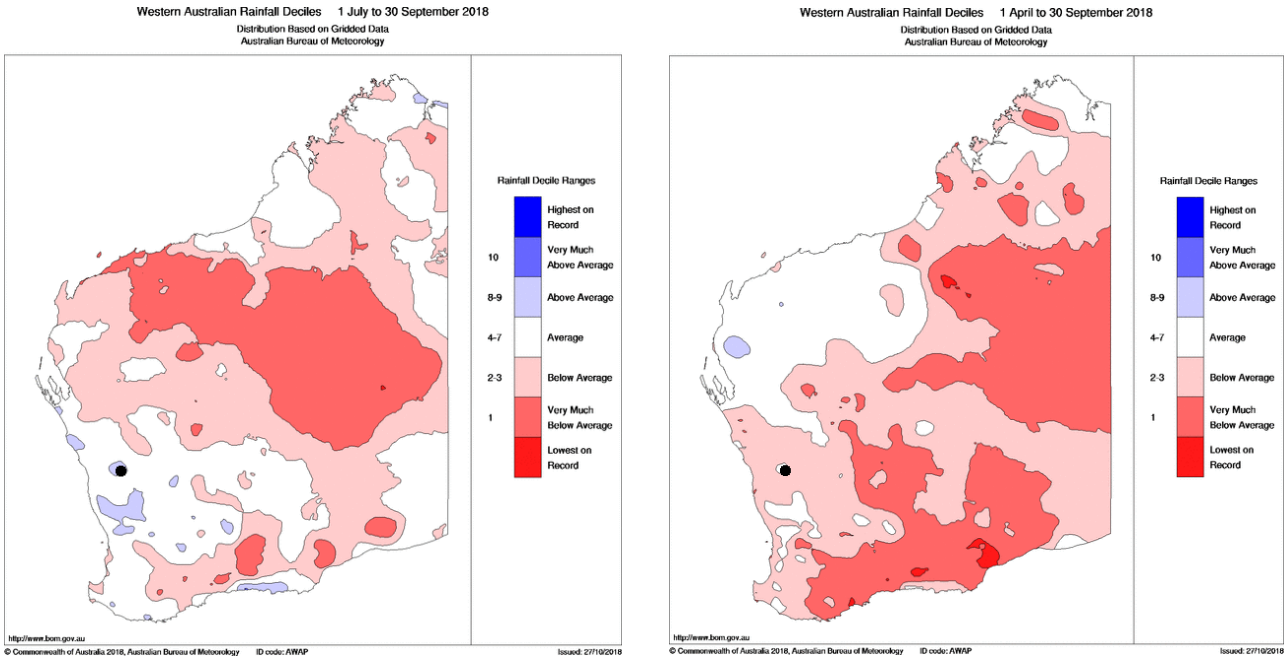

Figure 2.1: Western Australian rainfall deciles, 1 July to 30 September 2018 (left) and 1 April to 30 September (right) (BoM, 2018b) (Survey Area added to both maps by Maia – black dot)

2.2 Bioregion, Geology, Soil, Vegetation and Protected and Significant Areas

Information on the bioregion, sub-region, geology, soil landscape units and systems, pre-European vegetation associations, land systems, protected and significant areas (environmentally sensitive areas (ESA), conservation estate, Schedule 1 areas, Department of Biodiversity, Conservation and Attractions (DBCA) Lands of Interest, DBCA Legislated Lands and Waters, Environmental Protection Authority (EPA) Red Book areas and significant water bodies rivers and drainage lines), potential groundwater dependent ecosystems (GDE) and any other significant ecosystems is summarised in **Table 2.2**.

Table 2.2: Background Information

Background information on the Survey Area	
Bioregion and subregion (**Map 10.2A, Section 10**)	The Survey Area is in the Interim Biogeographic Regionalisaion for Australia (IBRA) Avon Wheatbelt bioregion (AVW) and Merredin subregion (AVW01) (Department of the Environment and Energy (DotEE), 2012).
Geology (**Map 10.2B, Section 10**)	The surface geology of the Survey Area is mapped as one unit (Stewart *et al.*, 2008): • **Asy**: Conglomerate, chert, small amounts felsic volcaniclastic rocks, sandstone, quartzite, siltstone, phyllite, schist, pelite, shale. Include former Hatfield Formation.
Soil landscape units	The Survey Area lies in the Murchison Province of the Western Region (Tille, 2006). The Murchison Province is described as hardpan wash plains and sandplains (with some stony plains, hills, mesas and salt lakes) on the granitic rocks and greenstone of the Yilgarn Craton. The Murchison Province is divided into seven soil-landscape zones and the Survey Area lies within the Karara Hills, Plains and Lakes zone (270), which is located in the south-western Murchison between Morawa, Paynes Find and Yalgoo. The Karara Hills, Plains and Lakes zone is described as 'Hills and ranges, sandy plains, hardpan wash plains, stony plains and salt lakes (with some mesas and plains) on greenstone and granitic rocks of the Yilgarn Craton. Red shallow sands, Stony soils and Red shallow sandy duplexes. Bowgada-mulga-jam woodlands (with some halophytic shrublands and York gum-salmon gum woodlands)' (Tille, 2006).
Soil landscape systems (**Map 10.2C, Section 10)**	The Survey Area lies over two soil landscape sub-systems (Department of Agriculture and Food Western Australia (DAFWA), 2014): • 270Ko_1, Koolanooka 1 Subsystem: Crests and slopes of steep low hills; rock and rocky soils with sandy loam matrix with loamy earths and duplexes on lower slopes. • 270Ps_4, Pindar South Subsystem 4: Gently undulating sandplain; red and yellow deep sands with sandy and loamy earths.
Pre-European vegetation associations and system associations (**Map 10.2D, Section 10**)	One of Beard's vegetation associations (VA) and vegetation system associations (VSA) occurs in the Survey Area (Department of Primary Industries and Regional Development (DPIRD), 2018a): • VA 693, VSA 693.1 – Mosaic: Low woodland: *Allocasuarina huegeliana* over mallee and acacia scrub / *Allocasuarina campestris* thicket. The pre-European and current extent of the VA and VSA in the Avon Wheatbelt bioregion and the Merredin subregion and the amount in reserves are listed in **Table 2.3** along with the prioritisation for reservation of the VA in the Avon Wheatbelt Merredin subregion. VA 693 and VSA 693.1 only occur in the Merredin subregion of the Avon Wheatbelt bioregion.

Background information on the Survey Area	
Protected and significant areas (**Map 10.3, Section 10**)	**Environmentally Sensitive Area (ESA)**: the Survey Area is in an ESA – the Koolanooka System TEC (Department of Water and Environmental Regulation (DWER), 2018a). **DBCA Lands of Interest**: no lands managed by DBCA occur in or close to the Survey Area (Department of Biodiversity, Conservation and Attractions (DBCA) 2018a) **DBCA Legislated Lands and Waters**: no legislated land or water occurs in the Survey Area. The closest is a Timber Reserve approximately 8 km northeast of the Survey Area at its closest, followed by Bowgada Nature Reserve, approximately 9 km to the east (DBCA, 2018b). **Schedule 1 Areas**: the Survey Area is in a Schedule 1 area (DWER, 2018b). **Environmental Protection Authority (EPA) Redbook areas**: no EPA Redbook areas occur within or close to the Survey Area (DBCA; 2018c).
Significant water bodies, rivers and drainage lines (**Map 10.3, Section 10**)	No Ramsar wetland (DBCA, 2018d) or wetland on the Directory of Important Wetlands (DBCA, 2018e) occurs in or close to the Survey Area. No watercourse areas, lakes, pools, waterholes and springs occur within or close to the Survey Area (Geoscience Australia, 2006). None of the Wild Rivers of WA occur in or close to the Survey Area (DWER, 2018c).
Other ecosystems at risk	No ecosystems at risk occur within the vicinity of the Survey Area (Beecham, 2001).
Terrestrial groundwater dependent ecosystems (GDE) (**Map 10.4, Section 10**)	A national GDE assessment has been carried out and the Survey Area is mapped as having low potential to be a GDE (BoM, 2018c).

Table 2.3: Beard's Pre-European Vegetation Association and System Association

Vegetation association and system association	Pre-European extent (ha)	Current extent (ha)	Remaining (%)	Current Extent Protected (IUCN 1-4) for Conservation (proportion of pre-European extent) (%)	Prioritisation for reservation of ecosystem in the AVW01 subregion (Beecham, 2001)
Avon Wheatbelt bioregion					
693	4,396.22	3,157.85	71.83	0	-
693.1	4,218.99	3,076.87	72.93	0	-
Merredin subregion					
693	4,396.22	3,157.85	71.83	0	High
693.1	4,218.99	3,076.87	72.93	0	Not assessed at VSA level

Source: Government of Western Australia (GoWA, 2018a), unless noted otherwise. AVW = Avon Wheatbelt bioregion, AVW01 = Avon Wheatbelt 01 subregion (currently Merredin subregion). IUCN = International Union for Conservation of Nature.

2.3 Desktop Assessment - Methods and Results

2.3.1 Methods

Information on the flora species and ecological communities occurring in the database search area (DSA) and Survey Area was gathered from the sources listed in **Table 2.4**. The literature used to gather additional information is also listed in **Table 2.4**. The DSA is shown on **Map 10.5 (Section 10)**.

Table 2.4: Databases Searched and Reports Used

Database / literature	Reference or reference number	Size
Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) Protected Matters Search Tool (PMST)	DotEE (2018a)	14 km x 20 km
Department of Parks and Wildlife's (DPaW) NatureMap	DPaW (2007-)	
DBCA's Threatened and Priority Flora database (TPFL)	DBCA reference #27-0918FL	
DBCA 's Threatened and Priority Flora List (TP List)		
The Western Australian Herbarium (WAHerb) – for threatened and priority flora species opportunistically collected in the area of interest		
DBCA's Threatened Ecological Communities database	DBCA reference #27-0918EC	
Corner co-ordinates of rectangular area: north-west 29^0 10' 44" S and 116^0 10' 38" E, north-east 29^0 10' 44" S and 116^0 23' 2" E, south-east 29^0 18' 24" S and 116^0 23' 3" E, south-west 29^0 18' 24" S and 116^0 10' 38" E (Geocentric Datum of Australia, 1994 (GDA94)). The EPBC PMST and NatureMap search results are included as **Figures A1.1 and A1.2 (Appendix 1)**.		
Koolanooka Hills section (survey type)	**Reference**	
Koolanooka and Perenjori Hills (detailed flora and vegetation)	Meissner and Caruso (2008)	
Koolanooka north (detailed flora and vegetation)	Ecologia (2008a)	
Koolanooka north and south (targeted flora survey (TFS))	Ecologia (2008b)	
Koolanooka south (TFS)	Borger (2009)	
Koolanooka north and south (TFS)	Maia (2011a)	
Koolanooka south (TFS)	Maia (2011b)	
Koolanooka north and south (TFS)	Maia (2011c)	
Koolanooka north (TFS)	Maia (2014)	
Koolanooka south (flora and vegetation) (Westralian Iron). Note: Ecologia carried out a flora and vegetation survey over Westralian Iron's Koolanooka South project area; however, the report is not publicly available. A native vegetation clearing permit decision report for the project area is available and it has been used to gather some information on the area surveyed by Ecologia.	Department of Mines and Petroleum (DMP) (2017)	

Other surveys have been carried out close to the DSA (InSight Ecology and Borger and McCaw (2015) and Mattiske (2014)), however, the project areas are outside the DSA and therefore have not been used in this desktop assessment.

2.3.2 Results

2.3.2.1 Conservation Significant Flora

2.3.2.1.1 Threatened Flora

The database search results for conservation significant flora (CSF) species are listed in **Table A1.1, Appendix 1**.

Commonwealth Environment Protection and Biodiversity Conservation Act 1999

Some flora species are protected by the Commonwealth EPBC Act based on the perceived levels of threat to the species population at a national level. These species are placed within one of six conservation categories **(Table A2.1, Appendix 2)** and four of these categories are specially protected under the EPBC Act (DotEE, 2018b).

- The collated results of the EPBC Act PMST (DotEE, 2018a), NatureMap (DPaW, 2007-) and DBCA database searches produced a list of 11 EPBC Act listed threatened flora species for which the species or species habitat either may occur in the DSA, is likely to occur in the DSA or has been recorded in the DSA (**Table A1.1, Appendix 1**).
- One of the 11 Threatened Flora (*Tecticornia bulbosa*) has one record within the DSA (**Map 10.6, Section 10**). The record is approximately 3.9 km north-west of the Survey Area. The description on FloraBase for the area where the specimen was collected is 'approximately 4 km west of the mine on the northern end of Koolanooka Hills' and the site is described as 'saline clay on loamy clay'. The *Tecticornia bulbosa* record within the DSA is approximately 5.8 km south south-east of the mine at Koolanooka, in the middle section of the Koolanooka Hills, in an area of low eucalypt woodland and not in a saline/loamy clay area. This record appears to be in the wrong location and it should probably be closer to the others in the saline wetland areas to the north-west of the current record's location.
- Given the vegetation and habitat of the Survey Area it is highly unlikely that this species will occur in the Survey Area.

Biodiversity Conservation Act 2016

In December 2016 selected parts of the new *Biodiversity Conservation Act 2016* (BC Act; to replace the *Wildlife Conservation Act 1950* (WC Act) and the *Sandalwood Act 1929*) came in to effect; however, the whole act will not come in to effect until the Biodiversity Conservation Regulations associated with the act have been made. The sections of the BC Act relating to threatened species and ecological communities will come into effect once the new regulations have been made (DBCA, 2018f). This is expected to be in early 2019.

Western Australian Wildlife Conservation Act 1950

Under the State's current WC Act all flora species native to WA are protected. Under the WC Act native plants (flora) can be specially protected and listed as 'threatened' if they are: under identifiable threat of extinction, rare, otherwise in need of special protection. Threatened species are listed under Schedules 1, 2, 3 and 4 of the Wildlife Conservation (Rare Flora) Notice (DPaW, 2017 and defined in **Table A2.3, Appendix 2**). The most recent Rare Flora Notice was published on January 16, 2018 (GoWA, 2018b).

- One hundred and fifty threatened flora species are currently listed on FloraBase for the Avon Wheatbelt bioregion (WAH, 1998-).
- The EPBC Act PMST (DotEE, 2018a), NatureMap (DPaW, 2007-) and DBCA database searches produced a list of 11 threatened species protected by the WC Act that could occur or have been recorded in the DSA.

Only *Tecticornia bulbosa* has a record within the DSA (**Map 10.6, Section 10**). See the text above for discussion of this species and its likelihood of occurrence in the Survey Area.

2.3.2.1.2 Priority Flora

Possibly threatened species that do not meet survey criteria, or are otherwise data deficient, are added to the Priority Flora List under Priorities (P) 1, 2 or 3. These three categories are ranked in order of priority for survey and evaluation of conservation status so that consideration can be given to their declaration as threatened flora. Species that are adequately known, are rare but not threatened, or meet criteria for near threatened, or that have been recently removed from the threatened species lists for other than taxonomic reasons, are placed in Priority 4. These species require regular monitoring (DPaW, 2017 and defined in **Table A2.4**, **Appendix 2**). The most recent Priority Flora List was published on January 16, 2018 (Smith & Jones, 2018).

- FloraBase (WAH, 1998-) lists 842 priority flora species for the Avon Wheatbelt bioregion and 571 for the Merredin subregion.
- The database and literature search results produced a list of 19 priority flora species with records in the DSA (**Table A1.1, Appendix 1**).
    - DBCA's TPFL and WAHERB database searches produced a collated list of 17 priority flora species with records in the DSA: *Acacia graciliformis*, *A. muriculata*, *Caesia* sp. Koolanooka Hills (R. Meissner & Y. Caruso 78), *Dodonaea scurra*, *Drummondita rubroviridis*, *Hemigenia* sp. major (C.A. Gardner 2677), *Lepidosperma* sp. Koolanooka (K.R. Newbey 9336), *Millotia dimorpha*, *Sclerolaena* sp. Koolanooka Hills (R. Meissner & Y. Caruso 437) (all P1), *Baeckea* sp. Perenjori (J.W. Green 1516) (P2), *Austrostipa blackii*, *Enekbatus longistylus*, *Melaleuca barlowii*, *Mirbelia ferricola*, *Persoonia pentasticha, Rhodanthe collina* and *Stenanthemum poicilum* (all P3). Their locations are shown (by conservation rank) on **Map 10.6, (Section 10)**.
    - None of DBCA's records fall within the Survey Area (**Map 10.6**, **Section 10**).
    - Two other species have been located within the DSA but were not in DBCA's database search results: *Aluta aspera* subsp. *localis* (P2) and *Gunniopsis rubra* (P3), both species were listed in the NatureMap search results for the DSA.
    - Five priority flora species have been located previously by Maia within the Survey Area (**Map 10.7, Section 10**): *Acacia graciliformis*, *Dodonaea scurra*, *Drummondita rubroviridis*, *Lepidosperma* sp. Koolanooka (K.R. Newbey 9336) (all P1) and *Baeckea* sp. Perenjori (J.W. Green 1516) (P2) (Maia 2011a, 2011b).
    - Six more priority flora species have been located previously by Maia outside the Survey Area but within the DSA: *Acacia muriculata* and *Millotia dimorpha* (both P1), and *Melaleuca barlowii, Mirbelia ferricola, Persoonia pentasticha* and *Stenanthemum poicilum* (P3) (Maia 2011a, 2011b, 2011c and 2014).

2.3.2.2 Weeds

2.3.2.2.1 Weeds of National Interest

A number of lists of weeds of national interest are currently recognised. The nature of the weeds and the resulting actions required for their control determine on which list a weed species may appear. Some weed species are of particular concern and, as a result, have been listed for priority management or in legislation. The weed lists are available on the Australian Government's website (Australian Government, 2018). These lists are: Weeds of National Significance (WoNS), National Environmental Alert, Sleeper Weeds, Six Species Targeted for

National Eradication and Species Targeted for Biological Control. The weed species list collated from the search results (**Table A1.2, Appendix 1**) was compared with these lists and one of the weed species is on one of the national lists.

- The EPBC Act PMST search results listed *Chrysanthemoides monilifera* as a species or species habitat that may occur in the DSA (DotEE, 2018a; **Figure A1.1, Appendix 1**). This species is a WoNS but it has not been located in the area previously, the closest record is in Albany (DPaW, 2007-).

2.3.2.2.2 Plant Pests Declared in Western Australia

To protect WA agriculture DPIRD regulates harmful plants under the *Biosecurity and Agriculture Management Act 2007* (BAM Act). The Western Australian Organism List (WAOL) provides the status of organisms which have been categorised under the BAM Act (DPIRD, 2018b). Under the Biosecurity and Agriculture Management Regulations 2013 declared pests can be assigned to one of three control categories and these are explained in **Table A3.1, Appendix 3**. The weed species list collated from the search results (**Table A1.2, Appendix 1**) was checked on WAOL and one of the weed species is a declared pest plant (DPP) in WA.

- The EPBC Act PMST search results listed *Tamarix aphylla* as a species or species habitat likely to occur within the DSA (DotEE, 2018a) (**Figure A1.1, Appendix 1**). *Tamarix aphylla* is a DPP for the whole of WA DPIRD, 2018b). This species is a DPP but it has not been located in the area previously, the closest record is in Geraldton (DPaW, 2007-).

2.3.2.2.3 General Weeds

A list of 48 general weed species (excluding WoNS and DPP) was collated from the results of the EPBC Act PMST search (DotEE, 2018a), NatureMap search (DPaW, 2007-) and from the results of surveys carried out within the DSA (**Table A1.2, Appendix 1**).

The DBCA prioritises weeds in each region based on their invasiveness, ecological impact, potential and current distribution and feasibility of control. The resulting priorities focus on weeds considered to be high impact, rapidly invasive and still at a population size that can feasibly be eradicated or contained to a manageable size (DBCA, 2018g).

Summaries of the species' ecological impact and invasiveness rankings are provided to help landholders, community groups and private enterprises manage weeds that might impact on the natural environment (DBCA, 2018g). Most recent species-led ecological impact and invasiveness ranking summary results are available for the different government regions in WA.

The Midwest region species prioritisation process 2014 impact and invasiveness ratings spread-sheet lists 324 weed species for which the impact and invasiveness have been ranked and a further seven weed species that have been listed as priority alert species (DPaW, 2014).

The ecological impact and invasiveness rankings for the 48 general weed species identified from the database and literature searches are listed in **Table A1.2 (Appendix 1)**. Twelve of the 48 general weed species listed have high ecological impact and rapid invasiveness ratings – *Aira caryophyllea*, *Arctotheca calendula*, *Avena fatua*, *Brassica tournefortii*, *Cenchrus ciliaris*, *Limonium lobatum, Mesembryanthemum crystallinum, M. nodiflorum*, *Raphanus raphanistrum*, *Rumex vesicarius*, *Urospermum picroides* and *Ursinia anthemoides*.

2.3.2.3 Conservation Significant Ecological Communities

Some ecological communities are protected by Commonwealth and State legislation (threatened ecological communities; TECs), while others are listed as priority ecological communities (PECs) while their significance is being assessed prior to being listed as a TEC. The conservation significance rankings for TECs and PECs are detailed in **Table A2.2**, **A2.5** and **Table A2.6** (**Appendix 2**).

2.3.2.3.1 Threatened Ecological Communities

EPBC Act Listed Ecological Communities

Some ecological communities are protected by Australian Government legislation (the EPBC Act) based on the perceived levels of threat to the community or species population at a national level. They are listed as TECs and can be classified as Critically Endangered, Endangered or Vulnerable (DotEE, 2018c). The communities are listed by state on the DotEE website (DotEE, 2018d).

- One TEC listed under the EPBC Act occurs in the DSA – Eucalypt Woodlands of the Western Australian Wheatbelt (EPBC Act PMST search (DotEE, 2018a), DBCA ecological community database search (reference 27-0918EC) and NatureMap (DPaW, 2007-)). This ecological community is listed as a Critically Endangered TEC nationally and as a Priority 3 PEC in WA (**Map 10.8, Section 10**).
- This TEC is not shown as occurring in the Survey Area.

Western Australian Ecological Communities

Some TECs are informally listed as significant in WA. The WA Minister for Environment; Disability Services may list an ecological community as being threatened through a non-statutory process if the community is presumed to be, or is at risk of becoming, totally destroyed. The BC Act will provide for the statutory listing of TECs by the Minister when the relevant Parts of the Act are proclaimed following the preparation of enabling Regulations. The new legislation also describes statutory processes for preparing recovery plans for TECs, the registration of their critical habitat and penalties for unauthorised modification of TECs. TECs are listed as presumed totally destroyed, critically endangered, endangered or vulnerable in WA (DBCA, 2018h).

The most recent WA TEC list is correct to June 28, 2018 (DBCA, 2018i) and includes 12 TECs listed for the Avon Wheatbelt bioregion.

- One TEC listed in WA occurs in the DSA and the Survey Area – Plant assemblages of the Koolanooka System (banded ironstone formation) - and it is listed as Vulnerable (DBCA ecological community database search (reference 27-0918EC)) (**Map 10.8, Section 10**).

2.3.2.3.2 Priority Ecological Communities

Ecological communities with insufficient information available to be considered a TEC, or which are rare but not currently threatened, are placed on a priority list and are referred to as PECs and listed as Priority 1 to 5 (Department of Environment and Conservation (DEC), 2013).

The most recent PEC list is dated June 30, 2017 (DBCA, 2017) and lists 23 PECs for the Wheatbelt.

- One PEC is mapped as occurring within the DSA - Eucalypt Woodlands of the Western Australian Wheatbelt – but none of the polygons indicating the potential distribution of this PEC are in the Survey Area (DBCA ecological community database search (reference 27-0918EC)) (**Map 10.8, Section 10**).

3 METHODS – SURVEY, TAXONOMY AND VEGETATION MAPPING

3.1 FIELD SURVEY

The survey methodology was developed to comply with the following:

- Technical Guide – Flora and Vegetation Surveys for Environmental Impact Assessment (EPA, 2016).

The survey was carried out over the Survey Area by three botanists between September 26 and October 2, 2018 and six field survey days were spent in the Survey Area.

Before undertaking the survey the botanists familiarised themselves with the CSF species produced by the database and literature searches.

In order to map the vegetation of the Survey Area the botanists assessed the flora and vegetation at 12, 20 m x 20 m quadrats. Quadrat locations were chosen before the survey using aerial imagery and Survey Area boundaries. Quadrats were placed to capture each habitat visible on the aerial imagery and the pre-European vegetation and land systems mapped in the Survey Area. The final location for the quadrats was selected by the botanists while carrying out the survey. The following parameters were recorded at each relevé site:

- Location details including Global Positioning System (GPS) co-ordinates (GDA94) for each corner of the quadrat.
- Site parameters such as soil description, topography and general habitat description, rock type and cover.
- A photograph of the site.
- Vegetation condition using the scale and criteria in EPA, 2016.
- Notes on any disturbance to the vegetation.
- Fire history.
- A description of the vegetation structure including the height, percentage cover and dominant species within each stratum.
- The name, height, percentage cover and any other significant recording details for any other species located at the relevé.

The botanists also walked traverses along the length of the two polygons of the Survey Area. Approximately 15 m of vegetation was assessed by each botanist while walking traverses. While walking, the botanists recorded the locations of any unknown species, suspected CSF or weed species encountered. Counts for these species were also recorded.

3.2 TAXONOMY AND NOMENCLATURE

Two hundred and eighty (280) plant specimens were collected by the botanists from the Survey Area. They were identified by Conrad Slee using taxonomic keys and reference specimens at the WA Herbarium. Specialists at the WA Herbarium were consulted as necessary.

Species names used in this report are those adopted by the WA Herbarium and they have been checked against current FloraBase records (WAH, 1998-). Undescribed taxa are referred to in the report and listed in the species list as “sp.” (species), subspecies as subsp. and varieties as var..

3.3 Vegetation Mapping

Bing aerial photography (Microsoft Corporation, 2018) was used to map the vegetation types ranging in scale from 1:500 to 1:5,000. Vegetation types were described according to the dominant species in each structural class. Data collected at quadrats and photo points were used to delineate the boundaries of each type.

Vegetation types are described using the current National Vegetation Inventory System (NVIS) methodology at the association level (Level 5). At this level up to three strata and a maximum of three taxa per stratum are used to describe an association (Executive Steering Committee for Australian Vegetation Information (ESCAVI), 2003). The NVIS structural formation terminology is outlined in **Appendix 4**; it utilises growth forms (**Table A4.1, Appendix 4**), height classes (**Table A4.2, Appendix 4**) and foliage cover characteristics (**Table A4.3, Appendix 4**).

3.4 Vegetation Condition

Vegetation condition was mapped using data collected at quadrats, notes recorded while carrying out the survey and disturbed areas visible on the aerial photograph. Field assessments of vegetation condition at each quadrat was updated as necessary once the plant identifications had been confirmed and the invasiveness of any weed species located had been determined. Aggressive weed species are considered to be those rated as having a rapid invasiveness and a high environmental impact rating. Vegetation condition ratings are based on the scale developed by Trudgen (1988) and modified and adapted by Keighery (1994). The vegetation condition scale used is that for the South West and Interzone Botanical Provinces indicated in EPA, 2016 (**Table 3.1**).

Table 3.1: Vegetation Condition Scale (EPA, 2016)

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

4 RESULTS - SURVEY

4.1 COVERAGE ACHIEVED OVER SURVEY AREA

Twelve quadrats were assessed and approximately 21 km of traverses were walked over the Survey Area (**Map 10.9, Section 10**). Between the quadrats (0.48 ha) and traverses (20.7 km x 15 m = 31.05 ha) approximately 31.5 ha (83.8%) of the 37.6 ha Survey Area was assessed. The following sections present the results of the survey and the information collected at each quadrat is included as **Table A5.1, Appendix 5**.

4.2 FLORA

4.2.1 General Flora

The following information was collected on the general flora of the Survey Area:

- One hundred and thirty-seven taxa were recorded from 91 genera and 47 families (63.5% perennial, 36.5% annual).
- The most common families were Asteraceae (21), Fabaceae (20) and Myrtaceae (14).
- The most common genera were *Acacia* (11), *Melaleuca* (6) and *Eucalyptus* (5).
- At the time of the survey 27.7% of the 140 taxa were flowering, 21.4% were fruiting and 37.9% were both flowering and fruiting i.e. approximately 87.1% of the species list was identified from specimens collected with reproductive material.
- The identity of four taxa could not be confirmed due to a lack of flowering or fruiting material – *Goodenia* sp., *Eucalyptus* ?*ebbanoensis*, *Eucalyptus* ?*loxophleba*, *Eucalyptus* ?*subangusta*. While all of these species are listed in the species list, *Eucalyptus* ?*ebbanoensis* and *Eucalyptus* ?*subangusta* have not been included in the counts as they are likely to be one of the taxa already listed.
- *Waitzia acuminata* is listed in the species list but has not been included in the counts as it is already in the species list as a variety.

A list of the vascular flora taxa collected from the Survey Area is included as **Table A6.1, Appendix 6**.

Information from the current survey and from surveys carried out in the surrounding area is listed in **Table 4.1**.

Table 4.1: Taxa Recorded During Current and Other Surveys

Survey location	Survey type	All taxa / natives / weeds	Survey timing (season)	No. of quadrats	Area surveyed (ha)	Report
Survey Area	Reconn. and TFS	137 / 123 / 14	September / October 2018 (spring)	12	31.5 ha	This report
Koolanooka and Perenjori Hills	Level 2 / detailed	237 / 214 / 23	October 2005 (spring)	50	2	Meissner & Caruso, 2008
Koolanooka Hills	Level 2 / detailed	45 / 43 / 2	July & September 2006 (winter, spring)	2	4.50	Ecologia, 2008a
Koolanooka Hills	TFS	72 / 72 / 0	November	None	2.28	Ecologia,

Survey location	Survey type	All taxa / natives / weeds	Survey timing (season)	No. of quadrats	Area surveyed (ha)	Report
			2007 (spring)			2008b
Koolanooka	TFS	103 / 103 / 0	June 2011 (winter)	None	Not in report	Maia, 2011a
Koolanooka Hills	TFS	49 / 49 / 0	June 2011 (winter)	None	Not in report	Maia, 2011b
Koolanooka Hills	TFS	103 / 79 / 24	September and October, 2011 (spring)	None	74.8	Maia, 2011c
Koolanooka Hills	TFS	117 / 103 / 14	July 2014 (winter)	None	8.82	Maia, 2014

Note: Reconn. = reconnaissance survey, TFS = targeted flora survey.

4.2.2 Conservation Significant Flora

4.2.2.1 THREATENED FLORA

Flora species specially protected by the EPBC Act or the WC Act are listed as threatened (T) species. Categories and definitions for threatened flora species are provided in **Tables A2.1 and A2.3 of Appendix 2.**

- No species protected by the EPBC Act were recorded in the Survey Area.
- No species protected by the WC Act were recorded in the Survey Area.

4.2.2.2 PRIORITY FLORA

Eleven confirmed priority flora species were recorded in the Survey Area: *Acacia graciliformis*, *Acacia muriculata*, *Dodonaea scurra*, *Drummondita rubroviridis*, *Lepidosperma* sp. Koolanooka (K.R. Newbey 9336), *Millotia dimorpha* (all P1), *Baeckea* sp. Perenjori (J.W. Green 1516) (P2), *Melaleuca barlowii*, *Mirbelia ferricola*, *Persoonia pentasticha* and *Stenanthemum poicilum* (all P3).

These species are described and shown in **Table 4.3** and their locations are shown on **Map 10.10, Section 10**. The locations have been supplied to SMC electronically but their coordinates are not included in this report.

The number of plants of each CSF species collated from the information presented in this report (FloraBase, DBCA databases, Maia, other relevant reports and from other Maia records) are presented in **Table 4.4**. As the areas proposed to be cleared for tracks and drill pads are not yet known an estimate is included in **Table 4.4** of the percentage impact to each species if the whole of the Survey Area were to be cleared. The highest impact estimated would be to *Drummondita rubroviridis* as 93.0% of the plants included in the analysis would be impacted. The second and third highest would be to *Acacia graciliformis* (54.2%) and *Millotia dimorpha* (49.7%). However, as these numbers have mostly been derived from targeted flora surveys and not from census surveys where more time is spent gathering plant number information as a grid system is usually employed, these numbers are estimates of the actual numbers and impacts.

Map 10.11 (Section 10) shows Maia's 2011 and 2018 combined CSF records.

Maps 10.12 to 10.15 (Section 10) show the Survey Area as a series of 20 m x 20 m cells and the CSF in each cell are represented in a different way on each map.

The maps show the cells coloured to represent a score relating to:

- The total number of plants of all CSF recorded in a cell (**Map 10.12**);
- The total number of CSF species recorded in a cell (**Map 10.13**);
- Cells where at least one P1 species occurs in it (**Map 10.14**); and,
- Cells coloured to show an overall score, which is the sum of the codes used for the total number of CSF plants and the total number of CSF species (**Map 10.15**).

Many cells are coloured white indicating that no CSF plants or species were recorded in them. However, the Survey Area was not grid searched and 13% of the Survey Area was not assessed, and some of the white cells in the areas not searched could have CSF in them.

Map 10.12 illustrates the total number of plants of any/all CSF recorded within each 20 m x 20 m cell. The score starts from 0 indicated by white cells (where no CSF plants were recorded), and then progresses from a score of 1 indicated by blue cells, where between 1 and 10 plants were located, to a score of 6 indicated by red cells, where more than 1,000 plants were recorded. The dominant classification for CSF plant number in the Survey Area is score 0 (no CSF) followed by score 1 (1 to 10 plants). The high scoring cells in the centre of the southern polygon are where *Millotia dimorpha* was recorded. *M. dimorpha* is a very small annual herb that occurs in very high numbers.

Map 10.13 shows the total number of species recorded in each cell. Scoring starts at 0 indicated by white cells (where no CSF species were recorded), and then progresses from a score of 1, indicated by blue cells, where 1 CSF species was located, to a score of 6, indicated by red cells, where the maximum of 6 CSF species were recorded. Most of the cells are white (no CSF species), followed by blue (1 CSF species). Only two cells have the highest score (as they had six CSF species in them) and both cells are in the southern polygon.

Map 10.14 shows the cells where P1 flora species were recorded (red cells). Fewer P1 flora species were recorded in the south-eastern section of both polygons than in the north-western section.

Map 10.15 colours the cells using the sum of the scores for total number of plants and total number of species in each cell. Highest scores occur in the cells in the north-western section of each polygon. The high scoring area in the centre of the southern polygon reflects the high numbers of the herb *Millotia dimorpha* found in that area.

These maps illustrate areas of higher and lower flora conservation significance in the Survey Area (although, as mentioned above, white cells indicate areas where either no CSF species were located in the cell or that the cell was not surveyed).

4.2.2.3 TAXA OF INTEREST

Two taxa of interest were recorded during the survey –*Labichea* sp. Koolanooka and *Beyeria* aff. *minor* (1 and 61 plants respectively).

The *Labichea* specimen has been temporarily named *Labichea* sp. Koolanooka. The taxonomist cross referenced the specimen collected by Maia with all of the *Labichea* specimens at the WA Herbarium Research Collection (PERTH) and only one similar specimen was found (reference number PERTH 06475795). This specimen is also from the Koolanooka Hills and was collected by Meissner & Caruso (2008) and has been labelled as *Labichea lanceolata* subsp. *brevifolia*. *Labichea lanceolata* subsp. *brevifolia* has much larger and broader leaves/leaflets than the specimen collected by Maia (pers. comm. Conrad Slee 6/11/2018). Maia's *Labichea* sp. Koolanooka specimen has narrow, linear folded leaves between 15 – 20 mm long and approximately 1 mm wide, with a mucro (pointed tip). The other specimens of *Labichea lanceolata* subsp. *brevifolia* have much larger leaves approximately 30 mm long and 5 mm wide) are narrowly oval / elliptic in shape, with a large mucro at the tip. One specimen of *Labichea lanceolata* subsp. *brevifolia* from Mount Gibson (PERTH 02218674) has smaller leaves,

approaching the small size of those from Koolanooka. The specimen collected from the Survey Area has been submitted to the WA Herbarium for identification.

The *Beyeria* specimens were sent to the WA Herbarium for identification and were identified as *Beyeria* aff. *minor* i.e. the specimens are similar to *Beyeria minor* but are not exactly the same. *Beyeria* aff. *minor* has been collected from the southern end of the Koolanooka Hills within the last year or so and it will probably need to be recognised as a distinct taxon (pers. comm. Michael Hislop, WA Herbarium, 29 November, 2018).

4.2.3 Regional Endemics

Regional endemics are plants that are geographically restricted to a particular locality or region. Three of the species recorded in the Survey Area are endemic to the Koolanooka Hills – *Acacia graciliformis*, *Acacia muriculata* and *Drummondita rubroviridis* - and *Lepidosperma* sp. Koolanooka (K.R. Newbey 9336) is endemic to the Koolanooka and Perenjori Hills. Two of the species recorded were listed as endemic to the database search area in the NatureMap search results – *Acacia muriculata* and *Drummondita rubroviridis* (both P1) (DPaW, 2007-; **Figure A1.2, Appendix 1**).

4.2.4 Range Extensions

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

Using 100 km as the minimum distance from an existing record to define a range extension, two range extension species were collected from the Survey Area (**Table 4.2**).

Table 4.2: Range Extension Species Located in the Survey Area

Specie	Closest WAH (1998 -) record from Survey Area	Distance and direction from Survey Area
**Hordeum hystrix*	East of Geraldton (Geraldton Sandplains bioregion)	120 km north-west
Levenhookia stipitata	Warradarge (Lesueur Sandplains bioregion)	125 km north-east

Note: * indicates a weed species.

4.2.5 Sandalwood

Western Australian sandalwood (*Santalum spicatum*) is a slow-growing, long-lived small woody tree or shrub that occurs naturally throughout the southern part of WA and into South Australia. It is valuable and highly sought-after for the oils contained in the heartwood. Western Australian sandalwood is now unique as the world's largest and only remaining wild resource. It occurs over the southern two thirds of WA and in South Australia. The species originally occurred throughout the Wheatbelt but has been reduced to smaller fragmented populations by clearing for agriculture (DPaW, 2015).

- No sandalwood was located in the Survey Area.

Table 4.3: Conservation Significant Flora Species Located in the Survey Area

Species (rank) – family Description and location	Photographs	
Acacia graciliformis **(P1) – Fabaceae** *A. graciliformis* is an openly branched shrub growing to 2 m in height. It occurs on hillslopes and rocky outcrops of laterite, basalt and banded ironstone. The terete phyllodes are wide-spreading and shallowly recurved and have a pungent tip (Maslin & Buscumb, 2007). *A. graciliformis* produces yellow flowers during September. The fruit pods have a texture similar to paper and are sometimes coiled (Maslin & Buscumb, 2007). *A. graciliformis* was located on flats and hill slopes in the Survey Area and was flowering and fruiting in September 2018. Nine hundred and thirty-seven (937) plants were located in the Survey Area and eight samples were collected for confirmation by the taxonomist.		
Acacia muriculata **(P1) – Fabaceae** *A. muriculata* is an intricately branched shrub growing to 2 m on hillslopes and crests of laterite and banded ironstone. It has red raised ribs on the branchlets and the leaves are sickle-shaped and recurved away from the branch. The leaves have yellowish margins and a raised midrib (Maslin & Buscumb, 2007). *A. muriculata* produces yellow flowers during October and the fruit pods are thickly textured and coiled (WAH, 1998-). *A. muriculata* was located on flats and hill slopes in the Survey Area and was flowering in September 2018. Eight hundred and seventy-two (872) plants were located in the Survey Area and four samples were collected for confirmation by the taxonomist.		

Species (rank) – family Description and location	Photographs	
Dodonaea scurra **(P1) – Sapindaceae** *D. scurra* is a dioecious shrub growing to 1 m on hillslopes, crests and rocky outcrops of gravel and banded ironstone. The shrub is multi-stemmed with linear leaves. The leaves are hairy, slightly folded and the tip is slightly pungent. *D. scurra* produces red to yellow flowers from August to October (WAH, 1998-). *D. scurra* was located on hill slopes and flats in the Survey Area and was flowering and fruiting in September 2018. Seven hundred and seventy plants (770) were located in the Survey Area and two samples were collected for confirmation by the taxonomist.		
Drummondita rubroviridis **(P1) – Rhamnaceae** *D. rubroviridis* is an erect, straggly shrub growing to 1.5 m on hillslopes and crests of sandy loam over banded ironstone. The long leaves are slightly hairy and taper at the ends. *D. rubroviridis* produces red and green flowers from September to October (WAH, 1998-). *D. rubroviridis* was located on stony and loam-sand flats and hill slopes in the Survey Area and was flowering in September 2018. Eight hundred and eight (808) plants were located in the Survey Area and four samples were collected for confirmation by the taxonomist.		

Species (rank) – family Description and location	Photographs	
***Lepidosperma* sp. Koolanooka (K.R. Newbey 9336) (P1) – Cyperaceae** *L.* sp. Koolanooka is a sedge. It grows to 0.5 m on hill slopes and rocky outcrops of orange-brown soils over banded ironstone. *L.* sp. Koolanooka produces brown flowers during October (WAH, 1998-). *L. sp. Koolanooka* was located on hill slopes, outcrops and stony flats in the Survey Area and was flowering and fruiting in September 2018. Five hundred and sixty-two (562) plants were located in the Survey Area and four samples were collected for confirmation by the taxonomist.		
***Millotia dimorpha* (P1) – Asteraceae** *M. dimorpha* is a small erect or ascending annual herb growing to 0.11 m high on slopes and outcrops of lateritised banded ironstone, banded ironstone and dolerite. The yellow flowers have two rows of glandular involucral bracts (ring of modified or reduced leaves around the flower) and are produced in September (WAH, 1998-). *M. dimorpha* was located on flats, hill slopes and on outcrops in the Survey Area and was flowering and fruiting in September 2018. Approximately 5,320 plants were located in the Survey Area and two samples were collected for confirmation by the taxonomist.		

Species (rank) – family Description and location	Photographs	
***Baeckea* sp. Perenjori (J.W. Green 1516) (P2) – Myrtaceae** *B.* sp. Perenjori is a rounded shrub growing to 0.5 m and 1 m wide on gravelly lower slopes and banded ironstone. The leaves are flat and contain many oil glands and the tip of the leaf is slightly acute. The leaves are aromatic when crushed. *B.* sp. Perenjori produces pink flowers between July and August (WAH, 1998-). *B. sp. Perenjori* was located on flats and hillslopes in the Survey Area and was flowering and fruiting in September 2018. Two thousand, two hundred and fifty-five plants (2,255) were located in the Survey Area and three samples were collected for confirmation by the taxonomist.		
***Melaleuca barlowii* (P3) – Myrtaceae** *M. barlowii* is a shrub growing to 1.8 m on yellow-brown sand and red-brown clay loam. The leaves are lanceolate and incurved. *M. barlowii* produces purple flowers during September (WAH, 1998-). *M. barlowii* was located on a BIF outcrop in the Survey Area and was fruiting in September 2018. One plant was located within the Survey Area and two samples were collected for confirmation by the taxonomist (another plant was located just outside the Survey Area).		

Species (rank) – family Description and location	Photographs	
***Mirbelia ferricola* (P3) – Fabaceae** *M. ferricola* is an erect leafless shrub growing to 1.2 m on hillslopes of stony loam and clayey sand over ironstone. The branches have raised ribs. *M. ferricola* produces yellow and brown flowers during September (WAH, 1998-). *M. ferricola* was located on flats and hillslopes in the Survey Area and was flowering in September 2018. One hundred and sixty-two (162) plants were located in the Survey Area and two samples were collected for confirmation by the taxonomist.		
***Persoonia pentasticha* (P3) – Proteaceae** *P. pentasticha* is an erect, spreading shrub growing to 1.8 m on lower hillslopes and outcrops of granite, haematite or banded ironstone. The terete leaves are simple, folded and are covered with short simple curled hairs. *P. pentasticha* produces yellow flowers from August to November (WAH, 1998-). *P. pentasticha* was located on outcrops and hill slopes in the Survey Area and the plants were not flowering or fruiting in September 2018. Three plants were located in the Survey Area and one sample was collected for confirmation by the taxonomist.	 Right photograph - Photography by G. Byrne & S.J. Patrick. Image used with Permission of the Western Australian Herbarium, Department of Environment and Conservation (http://florabse.dec.wa.gov.au/help/copyright). Accessed on Wednesday, 14 November 2018.	

Species (rank) – family Description and location	Photographs	
***Stenanthemum poicilum* (P3) – Rhamnaceae** *S. poicilum* is an erect or decumbent compact shrub growing to 0.5 m on hillslopes of ironstone, laterite or banded ironstone. *S. poicilum* produces white flowers from May to June and September to November (WAH, 1998-). *S. poicilum* was located on flats and footslopes in the Survey Area and was flowering and fruiting in September 2018. One hundred and sixty-seven (167) plants were located in the Survey Area and two samples were collected for confirmation by the taxonomist.		

Note: P1, P2 and P3 = Priority 1, 2 and 3 species. Unless otherwise stated - descriptions by the Western Australian Herbarium, Department of Biodiversity, Conservation and Attractions. Text used with permission (https://florabase.dpaw.wa.gov.au/help/copyright). Accessed on Monday, 12 November 2018. Unless otherwise stated all photographs taken by Maia.

Table 4.4: CSF Recorded in the Survey Area – Estimate of Number of Plants in WA and of the Maximum Potential Impact to Each Species if the Whole of the Survey Area were to be Cleared

Column 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Species	Rank	Number of plants												No. of plants in Survey Area	Total	Est. of impact if all plants were cleared in Survey Area (%)
		FBase	DBCA TPFL	Mattiske (2014)	DMP (2017)	Ecologia (2008b)	Maia surveys					Other SMC survey data	Sub-total			
							2011a	2011b	2011c	2014	Other					
Acacia graciliformis	P1	29	5	0	0	0	140	549	70	0	0	0	793	937	1,730	54.2
Acacia muriculata	P1	18	4	0	4,475	20	0	101	2	0	0	0	4,620	872	5,492	15.9
Dodonaea scurra	P1	22	7	0	28,655	4	1,510	191	0	0	0	0	30,389	770	31,159	2.5
Drummondita rubroviridis	P1	7	2	0	0	0	0	46	6	0	0	0	61	808	869	93.0
Lepidosperma sp. Koolanooka (K.R. Newbey 9336)	P1	58	0	34	45,993	217	1,628	905	5043	34	0	13	53,925	562	54,487	1.0
Millotia dimorpha	P1	532	6	851	0	0	0	0	2,363	0	0	1,630	5,382	5,320	10,702	49.7
Baeckea sp. Perenjori (J.W. Green 1516)	P2	66	7	529	0	10	1,628	917	2,260	410	0	0	5,827	2,255	8,082	27.9
Melaleuca barlowii	P3	32	5	2	0	0	3	0	18	2	0	3	65	2	67	3.0
Mirbelia ferricola	P3	12,370	2	10	0	0	50	21	18	0	0	8	12,479	162	12,641	1.3
Persoonia pentasticha	P3	54	10	66	0	3	10	4	37	0	176	218	578	3	581	0.5
Stenanthemum poicilum	P3	56	11	0	0	0	524	104	24	81	0	6	806	167	973	17.2

Note: Column 2 – P1, P2 and P3 = Priority 1, Priority 2 and Priority 3 species; Column 3 = WAH (1998-); Column 4 – DBCA (Reference #27-0918FL); Column 12 – surveys carried out by Maia in WA and the locations and project cannot be disclosed. Column 13 = data gathered by Maia from reports provided by SMC on other surveys conducted for other companies; Column 14 – subtotal = sum of columns 3 to 13; Column 15 – number of plants recorded during this survey by Maia; Column 16 – Total = column 14 + column 15; Column 17 – the estimated (Est.) maximum impact to the species if the whole of the Survey Area were to be cleared (the actual area to be cleared has not been defined): numbers in column 17 = column 15 / column 16 *100. The impact is very much an estimate as it is based on the numbers of plants from DBCA and FloraBase records and from selected surveys only.

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4.3 Introduced Flora

4.3.1 National Weeds Lists

- No weeds listed on a national weeds list was recorded in the Survey Area.

4.3.2 Plant Pests declared in Western Australia

- *Echium plantagineum* (Paterson's Curse) is listed as a declared pest in the whole of WA. Two plants were recorded in the Survey Area (**Map 10.16, Section 10**).

4.3.3 Environmental Weeds

Thirteen general environmental weed species were located in the Survey Area - *Arctotheca calendula*, *Avena barbata*, *Carrichtera annua*, *Cuscuta epithymum*, *Hordeum hystrix*, *Limonium lobatum*, *Medicago polymorpha*, *Medicago truncatula*, *Mesembryanthemum nodiflorum*, *Pentameris airoides* subsp. *airoides*, *Sisymbrium irio*, *Sonchus oleraceus* and *Spergula pentandra*. The Midwest region impact and invasiveness ratings (DPaW, 2014) for these 13 weed species are listed in **Table 4.5**; *Arctotheca calendula*, *Avena barbata*, *Limonium lobatum* and *Mesembryanthemum nodiflorum* have a high ecological impact and rapid invasiveness (highlighted orange in **Table 4.5**).

A map showing the distribution of all weeds located in the Survey Area is included as **Map 10.16, Section 10**. The locations have been supplied to SMC electronically but their coordinates are not included in this report.

More weeds were recorded in the southern polygon than the northern polygon. The southern polygon is not fenced off from open farmland to the west, whereas the northern polygon is.

Table 4.5: Weed Species Located in the Survey Area and Ecological Impact and Invasiveness Ratings

Taxa	Common name	Number of plants	Ecological impact	Invasiveness
Arctotheca calendula	Capeweed	130	High	Rapid
Avena barbata	Bearded Oat	3	High	Rapid
Carrichtera annua	Ward's Weed	2	Not listed	
Cuscuta epithymum	Lesser Dodder	1,046	Unknown	Rapid
Hordeum hystrix	Mediterranean Region Barley Grass	5	Unknown	Rapid
Limonium lobatum	Winged Sea-lavender	15	High	Rapid
Medicago polymorpha	Burr Medic	5	Unknown	Rapid
Medicago truncatula	Barrel Medic	1	Low	Moderate
Mesembryanthemum nodiflorum	Slenderleaf Iceplant	12,061	High	Rapid
Pentameris airoides subsp. *airoides*	-	5	Unknown	Rapid
Sisymbrium irio	London Rocket	1	Unknown	Unknown
Sonchus oleraceus	Common Sowthistle	1	Unknown	Rapid
Spergula pentandra	Five Anther Spurry	10	Low	Rapid

Note: Columns 4 and 5 from DPaW (2014).

4.4 VEGETATION

4.4.1 Vegetation Types

Five vegetation types are described and mapped over the Survey Area (**Table 4.6**; **Map 10.17, Section 10)**.

Table 4.6 provides the following information on each vegetation type:

- The vegetation code;
- The broad floristic formation;
- A detailed description of the vegetation type;
- The associated species;
- The quadrats assessed in vegetation type,
- The typical habitat where the vegetation type occurs; and,
- The vegetation condition.

In order to align with the broad floristic formation descriptions, the vegetation type descriptions have been ordered using the dominant cover class as the indicator and not the dominant stratum e.g. Tall Shrubland of *Melaleuca eleuterostachya* with a Tussock Grassland of *Amphipogon caricinus* var. *caricinus* and an Open mixed Mallee Woodland (mainly *Eucalyptus leptopoda* subsp. *arctata*, *Eucalyptus* ?*loxophleba, Eucalyptus subangusta* subsp. *pusilla*).

The vegetation type codes used in the report and on the vegetation map include the first letter of the genus and species of the dominant taxon or taxa in the vegetation type along with the first letters of the dominant stratum in bold font e.g. *Me***SL** is a *Melaleuca eleuterostachya* Shrubland.

Areas already cleared (tracks, fencelines and firebreaks) are mapped as disturbed.

The information collected at each quadrat is included in **Appendix 5**, the site by species matrix in **Table A7.1, Appendix 7** and the vegetation type by species matrix in **Table A7.2**.

Table 4.6: Vegetation Types Mapped in the Survey Area

Note: P1, P2, P3 = priority 1, 2, 3.

Code	Broad floristic formation, vegetation type and associated information	
*E*MWL	**Broad floristic formation**: *Eucalyptus* Mallee Woodland. **Vegetation type**: Mixed *Eucalyptus* species Mallee Woodland (mainly *Eucalyptus* ?*ebbanoensis*, *Eucalyptus subangusta* subsp. *pusilla*, *Eucalyptus kochii* subsp. *borealis*) with a Sparse Mid Shrubland of *Eremophila oppositifolia* subsp. *angustifolia*, *Acacia andrewsii*, +/- ***Acacia graciliformis*** **(P1)** and a Sparse Low Shrubland of *Acacia acanthoclada* subsp. *glaucescens* and *Sclerolaena diacantha.*	**Associated species:** *Arthropodium dyeri*, *Dodonaea inaequifolia*, *Enchylaena tomentosa* var. *tomentosa*, *Ptilotus obovatus*, *Rhagodia drummondii*, *Sclerolaena densiflora.* **Quadrats:** KS01, KS10, KS11
	Habitat: Lower slopes with a surface layer of laterite and ironstone gravel and stones.	**Vegetation condition:** Very Good: minor grazing and some non-aggressive weeds.

Code	Broad floristic formation, vegetation type and associated information	
*Me***SL**	**Broad floristic formation**: *Melaleuca* Tall Shrubland. **Vegetation type**: Tall Shrubland of *Melaleuca eleuterostachya* with a Tussock Grassland of *Amphipogon caricinus* var. *caricinus* and an Open mixed Mallee Woodland (mainly *Eucalyptus leptopoda* subsp. *arctata*, *Eucalyptus* ?*loxophleba, Eucalyptus subangusta* subsp. *pusilla*).	**Associated species:** *Acacia acuminata*, ***Acacia graciliformis* (P1)**, *Allocasuarina acutivalvis* subsp. *prinsepiana*, *Cheilanthes adiantoides*, *Comesperma integerrimum*, *Stenopetalum filifolium*, *Stylidium confluens.* **Quadrats:** KS03, KS05, KS06.
	Habitat: Footslopes and plateaus with a surface layer of sandy-loam.	**Vegetation condition:** Excellent: no disturbance evident.

Code	Broad floristic formation, vegetation type and associated information	
*Mn***SL**	**Broad floristic formation**: *Melaleuca* Tall Shrubland. **Vegetation type**: Open Tall Shrubland of *Melaleuca nematophylla* with an Open Mid Shrubland of *Melaleuca radula*, *Melaleuca nematophylla* and *Eremophila clarkei* with an Open Low Shrubland of ***Baeckea* sp. Perenjori (J.W. Green 1516) (P2)** and *Mirbelia microphylla***.**	**Associated species:** *Acacia acuminata*, *Allocasuarina acutivalvis* subsp. *prinsepiana*, *Amphipogon caricinus* var. *caricinus*, *Arthropodium dyeri*, *Austrostipa elegantissima*, *Dodonaea inaequifolia*, ***Lepidosperma* sp. Koolanooka (K.R. Newbey 9336) (P1)**, ***Millotia dimorpha* (P1)**, *Schoenia cassiniana*, *Solanum cleistogamum*, *Thysanotus manglesianus.* **Quadrats:** KS09, KS12
	Habitat: Footslopes with laterite stones and hillslopes with BIF boulders and ironstone stones.	**Vegetation condition:** Excellent: no disturbance evident.

Code	Broad floristic formation, vegetation type and associated information	
M**SL**	**Broad floristic formation**: Mixed Tall Shrubland. **Vegetation type**: Mixed Open Tall Shrubland (mainly of *Allocasuarina acutivalvis* subsp. *prinsepiana*, *Melaleuca cordata*, *Allocasuarina campestris*) with an Open Mid Shrubland of *Xanthosia kochii*, *Grevillea paradoxa*, *Aluta aspera* subsp. *hesperia* and Isolated Mallee Trees of *Eucalyptus ebbanoensis* and *Eucalyptus ?loxophleba.*	**Associated species:** *Acacia acuaria*, *Amphipogon caricinus* var. *caricinus*, *Arthropodium dyeri*, *Astroloma serratifolium*, ***Beyeria* aff. *minor* (TOI)**, *Cheilanthes adiantoides*, ***Dodonaea scurra* (P1)**, ***Drummondita rubroviridis* (P1)**, *Hibbertia arcuata*, ***Lepidosperma* sp. Koolanooka (K.R. Newbey 9336) (P1)**, *Lomandra marginata*, ***Melaleuca barlowii* (P3)**, *Micromyrtus racemosa.* **Quadrats:** KS04, KS08
	Habitat: Outcrops and hill slopes and crests with laterite and BIF stones and boulders.	**Vegetation condition:** Excellent: old regrown track close to KS08 but no other disturbance evident.
		

Code	Broad floristic formation, vegetation type and associated information	
M**SL**/**WL**	**Broad floristic formation**: Mixed Tall Shrubland / Low Woodland. **Vegetation type**: Tall Shrubland of *Melaleuca nematophylla*, *Melaleuca eleuterostachya* and *Allocasuarina acutivalvis* subsp. *prinsepiana* with a Sparse mixed Mid Shrubland (mainly of ***Dodonaea scurra*** **(P1)**, ***Acacia graciliformis*** **(P1)** and ***Drummondita rubroviridis*** **(P1)**) with a Sparse Low Shrubland of *Hibbertia exasperata* and *Hibbertia arcuata*.	**Associated species:** *Acacia daviesioides*, ***Acacia muriculata*** **(P1)**, *Allocasuarina campestris*, *Astroloma serratifolium*, *Cheiranthera simplicifolia*, *Eucalyptus ?ebbanoenis*, *Eucalyptus ?loxophleba*, *Melaleuca radula*, *Micromyrtus racemosa*, ***Mirbelia ferricola*** **(P3)**, *Xanthosia kochii.* **Quadrats:** KS02, KS07
	Habitat: Hill slopes and crests / ridge tops with laterite gravel.	**Vegetation condition:** Excellent: none evident.
		

4.4.2 Vegetation Type Cover

The area of each of the vegetation types mapped in the Survey Area is listed in **Table 4.7**.

Table 4.7: Area and Cover of Vegetation Types Mapped

Vegetation type code: broad floristic formation	Mapped in the Survey Area	
	Area (ha)	Cover (%)
*E***MWL** – Mixed *Eucalyptus* Woodland / Mallee Woodland.	4.29	11.41
*Me***SL** – *Melaleuca* Tall Shrubland	6.19	16.48
*Mn***SL** - *Melaleuca* Tall Shrubland	3.13	8.33
*M***SL** - Mixed Tall Shrubland	7.74	20.59
M**SL/WL** - Mixed Tall Shrubland / Low Woodland	15.53	41.34
Disturbed	0.70	1.86
Total Area (ha)/Cover (%)	37.57	100

4.4.3 Vegetation Condition

Based on the vegetation condition mapping (**Map 10.18, Section 10**), the overall vegetation condition at the Survey Area is rated as Excellent (86.73%). Additional information on vegetation condition at the Survey Area is included in **Table 4.8**.

Table 4.8: Vegetation Condition

Vegetation condition	Area (ha) / cover (%) in the Survey Area	Vegetation types	Comments
Excellent	32.59 / 86.73	*Me***SL**, *Mn***SL**, M**SL/WL,** *M***SL**	Includes the majority of the Survey Area, which is uncleared with few to no significant weeds.
Very Good	4.29 / 11.41	*E***MWL**	In areas mapped as Very Good there was evidence of mild grazing by goats and some invasive weeds, however, In most cases the weed cover was low. At one quadrat (KS10) the condition rating was changed from the Excellent field rating to Very Good based on the presence of three invasive weed species that were collected from the site but were present in low numbers.
Degraded	0.70 / 1.86	Disturbed	Includes cleared areas (fencelines, firebreaks and exploration areas). The vegetation structure has been significantly altered by clearing and some regrowth is present.

4.5 Ecological Communities

The Survey Area lies within the boundaries of the Plant assemblages of the Koolanooka System (banded ironstone formation) TEC and the vegetation types described for the Survey Area are similar to some of Meissner & Caruso's descriptions for the communities occurring in the TEC (Meissner & Caruso, 2008) (see Discussion).

None of the vegetation types in the Survey Area are similar to the federally listed TEC Eucalypt Woodlands of the Western Australian Wheatbelt. They do not contain the key species listed for the Eucalypt Woodlands TEC and the dominant *Eucalyptus* species of the Survey Area are mostly mallee species and the listed Eucalypt Woodlands do not include woodlands dominated by mallee trees (DotEE, 2016).

5 DISCUSSION

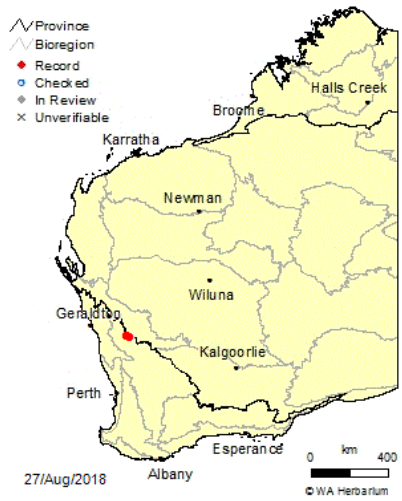
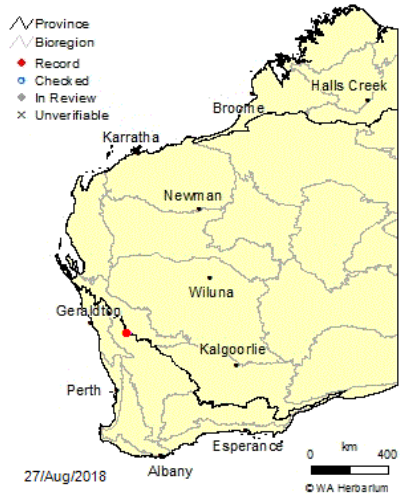
A discussion of the values and significance of the confirmed and queried CSF flora species and vegetation types of the Survey Area follows. The significance is discussed in both regional and local contexts (EPA, 2016).

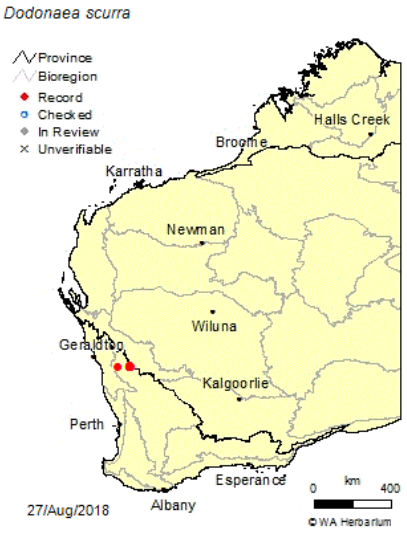
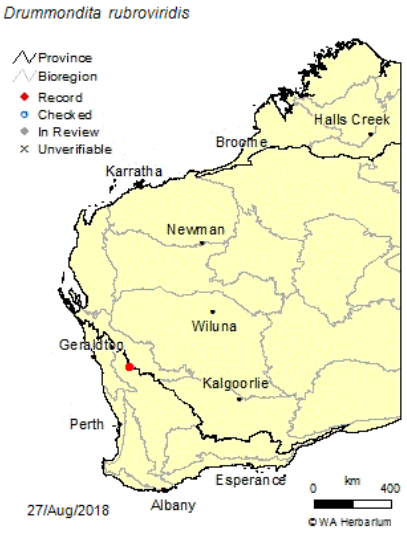
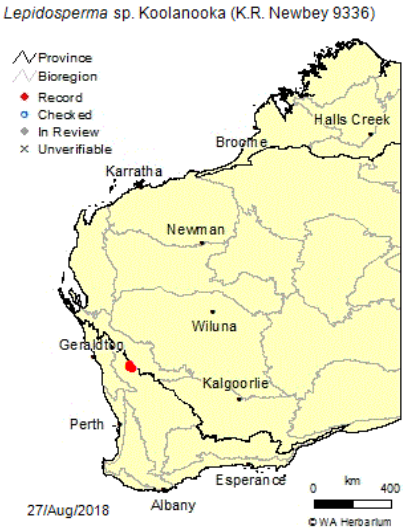
5.1 CONSERVATION SIGNIFICANCE - FLORA

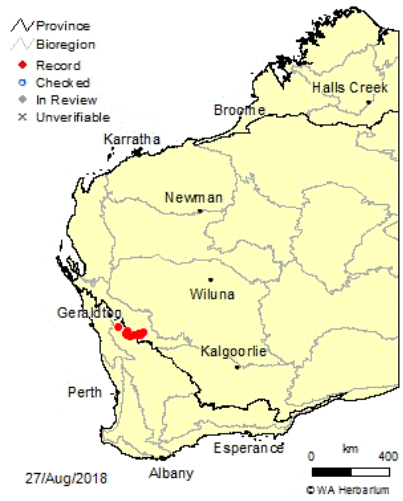
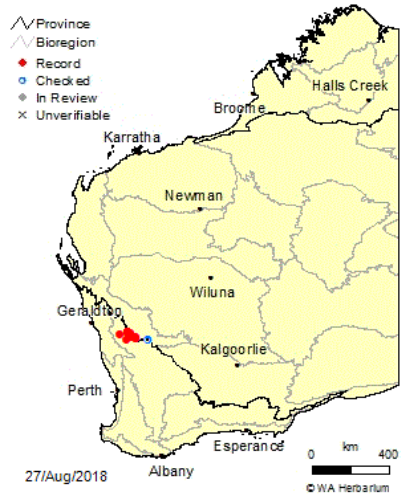
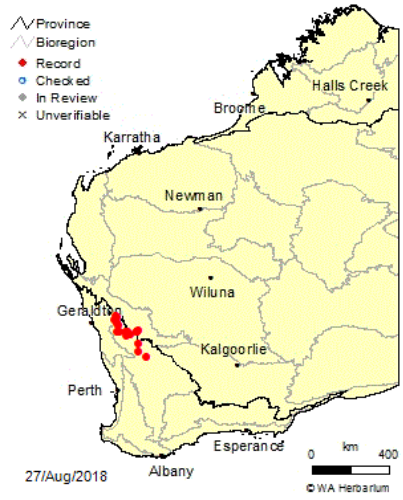
5.1.1 Regional Context

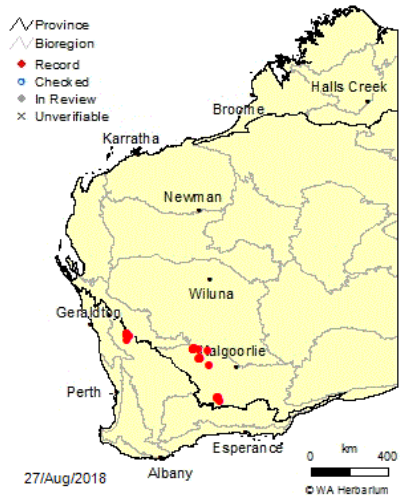
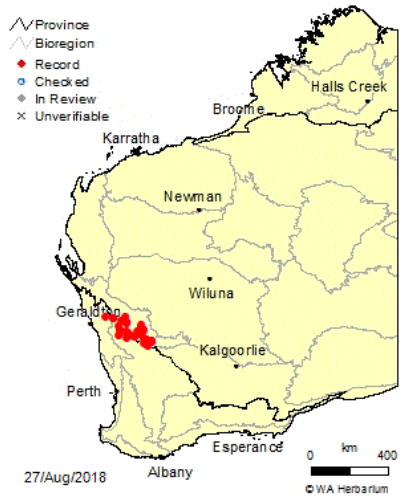
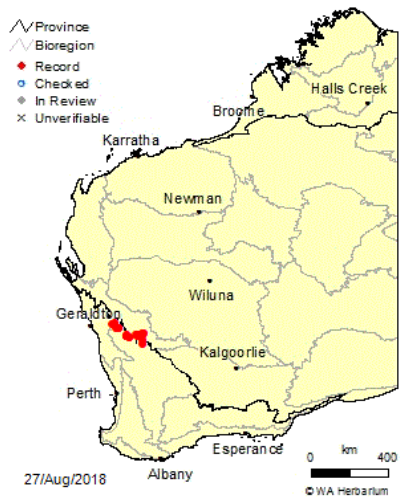
The regional significance of the 11 confirmed priority species recorded in the Survey Area is indicated by the current (or potential) priority listing for the species. Information on the number of bioregions the species has been found in, the number of FloraBase records, its priority rank and whether any of the plants occur in protected areas is included in **Table 5.1**.

Table 5.1: Priority Flora Species

Current status	Current distribution
Acacia graciliformis **– Priority 1** *A. graciliformis* has 11 records on FloraBase and they are all in the Avon Wheatbelt bioregion. Its frequency is described as occasional to isolated plants (WAH, 1998-). None of the records fall within DBCA Managed Lands and Lands of Interest (DBCA 2018a, 2018b). None of the records fall within IUCN protected land. *A. graciliformis* is a regional endemic.	*Acacia graciliformis* 
Acacia muriculata **– Priority 1** *A. muriculata* has nine records on FloraBase and they are all in the Avon Wheatbelt bioregion. Its frequency is described as occasional to isolated plants (WAH, 1998-). None of the records fall within DBCA Managed Lands and Lands of Interest (DBCA, 2018a; 2018b). None of the records fall within IUCN protected land. *A. muriculata* is a regional endemic.	*Acacia muriculata* 

Current status	Current distribution
Dodonaea scurra – **Priority 1** *D. scurra* has 14 records on FloraBase and they are all in the Avon Wheatbelt bioregion and its frequency is described as sparse to isolated plants (WAH, 1998-). None of the records fall within DBCA Managed Lands and Lands of Interest (DBCA, 2018a; 2018b). None of the records fall within IUCN protected land.	
Drummondita rubroviridis– **Priority 1** *D. rubroviridis* has six records on FloraBase and they are all in the Avon Wheatbelt bioregion and its frequency is described as occasional to isolated plants (WAH, 1998-). None of the records fall within DBCA Managed Lands and Lands of Interest (DBCA, 2018a; 2018b). None of the records fall within IUCN protected land. *D. rubroviridis* is a regional endemic.	
***Lepidosperma* sp. Koolanooka (K.R. Newbey 9336) –Priority 1** *L.* sp. Koolanooka (K.R. Newbey 9336) has 17 records on FloraBase and they are all in the Avon Wheatbelt bioregion and its frequency is described as sparse to isolated plants (WAH, 1998-). None of the records fall within DBCA Managed Lands and Lands of Interest (DBCA, 2018a; 2018b). None of the records fall within IUCN protected land. *L.* sp. Koolanooka (K.R. Newbey 9336) is a regional endemic.	

Current status	Current distribution
***Millotia dimorpha* – Priority 1** *M. dimorpha* has 23 records on FloraBase and they are all in the Avon Wheatbelt and Yalgoo bioregions. Frequency, when noted in the FloraBase records, is described as sparse to isolated plants, however, 300 plants were recorded at one location (WAH, 1998-). None of the records fall within DBCA Managed Lands and nine records fall within Lands of Interest (former leaseholds – ex Karara and ex Lochada) (DBCA, 2018a; 2018b). None of the records fall within IUCN protected land.	*Millotia dimorpha* 
***Baeckea* sp. Perenjori (J.W. Green 1516) – Priority 2** *Baeckea* sp. Perenjori (J.W. Green 1516) has 20 records on FloraBase and they are all in the Avon Wheatbelt and Yalgoo bioregions. Its frequency, when noted in the FloraBase records, is described as abundant to sparse (WAH, 1998-). One of the records falls within DBCA Managed Lands (Bowgarder Nature Reserve) and no records within Lands of Interest (DBCA, 2018a; 2018b). The one record within Bowgarder Nature Reserve is within IUCN protected land.	*Baeckea* sp. Perenjori (J.W. Green 1516) 
***Melaleuca barlowii* – Priority 3** *M. barlowii* has 34 records on FloraBase and they are in the Avon Wheatbelt and Yalgoo bioregions. Frequency, when noted in the FloraBase records, is described as occasional to isolated plants (WAH, 1998-). One of the records fall within DBCA Managed Lands (Wilroy Nature Reserve) and four records within Lands of Interest (former leasehold –ex Karara) (DBCA, 2018a; 2018b). The one record within Wilroy Nature Reserve is within IUCN protected land.	*Melaleuca barlowii* 

Current status	Current distribution
***Mirbelia ferricola* – Priority 3** *M. ferricola* has 35 records on FloraBase and they are in the Avon Wheatbelt and Coolagrdie bioregions. Frequency, when noted in the FloraBase records, is described as occasional to isolated plants (WAH, 1998-). Eleven of the records fall within DBCA Managed Lands (Mount Manning – Helena and Aurora Ranges Conservation Park) and seven records within Lands of Interest (former leaseholds – ex Diemals Station and ex Jaurdi) (DBCA, 2018a; 2018b). Those 13 records within the Conservation Park are within IUCN protected land.	*Mirbelia ferricola* 
***Persoonia pentasticha* – Priority 3** *Persoonia pentasticha* has 46 records on FloraBase and they are in the Avon Wheatbelt, Geraldton Sandplains and Yalgoo bioregions. Frequency, when noted in the FloraBase records, is described as occasional to isolated plants (WAH, 1998-). Three of the records fall within DBCA Managed Lands (Barrabarra, Bowgarder and East Yuna Nature Reserves) and 16 records within Lands of Interest (former leaseholds – ex Barnong, ex Karara and ex Warriedar) (DBCA 2018a; 2018b). Those three records within Nature Reserves are within IUCN protected land.	*Persoonia pentasticha* 
***Stenanthemum poicilum* – Priority 3** *S. poicilum* has 25 records on FloraBase and they are all in the Avon Wheatbelt and Yalgoo bioregions. Frequency, when noted in the FloraBase records, is described as common to isolated plants (WAH, 1998-). None of the records fall within DBCA Managed Lands and two records fall within Lands of Interest (former leaseholds – ex Karara and ex Warriedar) (DBCA, 2018a; 2018b). None of the records fall within IUCN protected land.	*Stenanthemum poicilum* 

Note: Images used with the permission of the Western Australian Herbarium, Department of Biodiversity, Conservation and Attractions (https://florabase.dpaw.wa.gov.au/help/copyright). Accessed on Wednesday, 14 November 2018.

5.1.2 Local Significance

The local conservation significance of the 11 confirmed and one potential priority species recorded in the Survey Area is discussed below. This assessment has been carried out to gauge the local value of the plants of the priority species recorded in the Survey Area (the local area). Significance ratings (low, moderate or high) are calculated by attributing scores for: the number of records on FloraBase for each species and in the Survey Area, an estimate of the number of known plants (**Table 4.4**); the priority rank of the species; their distribution within the Survey Area (limited or widespread); the number and cover of the vegetation type/s in which each occurs; and, the likelihood of it occurring in the surrounding area.

Acacia graciliformis (P1) was recorded at 132 locations (937 plants) in the Survey Area. It was found on flats and hillslopes, in all five vegetation types and its distribution was widespread in the Survey Area (over approximately 80% of it). It has been recorded in relatively high numbers during other surveys carried out on the Koolanooka Hills, therefore its occurrence is likely to be at a similar density in the surrounding area. Therefore the *A. graciliformis* of the Survey Area is rated as having low local significance.

Acacia muriculata (P1) was recorded at 377 locations (872 plants) in the Survey Area. It was found on flats and hill slopes and in four of the five vegetation types mapped in the Survey Area and its distribution was relatively widespread (over approximately 70% of it). It has been found in relatively high numbers in other surveys carried out on the Koolanooka Hills, therefore its occurrence is likely to be at a similar density in the surrounding area. As a result, the *A. muriculata* of the Survey Area is rated as having low local significance.

Dodonaea scurra (P1) was recorded at 292 locations (770 plants) in the Survey Area. It was found on hill slopes and flats and in all five vegetation types and it was recorded in approximately 75% of the Survey Area. Based on the results of other surveys carried out on the Koolanooka Hills, its occurrence is likely to be at a similar density in the surrounding area and therefore the *D. scurra* of the Survey Area is rated as having low local significance.

Drummondita rubroviridis (P1) was recorded at 327 locations (808 plants) in the Survey Area. It was found on stony and loam-sand flats and hill slopes and in four of the five vegetation types and its records occur over approximately 70% of the Survey Area. It has been found at many locations in other areas surveyed on the Koolanooka Hills and it more than probably occurs in similar numbers in the surrounding vegetation. The *D. rubroviridis* of the Survey Area is therefore rated as having low local significance.

Lepidosperma sp. Koolanooka (K.R. Newbey 9336) (P1) was recorded at 77 locations (562 plants) in the Survey Area. It was found on hill slopes, outcrops and stony flats and in all five of the vegetation types. It was recorded over approximately 60% of the Survey Area and has been recorded in high numbers during other surveys carried out on the Koolanooka Hills. The *L.* sp. Koolanooka of the Survey Area is rated as having low local significance.

Millotia dimorpha (P1) was recorded at 42 locations (5,320 plants) in the Survey Area. It was found on flats, hillslopes and outcrops and in four vegetation types. While it undoubtedly occurs in the surrounding area (and it has been located by Maia during earlier surveys on the Koolanooka Hills), given the relatively restricted distribution of this species in the Survey Area it is rated as having moderate to high local significance.

Baeckea sp. Perenjori (J.W. Green 1516) (P2) was recorded at 174 locations (2,255 plants) in the Survey Area. It was found on flats and hillslopes and in all five vegetation types and the records are distributed over about 60% of the Survey Area. The species has been recorded in relatively high numbers during other surveys carried out on the Koolanooka Hills and therefore the *B.* sp. Perenjori of the Survey Area is rated as having low local significance.

Melaleuca barlowii (P3) was recorded at two locations (two plants, one in the Survey Area and one just outside the boundary). It was found on a BIF outcrop and in one vegetation type. Given the localised distribution of this species in the Survey Area and the low number recorded in the surrounding area, the *M. barlowii* of the Survey Area is rated as having high local significance.

Mirbelia ferricola (P3) was recorded at 76 locations (162 plants) spread over about 60% of the Survey Area. It was found on flats and hillslopes and in three of the five vegetation types mapped. Given the moderate distribution of this species in the Survey Area and the relatively low numbers that have been found during other surveys on the Koolanooka Hills, the *M. ferricola* of the Survey Area is rated as having moderate local significance.

Persoonia pentasticha (P3) was recorded at two locations (three plants) in the Survey Area. It was found on rocky outcrops and hill slopes and in two vegetation types. Given the localised distribution and low number of this species in the Survey Area, it is rated as having high local significance.

Stenanthemum poicilum (P3) was recorded at 63 locations (167 plants) in the Survey Area. It was found on flats and footslopes and in four vegetation types and is distributed over about 20% of the Survey Area. Given its low to moderate spread in the Survey Area and the moderate number of plants estimated in the surrounding area, the *S. poicilum* of the Survey Area is rated as having moderate local significance.

The regional and local conservation significance assessment results are summarised in **Table 5.2** along with an overall score calculated for each CSF. The overall score is the sum of the score for the priority rank and local significance. Priority 1 species are given a score of 4 and P3 species a score of 2 while low local significance is given a score of 1 and high a score of 3. The highest overall score achievable for the CSF/potential CSF located in the Survey Area is 7 and the lowest is 3. The scores for the CSF/potential CSF range from 7 to 4 and are therefore in the moderate to high score range.

The *Millotia dimorpha* is the most significant species recorded in the Survey Area and the lowest scores were attained by *Mirbelia ferricola* and *Stenanthemum poicilum*.

Table 5.2: Summary of Regional and Local Significance Assessment – Conservation Significant Flora Species

Conservation significant flora species	Regional significance = priority rank (score)	Local significance (score)	Overall score (regional + local significance scores)
Acacia graciliformis	1 (4)	Low (1)	5
Acacia muriculata	1 (4)	Low (1)	5
Dodonaea scurra	1 (4)	Low (1)	5
Drummondita rubroviridis	1 (4)	Low (1)	5
Lepidosperma sp. Koolanooka (K.R. Newbey 9336)	1 (4)	Low (1)	5
Millotia dimorpha	1 (4)	Moderate (2)	6
Baeckea sp. Perenjori (J.W. Green 1516)	2 (3)	Low (1)	4
Melaleuca barlowii	3 (2)	High (3)	5
Mirbelia ferricola	3 (2)	Moderate (2)	4
Persoonia pentasticha	3 (2)	High (3)	5
Stenanthemum poicilum	3 (2)	Moderate (2)	4

Note: the maximum total score achievable for these CSF is 7 and the minimum is 3.

5.2 Conservation Significance - Vegetation

The values and significance of the vegetation of the Survey Area are discussed at a regional and local scale in the following paragraphs.

5.2.1 Regional Significance – Pre-European Vegetation

Conservation significance (low, moderate or high) of the vegetation of the Survey Area at a regional level is based on the representation of habitats recorded in the Survey Area at a bioregion level i.e. the Avon Wheatbelt bioregion. Beard's pre-European vegetation mapping has been used to assess the significance of vegetation and habitats of the Survey Area at this level.

One of Beards vegetation associations (BVA) is mapped in the Survey Area – BVA 693. Its significance assessment is based on its current extent, its distribution in the Avon Wheatbelt bioregion and the area occurring in IUCN land protected for conservation.

The extent and distribution of BVA 693 in the Avon Wheatbelt bioregion and Merredin subregion is shown in **Table 5.3.** (Survey Area outlined in black, the extent of BVA 693 in the Avon Wheatbelt bioregion and surrounds is coloured orange, and the boundaries for the two subregions in the Avon Wheatbelt bioregion (Merredin and Katanning) are outlined in green. The maps were produced using IBRA Subregions (DotEE, 2012) and pre-European vegetation shapefiles (DPIRD, 2018a)).

BVA 693 only occurs in the Merredin subregion of the Avon Wheatbelt bioregion. Currently, 71.83% (3,157.85 ha) of its Avon Wheatbelt pre-European extent still remains (**Table 5.4**) and none of it is protected for conservation. The Koolanooka TEC occurs within BVA 693 and it was given a high reservation priority by Beecham (2001). Based on this information BVA 639 is considered to be of high regional significance.

5.2.2 Local Significance – Pre-European Vegetation

The local significance of BVA 693 and the vegetation types occurring in the Survey Area is considered below. Local significance is based on the cover of BVA 693 in the Survey Area and surrounding local area, its spread in the local area i.e. restricted, moderate, widespread, how much of its current extent remains in the Survey Area, how much is mapped in conservation protected lands in the local area, the number of CSF located in BVA 693 and any other attributes e.g. does BVA 693 occur within the indicative boundaries of any TEC or PEC in the local area.

Given the limited distribution of BVA 693 in the Merredin subregion, the 1.17% of its current extent remaining in the Survey Area (**Table 5.4**), the 11 confirmed CSF along with one potential CSF and one TOI located in it, its high reservation priority (Beecham, 2001), and the fact that it occurs within the boundary of the 'Plant Assemblages of the Koolanooka System' TEC, BVA 639 has high local significance.

Table 5.3: Distribution of BVA 693 in the Avon Wheatbelt Bioregion and Subregions and the Survey Area.

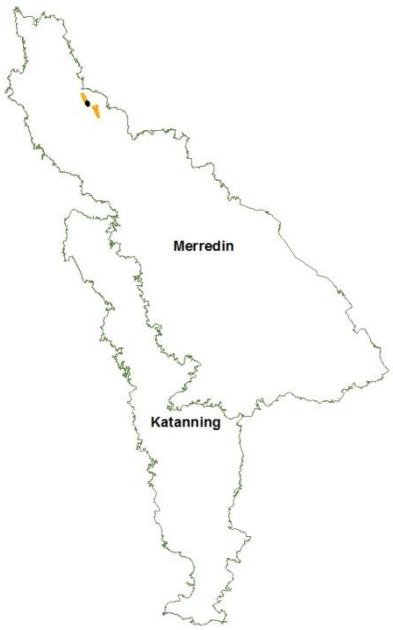
Distribution – Avon Wheatbelt bioregion	Distribution – Survey Area
	

Table 5.4: Proportion of Mapped and Local Extent of BVA 693 in the Survey Area

Column 1	2	3	4	5
Beard vegetation association	Current extent in the Avon Wheatbelt bioregion (ha) (GoWA, 2018a)	Current extent in the Survey Area	Proportion of the Survey Area (%)	Proportion of current Avon Wheatbelt extent in the Survey Area (%)
693	3,157.85	36.87	98.14	1.17

Note: Columns 2 = GoWA (2018a); Column 3 = Beard pre-European vegetation mapping shapefile (DPIRD, 2018a) minus 0.70 ha of disturbed land; Column 5 = Column 3 / Column 2 x 100.

5.2.3 Local Significance - Vegetation Types Mapped by Maia

The extent of the vegetation types mapped by Maia (Maia vegetation types, MVT) in the Survey Area is listed in **Table 5.5** along with the number of CSF located in each MVT, the average vegetation condition, the number of weed species recorded in the MVT, the vegetation association it occurs in, its occurrence outside the Survey Area and any other key attributes increasing its conservation value. These parameters have been used to generate a local significance rating for each MVT.

Key information on the five MVTs mapped in the Survey Area, including their similarity to Meissner & Caruso's Koolanooka and Perenjori Hills vegetation community types (Meissner & Caruso, 2008), is noted in the following paragraphs.

*E***MWL** is mapped over 11.41% of the Survey Area (4.29 ha) on the lower slopes of hills. *E***MWL** is most similar to community type 5 described by Meissner & Caruso (2008) who recorded the community on both the Koolanooka and Perenjori Ranges on colluvial outwash soils and sites in pockets of fertile soil in community type 1. Vegetation community type 5 is described as woodlands and mallee woodlands of *Eucalyptus* species over *Acacia* species and chenopods.

*Me***SL** is mapped over 16.48% of the Survey Area (6.19 ha) on sandy-loam footslopes and plateaus. Based on the dominant species in *Me***SL**, it is most similar to community type 1a that occurrs only on Koolanooka Hills and on all landforms except colluvial outwashes (Meissner & Caruso, 2008). Community type 1a is described as mallee shrublands, shrublands and woodlands of *Allocasuarina acutivalvis*, *Eucalyptus ebbanoensis* and *Melaleuca* species over shrublands with *Micromyrtus racemosa*, *Grevillea paradoxa* and *Mirbelia ferricola*.

*Mn***SL** is mapped over 8.33% of the Survey Area (3.13 ha) on hill slopes with banded iron formation (BIF) and ironstone boulders and stones and it is most similar to community type 3 that occurs on midslopes and crests of Koolanooka and Perenjori Hills (Meissner & Caruso, 2008). Community type 3 is described as open woodlands, shrublands and open shrublands of *Allocasuarina* species, *Melaleuca nematophylla* and *Calycopeplus paucifolius* over a mixed shrubland of *Dodonaea inaequifolia* and *Philotheca brucei* subsp. *brucei*.

M**SL** is mapped over 20.59% of the Survey Area (7.74 ha) on outcrops, hill slopes and crests with laterite stones and boulders. Based on the dominant species in M**SL** it is most similar to community type 1a, which is widespread across all landforms except the colluvial outwashes. Community type 1a is described as mallee shrublands, shrublands and woodlands of *Allocasuarina acutivalvis*, *Eucalyptus ebbanoensis* and *Melaleuca s*pecies over shrublands with *Micromyrtus racemosa*, *Grevillea paradoxa* and *Mirbelia ferricola*.

M**SL**/**WL** is mapped over the largest area 41.34% of the Survey Area (7.74 ha) on outcrops, hill slopes and crests with laterite gravel. Based on the dominant species in M**SL/WL** it is most similar to community type 1a - mallee shrublands, shrublands and woodlands of *Allocasuarina acutivalvis*, *Eucalyptus ebbanoensis* and *Melaleuca* species over shrublands with *Micromyrtus racemosa*, *Grevillea paradoxa* and *Mirbelia ferricola* (Meissner & Caruso, 2008).

Therefore three of the community types occurring on the Koolanooka and Perenjori Hills occur in the Survey Area – community types 1a, 3 and 5.

Given the Survey Area's location in a TEC, the number and priority ranks of the CSF located in each vegetation type and the condition of the vegetation all five vegetation types are regarded as having high local significance.

5.3 Ecological Communities

The Survey Area lies within the 'Plant Assemblages of the Koolanooka System (banded ironstone formation)' TEC and the five vegetation types mapped by Maia are similar to community types described by Meissner & Caruso (2008) on the Koolanooka and Perenjori Hills.

The Eucalypt Woodlands of the Western Australian Wheatbelt, a PEC in WA and a nationally listed TEC, could potentially occur in the surrounding area. The eucalypts in the Survey Area are not the key eucalypt species listed for the PEC/TEC and they are mostly mallee eucalypt species and the listed Eucalyptus Woodlands do not include woodlands dominated by mallee trees.

Table 5.5: Extent, Significant Flora, Condition and Local Significance of Maia Vegetation Types Mapped in the Survey Area

MVT	Extent in Survey Area		CSF in MVT (#) and species code	Average vegetation condition	# of weed species recorded in MVT	Vegetation association / system association	Any other key attributes increasing conservation value?	Occurs outside the Survey Area?	Significance rating
	ha	%							
*E*MWL	4.29	11.41	(8) Ag, BsP, Ds, Dr, LesK, Md, Pp, Sp	Very Good	8	693/693.1	TEC	Yes	High
*Me*SL	6.19	16.48	(9) Ag, Am, BsP, Ds, Dr, LesK, Mf, Pp, Sp	Excellent	1	693/693.1	TEC	Yes	High
*Mn*SL	3.13	8.33	(6) Ag, Am, BsP, Ds, LesK, Md	Excellent	3	693/693.1	TEC	Yes	High
MSL	7.74	20.59	(11) Ag, Am, BsP, Baffm, Ds, Dr, LesK, Mb, Md, Mf, Sp	Excellent	6	693/693.1	TEC	Yes	High
MSL/WL	15.53	41.34	(11) Ag, Am, BsP, Baffm, Ds, Dr, LasK, LesK, Md, Mf, Sp	Excellent	5	693/693.1	TEC	Yes	High
Disturbed	0.70	1.86	-	Degraded	-	-	-	-	-
Total	37.57	100							

Notes: MVT = Maia vegetation type; CSF = conservation significant flora; Ag = *Acacia graciliformis* (P1); Am = *Acacia muriculata* (P1); BsP = *Baeckea* sp. Perenjori (J.W. Green 1516) (P2); Baffm = *Beyeria* aff. *minor* (TOI); Ds = *Dodonaea scurra* (P1); Dr = *Drummondita rubroviridis* (P1); LasK = *Labichea* sp. Koolanooka (TOI); LesK = *Lepidosperma* sp. Koolanooka (K.R. Newbey 9336) (P1); Mb = *Melaleuca barlowii* (P3); Md = *Millotia dimorpha* (P1); Mf = *Mirbelia ferricola* (P3); Pp = *Persoonia pentasticha* (P3); Sp = *Stenanthemum poicilum* (P3); P1 = priority 1 flora; P2 = priority 2 flora; P3 = priority 3 flora; TOI = taxon of interest.

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6 Summary of Results and Recommendations

6.1 Flora

- One hundred and thirty-seven taxa were recorded from 91 genera and 47 families (63.50% perennial, 36.50% annual). In late September / early October 2018 approximately 87% of the species list was identified from fertile material.
- No threatened flora species were located in the Survey Area.
- Eleven confirmed priority flora species were located in the Survey Area – *Acacia graciliformis*, *Acacia muriculata*, *Dodonaea scurra*, *Drummondita rubroviridis*, *Lepidosperma* sp. Koolanooka (K.R. Newbey 9336), *Millotia dimorpha* (all P1), *Baeckea* sp. Perenjori (J.W. Green 1516) (P2), *Melaleuca barlowii*, *Mirbelia ferricola*, *Persoonia pentasticha*, *Stenanthemum poicilum* (all P3). Two taxa of interest were located – *Beyeria* aff. *minor* and *Labichea* sp. Koolanooka. Plant numbers recorded ranged from two (*Melaleuca barlowii*) to more than 5,000 (*Millotia dimorpha* an annual plant).
- No weed species on any of the national weed lists were located in the Survey Area. One of the 13 weed species located in the Survey Area is listed as a Declared Plant in WA – *Echium plantagineum* (Paterson's Curse).

6.2 Vegetation

- Five vegetation types plus disturbed areas (tracks and fencelines) were mapped over the Survey Area.
- Survey Area vegetation condition was rated as Excellent (87%), Very Good (11%) or Degraded (2%).

6.3 Significance of Flora and Vegetation

- The 11 confirmed CSF species located in the Survey Area are rated as having moderate to high conservation significance when the regional and local significance assessments carried out for each species are combined. *Millotia dimorpha* had the highest score and the scores for the remaining CSF species were moderate to high.
- The regional and local significance of the Beard pre-European vegetation association (631) mapped in the Survey Area is rated as high.
- The vegetation types described for the Survey Area are similar to three of the community types described for the Koolanooka and Perenjori Hills. The local significance of the five vegetation types mapped by Maia in the Survey Area is rated as high.

6.4 Ecological Communities and Other Significant Areas

- The Survey Area lies within the boundaries of state-listed TEC - the 'Plant assemblages of the Koolanooka System (banded ironstone formation)' TEC.
- None of the vegetation types recorded in the Survey Area contain the key species indicated for the nationally listed Eucalypt Woodlands of the Western Australian Wheatbelt TEC that could occur close to the Survey Area.
- None of the vegetation types recorded in the Survey Area is the Eucalypt Woodlands of the Western Australian Wheatbelt PEC (using the TEC description as a guide).
- The Survey Area lies in an ESA (the Koolanooka System TEC) and a Schedule 1 area (the Avon Wheatbelt is one of the non-permitted areas listed in Schedule 1 of the Environmental Protection (Clearing of Vegetation) Regulations 2004).
- The Survey Area does not lie within any of the lands managed by DBCA, there are no legislated land or waters in or close to the Survey Area, no EPA Red Book area, and no significant water bodies, rivers or drainage lines.

6.5 RECOMMENDATIONS

Vegetation clearing should only be carried out if a NVCP is granted for the exploration program.

Tracks and drill pads should be aligned to minimise direct and potential indirect impact to the confirmed priority flora species located in the Survey Area. Areas that were surveyed and where fewer CSF plants were located should be selected in preference to areas where many CSF plants were recorded.

Direct or indirect impact to the two taxa of interest - *Beyeria* aff. *minor* and *Labichea* sp. Koolanooka - should be avoided. Both taxa could be new species found only in that area.

Direct impact to the vegetation in the Survey Area should be minimised and clearing boundaries clearly defined. The area is a TEC and the vegetation and flora are conservation significant.

Every effort should be made to prevent a) the introduction of new weeds into the area on machinery used for the works and b) the spread of existing weeds into the surrounding area when soil is moved from place to place.

7 Survey Limitations and Project Team

7.1 Survey Limitations

Technical Guidance, Flora and Vegetation Surveys for Environmental Impact Assessment (EPA, 2016), states that any survey-specific issues/limitations should be addressed in a limitations section and that the following set of limitations should be addressed as standard, whether they were a limitation of survey or not:

- Availability of contextual information at a regional and local scale;
- Competency/experience of the team carrying out the survey, including experience in the bioregion surveyed;
- Proportion of flora recorded and/or collected, any identification issues;
- Was the appropriate area fully surveyed (effort and extent);
- Access restrictions within the survey area;
- Survey timing, rainfall, season of survey; and
- Disturbance that may have affected the results of survey such as fire, flood or clearing.

Each of these issues/limitations is discussed with respect to this survey in **Table 7.1**.

Table 7.1: Survey Limitations

Limitation	Comment
Availability of contextual information at a regional and local scale	**No limitation** A desktop study was carried out to gather contextual information at a regional and local scale. The EPBC Act Protected Matters search tool and NatureMap were used to gather information along with searches of the DBCA's threatened flora and ecological communities databases. Relevant environmental GIS layers were downloaded and Beard's pre-European vegetation mapping, soil landscape systems and GoWA's vegetation statistics were used to provide context. Information was also available from flora and vegetation and targeted surveys conducted in the vicinity of the Survey Area.
Competency /experience of the team carrying out the survey, including experience in the bioregion surveyed	**No limitation** Two of the three botanists who carried out the survey each have approximately 12 years of experience of surveys on the Koolanooka Hills (Scott Hitchcock and Christina Cox). The third (Michael Pezzaniti), is a trainee botanist who was accompanied by the experienced botanists at all times. Specimens for all of the species recorded during the survey were collected for formal identification by a taxonomist using the resources of the WA Herbarium in Perth. The specimens were identified by Conrad Slee, a taxonomist with more than 15 years of experience in the taxonomy of the flora of the WA. Conrad also liaised with experts at the WA Herbarium as necessary.

Limitation	Comment
Proportion of flora recorded and/or collected, any identification issues	**No limitation** Two hundred and eighty (280) plant specimens were collected from the Survey Area and 137 taxa from 47 families and 91 genera were recorded. Of these 137 taxa, 37% were annual and 63% perennial and 87% of them were identified from either flowering or fruiting or both flowering and fruiting material. Four taxa could not be identified beyond genus as no flowering or fruiting material was found. A species list generated by NatureMap for a 20 km by 14 km rectangular search area encompassing the Survey Area listed 378 species (DPaW, 2007-). Meissner and Caruso (2008) recorded 237 taxa from 53 families from 50 quadrats and adjacent areas assessed over the Koolanooka and Perenjori Hills. The proportion of the flora collected and identified based on sampling, survey time and intensity of survey effort was very good.
Was the appropriate area fully surveyed (effort and extent)	**Minor limitation** A combined flora and vegetation reconnaissance survey and targeted flora survey was conducted over the Survey Area by three botanists over two survey days. Approximately 84% of the Survey Area was assessed (12 quadrats (0.48 ha) and 20.7 km x 15 m of traverses (31.05 ha) over the 37.6 ha Survey Area). In some areas the vegetation was very dense and the coverage in these areas could have been less than in others because the botanists had to find a way through the vegetation and were not able to follow a pre-set line on a GPS. In spite of this very high coverage over the Survey Area was achieved and plants of known and suspected conservation significance were located and counted and their locations recorded on a GPS. Proposed track alignments and drill pad locations have not been finalised and therefore the areas proposed to be cleared were not surveyed. However, traverses were walked over the length and width of the two polygons and most (84%) of the Survey Area was assessed.
Access restrictions within the survey area	**No limitation** There were few access restrictions (apart from dense vegetation in some areas), as the Survey Area was accessible using existing tracks and by walking from these tracks to the boundaries of the Survey Area.
Survey timing, rainfall, season of survey	**No limitation** The survey was conducted in spring 2018 late September/early October. BoM's rainfall deciles map for 1 July to 30 September 2018 indicates that rainfall in the general area over the three months before the survey was above average. Therefore the flora and vegetation should have been in average to above average condition in spring 2018. Approximately 37% of the species recorded were annuals and approximately 87% of the flora taxa recorded were flowering, fruiting or both flowering and fruiting. Based on this information the survey timing, rainfall pre the survey and season of survey was good.

Limitation	Comment
	No limitation
Disturbances (fire, flood, accidental human intervention etc.)	Apart from areas cleared for existing tracks and fencelines (approximately 0.70 ha, 1.86% of the Survey Area), and some evidence of grazing, no other disturbances were evident. No floods, severe storms or fires had occurred in the weeks or months before the survey was carried out.

7.2 Project Team

The project team members and their roles are listed in **Table 7.2**.

Table 7.2: Project Team

Project team			
Name	**Qualification**	**Project role**	**DBCA flora licence (expiry) / DRF licence (expiry)**
Christina Cox	PhD	Survey and report	SL012373 (Apr 30, 2019)
Scott Hitchcock	BSc	Survey and report	SL012372 (Apr 30, 2019) / 170-1718 (May 31, 2019)
Michael Pezzaniti	MSc	Survey and report	SL012332 (Mar 31, 2019)
Rochelle Haycock	BSc	Report	Not applicable
Conrad Slee	BSc Hons	Taxonomist	Not applicable

8 CLEARING PRINCIPLES

Under the *Environmental Protection Act 1986* (EP Act), clearing of native vegetation requires a permit unless its purpose is exempt. Any vegetation clearing requiring a Native Vegetation Clearing Permit (NVCP) needs to address 10 clearing principles as part of the permitting process. The 10 clearing principles are addressed with respect to the Survey Area in **Table 8.1**.

These clearing principles have been addressed generally rather than specifically because track alignments and drill pad locations are not yet known.

Table 8.1: Clearing Principles and the Koolanooka South Survey Area

Clearing principle		Survey Area
1	**Native vegetation should not be cleared if it comprises a high level of biological diversity.**	**Potentially at variance to this principle** The Survey Area lies within the 'Plant assemblages of the Koolanooka System (banded ironstone formation)' TEC. The vegetation types mapped in the Survey Area are similar to three of the community types described for the Koolanooka and Perenjori Hills (Meissner & Caruso, 2008). Four CSF species endemic to the Koolanooka (*Acacia graciliformis*, *Acacia muriculata*, *Drummondita rubroviridis*) or Koolanooka and Perenjori Hills (*Lepidosperma* sp. Koolanooka (K.R. Newbey 9336)) were located in the Survey Area. Twelve quadrats were assessed and traverses walked over approximately 87% of the Survey Area and 137 taxa were recorded. This compares with the 237 taxa recorded by Meissner & Caruso (2008) from 50 quadrats (and adjacent areas) sampled on the Koolanooka and Perenjori Hills. Eleven confirmed priority flora species were recorded in the Survey Area: six P1 species - *Acacia graciliformis* (937 plants), *Acacia muriculata* (872 plants), *Dodonaea scurra* (770 plants), *Drummondita rubroviridis* (808 plants), *Lepidosperma* sp. Koolanooka (K.R. Newbey 9336) (562 plants) and *Millotia dimorpha* (5,320 plants); one P2 species - *Baeckea* sp. Perenjori (J.W. Green 1516) (2,255 plants); and, four P3 species - *Melaleuca barlowii* (2 plants), *Mirbelia ferricola* (162 plants), *Persoonia pentasticha* (3 plants), *Stenanthemum poicilum* (167 plants). Two taxa of interest were recorded in the Survey Area – *Beyeria* aff. *minor* (61 plants) and *Labichea* sp. Koolanooka (1 plant).
2	**Native vegetation should not be cleared if it comprises the whole or part of, or is necessary for the maintenance of, a significant habitat for fauna indigenous to Western Australia.**	**Potentially at variance to this principle** While fauna habitat was not assessed by Maia, four old *Leipoa ocellata* (Malleefowl) (Threatened) mounds were recorded in the Survey Area and one malleefowl was sighted (**Map 10.17, Section 10**). Malleefowl is listed as a Vulnerable species under both the EPBC Act and WC Act. The native vegetation in the Survey Area does not comprise the only habitat for this species as the surrounding vegetation is similar to that in the Survey Area.

Clearing principle		Survey Area
3	**Native vegetation should not be cleared if it includes, or is necessary for the continued existence of, rare flora.**	**Not likely to be at variance to this principle** No threatened flora species were located in the Survey Area. The closest threatened flora record is approximately 3.9 km north-west of the Survey Area and it is a *Tecticornia bulbosa* record. This species is unlikely to be found in the habitats of the Survey Area.
4	**Native vegetation should not be cleared if it comprises the whole or a part of, or is necessary for the maintenance of a TEC.**	**At variance to this principle** The Survey Area is in and comprises a part of the 'Plant Assemblages of the Koolanooka System' TEC. The vegetation types recorded in the Survey Area are similar to three of the community types described for the Koolanooka and Perenjori Hills (Meissner & Caruso, 2008).
5	**Native vegetation should not be cleared if it is significant as a remnant of native vegetation in an area that has been extensively cleared.**	**Not likely to be at variance to this principle** While native vegetation in the Avon Wheatbelt bioregion has been extensively cleared, approximately 72% of BVA 693 currently remains in the Avon Wheatbelt bioregion (GoWA, 2018a). The vegetation on the Koolanooka Hills is not highly fragmented. If the whole of the Survey Area were to be cleared, the impact to the current extent of BVA 693 would be 1.17% and 70.66% of its pre-European extent would still remain. Currently, 1.86% (0.70 ha) of the Survey Area is disturbed and 98.14% (36.87 ha) is intact native vegetation. While the vegetation in the flat surrounding areas has been cleared for agriculture, and the vegetation in the Avon Wheatbelt has been extensively cleared, the vegetation of the Koolanooka Hills is relatively intact. The Survey Area is not a significant remnant of vegetation in an area that has been locally extensively cleared.
6	**Native vegetation should not be cleared if it is growing in, or in association with, an environment associated with a watercourse or wetland.**	**Not at variance to this principle** The Survey Area does not include or form part of any significant wetlands or watercourses listed by the Federal or WA governments. None of the vegetation types mapped in the Survey Area are associated with drainage lines and no drainage lines are mapped in the Survey Area.
7	**Native vegetation should not be cleared if the clearing of the vegetation is likely to cause appreciable land degradation.**	**Not likely to be at variance to this principle** Drill pads and associated tracks will be cleared in the Survey Area. The Survey Area is in areas that have been rated for land instability, flood risk, water erosion risk and wind erosion risk. The risk ratings are: • Land instability risk: <3% of map unit having moderate to high hazard of land instability (GoWA, 2018c); • Flood risk: <3% moderate to high hazard of flooding (GoWA, 2018d); • Water erosion risk: 3-10% very high to extreme hazard of water erosion in the majority of the Survey Area and the southern end mapped within a unit of <3% of the unit as very high to extreme hazard (GoWA, 2018e);

Clearing principle		Survey Area
		• Wind erosion risk: <3% of the map unit having high to extreme hazard of wind erosion in the majority of the Survey Area and 50-70% of the other map unit with 50-70% of its area rated as having high to extreme hazard (GoWA, 2018f). Based on these ratings and the relatively small areas that will be cleared within a relatively large vegetated area, the clearing for tracks and drill pads is unlikely to cause appreciable land degradation.
8	**Native vegetation should not be cleared if the clearing of vegetation is likely to have an impact on the environmental values of any adjacent or nearby conservation area.**	**Not likely to be at variance to this principle** The Survey Area is not within or adjacent to a conservation area. The closest conservation area is Bowgarder Nature Reserve, which is approximately 9 km to the north-east of the Survey Area, and the clearing of tracks and drill pads in the Survey Area is unlikely to impact on the functioning of this reserve.
9	**Native vegetation should not be cleared if the clearing of the vegetation is likely to cause deterioration in the quality of surface or underground water.**	**Not likely to be at variance to this principle** There could be short term deterioration in the quality of water flowing over the land after clearing but this should cease once the disturbed soils become compacted with time. There are no water courses or wetlands in the Survey Area. It is unlikely that an exploration drilling program will cause the deterioration in the quality of underground water.
10	**Native vegetation should not be cleared if the clearing of the vegetation is likely to cause, or exacerbate, the incidence or intensity of flooding.**	**Not likely to be at variance to this principle** There are no water courses or wetlands in the Survey Area. Therefore it is unlikely that clearing for tracks and drill pads in the Survey Area will exacerbate the incidence or intensity of flooding in the local area.

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10 MAPS

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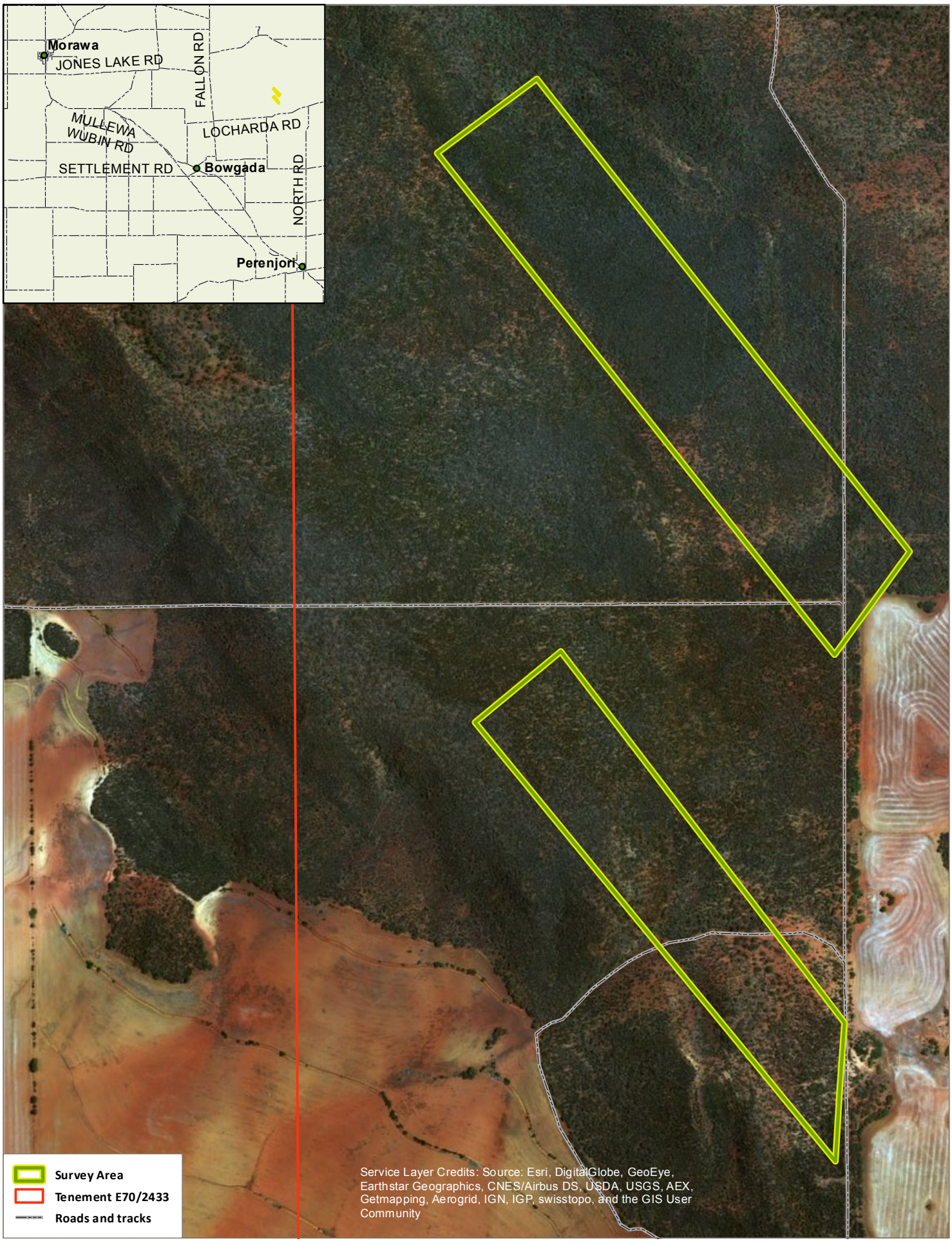

maia

Location Map

Survey Area

N

0 0.15

Kilometres

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Prepared for: SMC
Drawn by: SH
Date: 19/11/2018
Version: 1 **Size:** A4

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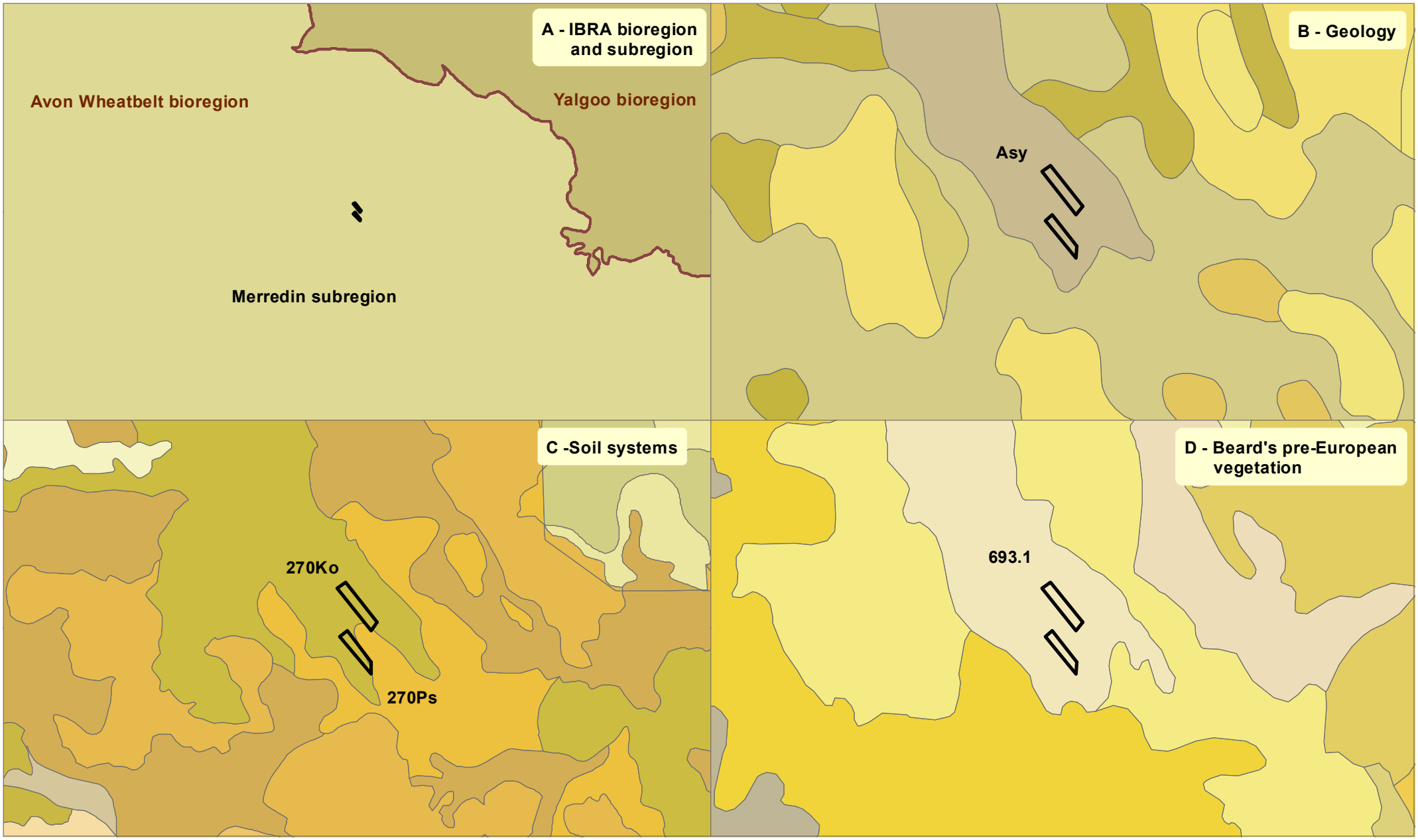

Location Map
Karatha
Newman
Wiluna
Geraldton
Kalgoorlie
Perth

Survey Area

IBRA Bioregion and Subregion, Geology, Soils and Beard's Pre-European Vegetation (Vegetation System Association)

maia

N

Datum: GDA 1994, MGA 50

Map: 10.2
Prepared for: SMC
Drawn by: SH
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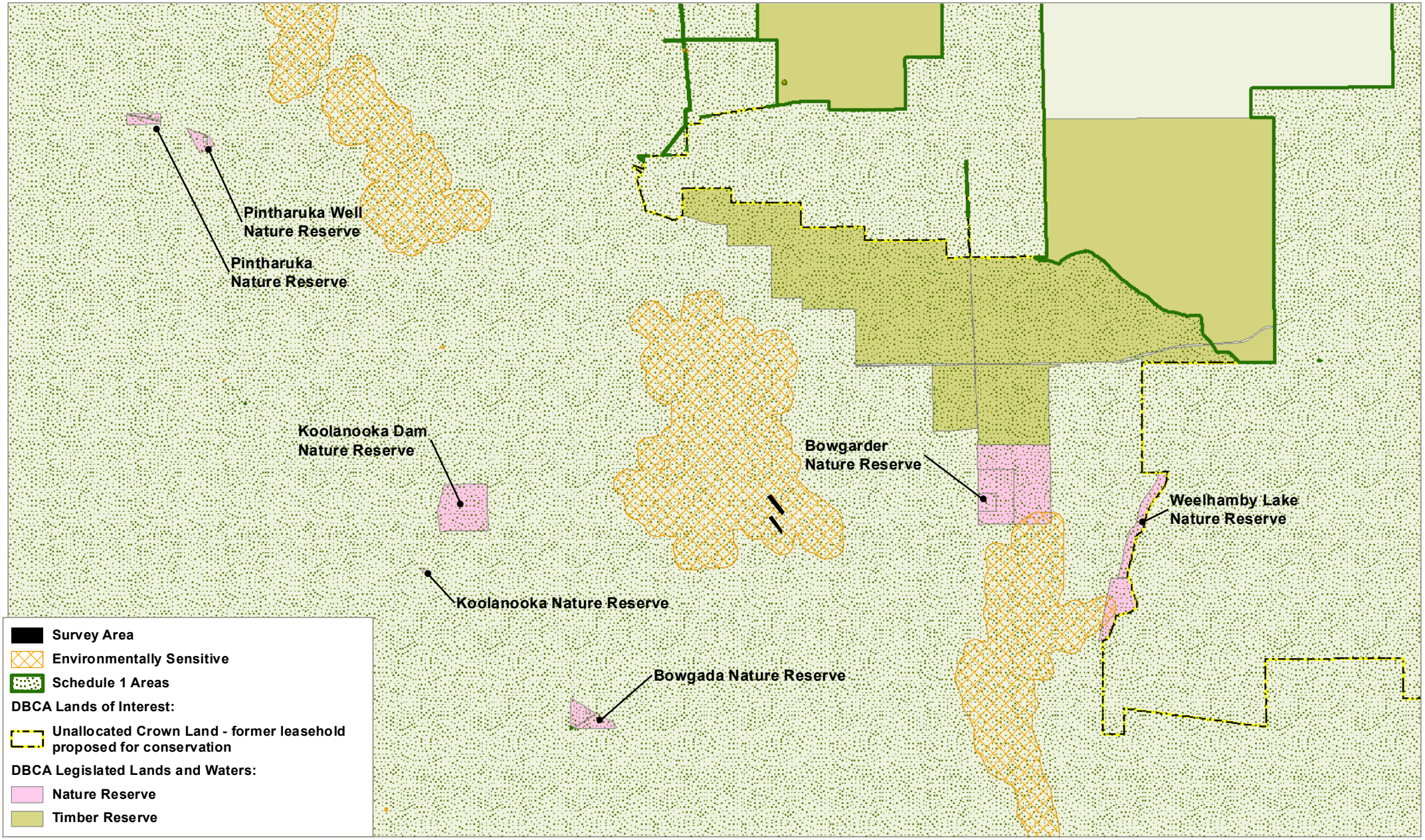

Location Map

Protected and Significant Areas

maia

N

0 5

Kilometres

Datum: GDA 1994, MGA 50

Map: 10.3
Prepared for: SMC
Drawn by: SH
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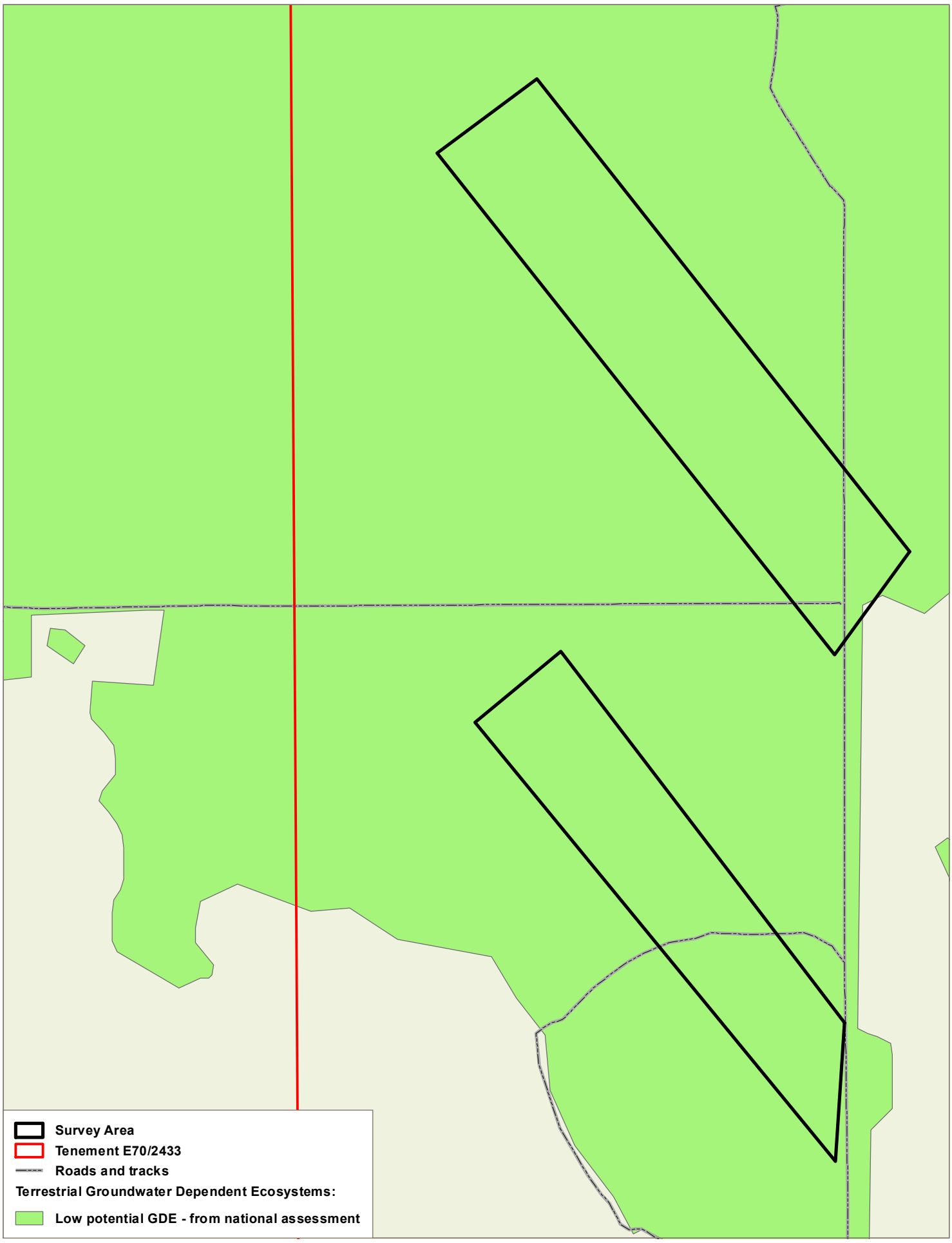

maia

Location Map

Terrestrial Groundwater Dependent Ecosystems

N

0 0.15

Kilometres

Datum: GDA 1994, MGA 50

Map: 10.4
Prepared for: SMC
Drawn by: SH
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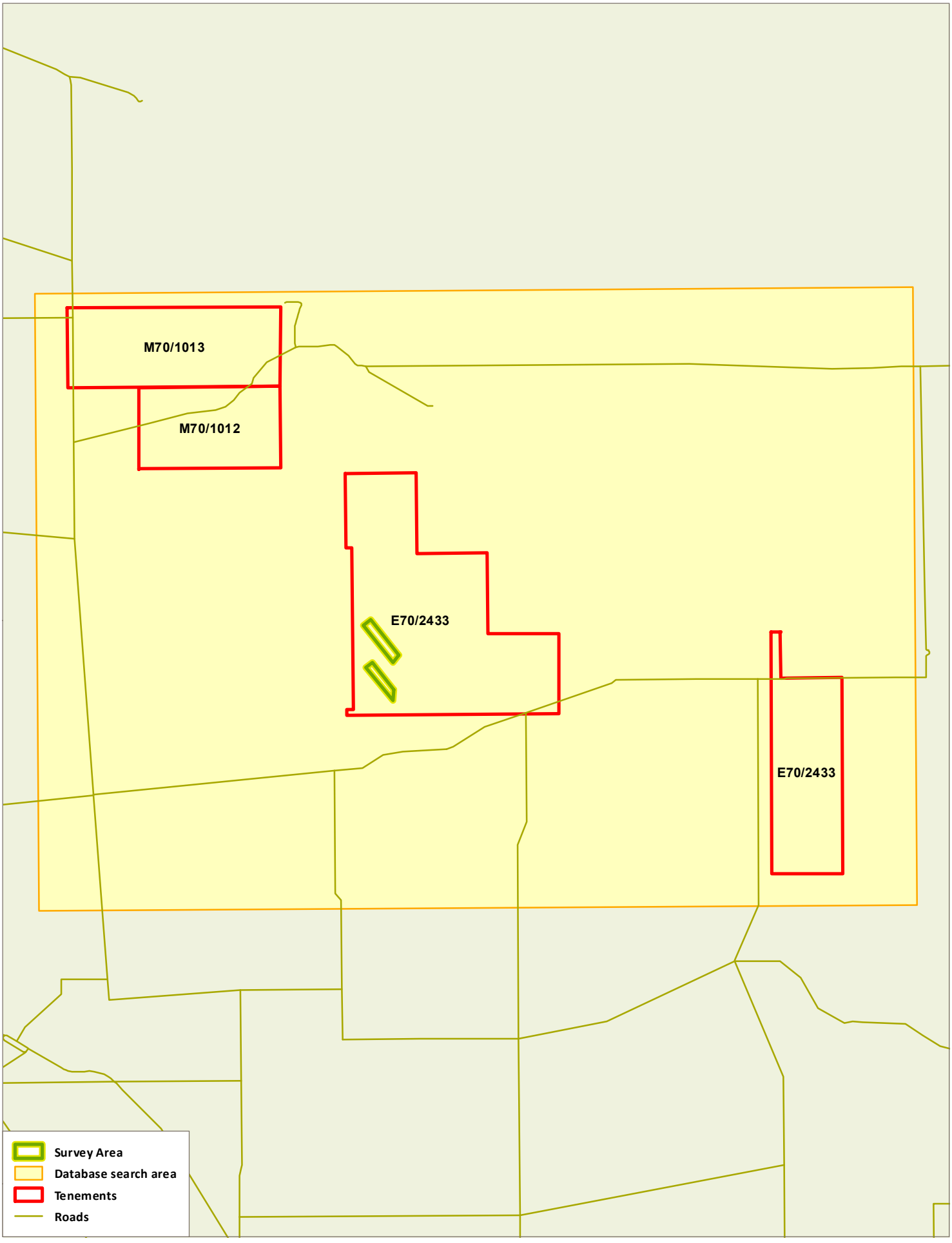

maia

Location Map

Database Search Area

N

0 2

Kilometres

Datum: GDA 1994, MGA 50

Map: 10.5

Prepared for: SMC

Drawn by: SH

Date: 19/11/2018

Version: 1 **Size:** A4

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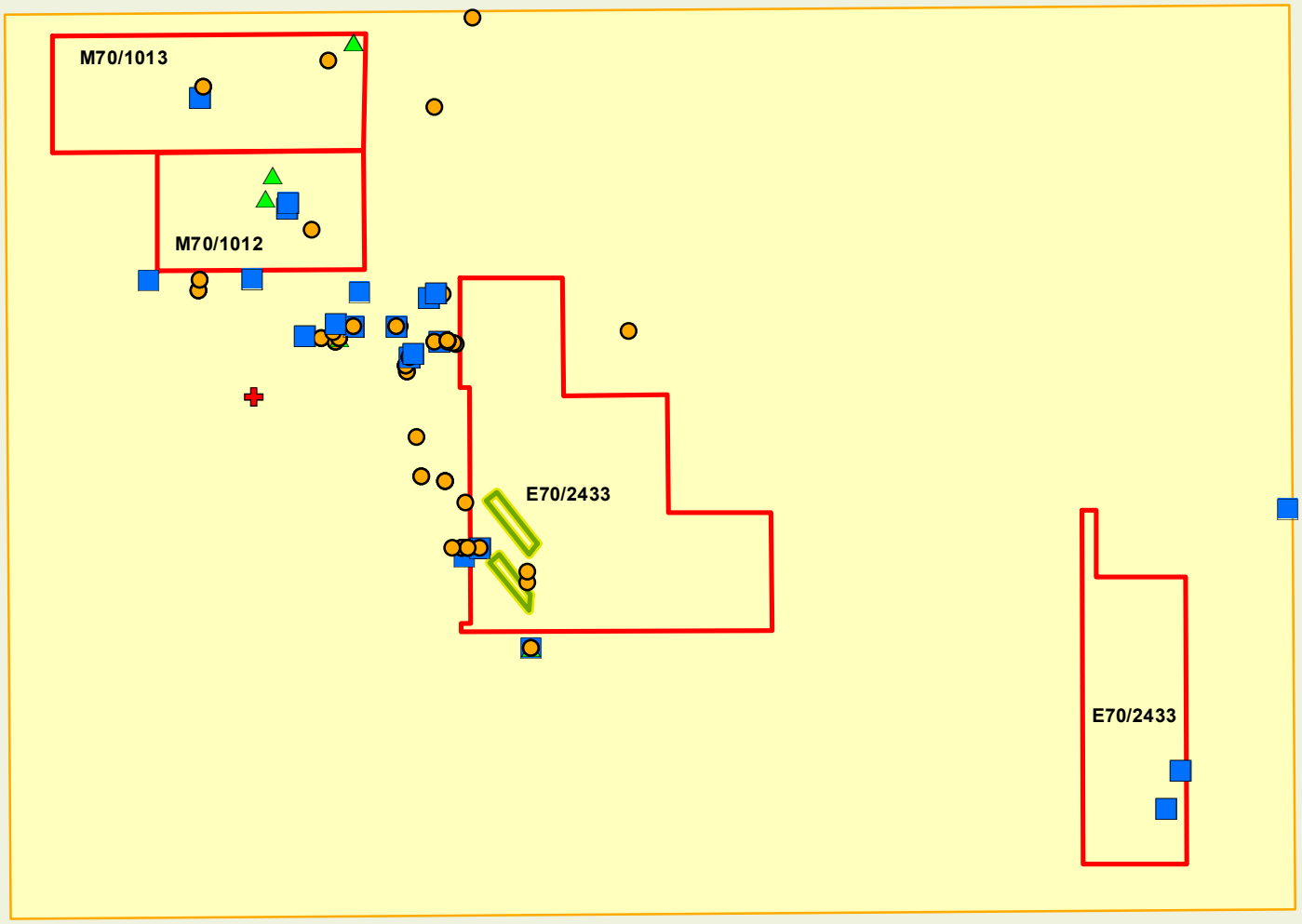

Survey Area
Database search area
Tenements
Conservation Significant Flora (DBCA search #27-0918FL)
T
P1
P2
P3

maia

Location Map
Karatha
Newman
Wiluna
Geraldton
Kalgoorlie
Perth

Conservation Significant Flora
DBCA TPFL and WAHERB Databases

N
0
2
Kilometres
Datum: GDA 1994, MGA 50

Map: 10.6
Prepared for: SMC
Drawn by: SH
Date: 22/11/2018
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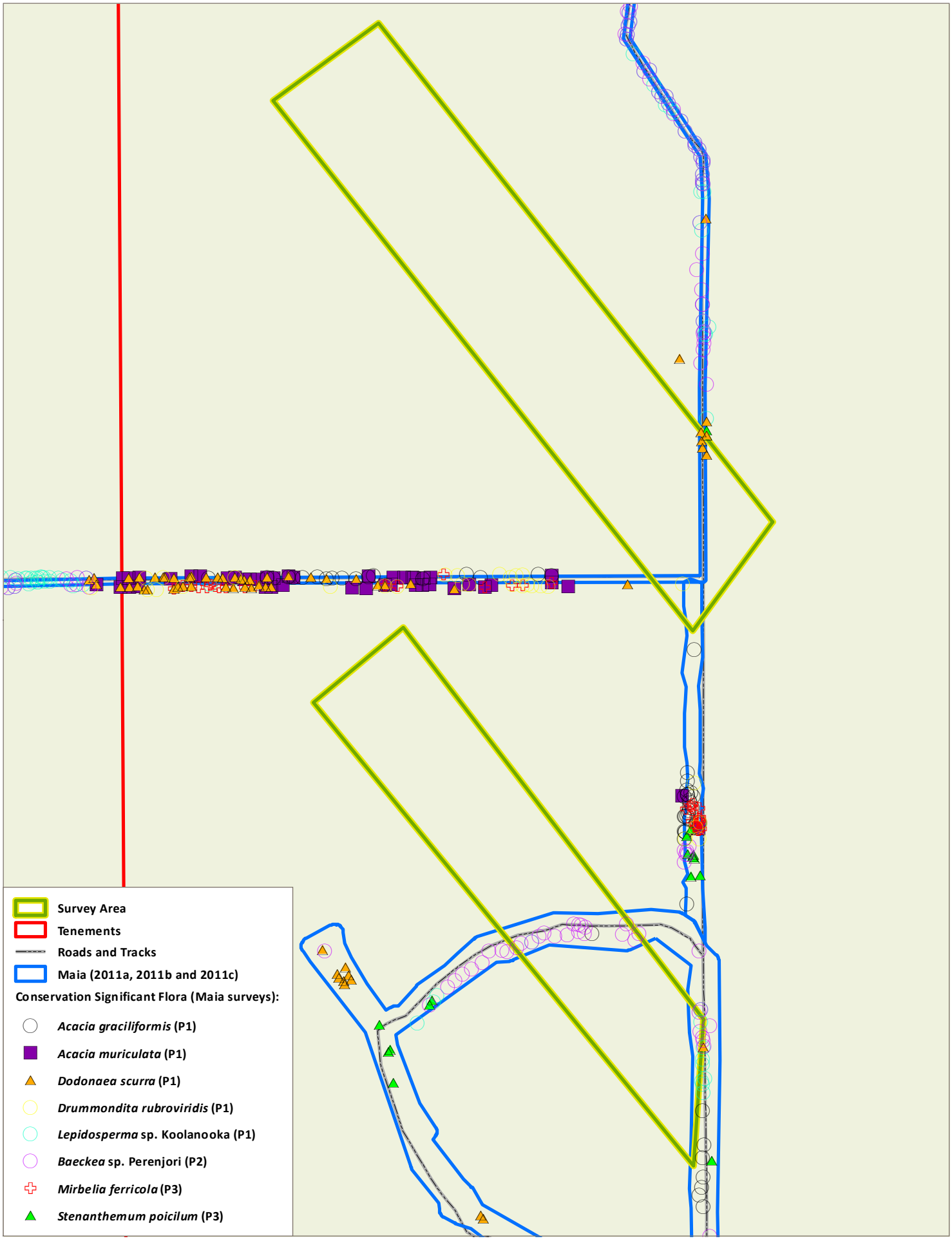

maia

Location Map

Conservation Significant Flora Maia (2011a, 2011b, 2011c)

N

0 0.125

Kilometres

Datum: GDA 1994, MGA 50

Map: 10.7
Prepared for: SMC
Drawn by: SH
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Version: 1 **Size:** A4

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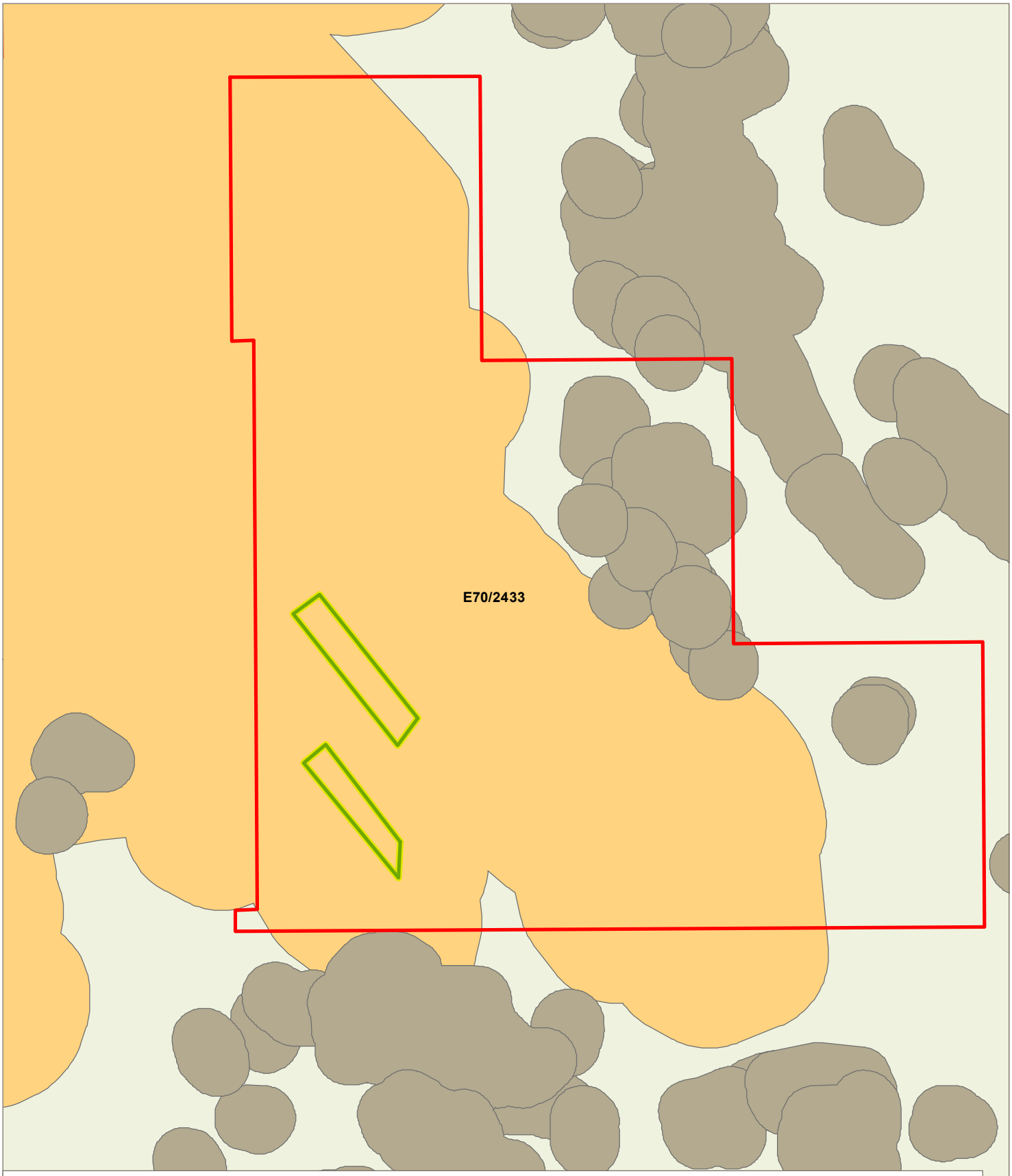

Survey Area

Tenements

Ecological Communities (DBCA search #27-0918EC):

Eucalypt woodlands of the Western Australian Wheatbelt (listed as a Priority 3 PEC in WA and Critically Endagered TEC nationally)

Plant assemblages of the Koolanooka System (banded ironstone formation) (listed as a Vulnerable TEC in WA)

maia

Location Map

Karatha
Newman
Wiluna
Geraldton
Kalgoorlie
Perth

Significant Ecological Communities

N

0 0.75

Kilometres

Datum: GDA 1994, MGA 50

Map: 10.8

Prepared for: SMC

Drawn by: SH

Date: 21/11/2018

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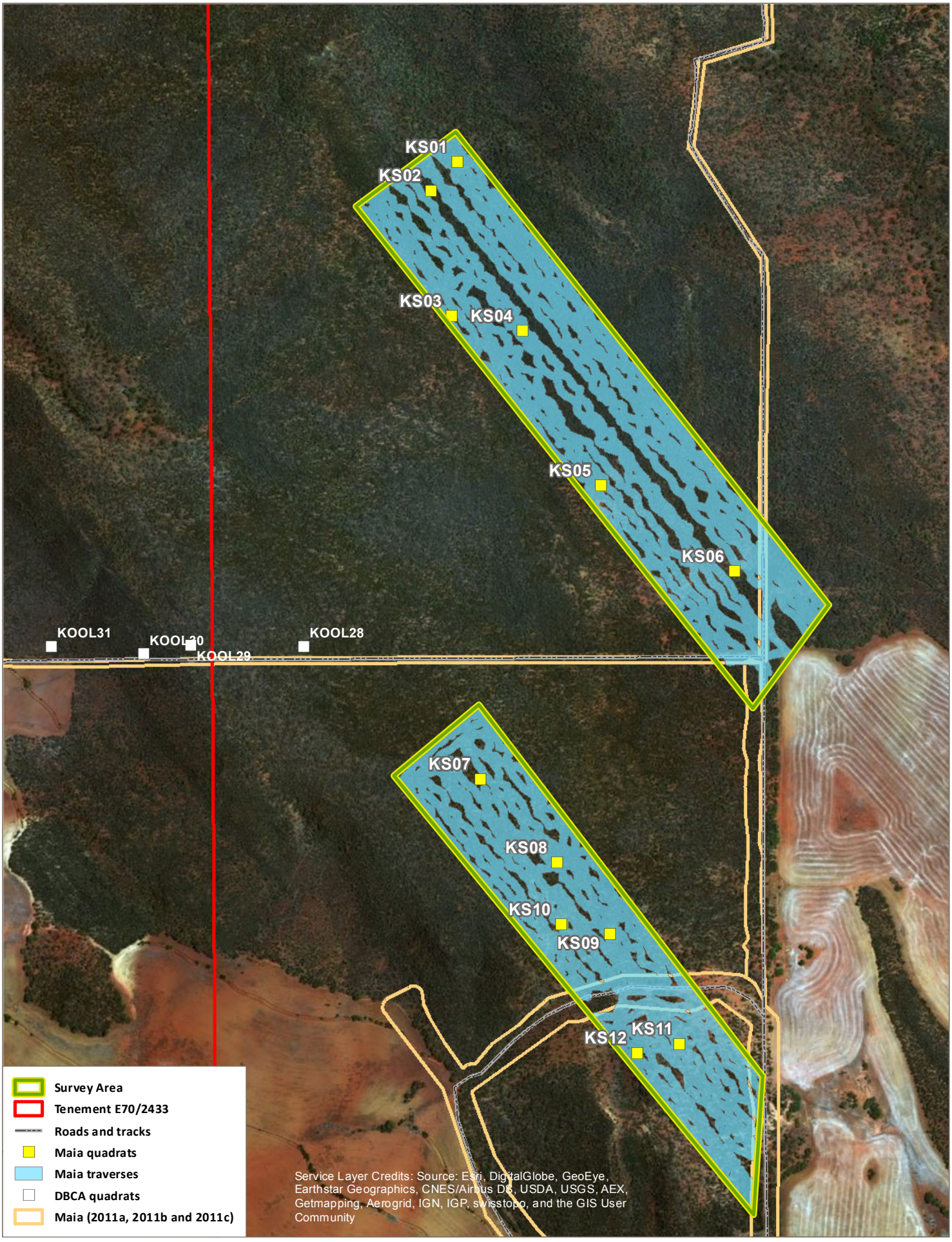

maia

Location Map

Quadrats and Traverses

N

0 0.125

Kilometres

Datum: GDA 1994, MGA 50

Map: 10.9
Prepared for: SMC
Drawn by: SH
Date: 22/11/2018
Version: 3 **Size:** A4

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maia

Location Map

Conservation Significant Flora Survey Area 2018

N

0 0.15

Kilometres

Datum: GDA 1994, MGA 50

Map: 10.10
Prepared for: SMC
Drawn by: SH
Date: 20/11/2018
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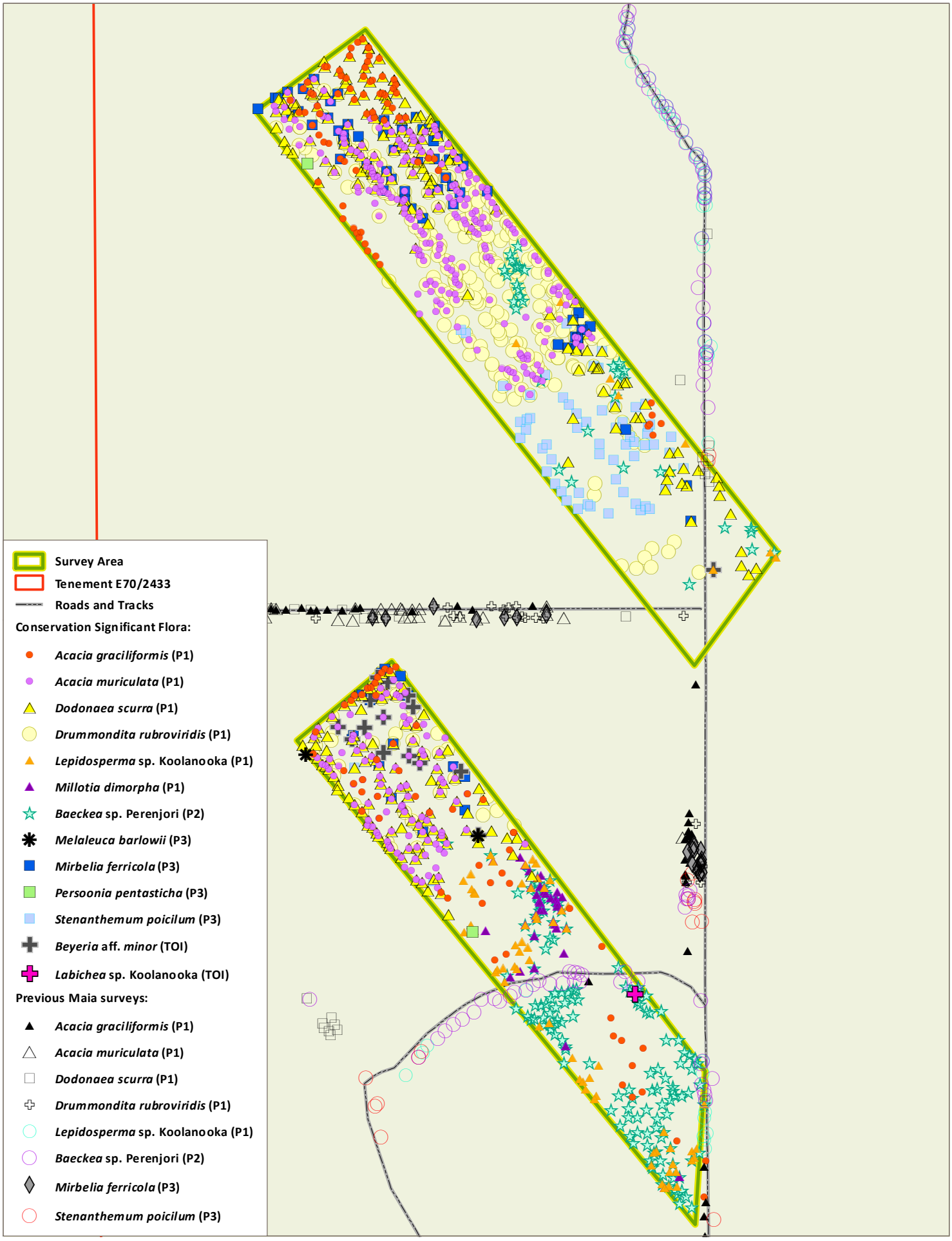

maia

Location Map

Conservation Significant Flora Survey Area 2011 and 2018

N

0 0.15

Kilometres

Datum: GDA 1994, MGA 50

Map: 10.11
Prepared for: SMC
Drawn by: SH
Date: 20/11/2018
Version: 1 **Size:** A4

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maia

Location Map

Karatha
Newman
Wiluna
Geraldton
Kalgoorlie
Perth

Conservation Significant Flora - Total Number of Plants

N

0 0.125

Kilometres

Datum: GDA 1994, MGA 50

Map: 10.12
Prepared for: SMC
Drawn by: SH
Date: 20/11/2018
Version: 1 **Size:** A4

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maia

Location Map

Karatha
Newman
Wiluna
Geraldton
Kalgoorlie
Perth

Conservation Significant Flora - Total Number of Species

N

0 0.125

Kilometres

Datum: GDA 1994, MGA 50

Map: 10.13
Prepared for: SMC
Drawn by: SH
Date: 20/11/2018
Version: 1 **Size:** A4

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maia

Location Map

Conservation Significant Flora - Priority 1 Species Presence

N

0 0.125

Kilometres

Datum: GDA 1994, MGA 50

Map: 10.14

Prepared for: SMC

Drawn by: SH

Date: 20/11/2018

Version: 1 **Size:** A4

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maia

Location Map

Karatha
Newman
Wiluna
Geraldton
Kalgoorlie
Perth

Conservation Significant Flora - Total Scores

N

0 0.125

Kilometres

Datum: GDA 1994, MGA 50

Map: 10.15
Prepared for: SMC
Drawn by: SH
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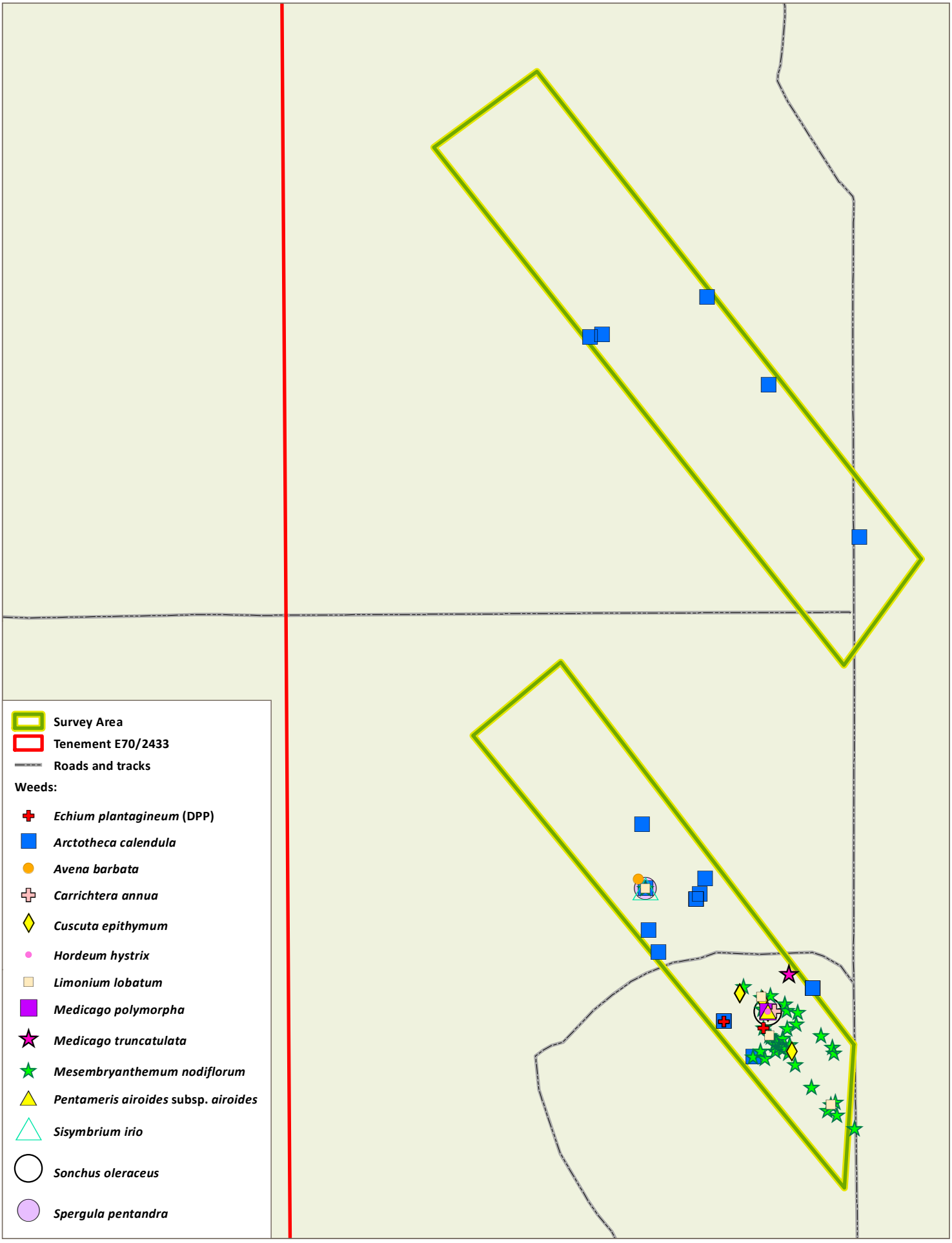

maia

Location Map

Weeds

N

0 0.125

Kilometres

Datum: GDA 1994, MGA 50

Map: 10.16
Prepared for: SMC
Drawn by: SH
Date: 29/11/2018
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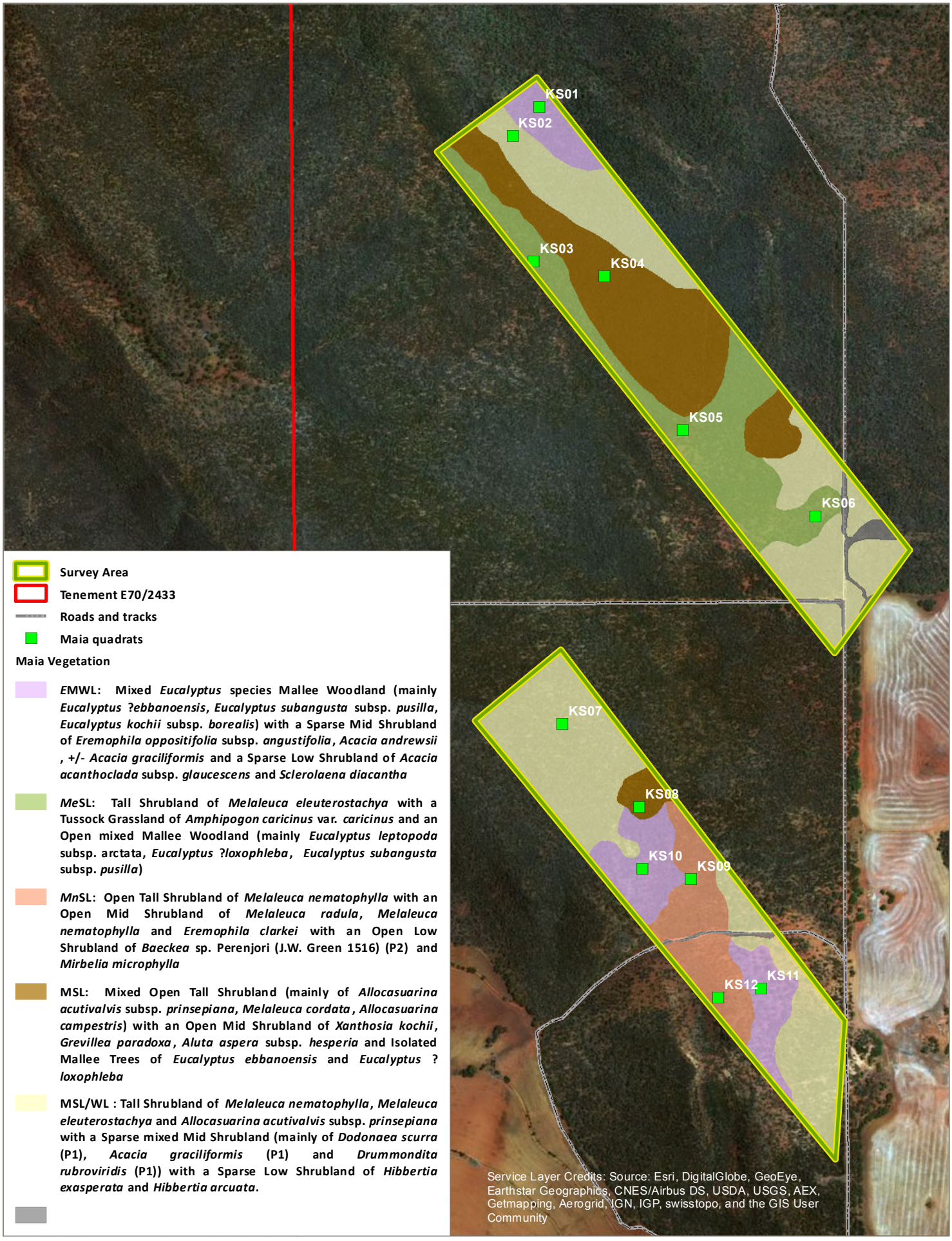

Survey Area

Tenement E70/2433

Roads and tracks

Maia quadrats

Maia Vegetation

*E*MWL: Mixed *Eucalyptus* species Mallee Woodland (mainly *Eucalyptus ?ebbanoensis*, *Eucalyptus subangusta* subsp. *pusilla*, *Eucalyptus kochii* subsp. *borealis*) with a Sparse Mid Shrubland of *Eremophila oppositifolia* subsp. *angustifolia*, *Acacia andrewsii* , +/- *Acacia graciliformis* and a Sparse Low Shrubland of *Acacia acanthoclada* subsp. *glaucescens* and *Sclerolaena diacantha*

*Me*SL: Tall Shrubland of *Melaleuca eleuterostachya* with a Tussock Grassland of *Amphipogon caricinus* var. *caricinus* and an Open mixed Mallee Woodland (mainly *Eucalyptus leptopoda* subsp. arctata, *Eucalyptus ?loxophleba*, *Eucalyptus subangusta* subsp. *pusilla*)

*Mn*SL: Open Tall Shrubland of *Melaleuca nematophylla* with an Open Mid Shrubland of *Melaleuca radula*, *Melaleuca nematophylla* and *Eremophila clarkei* with an Open Low Shrubland of *Baeckea* sp. Perenjori (J.W. Green 1516) (P2) and *Mirbelia microphylla*

MSL: Mixed Open Tall Shrubland (mainly of *Allocasuarina acutivalvis* subsp. *prinsepiana*, *Melaleuca cordata*, *Allocasuarina campestris*) with an Open Mid Shrubland of *Xanthosia kochii*, *Grevillea paradoxa*, *Aluta aspera* subsp. *hesperia* and Isolated Mallee Trees of *Eucalyptus ebbanoensis* and *Eucalyptus ? loxophleba*

MSL/WL : Tall Shrubland of *Melaleuca nematophylla*, *Melaleuca eleuterostachya* and *Allocasuarina acutivalvis* subsp. *prinsepiana* with a Sparse mixed Mid Shrubland (mainly of *Dodonaea scurra* (P1), *Acacia graciliformis* (P1) and *Drummondita rubroviridis* (P1)) with a Sparse Low Shrubland of *Hibbertia exasperata* and *Hibbertia arcuata*.

maia

Location Map

Maia Vegetation Types

N

0 0.125

Kilometres

Datum: GDA 1994, MGA 50

Map: 10.17

Prepared for: SMC

Drawn by: SH

Date: 20/11/2018

Version: 1 **Size:** A4

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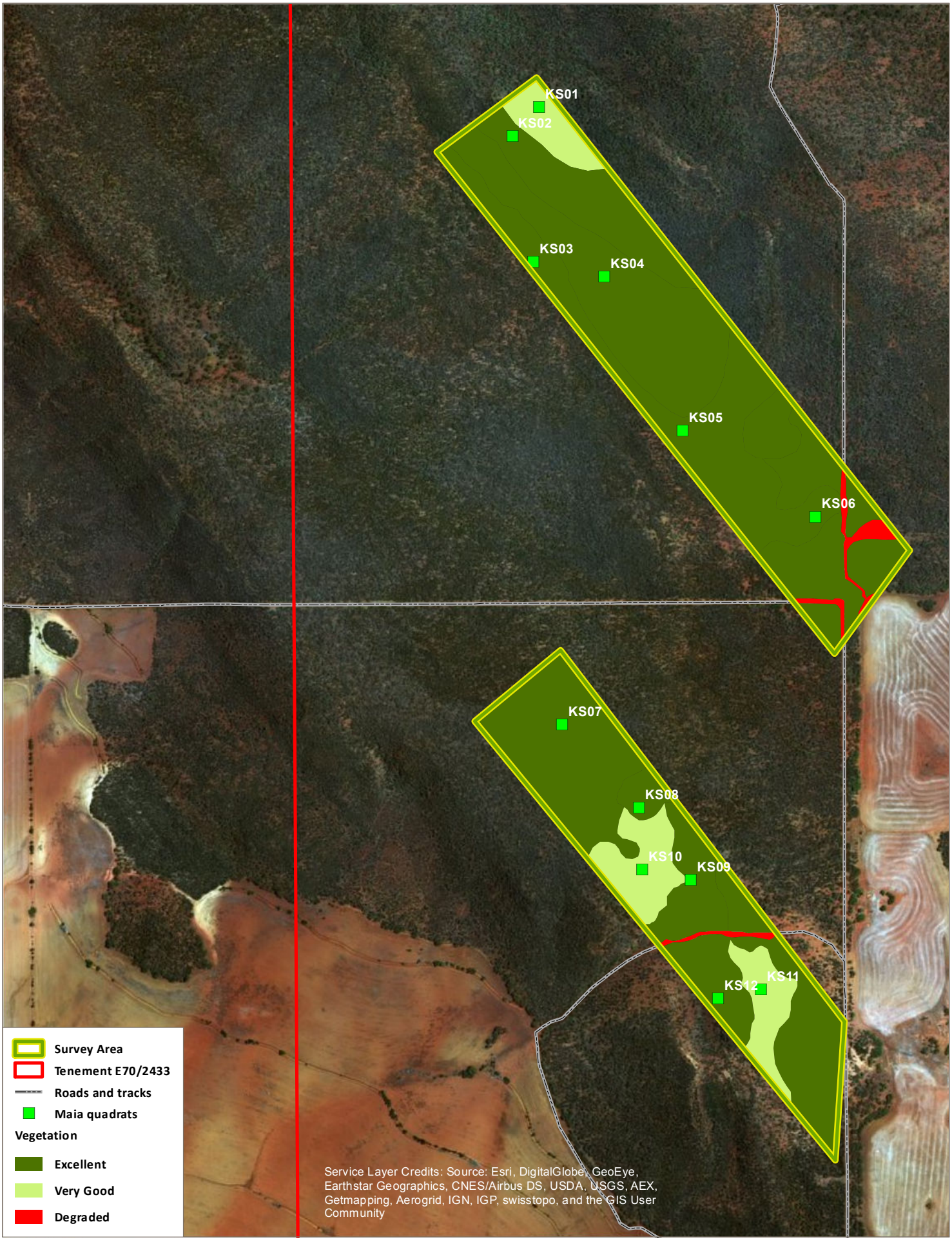

maia

Location Map

Vegetation Condition

N

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Kilometres

Datum: GDA 1994, MGA 50

Map: 10.18
Prepared for: SMC
Drawn by: SH
Date: 20/11/2018
Version: 1 **Size:** A4

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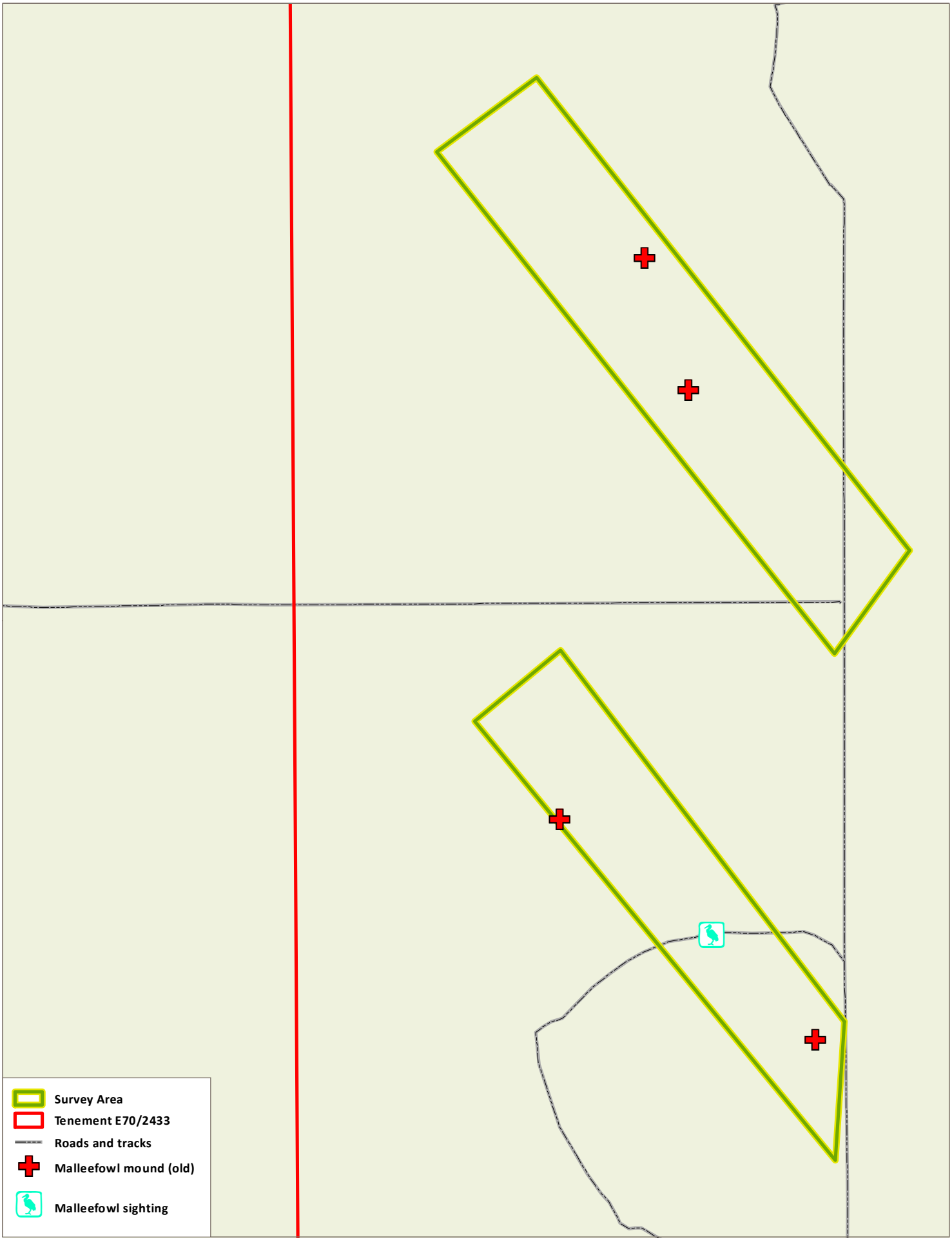

maia

Location Map

Karatha
Newman
Wiluna
Geraldton
Kalgoorlie
Perth

Malleefowl Mounds and Sighting

N

0 0.125

Kilometres

Datum: GDA 1994, MGA 50

Map: 10.19
Prepared for: SMC
Drawn by: SH
Date: 20/11/2018
Version: 1 **Size:** A4

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APPENDIX 1: DATABASE SEARCH RESULTS

Figure A1.1: EPBC Act Protected Matters Search Tool Results (I84TJ3, DotEE 2018a)

Australian Government
Department of the Environment and Energy

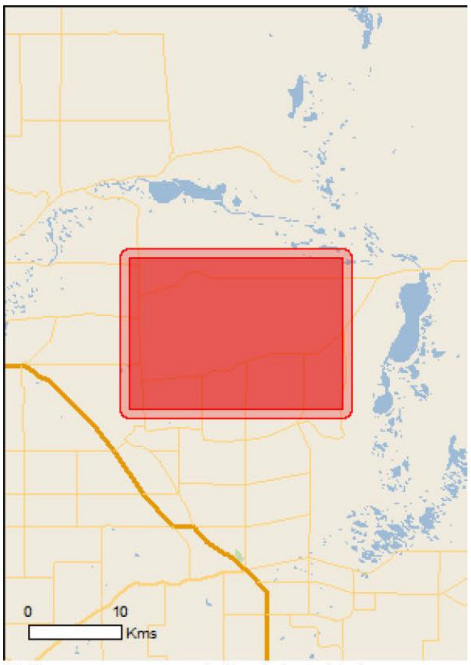
EPBC Act Protected Matters Report

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.

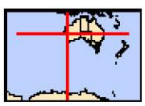
Information is available about Environment Assessments and the EPBC Act including significance guidelines, forms and application process details.

Report created: 07/11/18 13:33:33



This map may contain data which are ©Commonwealth of Australia (Geoscience Australia), ©PSMA 2010

Coordinates
Buffer: 1.0Km



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:	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	None
Listed Threatened Ecological Communities:	1
Listed Threatened Species:	19
Listed Migratory Species:	6

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:	12
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:	2
Regional Forest Agreements:	None
Invasive Species:	12
Nationally Important Wetlands:	None
Key Ecological Features (Marine)	None

Details

Matters of National Environmental Significance

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
Eucalypt Woodlands of the Western Australian Wheatbelt	Critically Endangered	Community likely to occur within area

Listed Threatened Species [Resource Information]

Name	Status	Type of Presence
Birds		
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Calyptorhynchus latirostris Carnaby's Cockatoo, Short-billed Black-Cockatoo [59523]	Endangered	Breeding likely to occur within area
Leipoa ocellata Malleefowl [934]	Vulnerable	Species or species habitat known to occur within area
Pezoporus occidentalis Night Parrot [59350]	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 area
Mammals		
Dasyurus geoffroii Chuditch, Western Quoll [330]	Vulnerable	Species or species habitat may occur within area
Other		
Idiosoma nigrum Shield-backed Trapdoor Spider, Black Rugose Trapdoor Spider [66798]	Vulnerable	Species or species habitat known to occur within area
Plants		
Acacia cochlocarpa subsp. cochlocarpa Spiral-fruited Wattle [23877]	Endangered	Species or species habitat may occur within area
Chorizema humile Prostrate Flame Pea [32573]	Endangered	Species or species habitat may occur within area
Dasymalla axillaris Native Foxglove [38829]	Critically Endangered	Species or species habitat likely to occur within area

Name	Status	Type of Presence
Eremophila nivea Silky Eremophila [14431]	Endangered	Species or species habitat likely to occur within area
Eremophila viscida Varnish Bush [2394]	Endangered	Species or species habitat may occur within area
Eucalyptus beardiana Beard's Mallee [18933]	Vulnerable	Species or species habitat may occur within area
Eucalyptus synandra Jingymia Mallee [3753]	Vulnerable	Species or species habitat likely to occur within area
Frankenia conferta Silky Frankenia [6074]	Endangered	Species or species habitat may occur within area
Gyrostemon reticulatus Net-veined Gyrostemon [8491]	Critically Endangered	Species or species habitat likely to occur within area
Roycea pycnophylloides Saltmat [21161]	Endangered	Species or species habitat likely to occur within area
Tecticornia bulbosa Large-articled Samphire [82741]	Vulnerable	Species or species habitat likely to occur within area
Reptiles		
Egernia stokesii badia Western Spiny-tailed Skink, Baudin Island Spiny-tailed Skink [64483]	Endangered	Species or species habitat known to 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 may occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may 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 may 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 likely to occur within area
Ardea ibis Cattle Egret [59542]		Species or species habitat may occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area
Chrysococcyx osculans Black-eared Cuckoo [705]		Species or species habitat 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
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 likely to occur within area

Extra Information

State and Territory Reserves [Resource Information]

Name	State
Bowgarder	WA
Kadji Kadji	WA

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		
Streptopelia senegalensis Laughing Turtle-dove, Laughing Dove [781]		Species or species habitat likely to occur within area
Mammals		
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
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 rattus Black Rat, Ship Rat [84]		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		
Carrichtera annua Ward's Weed [9511]		Species or species habitat may occur within area
Cenchrus ciliaris Buffel-grass, Black Buffel-grass [20213]		Species or species habitat may occur within area
Chrysanthemoides monilifera Bitou Bush, Boneseed [18983]		Species or species habitat may 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

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

-29.17889 116.17722,-29.17889 116.38389,-29.30667 116.38417,-29.30667 116.17722,-29.17889 116.17722

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.

Figure A1.2: NatureMap Search Results (DPaW, 2007-)

Created By Scott Hitchcock on 07/11/2018

Kingdom Plantae
Core Datasets Only Yes
Method 'By Polygon'
Vertices 29° 10' 44" S,116° 10' 37" E 29° 10' 44" S,116° 23' 02" E 29° 18' 24" S,116° 23' 03" E 29° 18' 24" S,116° 10' 37" E
Group By Conservation Status

Conservation Status	Species	Records
Non-conservation taxon	359	2171
Priority 1	9	157
Priority 2	2	12
Priority 3	7	56
Rare or likely to become extinct	1	1
TOTAL	378	2397

	Name ID	Species Name	Naturalised	Conservation Code	†Endemic To Query Area
Rare or likely to become extinct					
1.	31617	*Tecticornia bulbosa (Large-articled Samphire)*		T	
Priority 1					
2.	31032	*Acacia graciliformis*		P1	
3.	31033	*Acacia muriculata*		P1	Y
4.	29912	*Caesia sp. Koolanooka Hills (R. Meissner & Y. Caruso 76)*		P1	
5.	31880	*Dodonaea scurra*		P1	
6.	31831	*Drummondita rubroviridis*		P1	Y
7.	19203	*Hemigenia sp. major (C.A. Gardner 2677)*		P1	
8.	30435	*Lepidosperma sp. Koolanooka (K.R. Newbey 9335)*		P1	
9.	14335	*Millotia dimorpha*		P1	
10.	29914	*Sclerolaena sp. Koolanooka Hills (R. Meissner & Y. Caruso 437)*		P1	Y
Priority 2					
11.	19464	*Aluta aspera subsp. localis*		P2	
12.	14475	*Baeckea sp. Perenjori (J.W. Green 1616)*		P2	
Priority 3					
13.	17232	*Austrostipa blackii*		P3	
14.	19972	*Enekbatus longistylus*		P3	
15.	18275	*Melaleuca barlowii*		P3	
16.	41443	*Mirbelia ferricola*		P3	
17.	14569	*Persoonia pentasticha*		P3	
18.	13243	*Rhodanthe collina*		P3	
19.	14233	*Stenanthemum policium*		P3	
Non-conservation taxon					
20.		*Abutilon sp. Indet*			
21.	14613	*Acacia acanthoclada subsp. glaucescens*			
22.	3200	*Acacia acuminata (Jam, Mangard)*			
23.	3216	*Acacia andrewsii*			
24.	12247	*Acacia anthochaera*			
25.	15467	*Acacia assimilis subsp. assimilis*			
26.	3248	*Acacia burkittii (Sandhill Wattle)*			
27.	15472	*Acacia caveata*			
28.	3269	*Acacia coolgardiensis (Spinifex Wattle)*			
29.	15276	*Acacia coolgardiensis subsp. coolgardiensis*			
30.	3285	*Acacia daviesioides*			
31.	3315	*Acacia durfuscula*			
32.	3324	*Acacia erinacea*			
33.	3330	*Acacia exocarpoides*			
34.	3395	*Acacia libberdingensis*			
35.	3403	*Acacia kochii*			
36.	32116	*Acacia latior*			

NatureMap is a collaborative project of the Department of Parks and Wildlife and the Western Australian Museum.

Page 1

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
37.	15477	*Acacia lineolata subsp. lineolata*			
38.	3452	*Acacia murrayana (Sandplain Wattle)*			
39.	15290	*Acacia neurophylla subsp. erugata*			
40.	15291	*Acacia neurophylla subsp. neurophylla*			
41.	3458	*Acacia nigripilosa*			
42.	15479	*Acacia nigripilosa subsp. nigripilosa*			
43.	3495	*Acacia prainii (Prain's Wattle)*			
44.	3510	*Acacia ramulosa (Horse Mulga)*			
45.	19499	*Acacia ramulosa var. ramulosa*			
46.	8949	*Acacia sibirica (Bastard Mulga)*			
47.		*Acacia sp. Koolanooka Hills falcate (R. Meissner & Y. Caruso 64)*			Y
48.	29110	*Acacia sp. narrow phyllode (B.R. Maslin 7631)*			
49.	15294	*Acacia stereophylla var. stereophylla*			
50.	3577	*Acacia tetragonophylla (Kurara, Wakalpuka)*			
51.	3586	*Acacia tysonii*			
52.	31071	*Acacia umbraculiformis*			
53.	17739	*Acetosa vesicaria*	Y		
54.	7817	*Actinobole uliginosum (Flannel Cudweed)*			
55.	184	*Aira caryophyllea (Silvery Hairgrass)*	Y		
56.	1720	*Allocasuarina acutivalvis*			
57.	13904	*Allocasuarina acutivalvis subsp. acutivalvis*			
58.	13905	*Allocasuarina acutivalvis subsp. prinseplana*			
59.	1721	*Allocasuarina campestris*			
60.	1725	*Allocasuarina dielsiana (Northern Sheoak)*			
61.	19465	*Aluta aspera subsp. hesperia*			
62.	4905	*Alyogyne hakeifolia*			
63.	6565	*Alyxia buxifolia (Dysentery Bush)*			
64.	196	*Amphipogon caricinus (Long Greybeard Grass)*			
65.		*Amphipogon caricinus - strictus complex*			
66.	12025	*Amphipogon caricinus var. caricinus*			
67.	2382	*Amyema nestor*			
68.	40910	*Androcalva luteiflora (Yellow-flowered Rulingia)*			
69.	7838	*Arctotheca calendula (Cape Weed, African Marigold)*	Y		
70.	207	*Aristida contorta (Bunched Kerosene Grass)*			
71.		*Aristida sp.*			
72.	1265	*Arthropodium curvipes*			
73.	1266	*Arthropodium dyeri*			
74.		*Arthropodium sp. indet*			
75.	6336	*Astroloma serratifolium (Kondrung)*			
76.	17950	*Austrodanthonia caespitosa*			
77.	20369	*Austrodanthonia sp. Goomalling (A.G. Gunness et al. OAKP 10/63)*			
78.	17237	*Austrostipa elegantissima*			
79.	17238	*Austrostipa eremophila*			
80.	17241	*Austrostipa hemipogon*			
81.	17251	*Austrostipa scabra*			
82.		*Austrostipa sp. indet*			
83.	17255	*Austrostipa trichophylla*			
84.	234	*Avena fatua (Wild Oat)*	Y		
85.	7852	*Bellida graminea (Rosy Bellida)*			
86.	4598	*Beyeria lechenaultii (Pale Turpentine Bush)*			
87.	34261	*Beyeria minor*			
88.	7856	*Blennospora drummondii*			
89.	7870	*Brachyscome chelocarpa*			
90.	7872	*Brachyscome cilliocarpa*			
91.	7882	*Brachyscome perpusilla*			
92.		*Brachyscome sp.indet*			
93.	3000	*Brassica tournefortii (Mediterranean Turnip)*	Y		
94.	252	*Bromus madritensis (Madrid Brome)*	Y		
95.	253	*Bromus rubens (Red Brome)*	Y		
96.	7413	*Brunonia australis (Native Cornflower)*			
97.	1366	*Bulbine semibarbata (Leek Lily)*			
98.	15445	*Caesia alfordii*			
99.	29439	*Caesia sp. Wongan (K.F. Kenneally 8620)*			
100.	1595	*Caladenia hirta (Sugar Candy Orchid)*			
101.	15355	*Caladenia hirta subsp. rosea*			
102.	18026	*Caladenia pendens subsp. pendens*			
103.	30796	*Caladenia petrensis*			
104.		*Calandrinia aff. eremaea (smooth testa, metallic) (A. Markey & S. Dillon 3472)*			
105.	44184	*Calandrinia baccata*			
106.	2846	*Calandrinia calyptrata (Pink Purslane)*			

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
107.	2853	*Calandrinia eremaea (Twining Purslane)*			
108.		*Calandrinia eremaea complex (RM & JW 2414)*			
109.	40826	*Calandrinia flava*			
110.	2863	*Calandrinia primuliflora*			
111.	20478	*Calandrinia sp. Blackberry (D.M. Porter 171)*			
112.	19455	*Calandrinia sp. Bungalbin (G.J. Keighery & N. Gibson 1666)*			
113.	5395	*Callistemon phoeniceus (Lesser Bottlebrush, Dubarda)*			
114.	7895	*Calocephalus multiflorus (Yellow-top)*			
115.	5408	*Calothamnus gilesii*			
116.	7903	*Calotis hispidula (Blndy Eye)*			
117.	7905	*Calotis multicaulis (Many-stemmed Burr-daisy)*			
118.	16492	*Calycopeplus paucifolius*			
119.	2955	*Cassytha nodiflora*			
120.	7922	*Cephalipterum drummondii (Pompom Head)*			
121.	1216	*Chamaexeros macranthera*			
122.	5496	*Chamelaucium micranthum*			
123.	12796	*Cheilanthes adiantoides*			
124.	31	*Cheilanthes austrotenuifolia*			
125.	31768	*Cheiranthera simplicifolia*			
126.	7933	*Chthonocephalus pseudoevax (Wooly Groundheads)*			
127.	20406	*Cleretum papulosum*	Y		
128.	2778	*Codonocarpus cotinifolius (Native Poplar, Kundurangu)*			
129.	4555	*Comesperma integerrimum*			
130.	17701	*Crassula closiana*			
131.	3137	*Crassula colorata (Dense Stonecrop)*			
132.	11709	*Crassula colorata var. acuminata*			
133.	11563	*Crassula colorata var. colorata*			
134.	20268	*Crassula tetramera*			
135.	6663	*Cuscuta epithymum (Lesser Dodder, Greater Dodder)*	Y		
136.	11021	*Cuscuta planiflora*	Y		
137.	15400	*Cyanicula amplexans*			
138.	15405	*Cyanicula deformis*			
139.	279	*Cymbopogon ambiguus (Scentgrass)*			
140.	794	*Cyperus gymnocaulos (Spiny Flat-sedge)*			
141.	6218	*Daucus glochidiatus (Australian Carrot)*			
142.	3796	*Dawsiesia benthamii*			
143.	11367	*Dawsiesia benthamii subsp. benthamii*			
144.	11879	*Dawsiesia hakeoides subsp. hakeoides*			
145.	1259	*Dianella revoluta (Blueberry Lily)*			
146.	11636	*Dianella revoluta var. divaricata*			
147.	1289	*Dichopogon preissii*			
148.	18549	*Dicrastylis soliparma*			
149.	1509	*Dioscorea hastifolia (Warrine, Waramn)*			
150.	44161	*Diuris hazeliae*			
151.	15436	*Diuris pomifolia*			
152.	4752	*Dodonaea adenophora*			
153.	4760	*Dodonaea divaricata*			
154.	4766	*Dodonaea inaequifolia*			
155.	3092	*Drosera bulbosa (Red-leaved Sundew)*			
156.	3098	*Drosera glanduligera (Pimpernel Sundew)*			
157.	14298	*Drosera macrantha subsp. macrantha*			
158.	349	*Ehrharta longiflora (Annual Veldt Grass)*	Y		
159.		*Elymus sp.*			
160.	2510	*Enchylaena lanata*			
161.	7189	*Eremophila clarkei (Turpentine Bush)*			
162.	7198	*Eremophila deserti*			
163.	17576	*Eremophila latrobei subsp. latrobei*			
164.	17168	*Eremophila oldfieldii subsp. oldfieldii*			
165.	18570	*Eremophila oppositifolia subsp. angustifolia*			
166.	4335	*Erodium cygnorum (Blue Heronsbill)*			
167.	14377	*Erymophyllum ramosum subsp. ramosum*			
168.	12740	*Erymophyllum tenellum*			
169.	11978	*Eucalyptus celastroides subsp. virella*			
170.	5632	*Eucalyptus ebbanoensis (Sandplain Mallee)*			
171.	13549	*Eucalyptus ebbanoensis subsp. ebbanoensis*			
172.	18349	*Eucalyptus ebbanoensis subsp. glauciramula*			
173.	5641	*Eucalyptus ewartiana (Ewart's Mallee)*			
174.	19523	*Eucalyptus kochii subsp. amaryssia*			
175.	20303	*Eucalyptus kochii subsp. borealis*			
176.	11295	*Eucalyptus loxophleba subsp. loxophleba (York Gum)*			

	Name ID	Species Name	Naturalised	Conservation Code	Endemic To Query Area
177.	13038	*Eucalyptus loxophleba subsp. supralaevis*			
178.	5725	*Eucalyptus oldfieldii (Oldfield's Mallee)*			
179.	20060	*Eucalyptus oldfieldii subsp. oldfieldii*			
180.	5766	*Eucalyptus salmonophloia (Salmon Gum, Wurak)*			
181.	5767	*Eucalyptus salubris (Gimlet)*			
182.		*Eucalyptus sp. Indet*			
183.	12882	*Eucalyptus subangusta subsp. pusilla*			
184.	19816	*Eucalyptus wubinensis*			
185.	4620	*Euphorbia boophthona (Gascoyne Spurge)*			
186.	12622	*Feldstonia nitens*			
187.	904	*Gahnia drummondii*			
188.	12780	*Gilberta tenuifolia*			
189.	7977	*Gilruthia osbornei*			
190.	11008	*Gilruthia osbornii*			
191.	8002	*Gnephosis tenuissima*			
192.	6159	*Gonocarpus nodulosus*			
193.	7495	*Goodenia berardiana*			
194.	7527	*Goodenia mimuloides*			
195.	7531	*Goodenia occidentalis*			
196.	7535	*Goodenia pinnatifida (Cutleaf Goodenia)*			
197.	1988	*Grevillea didymobotrya*			
198.	2004	*Grevillea exoris*			
199.	16797	*Grevillea levis*			
200.	15984	*Grevillea obliquistigma subsp. funicularis*			
201.	15981	*Grevillea obliquistigma subsp. obliquistigma*			
202.	2057	*Grevillea paradoxa (Bottlebrush Grevillea)*			
203.	2068	*Grevillea pityophylla*			
204.	2809	*Gunniopsis rubra*			
205.	2182	*Hakea minyma*			
206.	2199	*Hakea recurva (Djarnokmurd)*			
207.	6180	*Halosarcia trigonocarpa*			
208.	33778	*Hemigenia botryphylla*			
209.	33781	*Hemigenia ciliata*			
210.		*Hemigenia sp.*			
211.	18402	*Hemigenia sp. Yuna (A.C. Burns 95)*			
212.		*Hibbertia aff. exasperata (RM & YC 66)*			Y
213.	14459	*Hibbertia arcuata*			
214.	5124	*Hibbertia exasperata*			
215.	19779	*Hibbertia glomerosa var. glomerosa*			
216.	12742	*Hyalosperma demissum*			
217.	15447	*Hyalosperma glutinosum subsp. glutinosum*			
218.	11973	*Hybanthus floribundus subsp. curvifolius*			
219.	6236	*Hydrocotyle pilifera*			
220.	8086	*Hypochaeris glabra (Smooth Catsear)*	Y		
221.	8087	*Isoetopsis graminifolia (Cushion Grass)*			
222.	11528	*Labichea lanceolata subsp. brevifolia*			
223.	468	*Lamarckia aurea (Goldentop)*	Y		
224.	13289	*Lawrencella davenportii*			
225.	13284	*Lawrencella rosea*			
226.	3033	*Lepidium oxytrichum*			
227.	930	*Lepidosperma costale*			
228.	4056	*Leptosema daviesioides*			
229.	7677	*Levenhookia stipitata (Common Stylewort)*			
230.	7402	*Lobelia gibbosa (Tall Lobelia)*			
231.	7409	*Lobelia winfridae (Little Lobelia)*			
232.	10957	*Lolium perenne x rigidum*	Y		
233.	2538	*Maireana carnosa (Cottony Bluebush)*			
234.	2544	*Maireana georgei (Satiny Bluebush)*			
235.	2550	*Maireana marginata*			
236.	2556	*Maireana planifolia (Low Bluebush)*			
237.		*Maireana planifolia x villosa*			
238.		*Maireana sp. Indet*			
239.	2566	*Maireana thesioides (Lax Bluebush)*			
240.	5866	*Malleostemon tuberculatus*			
241.		*Melaleuca aff. uncinata*			
242.	20284	*Melaleuca atroviridis*			
243.	5895	*Melaleuca conothamnoides*			
244.	5896	*Melaleuca cordata*			
245.	5908	*Melaleuca eleuterostachya*			
246.	19486	*Melaleuca hamata*			

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
247.	9183	*Melaleuca nematophylla (Wiry Honey-myrtle)*			
248.	5958	*Melaleuca radula (Graceful Honeymyrtle)*			
249.	2814	*Mesembryanthemum nodiflorum (Slender Iceplant)*	Y		
250.	6000	*Micromyrtus racemosa*			
251.	19406	*Micromyrtus racemosa var. racemosa*			
252.	8105	*Milotia myosotidifolia*			
253.	4094	*Mirbelia microphylla*			
254.	17048	*Mirbelia sp. Helena & Aurora (B.J. Lepschi 2003)*			
255.	4100	*Mirbelia spinosa*			
256.	490	*Monachather paradoxus*			
257.	8116	*Myriocephalus guerinae*			
258.	6976	*Nicotiana occidentalis (Native Tobacco)*			
259.	11734	*Nicotiana rosulata subsp. rosulata*			
260.	15450	*Olearia dampieri subsp. eremicola*			
261.	12734	*Olearia humilis*			
262.	8140	*Olearia muelleri (Goldfields Daisy)*			
263.	44401	*Olearia sp. Eremicola (Diels & Pritzel s.n. PERTH 00449628)*			
264.	12670	*Parietaria cardiostegia*			
265.	40424	*Pentameris airoides subsp. airoides*	Y		
266.	543	*Pentaschistis airoides (False Hairgrass)*	Y		
267.	24022	*Pentaschistis airoides subsp. airoides*	Y		
268.	19825	*Petrorhagia dubia*	Y		
269.	4504	*Phebalium tuberculosum*			
270.	20460	*Pheladenia deformis*			
271.	18537	*Philotheca brucei subsp. brucei*			
272.	18513	*Philotheca glabra*			
273.		*Phyllanglum sp.*			
274.	16824	*Phyllanglum sulcatum*			
275.	5233	*Pimelea avonensis*			
276.	11185	*Pimelea microcephala subsp. microcephala*			
277.	7299	*Plantago debilis*			
278.	6247	*Platysace cirrosa (Kama)*			
279.	45238	*Podolepis aristata subsp. affinis*			
280.	8172	*Podolepis canescens (Bright Podolepis, Grey Podolepis)*			
281.	8177	*Podolepis lessonii*			
282.	8184	*Podotheca gnaphalioides (Golden Long-heads)*			
283.	8188	*Pogonolepis stricta*			
284.	4691	*Poranthera microphylla (Small Poranthera)*			
285.	2718	*Ptilotus drummondii (Narrowleaf Mulla Mulla)*			
286.	48602	*Ptilotus eremita*			
287.	11225	*Ptilotus exaltatus var. exaltatus (Tall Mulla Mulla)*			
288.	2727	*Ptilotus gaudichaudii*			
289.	11577	*Ptilotus gaudichaudii var. gaudichaudii*			
290.	12001	*Ptilotus gaudichaudii var. parviflorus*			
291.	2729	*Ptilotus grandiflorus*			
292.	11311	*Ptilotus grandiflorus var. grandiflorus*			
293.	2732	*Ptilotus holosericeus*			
294.	2746	*Ptilotus nobilis (Tall Mulla Mulla)*			
295.	41001	*Ptilotus nobilis subsp. nobilis (Yellow Tails)*			
296.	2747	*Ptilotus obovatus (Cotton Bush)*			
297.	2751	*Ptilotus polystachyus (Prince of Wales Feather)*			
298.	17657	*Ptilotus polystachyus var. polystachyus (Prince of Wales Feather)*			
299.	2581	*Rhagodia drummondii*			
300.	11254	*Rhagodia preissii subsp. preissii*			
301.	13306	*Rhodanthe battii*			
302.	13308	*Rhodanthe charsleyae*			
303.	13241	*Rhodanthe chlorocephala subsp. rosea*			
304.	13242	*Rhodanthe chlorocephala subsp. splendida*			
305.	13294	*Rhodanthe laevis*			
306.	13238	*Rhodanthe maryonii*			
307.	13296	*Rhodanthe polycephala*			
308.	13309	*Rhodanthe spicata*			
309.	13303	*Rhodanthe sterilescens*			
310.	4698	*Ricinocarpos muricatus*			
311.	4704	*Ricinocarpos velutinus*			
312.	45148	*Roebuckiella cilocarpa*			
313.	11151	*Rostraria pumila*	Y		
314.	40425	*Rytidosperma caespitosum*			
315.	40440	*Rytidosperma sp. Goomalling (A.G. Gunness et al. OAKP 10/53)*			
316.	2356	*Santalum acuminatum (Quandong, Warrga)*			

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
317.	7644	*Scaevola spinescens (Currant Bush, Maroon)*			
318.	8200	*Schoenia cassiniana (Schoenia)*			
319.	1002	*Schoenus nanus (Tiny Bog Rush)*			
320.	2609	*Sclerolaena diacantha (Grey Copperburr)*			
321.	2610	*Sclerolaena drummondii*			
322.	2615	*Sclerolaena fusiformis*			
323.		*Sclerolaena sp.*			
324.	25883	*Senecio pinnatifolius var. pinnatifolius*			
325.	17645	*Senna artemisioides*			
326.	12276	*Senna artemisioides subsp. filifolia*			
327.	12275	*Senna artemisioides subsp. x coriacea*			
328.	18444	*Senna charlesiana*			
329.	14579	*Senna sp. Austin (A. Strid 20210)*			
330.	4970	*Sida calyxhymenia (Tall Sida)*			
331.	4985	*Sida petrophila*			
332.	19712	*Sida sp. dark green fruits (S. van Leeuwen 2260)*			
333.	2910	*Silene nocturna (Mediterranean Catchfly)*	Y		
334.	3069	*Sisymbrium erysimoides (Smooth Mustard)*	Y		
335.	3073	*Sisymbrium runcinatum*	Y		
336.	6998	*Solanum cleistogamum*			
337.	7006	*Solanum ellipticum (Potato Bush)*			
338.	7018	*Solanum lasiophyllum (Flannel Bush, Mindjulu)*			
339.		*Solanum sp. indet*			
340.	8231	*Sonchus oleraceus (Common Sowthistle)*	Y		
341.	3076	*Stenopetalum filifolium*			
342.	3077	*Stenopetalum lineare (Narrow Thread Petal)*			
343.	19419	*Stenopetalum salicola*			
344.	7704	*Stylidium confluens*			
345.	7720	*Stylidium elongatum (Tall Triggerplant)*			
346.	1260	*Stypandra glauca (Blind Grass)*			
347.	33297	*Tecticornia pergranulata subsp. pergranulata (Blackseed Samphire)*			
348.		*Tetraria aff. capillaris (RJI & YC 61)*			Y
349.	19696	*Thryptomene costata*			
350.	6060	*Thryptomene mucronulata*			
351.	1338	*Thysanotus manglesianus (Fringed Lily)*			
352.	1346	*Thysanotus pyramidalis*			
353.	6268	*Trachymene cyanopetala*			
354.	6279	*Trachymene ornata (Spongefruit)*			
355.	6280	*Trachymene pilosa (Native Parsnip)*			
356.	6727	*Trichodesma zeylanicum (Camel Bush, Kumbalin)*			
357.	1361	*Tricoryne elatior (Yellow Autumn Lily)*			
358.	18042	*Tricoryne tuberosa*			
359.	45094	*Tricoryne tuberosa*			
360.	7656	*Velleia cycnopotamica*			
361.	7661	*Velleia hispida (Hispid Velleia)*			
362.	7664	*Velleia rosea (Pink Velleia)*			
363.	11018	*Vulpia muralis*	Y		
364.	724	*Vulpia myuros (Rat's Tail Fescue)*	Y		
365.		*Vulpia sp.*			
366.	7386	*Wahlenbergia gracilenta (Annual Bluebell)*			
367.	7389	*Wahlenbergia preissii*			
368.	7393	*Wahlenbergia tumidifructa*			
369.	8275	*Waitzia acuminata (Orange Immortelle)*			
370.	13331	*Waitzia acuminata var. acuminata*			
371.	6938	*Westringia cephalantha*			
372.	34602	*Westringia cephalantha var. cephalantha*			
373.	1391	*Wurmbea densiflora*			
374.	31272	*Wurmbea sp. Paynes Find (C.J. French 1237)*			
375.	12685	*Xanthosia bungei*			
376.	44040	*Xanthosia kochii*			
377.	4385	*Zygophyllum apiculatum (Galiweed)*			
378.	4394	*Zygophyllum ovatum (Dwarf Twinleaf)*			

Conservation Codes
T - Rare or likely to become extinct
X - Presumed extinct
IA - Protected under international agreement
S - Other specially protected fauna
1 - Priority 1
2 - Priority 2
3 - Priority 3
4 - Priority 4
5 - Priority 5

Table A1.1: Conservation Significant Flora – List Collated from Database and Literature Search Results

Species	Rank	TPFL	WAHERB	Nature Map	EPBC PMST	Maia (2011a)	Maia (2011b)	Maia (2011c)	Maia (2014)	Borger (2009)	Ecologia (2008b)	Meissner and Caruso (2008)
Acacia cochlocarpa subsp. *cochlocarpa*	T (EPBC - EN, WC - CR)				•							
Chorizema humile	T (EPBC - EN, WC - CR)				•							
Dasymalla axillaris	T (EPBC - CR, WC - CR)				•							
Eremophila nivea	T (EPBC - EN, WC - CR)				•							
Eremophila viscida	T (EPBC - EN, WC - EN)				•							
Eucalyptus beardiana	T (EPBC - VU, WC - EN)				•							
Eucalyptus synandra	T (EPBC - VU, WC - VU)				•							
Frankenia conferta	T (EPBC - EN, WC - VU)				•							
Gyrostemon reticulatus	T (EPBC - CR, WC - CR)				•							
Roycea pycnophylloides	T (EPBC - EN, WC - VU)				•							
Tecticornia bulbosa	T (EPBC - VU, WC - VU)		•	•	•							
Acacia graciliformis	P1	•	•	•		•	•	•		•		•
Acacia muriculata	P1	•	•	•			•	•		•	•	•
Caesia sp. Koolanooka Hills (R. Meissner & Y. Caruso 78)	P1	•	•	•								•
Dodonaea scurra	P1	•	•	•		•	•			•	•	•
Drummondita rubroviridis	P1	•	•	•			•	•				•
Hemigenia sp. major (C.A. Gardner 2677)	P1		•	•								
Lepidosperma sp. Koolanooka (K.R. Newbey 9336)	P1		•	•		•	•	•	•	•	•	

Species	Rank	TPFL	WAHERB	Nature Map	EPBC PMST	Maia (2011a)	Maia (2011b)	Maia (2011c)	Maia (2014)	Borger (2009)	Ecologia (2008b)	Meissner and Caruso (2008)
Millotia dimorpha	P1	•	•	•				•				•
Sclerolaena sp. Koolanooka Hills (R. Meissner & Y. Caruso 437)	P1		•	•								
Aluta aspera subsp. *localis*	P2			•								
Baeckea sp. Perenjori (J.W. Green 1516)	P2		•	•		•	•	•	•	•	•	•
Austrostipa blackii	P3		•	•								
Enekbatus longistylus	P3		•	•								
Gunniopsis rubra	P3											•
Melaleuca barlowii	P3	•	•	•		•		•	•			•
Mirbelia ferricola	P3	•	•	•		•	•	•				•
Persoonia pentasticha	P3		•	•		•	•	•		•	•	•
Rhodanthe collina	P3	•	•	•								•
Stenanthemum poicilum	P3	•	•	•		•	•	•	•	•		•
Total		**10**	**18**	**19**	**11**	**8**	**9**	**10**	**4**	**7**	**5**	**13**

Note: T = Threatened Flora Species, EPBC = *Environmental Protection Biodiversity and Conservation Act*, WC = *Wildlife Conservation Act 1950*, CR = Critically Endangered, EN = Endangered, VU = Vulnerable, P1 – P3 = Priority 1 to Priority 3 Flora species, NatureMap (DPaW, 2007-), EPBC PMST (DotEE, 2018a). This table does not include conservation significant flora recorded in literature outside the database search area and in DMP, 2017 (data not in document).

Table A1.2: Weeds – List Collated from Database and Literature Search Results

Species	Common name	Rank	Ecological Impact	Invasiveness	Nature Map	EPBC PMST	Maia (2011c)	Maia (2014)	Borger (2009)	Ecologia (2008a)	Meissner and Caruso (2008)
			DBCA (2014)								
Chrysanthemoides monilifera	Boneseed	WoNS, DPP	Priority Alert			•					
Tamarix aphylla	Tamarisk	DPP	Not rated			•					
Aira caryophyllea	Silver hair-grass	EW	H	R	•						
Arctotheca calendula	Capeweed	EW	H	R	•		•		•		•
Avena fatua	Wild oat	EW	H	R	•		•		•		•
Brassica tournefortii	Wild turnip	EW	H	R	•				•		•
Cenchrus ciliaris	Buffel grass	EW	H	R		•					
Limonium lobatum	Winged sea-lavender	EW	H	R			•	•			
Mesembryanthemum crystallinum	Iceplant	EW	H	R					•		
Mesembryanthemum nodiflorum	Slenderleaf iceplant	EW	H	R	•		•	•	•		•
Raphanus raphanistrum	Wild radish	EW	H	R			•		•		
Rumex vesicarius	Ruby dock	EW	H	R	•		•	•		•	•
Urospermum picroides	Prickly goldenfleece	EW	H	R							•
Ursinia anthemoides	South African marigold	EW	H	R					•		
Citrullus lanatus	Jam melon	EW	L	R					•		
Emex australis	Doublegee	EW	L	R			•				
Erodium aureum	-	EW	L	R					•		
Erodium botrys	Longbeak stork's bill	EW	L	R			•				
Hypochaeris glabra	Flatweed	EW	L	R	•						•
Petrorhagia dubia	Velvety pink	EW	L	R	•			•			•
Rumex hypogaeus	Doublegee	EW	L	R					•		
Silene nocturna	Mediterranean catchfly	EW	L	R	•						•
Spergula arvensis	Corn spurry	EW	L	R				•			
Medicago truncatula	Barrel medic	EW	L	M			•				
Polycarpon tetraphyllum	Fourleaf allseed	EW	L	M			•				
Limonium sinuatum	Perennial sea lavender	EW	L	S					•		

Species	Common name	Rank	Ecological Impact	Invasiveness	Nature Map	EPBC PMST	Maia (2011c)	Maia (2014)	Borger (2009)	Ecologia (2008a)	Meissner and Caruso (2008)
			DBCA (2014)								
Malva parviflora	Marshmallow	EW	L	S				•	•		
Bromus rubens	Red brome	EW	U	R	•		•	•			•
Chenopodium murale	Nettle-leaf goosefoot	EW	U	R			•				
Cleretum papulosum	-	EW	U	R	•		•				•
Cucumis myriocarpus	Striped wild cucumber	EW	U	R					•		
Cuscuta epithymum	Lesser dodder	EW	U	R	•				•		•
Cuscuta planiflora	-	EW	U	R	•		•	•			
Ehrharta longiflora	Annual Veld grass	EW	U	R	•		•	•			•
Hordeum leporinum	Barley grass	EW	U	R			•		•		
Lamarckia aurea	Goldentop	EW	U	R	•		•		•		•
Monoculus monstrosus	Tripteris	EW	U	R			•	•			
Pentameris airoides subsp. *airoides*	-	EW	U	R	•		•		•		•
Reichardia tingitana	False sowthistle	EW	U	R			•				
Sonchus oleraceus	Common sowthistle	EW	U	R	•			•		•	•
Vulpia muralis	-	EW	U	R	•						•
Vulpia myuros	Rat's tail fescue	EW	U	R	•						•
Lolium perenne x *rigidum*	Ryegrass	EW	U	M	•						•
Bromus madritensis	Madrid brome	EW	U	S	•						•
Rostraria pumila	Roughtail	EW	U	U	•		•	•			•
Sisymbrium erysimoides	Mediterranean rocket	EW	U	U	•		•	•			•
Sisymbrium runcinatum	-	EW	U	U	•						
Carrichtera annua	Ward's weed	EW	Not rated			•	•				
Elymus sp.	-	EW	Not rated								•
Hypochaeris radicata	Flat weed	EW	Not rated				•				
				Total number	**24**	**4**	**24**	**13**	**17**	**2**	**23**

Note: WoNS = Weed of National Significance, DPP = declared pest plant, EW = environmental weed, NatureMap (DPaW, 2007-), EPBC PMST (DotEE, 2018a). This table does not include CSF recorded in literature outside the database search area and DMP (2017, incomplete information reported).

APPENDIX 2: CONSERVATION SIGNIFICANCE (FLORA AND ECOLOGICAL COMMUNITIES)

Commonwealth *Environment Protection and Biodiversity Act 1999*

Table A2.1: Categories and Definitions for Threatened Species (DotEE, 2018d)

Criteria for listing species in the critically endangered, endangered or vulnerable categories			
Criterion	**Critically Endangered**	**Endangered**	**Vulnerable**
1. It has undergone, is suspected to have undergon or is likely to undergo in the immediate future:	a very severe reduction in numbers	a severe reduction in numbers	a substantial reduction in numbers
2. Its geographic distribution is precarious for the survival of the species and is:	very restricted	restricted	limited
3. The estimated total number of individuals is:	very low	low	limited
And either of (a) or (b) is true:			
a) Evidence suggests that the number will continue to decline at: **b) The number is likely to continue to decline and its geographic distribution is:**	A very high rate Precarious for its survival	A high rate Precarious for its survival	A substantial rate Precarious for its survival
4. The estimated total number of mature individuals is:	extremely low	very low	low
5. The probability of its extinction in the wild is at least:	50% in the immediate future	20% in the near future	10% in the medium-term future

Eligibility for listing species in the extinct, extinct in the wild, or conservation dependent categories	
Category	**Definition**
Extinct*	A native species is eligible to be included in the extinct category at a particular time if, at that time, there is no reasonable doubt that the last member of the species has died.
Extinct in the wild	A native species is eligible to be included in the extinct in the wild category at a particular time if, at that time: a) it is only known to survive in cultivation, in captivity or as a naturalized population well outside its past range; or b) it has not been recorded in its known and/or expected habitat, at appropriate seasons, anywhere in its past range, despite exhaustive surveys over a time frame appropriate to its life cycle and form.
Conservation dependent*	A native species is eligible to be included in the conservation dependent category if, at that time: a) the species is the focus of a specific conservation program the cessation of which would result in the species becoming vulnerable, endangered or critically endangered; **or** b) the following subparagraphs are satisfied; I. the species is a species of fish; II. the species is the focus of a plan of management that provides for management actions necessary to stop the decline of, and support the recovery of, the species so that its chances of long term survival in nature are maximised; III. the plan of management is in force under a law of the Commonwealth or of a State or Territory; IV. cessation of the plan of management would adversely affect the conservation status of the species.
*Note: Species listed as 'conservation dependent' and 'extinct' are not matters of national environmental significance and therefore do not trigger the EPBC Act.	

Table A2.2: Categories, Definitions and Criteria for Threatened Ecological Communities (TECs) (Austlii, 2018)

Criteria for listing species in the critically endangered, endangered or vulnerable categories				
Item	**Criterion**	**Category**		
		Critically Endangered	**Endangered**	**Vulnerable**
1	Its decline in geographic distribution is:	Very severe	severe	substantial
2	Its geographic distribution is: and the nature of its distribution makes it likely that the action of a threatening process could cause it to be lost in:	Very restricted The immediate future	Restricted The near future	Limited The medium-term future
3	For a population of a native species that is likely to play a major role in the community, there is a: to the extent that restoration of the community is not likely to be possible in:	Very severe decline The immediate future	Severe decline The near future	Substantial decline The medium-term future
4	The reduction in its integrity across most of its geographic distribution is: As indicated by degradation of the community or its habitat, or distruption of important community processes that is:	Very severe Very severe	Severe Severe	Substantial Substantial
5	Its rate of continuing detrimental change is: As indicated by: a) A rate of continuing decline in its geographic distribution, or a population of a native species that is believed to play a major role in the community, that is: Or b) Intensification, across most of its geographic distribution, in degradation, or disruption of important community processes, that is:	Very severe Very severe Very severe	Severe Severe Severe	Substantial Substantial Serious
6	A quantitative analysis shows that its probability of extinction, or extreme degradation over all of its geographic distribution is:	At least 50% in the immediate future	At least 20% in the near future	At least 10% in the medium-term future

Western Australian *Wildlife Conservation Act 1950*

Table A2.3: Categories and Definitions for Threatened (Declared Rare) Flora and Fauna (DPaW, 2017)

Code	Definition
T	**Threatened species** Published as Specially Protected under the *Wildlife Conservation Act 1950*, and listed under Schedules 1 to 4 of the Wildlife Conservation (Specially Protected Fauna) Notice for Threatened Fauna and Wildlife Conservation (Rare Flora) Notice for Threatened Flora (which may also be referred to as Declared Rare Flora). Threatened Fauna is that subset of 'Specially Protected Fauna' declared to be 'likely to become extinct' pursuant to section 14(4) of the Wildlife Conservation Act. Threatened flora is flora that has been declared to be 'likely to become extinct or is rare, or otherwise in need of special protection', pursuant to section 23F(2) of the Wildlife Conservation Act. The assessment of the conservation status of these species is based on their national extent and ranked according to their level of threat using IUCN Red List categories and criteria as detailed below.
CR	**Critically endangered species** Threatened species considered to be facing an extremely high risk of extinction in the wild. Published as Specially Protected under the *Wildlife Conservation Act 1950*, in Schedule 1 of the Wildlife Conservation (Specially Protected Fauna) Notice for Threatened Fauna and Wildlife Conservation (Rare Flora) Notice for Threatened Flora.
EN	**Endangered species** Threatened species considered to be facing a very high risk of extinction in the wild. Published as Specially Protected under the *Wildlife Conservation Act 1950*, in Schedule 2 of the Wildlife Conservation (Specially Protected Fauna) Notice for Threatened Fauna and Wildlife Conservation (Rare Flora) Notice for Threatened Flora.
VU	**Vulnerable species** Threatened species considered to be facing a high risk of extinction in the wild. Published as Specially Protected under the *Wildlife Conservation Act 1950*, in Schedule 3 of the Wildlife Conservation (Specially Protected Fauna) Notice for Threatened Fauna and Wildlife Conservation (Rare Flora) Notice for Threatened Flora.
EX	**Presumed extinct species** Species which have been adequately searched for and there is no reasonable doubt that the last individual has died. Published as Specially Protected under the *Wildlife Conservation Act 1950*, in Schedule 4 of the Wildlife Conservation (Specially Protected Fauna) Notice for Presumed Extinct Fauna and Wildlife Conservation (Rare Flora) Notice for Presumed Extinct Flora.
IA	**Migratory birds protected under an international agreement** Birds that are subject to an agreement between the government of Australia and the governments of Japan (JAMBA), China (CAMBA) and The Republic of Korea (ROKAMBA), and the Bonn Convention, relating to the protection of migratory birds. Published as Specially Protected under the *Wildlife Conservation Act 1950*, in Schedule 5 of the Wildlife Conservation (Specially Protected Fauna) Notice.
CD	**Conservation dependent fauna** Fauna of special conservation need being species dependent on ongoing conservation intervention to prevent it becoming eligible for listing as threatened. Published as Specially Protected under the *Wildlife Conservation Act 1950*, in Schedule 6 of the Wildlife Conservation (Specially Protected Fauna) Notice.
OS	**Other specially protected fauna** Fauna otherwise in need of special protection to ensure their conservation. Published as Specially Protected under the *Wildlife Conservation Act 1950*, in Schedule 7 of the Wildlife Conservation (Specially Protected Fauna) Notice.

Table A2.4: Categories and Definitions for Priority Species (DPaW, 2017)

Code	Definition
P	**Priority species** Possibly threatened species that do not meet survey criteria, or are otherwise data deficient, are added to the Priority Fauna or Priority Flora Lists under Priorities 1, 2 or 3. These three categories are ranked in order of priority for survey and evaluation of conservation status so that consideration can be given to their declaration as threatened flora or fauna. Species that are adequately known, are rare but not threatened, or meet criteria for near threatened, or that have been recently removed from the threatened species or other specially protected fauna lists for other than taxonomic reasons, are placed in Priority 4. These species require regular monitoring. Assessment of Priority codes is based on the Western Australian distribution of the species, unless the distribution in WA is part of a contiguous population extending into adjacent States, as defined by the known spread of locations.
1	**Priority One: Poorly-known species** Species that are known from one or a few locations (generally five or less) which are potentially at risk. All occurrences are either: very small; or on lands not managed for conservation, e.g. agricultural or pastoral lands, urban areas, road and rail reserves, gravel reserves and active mineral leases; or otherwise under threat of habitat destruction or degradation. Species may be included if they are comparatively well known from one or more locations but do not meet adequacy of survey requirements and appear to be under immediate threat from known threatening processes. Such species are in urgent need of further survey.
2	**Priority Two: Poorly-known species** Species that are known from one or a few locations (generally five or less), some of which are on lands managed primarily for nature conservation, e.g. national parks, conservation parks, nature reserves and other lands with secure tenure being managed for conservation. Species may be included if they are comparatively well known from one or more locations but do not meet adequacy of survey requirements and appear to be under threat from known threatening processes. Such species are in urgent need of further survey.
3	**Priority Three: Poorly-known species** Species that are known from several locations, and the species does not appear to be under imminent threat, or from few but widespread locations with either large population size or significant remaining areas of apparently suitable habitat, much of it not under imminent threat. Species may be included if they are comparatively well known from several locations but do not meet adequacy of survey requirements and known threatening processes exist that could affect them. Such species are in need of further survey.
4	**Priority Four: Rare, Near Threatened and other species in need of monitoring** (a) Rare. Species that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection, but could be if present circumstances change. These species are usually represented on conservation lands. (b) Near Threatened. Species that are considered to have been adequately surveyed and that are close to qualifying for Vulnerable, but are not listed as Conservation Dependent. (c) Species that have been removed from the list of threatened species during the past five years for reasons other than taxonomy.
*Species includes all taxa (plural of taxon - a classificatory group of any taxonomic rank, e.g. a family, genus, species or any intraspecific category i.e. subspecies or variety, or a distinct population).	

Table A2.5: Categories, Definitions and Criteria for Threatened Ecological Communities (TECs) (DEC, 2013)

Category	Definition and Criteria
Presumed Totally Destroyed (PD)	An ecological community that has been adequately searched for but for which no representative occurrences have been located. The community has been found to be totally destroyed or so extensively modified throughout its range that no occurrence of it is likely to recover its species composition and/or structure in the foreseeable future. An ecological community will be listed as presumed totally destroyed if there are no recent records of the community being extant and either of the following applies (A or B): A) Records within the last 50 years have not been confirmed despite thorough searches of known or likely habitats; or B) All occurrences recorded within the last 50 years have since been destroyed.
Critically Endangered (CR)	An ecological community that has been adequately surveyed and found to have been subject to a major contraction in area and/or that was originally of limited distribution and is facing severe modification or destruction throughout its range in the immediate future, or is already severely degraded throughout its range but capable of being substantially restored or rehabilitated. An ecological community will be listed as **Critically Endangered** when it has been adequately surveyed and is found to be facing an extremely high risk of total destruction in the immediate future. This will be determined on the basis of the best available information, by it meeting **any one or more** of the following criteria (A, B or C): A) The estimated geographic range, and/or total area occupied, and/or number of discrete occurrences since European settlement have been reduced by at least 90% **and either or both** of the following apply (i or ii): (i) geographic range, and/or total area occupied and/or number of discrete occurrences are continuing to decline such that total destruction of the community is imminent (within approximately 10 years); (ii) modification throughout its range is continuing such that in the immediate future (within approximately 10 years) the community is unlikely to be capable of being substantially rehabilitated.
Critically Endangered (CR)	B) Current distribution is limited, **and one or more** of the following apply (i, ii or iii): (i) geographic range and/or number of discrete occurrences, and/or area occupied is highly restricted and the community is currently subject to known threatening processes which are likely to result in total destruction throughout its range in the immediate future (within approximately 10 years); (ii) there are very few occurrences, each of which is small and/or isolated and extremely vulnerable to known threatening processes; (iii) there may be many occurrences but total area is very small and each occurrence is small and/or isolated and extremely vulnerable to known threatening processes. C) The ecological community exists only as highly modified occurrences that may be capable of being rehabilitated if such work begins in the immediate future (within approximately 10 years).
Endangered (EN)	An ecological community that has been adequately surveyed and found to have been subject to a major contraction in area and/or was originally of limited distribution and is in danger of significant modification throughout its range or severe modification or destruction over most of its range in the near future. An ecological community will be listed as **Endangered** when it has been adequately surveyed and is not Critically Endangered but is facing a very high risk of total destruction in the near future. This will be determined on the basis of the best available information by it meeting **any one or more of** the following criteria (A, B, or C): A) The geographic range, and/or total area occupied, and/or number of discrete occurrences have been reduced by at least 70% since European settlement and either or both of the following apply (i or ii): (i) the estimated geographic range, and/or total area occupied and/or number of discrete occurrences are continuing to decline such that total destruction of the community is likely in the short term future (within approximately 20 years); (ii) modification throughout its range is continuing such that in the short term future (within approximately 20 years) the community is unlikely to be capable of being substantially restored or rehabilitated.

Category	Definition and Criteria
Endangered (EN)	B) Current distribution is limited, **and one or more** of the following apply (i, ii or iii): (i) geographic range and/or number of discrete occurrences, and/or area occupied is highly restricted and the community is currently subject to known threatening processes which are likely to result in total destruction throughout its range in the short term future (within approximately 20 years); (ii) there are few occurrences, each of which is small and/or isolated and all or most occurrences are very vulnerable to known threatening processes; (iii) there may be many occurrences but total area is small and all or most occurrences are small and/or isolated and very vulnerable to known threatening processes. C) The ecological community exists only as very modified occurrences that may be capable of being substantially restored or rehabilitated if such work begins in the short-term future (within approximately 20 years).
Vulnerable (VU)	An ecological community that has been adequately surveyed and is found to be declining and/or has declined in distribution and/or condition and whose ultimate security has not yet been assured and/or a community that is still widespread but is believed likely to move into a category of higher threat in the near future if threatening processes continue or begin operating throughout its range. An ecological community will be listed as **Vulnerable** when it has been adequately surveyed and is not Critically Endangered or Endangered but is facing a high risk of total destruction or significant modification in the medium to long-term future. This will be determined on the basis of the best available information by it meeting **any one or more of** the following criteria (A, B or C): A) The ecological community exists largely as modified occurrences that are likely to be capable of being substantially restored or rehabilitated. B) The ecological community may already be modified and would be vulnerable to threatening processes, is restricted in area and/or range and/or is only found at a few locations. C) The ecological community may be still widespread but is believed likely to move into a category of higher threat in the medium to long term future because of existing or impending threatening processes.

Possible threatened ecological communities that do not meet survey criteria or that are not adequately defined are added to the Priority Ecological Community Lists under Priorities 1, 2 and 3. These three categories are ranked in order of priority for survey and/or definition of the community, and evaluation of conservation status, so that consideration can be given to their declaration as threatened ecological communities. Ecological Communities that are adequately known, and are rare but not threatened or meet criteria for Near Threatened, or that have been recently removed from the threatened list, are placed in Priority 4. These ecological communities require regular monitoring. Conservation Dependent ecological communities are placed in Priority 5.

Table A2.6: Categories, Definitions and Criteria for Priority Ecological Communities (PECs) (DEC, 2013)

Category	Definition and Criteria
Priority One: Poorly-known ecological communities	Ecological communities that are known from very few occurrences with a very restricted distribution (generally ≤5 occurrences or a total area of ≤ 100ha). Occurrences are believed to be under threat either due to limited extent, or being on lands under immediate threat (e.g. within agricultural or pastoral lands, urban areas, active mineral leases) or for which current threats exist. May include communities with occurrences on protected lands. Communities may be included if they are comparatively well-known from one or more localities but do not meet adequacy of survey requirements, and/or are not well defined, and appear to be under immediate threat from known threatening processes across their range.

Category	Definition and Criteria
Priority Two: Poorly-known ecological communities	Communities that are known from few occurrences with a restricted distribution (generally ≤10 occurrences or a total area of ≤200ha). At least some occurrences are not believed to be under immediate threat of destruction or degradation. Communities may be included if they are comparatively well known from one or more localities but do not meet adequacy of survey requirements, and/or are not well defined, and appear to be under threat from known threatening processes.
Priority Three: Poorly-known ecological communities	(i) Communities that are known from several to many occurrences, a significant number or area of which are not under threat of habitat destruction or degradation or: (ii) communities known from a few widespread occurrences, which are either large or within significant remaining areas of habitat in which other occurrences may occur, much of it not under imminent threat, or; (iii) Communities made up of large, and/or widespread occurrences that may or not be represented in the reserve system, but are under threat of modification across much of their range from processes such as grazing by domestic and/or feral stock, and inappropriate fire regimes. Communities may be included if they are comparatively well known from several localities but do not meet adequacy of survey requirements and/or are not well defined, and known threatening processes exist that could affect them.
Priority Four: Ecological communities that are adequately known, rare but not threatened or meet criteria for Near Threatened or that have been recently removed from the threatened list. These communities require regular monitoring.	(a) Rare. Ecological communities known from few occurrences that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection, but could be if present circumstances change. These communities are usually represented on conservation lands. (b) Near Threatened. Ecological communities that are considered to have been adequately surveyed and that do not qualify for Conservation Dependent, but that are close to qualifying for Vulnerable. (c) Ecological communities that have been removed from the list of threatened communities during the past five years.
Priority Five: Conservation Dependent ecological communities	Ecological communities that are not threatened but are subject to a specific conservation program, the cessation of which would result in the community becoming threatened within five years.

APPENDIX 3: DECLARED PEST CATEGORIES

Table A3.1: Control Categories for Declared Pests (DPIRD, 2018c)

Category (C)	Definition
C1 (Exclusion)	Organisms which should be excluded from part or all of Western Australia.
C2 (Eradication)	Organisms which should be eradicated from part or all of Western Australia.
C3 (Management)	Organisms that should have some form of management applied that will alleviate the harmful impact of the organism, reduce the numbers or distribution of the organism or prevent or contain the spread of the organism.
Unassigned	Unassigned: Declared pests that are recognised as having a harmful impact under certain circumstances, where their subsequent control requirements are determined by a Plan or other legislative arrangements under the Act.

APPENDIX 4: NATIONAL VEGETATION INFORMATION SYSTEM VEGETATION CLASSIFICATION

Table A4.1: NVIS Growth Forms and Descriptions

Growth Form	Description
Tree	Woody plants, more than 2m tall with a single stem or branches well above the base.
Tree Mallee	Woody perennial plant usually of the genus *Eucalyptus*. Multi-stemmed with fewer than 5 trunks of which at least 3 exceed 100 mm at breast height (1.3 m). Usually 8 m or more in
Shrub	Woody plants multi-stemmed at the base (or within 200 mm from ground level) or if single stemmed, less than 2 m in height.
Mallee Shrub	Commonly less than 8 m tall, usually with 5 or more trunks, of which at least 3 of the largest do not exceed 100 mm at breast height (1.3 m).
Heath Shrub	Shrub usually less than 2 m, with sclerophyllous leaves having high fibre: protein ratios and with an area of nanophyll or smaller (less than 225 sq. m.). Often a member of the following families: Epacridaceae, Myrtaceae, Fabaceae and Proteaceae. Commonly occur in nutrient-poor substrates.
Chenopod Shrub	Single or multi-stemmed, semi-succulent shrub of the family Chenopodiaceae exhibiting drought and salt tolerance.
Samphire Shrub	Genera (of Tribe Salicornioideae, viz: *Halosarcia*, *Pachycornia, Sarcocornia*, *Sclerostegia*, *Tecticornia* and *Tegicornia*) with articulate branches, fleshy stems and reduced flowers within the Chenopodiaceae family, succulent chenopods. Also genus *Suaeda*.
Tussock Grass	Forms discrete but open tussocks usually with distinct individual shoots, or if not, then forming a hummock. These are common agricultural grasses.
Hummock Grass	Coarse xeromorphic grass with a mound-like form often dead in the middle; genera are *Triodia* and *Plectrachne*.
Sedge	Herbaceous, usually perennial erect plant generally with a tufted habit and of the families Cyperaceae (true sedges) or Restionaceae (node sedges).
Rush	Herbaceous, usually perennial erect monocot that is neither a grass nor sedge. For the purposes of NVIS, rushes include the monocotyledon families Juncaceae, Typhaceae, Liliaceae, Iridaceae, Xyridaceae and the genus *Lomandra* (i.e. "graminoid" or grass-like genera).
Forb	Herbaceous or slightly woody, annual or sometimes perennial plant (usually a dicotyledon).
Grass-tree	Australian grass trees. Members of the family Xanthorrhoeaceae.
Cycad	Members of the families Cycadaceae and Zamiaceae.

Table A5.2: Height classes defined for the NVIS

Height classes	Height range (m)	Tree	Shrub, heath shrub, chenopod shrub, samphire shrub, cycad, grass-tree	Tree mallee, mallee shrub	Tussock grasses, sedges, rushes and forbs
8	**>30**	tall			
7	**10-30**	mid		tall	
6	**<10**	low		mid	
5	**<3**			low	
4	**>2**		tall		tall
3	**1-2**		mid		tall
2	**0.5-1**		low		mid
1	**<0.5**		low		low

Table A5.3: NVIS Structural Formation Terminology

Growth Form	Height (m)	Foliage Cover (%)					
		>70	30-70	10-30	2-10	<2 (isolated)	<2 (isolated clump)
Tree	**<10,10-30, >30**	Closed Forest	Open Forest	Woodland	Open Woodland	Isolated Trees	Isolated Clumps Of Trees
Tree Mallee	**<3, <10, 10-30**	Closed Mallee Forest	Open Mallee Forest	Mallee Woodland	Open Mallee Woodland	Isolated Mallee Trees	Isolated Clumps Of Mallee Trees
Shrub	**<1,1-2,>2**	Closed Shrubland	Shrubland	Open Shrubland	Sparse Shrubland	Isolated Shrubs	Isolated Clumps Of Shrubs
Mallee Shrub	**<3, <10, 10-30**	Closed Mallee Shrubland	Mallee Shrubland	Open Mallee Shrubland	Sparse Mallee Shrubland	Isolated Mallee Shrubs	Isolated Clumps Of Mallee Shrubs
Heath Shrub	**<1,1-2,>2**	Closed Heathland	Heathland	Open Heathland	Sparse Heathland	Isolated Heath Shrubs	Isolated Clumps Of Heath Shrubs
Chenopod Shrub	**<1,1-2,>2**	Closed Chenopod Shrubland	Chenopod Shrubland	Open Chenopod Shrubland	Sparse Chenopod Shrubland	Isolated Chenopod Shrubs	Isolated Clumps Of Chenopod Shrubs
Samphire Shrub	**<0.5,>0.5**	Closed Samphire Shrubland	Samphire Shrubland	Open Samphire Shrubland	Sparse Samphire Shrubland	Isolated Samphire Shrubs	Isolated Clumps Of Samphire Shrubs
Hummock Grass	**<2,>2**	Closed Hummock Grassland	Hummock Grassland	Open Hummock Grassland	Sparse Hummock Grassland	Isolated Hummock Grasses	Isolated Clumps Of Hummock Grasses
Tussock Grass	**<0.5,>0.5**	Closed Tussock Grassland	Tussock Grassland	Open Tussock Grassland	Sparse Tussock Grassland	Isolated Tussock Grasses	Isolated Clumps Of Tussock Grasses
Sedge	**<0.5,>0.5**	Closed Sedgeland	Sedgeland	Open Sedgeland	Sparse Sedgeland	Isolated Sedges	Isolated Clumps Of Sedges
Rush	**<0.5,>0.5**	Closed Rushland	Rushland	Open Rushland	Sparse Rushland	Isolated Rushes	Isolated Clumps Of Rushes
Forb	**<0.5,>0.5**	Closed Forbland	Forbland	Open Forbland	Sparse Forbland	Isolated Forbs	Isolated Clumps Of Forbs

Source: **Tables A5.1 to A5.3** from ESCAVI (2003).

APPENDIX 5: SITE DATA

Table A5.1: Information Collected at 20 m by 20 m Quadrats

Quadrat: KS01	Assessor: Christina Cox	Date: 27/09/2018	Photograph
Location (GDA94):	MGA50 427686 m E 6764373 m N		
Habitat:	Hill (gentle north facing midslope)		
Soil:	Orange sandy-loam surface crust (20%)		
Rocks:	Laterite stones (10%), gravel (70%)		
Mapped as:	*E***MWL**		
Vegetation Type:	Mallee Woodland of *Eucalyptus subangusta* subsp. *pusilla* with Open Mid Shrubland of *Acacia andrewsii*, ***Acacia graciliformis*** **(P1)** with a Sparse Tall Shrubland of *Eremophila oppositifolia* subsp. *angustifolia* and a Sparse Low Shrubland of *Acacia acanthoclada* subsp. *glaucescens*		
Vegetation Condition:	Excellent		
Disturbances:	Grazing		
Fire Age:	Old (> 5yrs)		
Species:	*Acacia acanthoclada* subsp. *glaucescens*, *Acacia andrewsii, Acacia anthochaera,* ***Acacia graciliformis*** **(P1),** *Arthropodium dyeri, Crassula colorata* var. *colorata*, *Dianella revoluta* var. *divaricata*, ***Dodonaea scurra*** **(P1),** *Eremophila oppositifolia* subsp. *angustifolia*, *Erymophyllum tenellum, Eucalyptus* ?*subangusta*, *Eucalyptus leptopoda* subsp. *arctata*, *Eucalyptus subangusta* subsp. *pusilla*, *Hibbertia exasperata, Melaleuca eleuterostachya, Olearia muelleri, Podolepis aristata* subsp. *aristata*, *Schoenia filifolia* subsp. *filifolia*, *Waitzia acuminata* var. *acuminata*		

Quadrat: KS02	Assessor: Christina Cox	Date: 27/09/2018	Photograph
Location (GDA94):	MGA50 427641 m E 6764325 m N		
Habitat:	Low rolling hill (gentle midslope)		
Soil:	Orange sandy-loam surface crust (10%)		
Rocks:	Laterite gravel (80%), stones (2%)		
Mapped as:	M**SL/WL**		
Vegetation Type:	Tall Shrubland of *Melaleuca eleuterostachya* with an Open Low Shrubland of *Hibbertia exasperata*, a Sparse Mid Shrubland of *Melaleuca nematophylla* and *Hibbertia exasperata* and Isolated Low Trees of *Allocasuarina acutivalvis* subsp. *prinsepiana*		
Vegetation Condition:	Excellent		
Disturbances:	None		
Fire Age:	None evident		
Species:	*Acacia daviesioides,* ***Acacia graciliformis*** **(P1),** ***Acacia muriculata*** **(P1),** *Allocasuarina acutivalvis* subsp. *prinsepiana*, *Astroloma serratifolium,* ***Dodonaea scurra*** **(P1),** ***Drummondita rubroviridis*** **(P1),** *Eucalyptus* ?*ebbanoensis*, *Hibbertia arcuata, Hibbertia exasperata, Melaleuca eleuterostachya, Melaleuca nematophylla, Micromyrtus racemosa,* ***Mirbelia ferricola*** **(P3),** *Waitzia acuminata* var. *acuminata*		

Quadrat: KS03	Assessor:	Christina Cox		Date:	27/09/2018	Photograph
Location (GDA94):	MGA50	427677	m E	6764110	m N	
Habitat:	Sandplain (plateau, very gentle slope)					
Soil:	Orange sandy-loam surface crust (60%)					
Rocks:	Nil					
Mapped as:	*Me***SL**					
Vegetation Type:	Tall Shrubland of *Melaleuca eleuterostachya* with a Mid Shrubland of ***Acacia graciliformis* (P1)**, an Open Mallee Woodland of *Eucalyptus leptopoda* subsp. *arctata*, Isolated Low Shrubs of ***Acacia graciliformis* (P1)** and Isolated Tussock Grasses of *Amphipogon caricinus* var. *caricinus*					
Vegetation Condition:	Excellent					
Disturbances:	None					
Fire Age:	None evident					
Species:	*Acacia acuminata, Acacia anthochaera,* ***Acacia graciliformis* (P1),** *Allocasuarina acutivalvis* subsp. *prinsepiana*, *Amphipogon caricinus* var. *caricinus*, *Arthropodium dyeri, Astroloma serratifolium, Austrostipa elegantissima, Austrostipa trichophylla, Comesperma integerrimum, Erodium cygnorum, Erymophyllum tenellum, Eucalyptus leptopoda* subsp. *arctata*, *Hakea recurva* subsp. *recurva*, *Melaleuca eleuterostachya, Melaleuca nematophylla, Waitzia acuminata* var. *acuminata*					

Quadrat: KS04	Assessor:	Christina Cox		Date:	26/09/2018	Photograph
Location (GDA94):	MGA50	427798	m E	6764085	m N	
Habitat:	Stony plain (very gentle footslope)					
Soil:	Orange sandy-loam surface crust (50%)					
Rocks:	Granite stones (10%), gravel (30%)					
Mapped as:	M**SL**					
Vegetation Type:	Open Mid Shrubland of *Aluta aspera* subsp. *hesperia* with an Open Mallee Woodland of *Eucalyptus* ?*loxophleba* and *Allocasuarina acutivalvis* subsp. *prinsepiana* with a Sparse Tall Shrubland of *Allocasuarina campestris* with a Sparse Low Shrubland of *Micromyrtus racemosa*, ***Acacia muriculata* (P1)** and Isolated Tussock Grasses of *Amphipogon caricinus* var. *caricinus*					
Vegetation Condition:	Excellent					
Disturbances:	None					
Fire Age:	None evident					
Species:	*Acacia acuaria,* ***Acacia muriculata* (P1),** *Allocasuarina acutivalvis* subsp. *prinsepiana*, *Allocasuarina campestris, Aluta aspera* subsp. *hesperia*, *Amphipogon caricinus* var. *caricinus*, *Brunonia* sp. Goldfields (K.R. Newbey 6044), *Cheilanthes adiantoides, Drosera macrantha,* ***Drummondita rubroviridis* (P1),** *Eucalyptus* ?*loxophleba*, *Hibbertia arcuata, Lawrencella rosea, Melaleuca cordata, Micromyrtus racemosa, Podolepis aristata* subsp. *aristata*, *Stylidium confluens, Thysanotus manglesianus, Trachymene cyanopetala, Waitzia acuminata* var. *acuminata*					

Quadrat:	KS05	Assessor:	Christina Cox		Date:	27/09/2018	Photograph
Location (GDA94):		MGA50	427931	m E	6763822	m N	
Habitat:		Hardpan plain (plateau, gentle west facing slope)					
Soil:		Orange sandy-loam surface crust (70%)					
Rocks:		Ironstone stones (10%)					
Mapped as:		*Me***SL**					
Vegetation Type:		Open Tussock Grassland of *Amphipogon caricinus* var. *caricinus* with a Sparse Tall Shrubland of *Melaleuca eleuterostachya* and *Melaleuca stereophloia* with a Sparse Mid Shrubland of *Melaleuca stereophloia* with Isolated Low Trees of *Allocasuarina acutivalvis* subsp. *prinsepiana* with Isolated Mallee Trees of *Eucalyptus* ?*loxophleba* and Isolated Low Shrubs of ***Stenanthemum poicilum*** **(P3)**					
Vegetation Condition:		Excellent					
Disturbances:		None					
Fire Age:		None evident					
Species:		*Acacia acuminata, Allocasuarina acutivalvis* subsp. *prinsepiana*, *Amphipogon caricinus* var. *caricinus*, *Brachyscome iberidifolia, Cheilanthes adiantoides, Dianella revoluta* var. *divaricata*, *Drosera macrantha, Eucalyptus* ?*loxophleba*, *Gilberta tenuifolia, Goodenia* sp., *Lawrencella rosea, Melaleuca eleuterostachya, Melaleuca stereophloia, Micromyrtus racemosa, Monachather paradoxus,* ***Stenanthemum poicilum*** **(P3),** *Stenopetalum filifolium, Stylidium confluens, Trachymene cyanopetala, Trachymene ornata, Velleia cycnopotamica, Waitzia acuminata* var. *acuminata*					

Quadrat:	KS06	Assessor:	Christina Cox		Date:	27/09/2018	Photograph
Location (GDA94):		MGA50	428158	m E	6763676	m N	
Habitat:		Gravelly plain (plateau, very gentle slope)					
Soil:		Orange sandy-loam surface crust (50%)					
Rocks:		Ironstone gravel (20%), laterite gravel (20%)					
Mapped as:		*Me***SL**					
Vegetation Type:		Tussock Grassland of *Amphipogon caricinus* var. *caricinus* with an Open Tall Shrubland of *Melaleuca eleuterostachya* and Open Mallee Woodland of *Eucalyptus subangusta* subsp. *pusilla* and *Eucalyptus* ?*ebbanoensis*					
Vegetation Condition:		Excellent					
Disturbances:		None					
Fire Age:		None evident					
Species:		*Acacia acuminata, Allocasuarina acutivalvis* subsp. *prinsepiana*, *Amphipogon caricinus* var. *caricinus*, *Arthropodium dyeri, Cheilanthes adiantoides, Comesperma integerrimum, Eucalyptus* ?*ebbanoensis*, *Eucalyptus subangusta* subsp. *pusilla*, *Goodenia berardiana, Lawrencella rosea, Melaleuca eleuterostachya, Stenopetalum filifolium, Stylidium confluens, Trachymene cyanopetala, Trachymene ornata, Velleia cycnopotamica, Waitzia acuminata* var. *acuminata*					

Quadrat:	KS07	Assessor:	Scott Hitchcock		Date:	26/09/2018	Photograph
Location (GDA94):		MGA50	427726	m E	6763322	m N	
Habitat:		Ridge (ridgetop, moderate slope)					
Soil:		Orange sandy-loam					
Rocks:		Laterite (80%), ironstone					
Mapped as:		M**SL/WL**					
Vegetation Type:		Low Woodland of *Melaleuca nematophylla* and *Allocasuarina acutivalvis* subsp. *prinsepiana* with a Sparse Mid Shrubland of *Hibbertia exasperata*, ***Dodonaea scurra*** **(P1)** and Isolated Mallee Trees of *Eucalyptus ?loxophleba*					
Vegetation Condition:		Excellent					
Disturbances:		Track					
Fire Age:		None evident					
Species:		*Acacia daviesioides,* ***Acacia graciliformis*** **(P1),** ***Acacia muriculata*** **(P1),** *Allocasuarina acutivalvis* subsp. *prinsepiana*, *Allocasuarina campestris, Cheiranthera simplicifolia,* ***Dodonaea scurra*** **(P1),** ***Drummondita rubroviridis*** **(P1),** *Eucalyptus ?loxophleba*, *Hibbertia exasperata, Melaleuca nematophylla, Melaleuca radula, Micromyrtus racemosa,* ***Mirbelia ferricola*** **(P3),** *Waitzia acuminata* var. *acuminata*, *Xanthosia kochii*					

Quadrat:	KS08	Assessor:	Scott Hitchcock		Date:	26/09/2018	Photograph
Location (GDA94):		MGA50	427857	m E	6763181	m N	
Habitat:		Ridge (gentle east facing upperslope)					
Soil:		Orange sandy-loam					
Rocks:		Laterite stones (80%), gravel, fine gravel					
Mapped as:		M**SL**					
Vegetation Type:		Open Tall Shrubland of *Allocasuarina acutivalvis* subsp. *prinsepiana*, *Melaleuca cordata* with an Open Mid Shrubland of *Xanthosia kochii*, *Grevillea paradoxa*, *Aluta aspera* subsp. *hesperia* and Isolated Mallee Trees of *Eucalyptus ebbanoensis*					
Vegetation Condition:		Excellent					
Disturbances:		None					
Fire Age:		None evident					
Species:		*Acacia acuaria, Allocasuarina acutivalvis* subsp. *prinsepiana*, *Allocasuarina campestris, Aluta aspera* subsp. *hesperia,* ***Arctotheca calendula****, *Arthropodium dyeri, Astroloma serratifolium,* ***Beyeria*** **aff. *minor* (TOI),** *Cassytha nodiflora, Dianella revoluta* var. *divaricata,* ***Dodonaea scurra*** **(P1),** *Drosera macrantha,* ***Drummondita rubroviridis*** **(P1),** *Eucalyptus ebbanoensis, Grevillea paradoxa, Hibbertia arcuata, Lawrencella davenportii, Lawrencella rosea,* ***Lepidosperma*** **sp. Koolanooka (K.R. Newbey 9336) (P1),** *Lomandra marginata,* ***Melaleuca barlowii*** **(P3),** *Melaleuca cordata,* ***Millotia dimorpha*** **(P1),** *Podolepis aristata* subsp. *aristata*, *Thysanotus manglesianus, Trachymene ornata, Waitzia acuminata* var. *acuminata*, *Xanthosia kochii*					

Quadrat:	KS09	Assessor:	Christina Cox and Michael Pezzaniti		Date:	26/09/2018	Photograph
Location (GDA94):		MGA50	427946	m E	6763057	m N	
Habitat:		Stony plain (gentle footslope)					
Soil:		Orange coarse sand surface crust (20%)					
Rocks:		Laterite stones (80%)					
Mapped as:		*Mn***SL**					
Vegetation Type:		Open Tall Shrubland of *Melaleuca nematophylla* with an Open Mid Shrubland of *Melaleuca radula* with an Open Low Shrubland of ***Baeckea* sp. Perenjori (J.W. Green 1516) (P2)** and Isolated Low Trees of *Acacia acuminata*					
Vegetation Condition:		Excellent					
Disturbances:		None					
Fire Age:		None evident					
Species:		*Acacia acuminata, Amphipogon caricinus* var. *caricinus*, ***Arctotheca calendula****, *Aristida contorta, Arthropodium dyeri, Astroloma serratifolium, Austrostipa elegantissima,* ***Baeckea* sp. Perenjori (J.W. Green 1516) (P2),** *Dianella revoluta* var. *divaricata, Dodonaea inaequifolia, Drosera macrantha, Lawrencella rosea,* ***Lepidosperma* sp. Koolanooka (K.R. Newbey 9336) (P1),** *Melaleuca nematophylla, Melaleuca radula,* ***Millotia dimorpha* (P1),** *Mirbelia microphylla, Myriocephalus guerinae, Schoenia cassiniana, Solanum cleistogamum, Stylidium confluens, Thysanotus manglesianus, Trachymene cyanopetala, Waitzia acuminata* var. *acuminata*					

Quadrat:	KS10	Assessor:	Scott Hitchcock		Date:	26/09/2018	Photograph
Location (GDA94):		MGA50	427863	m E	6763075	m N	
Habitat:		Hill (gentle south-east facing midslope)					
Soil:		Orange sandy-loam					
Rocks:		Laterite gravel (80%), quartz stones					
Mapped as:		*E***MWL**					
Vegetation Type:		Low Woodland of *Eucalyptus ?ebbanoensis* with a Sparse Mid Shrubland of *Acacia andrewsii*, *Acacia acanthoclada* subsp. *glaucescens* and Sparse Low Shrubland of *Sclerolaena diacantha* and *Rhagodia drummondii*					
Vegetation Condition:		Excellent					
Disturbances:		Weeds					
Fire Age:		None evident					
Species:		*Acacia acanthoclada* subsp. *glaucescens*, *Acacia andrewsii,* ***Acacia graciliformis* (P1),** *Alyxia buxifolia,* ***Arctotheca calendula****, *Arthropodium dyeri, Austrostipa scabra, Calandrinia eremaea* non-papillate variant, *Calotis hispidula, Cassytha nodiflora, Crassula colorata* var. *colorata*, *Dodonaea inaequifolia, Enchylaena tomentosa* var. *tomentosa*, *Eucalyptus ?ebbanoensis*, *Goodenia berardiana, Lepidium oxytrichum,* ***Limonium lobatum****, *Maireana carnosa, Maireana tomentosa* subsp. *tomentosa*, ***Mesembryanthemum nodiflorum***,* *Podolepis aristata* subsp. *aristata, Ptilotus gaudichaudii, Ptilotus holosericeus, Ptilotus obovatus, Ptilotus polystachyus, Rhagodia drummondii, Rhodanthe polycephala, Sclerolaena densiflora, Sclerolaena diacantha,* ***Sisymbrium irio*, Spergula pentandra*,*** *Trachymene ornata, Waitzia acuminata* var. *acuminata*					

Quadrat:	KS11	Assessor:	Christina Cox and Michael Pezzaniti	Date:	26/09/2018	Photograph
Location (GDA94):		MGA50	428065 m E	6762871 m N		
Habitat:		Hill (gentle north-west facing footslope)				
Soil:		Red sandy-loam surface crust (40%), loose soil (40%)				
Rocks:		Ironstone stones (10%), granite stones (5%), quartz stones (2%)				
Mapped as:		*E***MWL**				
Vegetation Type:		Mid Shrubland of *Eremophila clarkei* and *Senna* sp. Austin (A. Strid 20210) with a Forbland of *Erymophyllum ramosum* subsp. *ramosum* with an Open Low Woodland of *Eucalyptus kochii* subsp. *borealis* with a Sparse Tall Shrubland of *Eremophila oppositifolia* subsp. *angustifolia*, *Acacia acuminata* and a Sparse Low Shrubland of *Rhagodia drummondii*, *Acacia acuminata* and *Eremophila clarkei*				
Vegetation Condition:		Very Good				
Disturbances:		Animal tracks - trampled vegetation				
Fire Age:		None evident				
Species:		*Acacia acanthoclada* subsp. *glaucescens*, *Acacia acuminata, Acacia andrewsii,* ***Acacia graciliformis*** **(P1),** *Acacia tetragonophylla,* ***Arctotheca calendula****, Austrostipa trichophylla,* ***Carrichtera annua****,* *Crassula colorata* var. *colorata*, ***Cuscuta epithymum****,* *Daucus glochidiatus, Dodonaea inaequifolia, Enchylaena tomentosa* var. *tomentosa*, *Eremophila clarkei, Eremophila oppositifolia* subsp. *angustifolia*, *Erodium cygnorum,* ***Erymophyllum ramosum*** **subsp.** ***ramosum*** **(RE),** *Eucalyptus kochii* subsp. *borealis*, ***Hordeum hystrix**** **(RE),** *Lawrencella rosea, Maireana georgei,* ***Medicago polymorpha****,* *Parietaria cardiostegia,* ***Pentameris airoides*** **subsp.** ***airoides****, Podolepis aristata* subsp. *aristata*, *Ptilotus gaudichaudii, Ptilotus obovatus, Ptilotus polystachyus, Rhagodia drummondii, Roepera apiculata, Schoenia cassiniana, Schoenia filifolia* subsp. *filifolia*, *Sclerolaena densiflora, Sclerolaena diacantha, Senna* sp. Austin (A. Strid 20210), *Solanum cleistogamum,* ***Sonchus oleraceus****,* *Trachymene cyanopetala, Waitzia acuminata* var. *acuminata*				

Quadrat:	KS12	Assessor:	Christina Cox and Michael Pezzaniti	Date:	26/09/2018	Photograph
Location (GDA94):		MGA50	427992 m E	6762855 m N		
Habitat:		Hill (hilltop, moderate south-west facing slope)				
Soil:		Red sandy-loam surface crust (50%)				
Rocks:		BIF boulders (30%), ironstone stones (20%)				
Mapped as:		*Mn***SL**				
Vegetation Type:		Tall Shrubland of *Melaleuca nematophylla* and *Dodonaea inaequifolia* with a Low Woodland of *Allocasuarina acutivalvis* subsp. *prinsepiana* with an Open Mid Shrubland of *Melaleuca nematophylla* and *Eremophila clarkei* with a Sparse Low Shrubland of *Mirbelia microphylla* and Isolated Tussock Grasses of *Austrostipa elegantissima*				
Vegetation Condition:		Excellent				
Disturbances:		None				
Fire Age:		None evident				
Species:		*Allocasuarina acutivalvis* subsp. *prinsepiana*, ***Arctotheca calendula****, Arthropodium dyeri, Austrostipa elegantissima,* ***Baeckea*** **sp. Perenjori (J.W. Green 1516) (P2),** *Daviesia hakeoides* subsp. *hakeoides*, *Dioscorea hastifolia, Dodonaea inaequifolia,* ***Echium plantagineum**** **(DPP),** *Eremophila clarkei, Erodium cygnorum, Goodenia berardiana, Grevillea paradoxa, Lobelia winfridae, Lomandra marginata, Melaleuca nematophylla, Melaleuca radula,* ***Millotia dimorpha*** **(P1),** *Mirbelia microphylla, Phyllangium sulcatum, Ptilotus polystachyus, Rhodanthe stricta, Schoenia cassiniana, Sida* sp. dark green fruits (S. van Leeuwen 2260), *Solanum cleistogamum, Thysanotus manglesianus, Trachymene ornata, Waitzia acuminata* var. *acuminata*				

Note: MGA50 = Metric Grid of Australia zone 50, mE = easting, mN = northing.

APPENDIX 6: VASCULAR FLORA SPECIES LIST

Table A6.1: Vascular Flora Species List

Family	Taxa List	Quadrat	OppColl	FlFr
Aizoaceae	***Mesembryanthemum nodiflorum****	•		
Amaranthaceae	*Ptilotus gaudichaudii*	•		Fl
Amaranthaceae	*Ptilotus holosericeus*	•		Fl
Amaranthaceae	*Ptilotus obovatus*	•		Fl
Amaranthaceae	*Ptilotus polystachyus*	•		Fl
Apiaceae	*Daucus glochidiatus*	•		Fr
Apiaceae	*Xanthosia kochii*	•		Fl
Apocynaceae	*Alyxia buxifolia*	•		Fl
Araliaceae	*Trachymene cyanopetala*	•	•	Fr
Araliaceae	*Trachymene ornata*	•	•	Fr
Asparagaceae	*Arthropodium dyeri*	•		FlFr
Asparagaceae	*Lomandra marginata*	•		Fl
Asparagaceae	*Thysanotus manglesianus*	•		Fl
Asteraceae	***Arctotheca calendula****	•	•	FlFr
Asteraceae	*Bellida graminea*		•	Fl
Asteraceae	*Blennospora drummondii*		•	Fl
Asteraceae	*Brachyscome iberidifolia*	•		Fl
Asteraceae	*Calotis hispidula*	•		FlFr
Asteraceae	*Erymophyllum ramosum* subsp. *ramosum*	•	•	FlFr
Asteraceae	*Erymophyllum tenellum*	•		Fl
Asteraceae	*Gilberta tenuifolia*	•	•	Fl
Asteraceae	*Lawrencella davenportii*	•		Fl
Asteraceae	*Lawrencella rosea*	•	•	FlFr
Asteraceae	***Millotia dimorpha*** **(P1)**	•		FlFr
Asteraceae	*Myriocephalus guerinae*	•		FlFr
Asteraceae	*Olearia muelleri*	•		FlFr
Asteraceae	*Podolepis aristata* subsp. *aristata*	•		FlFr
Asteraceae	*Rhodanthe battii*		•	Fl
Asteraceae	*Rhodanthe polycephala*	•		Fl
Asteraceae	*Rhodanthe stricta*	•		FlFr
Asteraceae	*Schoenia cassiniana*	•		Fl
Asteraceae	*Schoenia filifolia* subsp. *filifolia*	•		FlFr
Asteraceae	***Sonchus oleraceus****	•		FlFr
Asteraceae	*Waitzia acuminata*		•	Fl
Asteraceae	*Waitzia acuminata* var. *acuminata*	•		Fl
Boraginaceae	***Echium plantagineum*** **(DPP)**	•	•	Fl
Boryaceae	*Borya sphaerocephala*		•	Fl
Brassicaceae	***Carrichtera annua****	•		FlFr
Brassicaceae	*Lepidium oxytrichum*	•		Fr
Brassicaceae	***Sisymbrium irio****	•		Fl
Brassicaceae	*Stenopetalum filifolium*	•		FlFr
Campanulaceae	*Lobelia winfridae*	•		FlFr
Caryophyllaceae	***Spergula pentandra****	•		Fl
Casuarinaceae	*Allocasuarina acutivalvis* subsp. *prinsepiana*	•		Fr
Casuarinaceae	*Allocasuarina campestris*	•		Fr

Family	Taxa List	Quadrat	OppColl	FlFr
Chenopodiaceae	*Enchylaena lanata*		•	Fr
Chenopodiaceae	*Enchylaena tomentosa* var. *tomentosa*	•		Fr
Chenopodiaceae	*Maireana carnosa*	•		Fr
Chenopodiaceae	*Maireana georgei*	•		Fr
Chenopodiaceae	*Maireana tomentosa* subsp. *tomentosa*	•	•	Fr
Chenopodiaceae	*Rhagodia drummondii*	•		Fl
Chenopodiaceae	*Sclerolaena densiflora*	•		Fr
Chenopodiaceae	*Sclerolaena diacantha*	•		
Convolvulaceae	***Cuscuta epithymum****	•	•	Fr
Crassulaceae	*Crassula colorata* var. *colorata*	•		FlFr
Cyperaceae	***Lepidosperma* sp. Koolanooka (K.R. Newbey 9336) (P1)**	•	•	FlFr
Dilleniaceae	*Hibbertia arcuata*	•		FlFr
Dilleniaceae	*Hibbertia exasperata*	•		FlFr
Dioscoreaceae	*Dioscorea hastifolia*	•		Fr
Droseraceae	*Drosera macrantha*	•		FlFr
Ericaceae	*Astroloma serratifolium*	•		Fl
Euphorbiaceae	***Beyeria* aff. *minor* (TOI)**	•	•	FlFr
Fabaceae	*Acacia acanthoclada* subsp. *glaucescens*	•	•	FlFr
Fabaceae	*Acacia acuaria*	•		Fl
Fabaceae	*Acacia acuminata*	•		
Fabaceae	*Acacia andrewsii*	•		FlFr
Fabaceae	*Acacia anthochaera*	•	•	Fl
Fabaceae	*Acacia daviesioides*	•	•	Fl
Fabaceae	***Acacia graciliformis* (P1)**	•	•	FlFr
Fabaceae	***Acacia muriculata* (P1)**	•	•	Fl
Fabaceae	*Acacia neurophylla subsp. erugata*		•	
Fabaceae	*Acacia tetragonophylla*	•		
Fabaceae	*Acacia tratmaniana*		•	
Fabaceae	*Daviesia hakeoides* subsp. *hakeoides*	•		
Fabaceae	***Labichea* sp. Koolanooka (TOI)**		•	
Fabaceae	***Medicago polymorpha****	•		Fr
Fabaceae	***Medicago truncatula****		•	Fr
Fabaceae	***Mirbelia ferricola* (P3)**	•		Fl
Fabaceae	*Mirbelia microphylla*	•	•	FlFr
Fabaceae	*Senna artemisioides* subsp. *filifolia*		•	
Fabaceae	*Senna artemisioides* subsp. *petiolaris*		•	
Fabaceae	*Senna* sp. Austin (A. Strid 20210)	•		Fl
Geraniaceae	*Erodium cygnorum*	•		FlFr
Goodeniaceae	*Brunonia* sp. Goldfields (K.R. Newbey 6044)	•	•	FlFr
Goodeniaceae	*Goodenia berardiana*	•		FlFr
Goodeniaceae	*Goodenia* sp.	•		Fl
Goodeniaceae	*Velleia cycnopotamica*	•		FlFr
Hemerocallidaceae	*Dianella revoluta* var. *divaricata*	•		
Lamiaceae	*Hemigenia botryphylla*		•	FlFr
Lauraceae	*Cassytha nodiflora*	•		Fl
Loganiaceae	*Phyllangium sulcatum*	•		FlFr
Malvaceae	*Sida* sp. dark green fruits (S. van Leeuwen 2260)	•		FlFr
Montiaceae	*Calandrinia eremaea* non-papillate variant	•		FlFr
Myrtaceae	*Aluta aspera* subsp. *hesperia*	•	•	FlFr
Myrtaceae	***Baeckea* sp. Perenjori (J.W. Green 1516) (P2)**	•	•	FlFr

Family	Taxa List	Quadrat	OppColl	FlFr
Myrtaceae	*Eucalyptus ?ebbanoensis*	•		
Myrtaceae	*Eucalyptus ?loxophleba*	•		
Myrtaceae	*Eucalyptus ?subangusta*	•		
Myrtaceae	*Eucalyptus ebbanoensis*	•		Fr
Myrtaceae	*Eucalyptus kochii* subsp. *borealis*	•		Fr
Myrtaceae	*Eucalyptus leptopoda* subsp. *arctata*	•		Fr
Myrtaceae	*Eucalyptus subangusta* subsp. *pusilla*	•		Fr
Myrtaceae	***Melaleuca barlowii* (P3)**	•	•	Fr
Myrtaceae	*Melaleuca cordata*	•		Fr
Myrtaceae	*Melaleuca eleuterostachya*	•		Fr
Myrtaceae	*Melaleuca nematophylla*	•	•	FlFr
Myrtaceae	*Melaleuca radula*	•		FlFr
Myrtaceae	*Melaleuca stereophloia*	•		FlFr
Myrtaceae	*Micromyrtus racemosa*	•		FlFr
Pittosporaceae	*Cheiranthera simplicifolia*	•		FlFr
Plumbaginaceae	***Limonium lobatum****	•		FlFr
Poaceae	*Amphipogon caricinus* var. *caricinus*	•		FlFr
Poaceae	*Aristida contorta*	•		
Poaceae	*Austrostipa elegantissima*	•		Fr
Poaceae	*Austrostipa scabra*	•		Fr
Poaceae	*Austrostipa trichophylla*	•		Fr
Poaceae	***Avena barbata****		•	Fr
Poaceae	***Hordeum hystrix**** **(RE)**	•		Fl
Poaceae	*Monachather paradoxus*	•		FlFr
Poaceae	***Pentameris airoides* subsp. *airoides****	•		Fr
Polygalaceae	*Comesperma integerrimum*	•	•	FlFr
Proteaceae	*Grevillea levis*		•	Fr
Proteaceae	*Grevillea paradoxa*	•	•	FlFr
Proteaceae	*Hakea recurva* subsp. *recurva*	•	•	Fr
Proteaceae	***Persoonia pentasticha* (P3)**		•	
Pteridaceae	*Cheilanthes adiantoides*	•		
Rhamnaceae	***Stenanthemum poicilum* (P3)**	•	•	FlFr
Rutaceae	***Drummondita rubroviridis* (P1)**	•		Fl
Sapindaceae	*Dodonaea inaequifolia*	•		FlFr
Sapindaceae	***Dodonaea scurra* (P1)**	•		FlFr
Scrophulariaceae	*Eremophila clarkei*	•	•	FlFr
Scrophulariaceae	*Eremophila decipiens* subsp. *decipiens*		•	Fl
Scrophulariaceae	*Eremophila eriocalyx*		•	FlFr
Scrophulariaceae	*Eremophila oppositifolia* subsp. *angustifolia*	•		FlFr
Solanaceae	*Solanum cleistogamum*	•		Fl
Stylidiaceae	***Levenhookia stipitata* (RE)**		•	FlFr
Stylidiaceae	*Stylidium confluens*	•		Fl
Thymelaeaceae	*Pimelea avonensis*		•	Fl
Urticaceae	*Parietaria cardiostegia*	•		FlFr
Zygophyllaceae	*Roepera apiculata*	•		Fl

Note: * = environmental weed, DPP = declared pest plant, Priority 1 species, P1-P3 = Priority 1 to Priority 3 flora species, Fl = flowering material, Fr = fruiting material, subsp. = subspecies, var. = variety, sp. = species, ? = query species. Nomenclature based on current WA Herbarium terminology and confirmed on FloraBase (WAH, 1998-).

APPENDIX 7: SITE BY SPECIES AND SITE BY VEGETATION TYPE MATRICES

Table A7.1: Site by Species Matrix

Note: * = weed species, DPP = Declared Pest Plant, ?P1 = potential Priority 1 species, P1-P3 = Priority 1 to Priority 3 flora species, Fl = flowering material, Fr = fruiting material, RE = range extension, subsp. = subspecies, var. = variety, sp. = species, ? = query species or range extension. Nomenclature based on current WA Herbarium terminology and confirmed on FloraBase (WAH, 1998-).

Family	Species	KS01	KS02	KS03	KS04	KS05	KS06	KS07	KS08	KS09	KS10	KS11	KS12	OppColl
		*E*MWL	MSL/WL	*Me*SL	MSL	*Me*SL	*Me*SL	MSL/WL	MSL	*Mn*SL	*E*MWL	*E*MWL	*Mn*SL	
Aizoaceae	***Mesembryanthemum nodiflorum****										1			
Amaranthaceae	*Ptilotus gaudichaudii*										1	1		
Amaranthaceae	*Ptilotus holosericeus*										1			
Amaranthaceae	*Ptilotus obovatus*										1	1		
Amaranthaceae	*Ptilotus polystachyus*										1	1	1	
Apiaceae	*Daucus glochidiatus*											1		
Apiaceae	*Xanthosia kochii*							1	1					
Apocynaceae	*Alyxia buxifolia*										1			
Araliaceae	*Trachymene cyanopetala*				1	1	1			1		1		1
Araliaceae	*Trachymene ornata*					1	1		1		1		1	1
Asparagaceae	*Arthropodium dyeri*	1		1			1		1	1	1		1	
Asparagaceae	*Lomandra marginata*								1				1	
Asparagaceae	*Thysanotus manglesianus*				1				1	1			1	
Asteraceae	***Arctotheca calendula****								1	1	1	1	1	1
Asteraceae	*Bellida graminea*													1
Asteraceae	*Blennospora drummondii*													1
Asteraceae	*Brachyscome iberidifolia*					1								
Asteraceae	*Calotis hispidula*										1			
Asteraceae	*Erymophyllum ramosum* subsp. *ramosum*											1		1
Asteraceae	*Erymophyllum tenellum*	1		1										
Asteraceae	*Gilberta tenuifolia*					1								1
Asteraceae	*Lawrencella davenportii*								1					
Asteraceae	*Lawrencella rosea*				1	1	1		1	1		1		1
Asteraceae	***Millotia dimorpha* (P1)**								1	1			1	
Asteraceae	*Myriocephalus guerinae*									1				
Asteraceae	*Olearia muelleri*	1												
Asteraceae	*Podolepis aristata* subsp.	1			1				1		1	1		

Family	Species	KS01	KS02	KS03	KS04	KS05	KS06	KS07	KS08	KS09	KS10	KS11	KS12	OppColl
		*E*MWL	MSL/WL	*Me*SL	MSL	*Me*SL	*Me*SL	MSL/WL	MSL	*Mn*SL	*E*MWL	*E*MWL	*Mn*SL	
	aristata													
Asteraceae	*Rhodanthe battii*													1
Asteraceae	*Rhodanthe polycephala*										1			
Asteraceae	*Rhodanthe stricta*												1	
Asteraceae	*Schoenia cassiniana*									1		1	1	
Asteraceae	*Schoenia filifolia* subsp. *filifolia*	1										1		
Asteraceae	***Sonchus oleraceus****											1		
Asteraceae	*Waitzia acuminata*													1
Asteraceae	*Waitzia acuminata* var. *acuminata*	1	1	1	1	1	1	1	1	1	1	1	1	
Boraginaceae	***Echium plantagineum**** **(DPP)**												1	1
Boryaceae	*Borya sphaerocephala*													1
Brassicaceae	***Carrichtera annua****											1		
Brassicaceae	*Lepidium oxytrichum*										1			
Brassicaceae	***Sisymbrium irio****										1			
Brassicaceae	*Stenopetalum filifolium*					1	1							
Campanulaceae	*Lobelia winfridae*												1	
Caryophyllaceae	***Spergula pentandra****										1			
Casuarinaceae	*Allocasuarina acutivalvis* subsp. *prinsepiana*		1	1	1	1	1	1	1				1	
Casuarinaceae	*Allocasuarina campestris*				1			1	1					
Chenopodiaceae	*Enchylaena lanata*													1
Chenopodiaceae	*Enchylaena tomentosa* var. *tomentosa*										1	1		
Chenopodiaceae	*Maireana carnosa*										1			
Chenopodiaceae	*Maireana georgei*											1		
Chenopodiaceae	*Maireana tomentosa* subsp. *tomentosa*										1			1
Chenopodiaceae	*Rhagodia drummondii*										1	1		
Chenopodiaceae	*Sclerolaena densiflora*										1	1		
Chenopodiaceae	*Sclerolaena diacantha*										1	1		
Convolvulaceae	***Cuscuta epithymum****											1		1
Crassulaceae	*Crassula colorata* var.	1									1	1		

Family	Species	KS01	KS02	KS03	KS04	KS05	KS06	KS07	KS08	KS09	KS10	KS11	KS12	OppColl
		*E*MWL	MSL/WL	*Me*SL	MSL	*Me*SL	*Me*SL	MSL/WL	MSL	*Mn*SL	*E*MWL	*E*MWL	*Mn*SL	
	colorata													
Cyperaceae	***Lepidosperma* sp. Koolanooka (K.R. Newbey 9336) (P1)**								1	1				1
Dilleniaceae	*Hibbertia arcuata*		1		1				1					
Dilleniaceae	*Hibbertia exasperata*	1	1					1						
Dioscoreaceae	*Dioscorea hastifolia*												1	
Droseraceae	*Drosera macrantha*				1	1			1	1				
Ericaceae	*Astroloma serratifolium*		1	1					1	1				
Euphorbiaceae	***Beyeria* aff. minor (TOI)**								1					1
Fabaceae	*Acacia acanthoclada* subsp. *glaucescens*	1									1	1		1
Fabaceae	*Acacia acuaria*				1				1					
Fabaceae	*Acacia acuminata*			1		1	1			1		1		
Fabaceae	*Acacia andrewsii*	1									1	1		
Fabaceae	*Acacia anthochaera*	1		1										1
Fabaceae	*Acacia daviesioides*		1					1						1
Fabaceae	***Acacia graciliformis* (P1)**	1	1	1				1			1	1		1
Fabaceae	***Acacia muriculata* (P1)**		1		1			1						1
Fabaceae	*Acacia neurophylla subsp. erugata*													1
Fabaceae	*Acacia tetragonophylla*											1		
Fabaceae	*Acacia tratmaniana*													1
Fabaceae	*Daviesia hakeoides* subsp. *hakeoides*												1	
Fabaceae	***Labichea* sp. Koolanooka (TOI)**													1
Fabaceae	***Medicago polymorpha****											1		
Fabaceae	***Medicago truncatula****													1
Fabaceae	***Mirbelia ferricola* (P3)**		1					1						
Fabaceae	*Mirbelia microphylla*									1			1	1
Fabaceae	*Senna artemisioides* subsp. *filifolia*													1
Fabaceae	*Senna artemisioides* subsp. *petiolaris*													1
Fabaceae	*Senna* sp. Austin (A. Strid											1		

Family	Species	KS01	KS02	KS03	KS04	KS05	KS06	KS07	KS08	KS09	KS10	KS11	KS12	OppColl
		*E*MWL	MSL/WL	*Me*SL	MSL	*Me*SL	*Me*SL	MSL/WL	MSL	*Mn*SL	*E*MWL	*E*MWL	*Mn*SL	
	20210)													
Geraniaceae	*Erodium cygnorum*			1								1	1	
Goodeniaceae	*Brunonia* sp. Goldfields (K.R. Newbey 6044)				1									1
Goodeniaceae	*Goodenia berardiana*						1				1		1	
Goodeniaceae	*Goodenia* sp.					1								
Goodeniaceae	*Velleia cycnopotamica*					1	1							
Hemerocallidaceae	*Dianella revoluta* var. *divaricata*	1				1			1	1				
Lamiaceae	*Hemigenia botryphylla*													1
Lauraceae	*Cassytha nodiflora*								1		1			
Loganiaceae	*Phyllangium sulcatum*												1	
Malvaceae	*Sida* sp. dark green fruits (S. van Leeuwen 2260)												1	
Montiaceae	*Calandrinia eremaea* non-papillate variant										1			
Myrtaceae	*Aluta aspera* subsp. *hesperia*				1				1					1
Myrtaceae	***Baeckea* sp. Perenjori (J.W. Green 1516) (P2)**									1			1	1
Myrtaceae	*Eucalyptus ?ebbanoenis*		1				1				1			
Myrtaceae	*Eucalyptus ?loxophleba*				1	1		1						
Myrtaceae	*Eucalyptus ?subangusta*	1												
Myrtaceae	*Eucalyptus ebbanoensis*								1					
Myrtaceae	*Eucalyptus kochii* subsp. *borealis*											1		
Myrtaceae	*Eucalyptus leptopoda* subsp. *arctata*	1		1										
Myrtaceae	*Eucalyptus subangusta* subsp. *pusilla*	1					1							
Myrtaceae	***Melaleuca barlowii* (P3)**								1					1
Myrtaceae	*Melaleuca cordata*				1				1					
Myrtaceae	*Melaleuca eleuterostachya*	1	1	1		1	1							
Myrtaceae	*Melaleuca nematophylla*		1	1				1		1			1	1
Myrtaceae	*Melaleuca radula*							1		1			1	
Myrtaceae	*Melaleuca stereophloia*					1								

Family	Species	KS01	KS02	KS03	KS04	KS05	KS06	KS07	KS08	KS09	KS10	KS11	KS12	OppColl
		*E*MWL	MSL/WL	*Me*SL	MSL	*Me*SL	*Me*SL	MSL/WL	MSL	*Mn*SL	*E*MWL	*E*MWL	*Mn*SL	
Myrtaceae	*Micromyrtus racemosa*		1		1	1		1						
Pittosporaceae	*Cheiranthera simplicifolia*							1						
Plumbaginaceae	***Limonium lobatum****										1			
Poaceae	*Amphipogon caricinus* var. *caricinus*			1	1	1	1			1				
Poaceae	*Aristida contorta*									1				
Poaceae	*Austrostipa elegantissima*			1						1			1	
Poaceae	*Austrostipa scabra*										1			
Poaceae	*Austrostipa trichophylla*			1								1		
Poaceae	***Avena barbata****													1
Poaceae	***Hordeum hystrix**** (RE)											1		
Poaceae	*Monachather paradoxus*					1								
Poaceae	***Pentameris airoides* subsp. *airoides****											1		
Polygalaceae	*Comesperma integerrimum*			1			1							1
Proteaceae	*Grevillea levis*													1
Proteaceae	*Grevillea paradoxa*								1				1	1
Proteaceae	*Hakea recurva* subsp. *recurva*			1										1
Proteaceae	***Persoonia pentasticha* (P3)**													1
Pteridaceae	*Cheilanthes adiantoides*				1	1	1							
Rhamnaceae	***Stenanthemum poicilum* (P3)**					1								1
Rutaceae	***Drummondita rubroviridis* (P1)**		1		1			1	1					
Sapindaceae	*Dodonaea inaequifolia*									1	1	1	1	
Sapindaceae	***Dodonaea scurra* (P1)**	1	1					1	1					
Scrophulariaceae	*Eremophila clarkei*											1	1	1
Scrophulariaceae	*Eremophila decipiens* subsp. *decipiens*													1
Scrophulariaceae	*Eremophila eriocalyx*													1
Scrophulariaceae	*Eremophila oppositifolia* subsp. *angustifolia*	1										1		
Solanaceae	*Solanum cleistogamum*									1		1	1	
Stylidiaceae	***Levenhookia stipitata* (RE)**													1

Family	Species	KS01	KS02	KS03	KS04	KS05	KS06	KS07	KS08	KS09	KS10	KS11	KS12	OppColl
		*E*MWL	MSL/WL	*Me*SL	MSL	*Me*SL	*Me*SL	MSL/WL	MSL	*Mn*SL	*E*MWL	*E*MWL	*Mn*SL	
Stylidiaceae	*Stylidium confluens*				1	1	1			1				
Thymelaeaceae	*Pimelea avonensis*													1
Urticaceae	*Parietaria cardiostegia*											1		
Zygophyllaceae	*Roepera apiculata*											1		

Table A7.2: Vegetation Type by Species Matrix

Note: * = environmental weed, DPP = Declared Pest Plant, ?P1 = potential Priority 1 species, P1-P3 = Priority 1 to Priority 3 flora species, subsp. = subspecies, var. = variety, sp. = species, ? = query species. Nomenclature based on current WA Herbarium terminology and confirmed on FloraBase (WAH, 1998-). Cells not highlighted indicate species in each Meissner & Caruso (2008) community type description.

Family	Species	KS01, 10, 11	KS03, 05, 06	KS09, 12	KS04, 08	KS02, 07
		***E*MWL**	***Me*SL**	***Mn*SL**	**MSL**	**MSL/WL**
		Similar to Meissner & Caruso community type **5**	Similar to Meissner & Caruso community type **1a**	Similar to Meissner & Caruso community type **3**	Similar to Meissner & Caruso community type **1a**	Similar to Meissner & Caruso community type **1a**
Aizoaceae	***Mesembryanthemum nodiflorum****	1				
Amaranthaceae	*Ptilotus gaudichaudii*	1				
Amaranthaceae	*Ptilotus holosericeus*	1				
Amaranthaceae	*Ptilotus obovatus*	1				
Amaranthaceae	*Ptilotus polystachyus*	1		1		
Apiaceae	*Daucus glochidiatus*	1				
Apiaceae	*Xanthosia kochii*				1	1
Apocynaceae	*Alyxia buxifolia*	1				
Araliaceae	*Trachymene cyanopetala*	1	1	1	1	
Araliaceae	*Trachymene ornata*	1	1	1	1	
Asparagaceae	*Arthropodium dyeri*	1	1	1	1	
Asparagaceae	*Lomandra marginata*			1	1	
Asparagaceae	*Thysanotus manglesianus*			1	1	
Asteraceae	***Arctotheca calendula****	1		1	1	
Asteraceae	*Brachyscome iberidifolia*		1			
Asteraceae	*Calotis hispidula*	1				
Asteraceae	*Erymophyllum ramosum* subsp. *ramosum*	1				
Asteraceae	*Erymophyllum tenellum*	1	1			
Asteraceae	*Gilberta tenuifolia*		1			
Asteraceae	*Lawrencella davenportii*				1	
Asteraceae	*Lawrencella rosea*	1	1	1	1	
Asteraceae	***Millotia dimorpha* (P1)**			1	1	

Family	Species	KS01, 10, 11	KS03, 05, 06	KS09, 12	KS04, 08	KS02, 07
		***E*MWL**	***Me*SL**	***Mn*SL**	**MSL**	**MSL/WL**
		Similar to Meissner & Caruso community type **5**	Similar to Meissner & Caruso community type **1a**	Similar to Meissner & Caruso community type **3**	Similar to Meissner & Caruso community type **1a**	Similar to Meissner & Caruso community type **1a**
Asteraceae	*Myriocephalus guerinae*			1		
Asteraceae	*Olearia muelleri*	1				
Asteraceae	*Podolepis aristata* subsp. *aristata*	1			1	
Asteraceae	*Rhodanthe polycephala*	1				
Asteraceae	*Rhodanthe stricta*			1		
Asteraceae	*Schoenia cassiniana*	1		1		
Asteraceae	*Schoenia filifolia* subsp. *filifolia*	1				
Asteraceae	***Sonchus oleraceus****	1				
Asteraceae	*Waitzia acuminata* var. *acuminata*	1	1	1	1	1
Boraginaceae	***Echium plantagineum**** **(DPP)**			1		
Brassicaceae	***Carrichtera annua****	1				
Brassicaceae	*Lepidium oxytrichum*	1				
Brassicaceae	***Sisymbrium irio****	1				
Brassicaceae	*Stenopetalum filifolium*		1			
Campanulaceae	*Lobelia winfridae*			1		
Caryophyllaceae	***Spergula pentandra****	1				
Casuarinaceae	*Allocasuarina acutivalvis* subsp. *prinsepiana*		**1**	**1**	**1**	**1**
Casuarinaceae	*Allocasuarina campestris*				1	1
Chenopodiaceae	*Enchylaena tomentosa* var. *tomentosa*	**1**				
Chenopodiaceae	*Maireana carnosa*	**1**				
Chenopodiaceae	*Maireana georgei*	**1**				
Chenopodiaceae	*Maireana tomentosa* subsp. *tomentosa*	**1**				
Chenopodiaceae	*Rhagodia drummondii*	**1**				
Chenopodiaceae	*Sclerolaena densiflora*	**1**				
Chenopodiaceae	*Sclerolaena diacantha*	**1**				
Convolvulaceae	***Cuscuta epithymum****	1				

Family	Species	KS01, 10, 11	KS03, 05, 06	KS09, 12	KS04, 08	KS02, 07
		***E*MWL**	***Me*SL**	***Mn*SL**	**MSL**	**MSL/WL**
		Similar to Meissner & Caruso community type **5**	Similar to Meissner & Caruso community type **1a**	Similar to Meissner & Caruso community type **3**	Similar to Meissner & Caruso community type **1a**	Similar to Meissner & Caruso community type **1a**
Crassulaceae	*Crassula colorata* var. *colorata*	1				
Cyperaceae	***Lepidosperma* sp. Koolanooka (K.R. Newbey 9336) (P1)**			1	1	
Dilleniaceae	*Hibbertia arcuata*				1	1
Dilleniaceae	*Hibbertia exasperata*	1				1
Dioscoreaceae	*Dioscorea hastifolia*			1		
Droseraceae	*Drosera macrantha*		1	1	1	
Ericaceae	*Astroloma serratifolium*		1	1	1	1
Euphorbiaceae	***Beyeria* aff. *minor* (TOI)**				1	
Fabaceae	*Acacia acanthoclada* subsp. *glaucescens*	1				
Fabaceae	*Acacia acuaria*				1	
Fabaceae	*Acacia acuminata*	1	1	1		
Fabaceae	*Acacia andrewsii*	1				
Fabaceae	*Acacia anthochaera*	1	1			
Fabaceae	*Acacia daviesioides*					1
Fabaceae	***Acacia graciliformis* (P1)**	1	1			1
Fabaceae	***Acacia muriculata* (P1)**				1	1
Fabaceae	*Acacia tetragonophylla*	1				
Fabaceae	*Daviesia hakeoides* subsp. *hakeoides*			1		
Fabaceae	***Medicago polymorpha****	1				
Fabaceae	***Mirbelia ferricola* (P3)**					1
Fabaceae	*Mirbelia microphylla*			1		
Fabaceae	*Senna* sp. Austin (A. Strid 20210)	1				
Geraniaceae	*Erodium cygnorum*	1	1	1		
Goodeniaceae	*Brunonia* sp. Goldfields (K.R. Newbey 6044)				1	
Goodeniaceae	*Goodenia berardiana*	1	1	1		
Goodeniaceae	*Goodenia* sp.		1			

Family	Species	KS01, 10, 11	KS03, 05, 06	KS09, 12	KS04, 08	KS02, 07
		***E*MWL**	***Me*SL**	***Mn*SL**	**MSL**	**MSL/WL**
		Similar to Meissner & Caruso community type **5**	Similar to Meissner & Caruso community type **1a**	Similar to Meissner & Caruso community type **3**	Similar to Meissner & Caruso community type **1a**	Similar to Meissner & Caruso community type **1a**
Goodeniaceae	*Velleia cycnopotamica*		1			
Hemerocallidaceae	*Dianella revoluta* var. *divaricata*	1	1	1	1	
Lauraceae	*Cassytha nodiflora*	1			1	
Loganiaceae	*Phyllangium sulcatum*			1		
Malvaceae	*Sida* sp. dark green fruits (S. van Leeuwen 2260)			1		
Montiaceae	*Calandrinia eremaea* non-papillate variant	1				
Myrtaceae	*Aluta aspera* subsp. *hesperia*				1	
Myrtaceae	***Baeckea* sp. Perenjori (J.W. Green 1516) (P2)**			1		
Myrtaceae	*Eucalyptus* ?*ebbanoenis*	**1**	**1**			**1**
Myrtaceae	*Eucalyptus ebbanoensis*				**1**	
Myrtaceae	*Eucalyptus kochii* subsp. *borealis*	**1**				
Myrtaceae	*Eucalyptus leptopoda* subsp. *arctata*	**1**	1			
Myrtaceae	*Eucalyptus* ?*loxophleba*		1		1	1
Myrtaceae	*Eucalyptus* ?*subangusta*	**1**				
Myrtaceae	*Eucalyptus subangusta* subsp. *pusilla*	**1**	1			
Myrtaceae	***Melaleuca barlowii* (P3)**				**1**	
Myrtaceae	*Melaleuca cordata*				**1**	
Myrtaceae	*Melaleuca eleuterostachya*	1	**1**			**1**
Myrtaceae	*Melaleuca nematophylla*		**1**	**1**		**1**
Myrtaceae	*Melaleuca radula*			1		**1**
Myrtaceae	*Melaleuca stereophloia*		**1**			
Myrtaceae	*Micromyrtus racemosa*		**1**		**1**	**1**
Pittosporaceae	*Cheiranthera simplicifolia*					1
Plumbaginaceae	***Limonium lobatum****	1				
Poaceae	*Amphipogon caricinus* var.		1	1	1	

Family	Species	KS01, 10, 11	KS03, 05, 06	KS09, 12	KS04, 08	KS02, 07
		***E*MWL**	***Me*SL**	***Mn*SL**	**MSL**	**MSL/WL**
		Similar to Meissner & Caruso community type **5**	Similar to Meissner & Caruso community type **1a**	Similar to Meissner & Caruso community type **3**	Similar to Meissner & Caruso community type **1a**	Similar to Meissner & Caruso community type **1a**
	caricinus					
Poaceae	*Aristida contorta*			1		
Poaceae	*Austrostipa elegantissima*		1	1		
Poaceae	*Austrostipa scabra*	1				
Poaceae	*Austrostipa trichophylla*	1	1			
Poaceae	***Hordeum hystrix**** **(RE)**	1				
Poaceae	*Monachather paradoxus*		1			
Poaceae	***Pentameris airoides* subsp. *airoides****	1				
Polygalaceae	*Comesperma integerrimum*		1			
Proteaceae	*Grevillea paradoxa*			1	1	
Proteaceae	*Hakea recurva* subsp. *recurva*		1			
Pteridaceae	*Cheilanthes adiantoides*		1		1	
Rhamnaceae	***Stenanthemum poicilum* (P3)**		1			
Rutaceae	***Drummondita rubroviridis* (P1)**				1	1
Sapindaceae	*Dodonaea inaequifolia*	1		1		
Sapindaceae	***Dodonaea scurra* (P1)**	1			1	1
Scrophulariaceae	*Eremophila clarkei*	1		1		
Scrophulariaceae	*Eremophila oppositifolia* subsp. *angustifolia*	1				
Solanaceae	*Solanum cleistogamum*	1		1		
Stylidiaceae	*Stylidium confluens*		1	1	1	
Urticaceae	*Parietaria cardiostegia*	1				
Zygophyllaceae	*Roepera apiculata*	1				

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