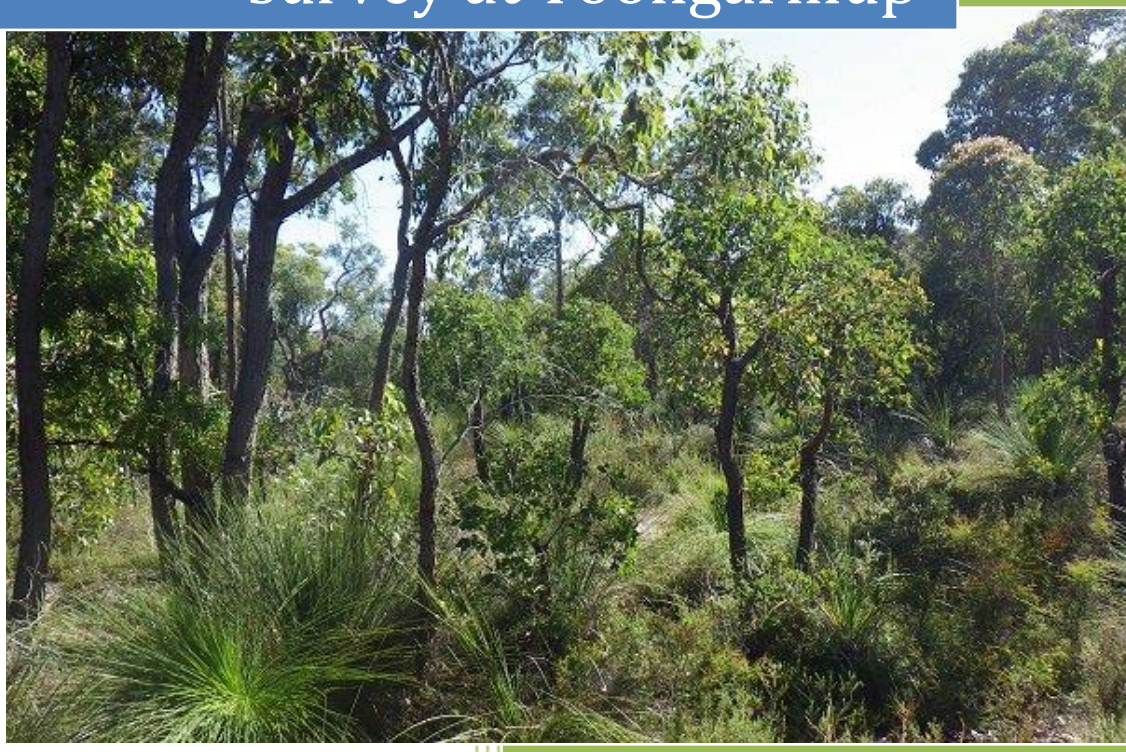
Report of a Level 2 Flora and Vegetation survey at Yoongarillup



Prepared for Doral Mineral Sands Pty Ltd

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Executive Summary

Ecoedge was commissioned in August 2012 by Doral Mineral Sands Pty Ltd to undertake a flora and vegetation survey within their Yoongarillup Resource Zone (State Forest 33, Mining Lease M70-0459, 45.1ha) hereafter referred to as the "Study Area". The main objectives of the survey were to confirm the presence of previously discovered threatened flora within the Study Area and to search for undiscovered occurrences, and to assess the vegetation in the Study Area, particularly with regard to the presence of Priority Ecological Communities.

The threatened flora survey, carried out in late September and early October, confirmed the presence of *Daviesia elongata* subsp. *elongata* (DRF, 'vulnerable'), and two Priority listed species: *Acacia semitrullata* (P4) and *Conospermum paniculatum* (P3). A population of *Verticordia densiflora* var. *pedunculata* (DRF, 'endangered') was also found within the Study Area; this taxon had previously been misidentified as the common *Verticordia densiflora* var. *caespitosa*. Another taxon, provisionally identified as the Priority species *Jacksonia gracillima* following the previous survey of the Study Area, was instead confirmed as the Whicher Range variety of the common species *J. horrida*. Numbers of populations and individuals of *D. elongata* subsp. *elongata* and the two Priority species were similar to those found during the previous survey by Mattiske Consulting Pty Ltd.

As well as being Declared Rare Flora pursuant to Schedule 1 of the *Wildlife Conservation Act 1950 (WC Act)*, and protected under provisions of that Act, *D. elongata* subsp. *elongata* is also listed as 'vulnerable' and *V. densiflora* var. *pedunculata* is listed as 'endangered' pursuant to section 179 of the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (*EPBC Act*). Listed threatened species are matters of national environmental significance (protected matters) under the *EPBC Act*'s assessment and approval provisions.

In total, two hundred and thirty three taxa from 44 families were identified in the Study Area. In addition to the DRF and Priority species listed above, three taxa considered to be regionally significant by the DEC were also recorded, these being the Whicher Range variant of *Crowea angustifolia* var. *angustifolia* and populations of *Pityrodia bartlingii* and *Petrophile serruriae*, which are geographical outliers.

Twenty one 100 m^2 floristic quadrats were placed in the Study Area and following multivariate analysis, four quadrat groups (A, B, C, and D) were derived. These quadrat groups formed the basis of four vegetation units (named after the quadrat groups), that were mapped in the Study Area. Information from fifty assessment points where floristic or soil information was collected, supplemented by information from the previous survey (by Mattiske Consulting, 2012) was used to determine the boundaries for the vegetation units.

The vegetation units were described in relation to structure and dominant taxa; a map is presented showing their distribution within the Study Area.

Vegetation unit 'A', an open forest or woodland of *Eucalyptus marginata* and *Corymbia calophylla*, situated in the northern part of the Study Area and covering about 14.7 ha is mainly associated with 'coloured' (yellow, yellow-brown and red-brown) soil. The Department of Parks and Wildlife (DPaW) has mapped 4.4 ha of FCT C1 ('Central Whicher Scarp Jarrah woodland'), which is a priority 1 ecological community, in the northern part of the area mapped as vegetation unit A. Quadrat group A, which this vegetation unit is based on, shares about 65% of its typical and common taxa with FCT C1. Based on this evidence, and the fact that FCT C1 is already recognised as occurring within its boundaries, it is inferred that vegetation unit A as mapped during the survey reported here represents an expanded extent of this priority ecological community. It is recommended that the extent of vegetation unit A, at least that occurring on yellow-brown or yellow sands, is considered for inclusion in the DPaW database as an increase of the area mapped for FCT C1 within the Study Area.

The affinities of vegetation unit B, which is the most extensive unit in the Study Area (18.8 ha) are less apparent. Structurally it is a woodland of *Eucalyptus marginata*, with admixtures of *Corymbia calophylla* and *C. haematoxylon,* and occurs mainly on grey-brown loamy sand to light grey sand with a small amount of laterite along its eastern boundary with vegetation unit A. Quadrat group B, on which this vegetation unit is based, was compared in tabular form with three floristic community types known to occur within or close to the Study Area on similar soils (FCT A1, FCT C3 and FCT C4). This comparison showed that it was most similar to FCT A1 (Central Whicher Scarp Mountain Marri woodland), which is a priority 1 ecological community. However, although FCT A1 is the closest match of the three, there is considerable dissimilarity between quadrat group B and this floristic community type.

Vegetation unit C, a *Eucalyptus marginata* and *Corymbia calophylla* open forest on gravelly sand or grey brown loamy sand over laterite in the south-western part of the Study Area, has a small area of the priority 1 ecological community FCT A1 that has been mapped within its boundary by DPaW. Comparison of quadrat group C, on which this vegetation unit is based, with the two most likely floristic community types (FCT A1 and FCT C4) showed that quadrat group C is closer in composition to FCT C4 than FCT A1. However, vegetation unit C is based on only four quadrats and the surveying of more quadrats within this area is likely to confirm the presence of FCT A1 as mapped by DPaW.

Vegetation unit D, which forms a *Eucalyptus marginata*, *Corymbia haematoxylon* and *Allocasuarina fraseriana* open forest, is situated on grey-brown or yellow-brown loamy sand and sandy clay loam at the southern boundary of the Study Area. Only one quadrat was placed within the boundaries of vegetation unit A. It shares species with the three most likely floristic

community types in the area, but further survey work and analysis would be required to identify its floristic affinities.

Of the two priority ecological communities occurring within the Study Area FCT C1 is the one which is located within the proposed disturbance area (EPA, 2014). DPaW records show that there are eight known occurrences of FCT C1 with a total area of 54 ha. If the boundaries of vegetation unit A as mapped during this study are accepted as the actual extent of FCT C1 in the Study Area it represents an increase of just over 10 ha on the previously mapped extent and brings the total known area for the community to just over 64 ha. The proposed disturbance area for the Yoongarillup Mineral Sands Project includes most of the area of vegetation unit A and of the extent of FCT C1 as previously mapped by DPaW.

The vegetation in the Study Area is mainly in Very Good to Excellent condition, with effects of partial clearing carried out 40 to 50 years ago having only a marginal effect on species richness and weed invasion. Species-richness (α-diversity), as estimated by the total numbers of taxa per quadrat within the Study Area, was moderately high with a mean of 47.2 taxa (range 31-65) for the 21 quadrats.

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Statement of limitations

Reliance on Data

In the preparation of this report, Ecoedge has relied on data, surveys, analyses, designs, plans and other information provided by the Client and other individuals and organisations, most of which are referred to in the report. Unless stated otherwise in the report, Ecoedge has not verified the accuracy or completeness of the data. To the extent that the statements, opinions, facts, information, conclusions and/or recommendations in the report are based in whole or in part on the data, those conclusions are contingent upon the accuracy and completeness of the data. Ecoedge will not be liable in relation to incorrect conclusions should any data, information or condition be incorrect or have been concealed, withheld, unavailable, misrepresented or otherwise not fully disclosed to Ecoedge.

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The report has been prepared for the benefit of the Client and for no other party. Ecoedge assumes no responsibility and will not be liable to any other person or organisation for or in relation to any matter dealt with or conclusions expressed in the report, or for any loss or damage suffered by any other person or organisation arising from matters dealt with or conclusions expressed in the report (including, without limitation, matters arising from any negligent act or omission of Ecoedge or for any loss or damage suffered by any other party relying on the matters dealt with or conclusions expressed in the report). Other parties should not rely upon the report or the accuracy or completeness of any conclusions, and should make their own enquiries and obtain independent advice in relation to such matters.

1. Introduction

Ecoedge was engaged by Doral Mineral Sands in September 2012 to undertake a Level 2 Flora and Vegetation Survey within their Yoongarillup Resource Zone (State Forest 33, Mining Lease M70-0459, 44 ha); the "Study Area". The lease area within the Millbrook State Forest covers an area of approximately 45.1ha.

1.1 Previous surveys

Mattiske Consulting Pty Ltd undertook a Flora and Vegetation Survey within the Yoongarillup Resource Zone in 2011, which included the current Study Area. This survey included desktop and field investigations, and resulted in a report detailing the conservation significance of the resource zone vegetation and flora.

Mattiske Consulting Pty Ltd also undertook a survey for Threatened and Priority flora of drill lines within the Millbrook State Forest in March, 2012. During this survey, one threatened flora species, *Daviesia elongata* subsp. *elongata*, and two Priority flora species (*Conospermum paniculatum* (P3) and *Acacia semitrullata* (P4)) and one potential Priority flora species (*Jacksonia* ?*gracillima* (P3)) were recorded within the Millbrook state forest Study Area.

The main objectives of the current survey were to confirm the presence of previously discovered threatened flora within the Study Area and to search for undiscovered occurrences, and to assess the vegetation in the Study Area, particularly with regard to the presence of Priority Ecological Communities.

The Study Area was visited on several occasions during the spring season to carry out the assessment, viz. 19th - 25th September, 2nd October, 11th and 12th October, 27th October 2012. The vegetation survey was undertaken in accordance with EPA Guidance Statement 51 'Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia' (EPA, 2004).

1.2 Objectives

The scope and objectives of the flora and vegetation survey for the Study Area were to:

- conduct an assessment of flora and vegetation values, building on existing studies in the nearby areas
- conduct a review of other literature to summarise the values of flora and vegetation significance in the Study Area
- review the documented flora and vegetation of significance, based on Department of Parks and Wildlife (DPaW) records (databases)
- conduct a field assessment to:
    - identify the vascular flora species present

    - determine the presence or absence of Declared Rare Flora (DRF), Priority or Significant Species
    - define and spatially map vegetation communities
    - define and spatially map vegetation condition
- prepare a report that summarises the findings of the desktop and field assessments
- provide recommendations for flora and vegetation protection, in order to assist Doral Mineral Sands with progressing the environmental approvals process for the project

1.3 Biogeographic region

The Study Area is located within the Southern Jarrah Forest sub-region of the Jarrah Forest Bioregion, as defined in the Interim Biogeographical Regionalisation for Australia (IBRA) (Australian Government, 2009).

1.4 Site location and features

The Study Area is situated approximately 14.2 km South-South-East of the Busselton town site (**Figure 1**).

Elevation falls from 75 m above sea level (ASL) at the southern boundary to 50 m at the northern, and continues to fall further to the north of the site as the transition zone into the Abba Plain System is reached (**Figure 2**). **Figure 2** also shows the location of proposed pit areas.

1.5 Geology and Soils

The Study Area is situated on the Whicher Scarp, a sickle shape band of low hills thought to have formed as a result of marine erosion of the Perth Sedimentary Basin around two million years ago in the Pleistocene or late Tertiary period. Following ancient shorelines at the foot of the Whicher Scarp is the Yoganup Formation, a gently sloping shelf which contains localised concentrations of heavy minerals (Churchward and McArthur, 1980). The nature of its geology, landform and soils gives the Whicher Scarp affinities with the Swan Coastal Plain. The Study Area is located on the 'Central Whicher Scarp', which is described by Keighery *et al.* (2008) as having moderate north facing slopes with areas of laterite capped rises and soils ranging from deep sands to sand, gravel, silt, clay and ironstone combinations.

The Study Area is situated on the Whicher Scarp soil landscape system (214Ws) (Tille and Lantzke, 1990), which is described as consisting of "….gentle lateritic slopes with gravels. These slopes form a low scarp which separates the Swan Coastal Plain and the Blackwood Plateau. This subsystem is similar to parts of the Cartis Land unit mapped by Churchward and McArthur (1980)." One soil mapping unit (or 'phase' of the soil-landscape systems), 214WsYL1, occurs within the Study Area (**Figure 3**). This mapping unit is described as "Raised flats. Duplex sandy gravels, semi-wet soils, yellow deep sands and sandy earths and loamy gravels."

Based on observations taken during the current survey of the Study Area, a surface soil map was developed to assist with interpretation of vegetation unit boundaries (**Figure 4**). The eight soil mapping units recognised and the extent of each are presented below in **Table 1**.

SOIL	AREA (ha)
Gravel and laterite	5.6
Grey and grey-brown sandy loam	4.8
Grey-brown loamy sand and sandy clay loam	8.4
Grey-brown sandy loam	1.6
Light grey sand	7.9
Light grey sand/gravel and laterite	1.3
Red-brown loam	0.5
Yellow-brown sandy loam	12.2

Table 1. Surface soils (0- 5 cm) mapped within the Study Area.

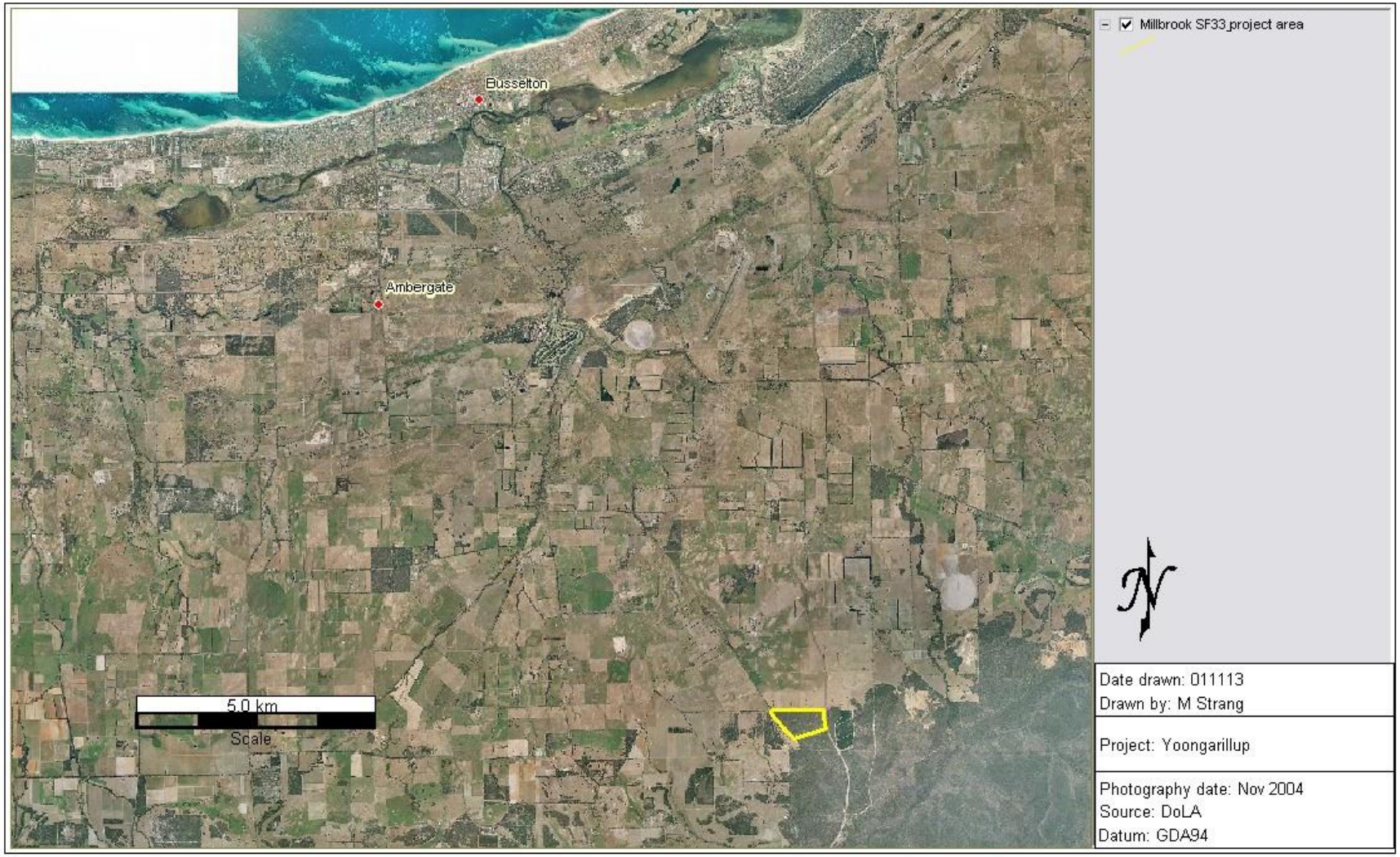

Figure 1. Aerial Photograph showing location of Study Area.

Figure 2. Study Area showing contours

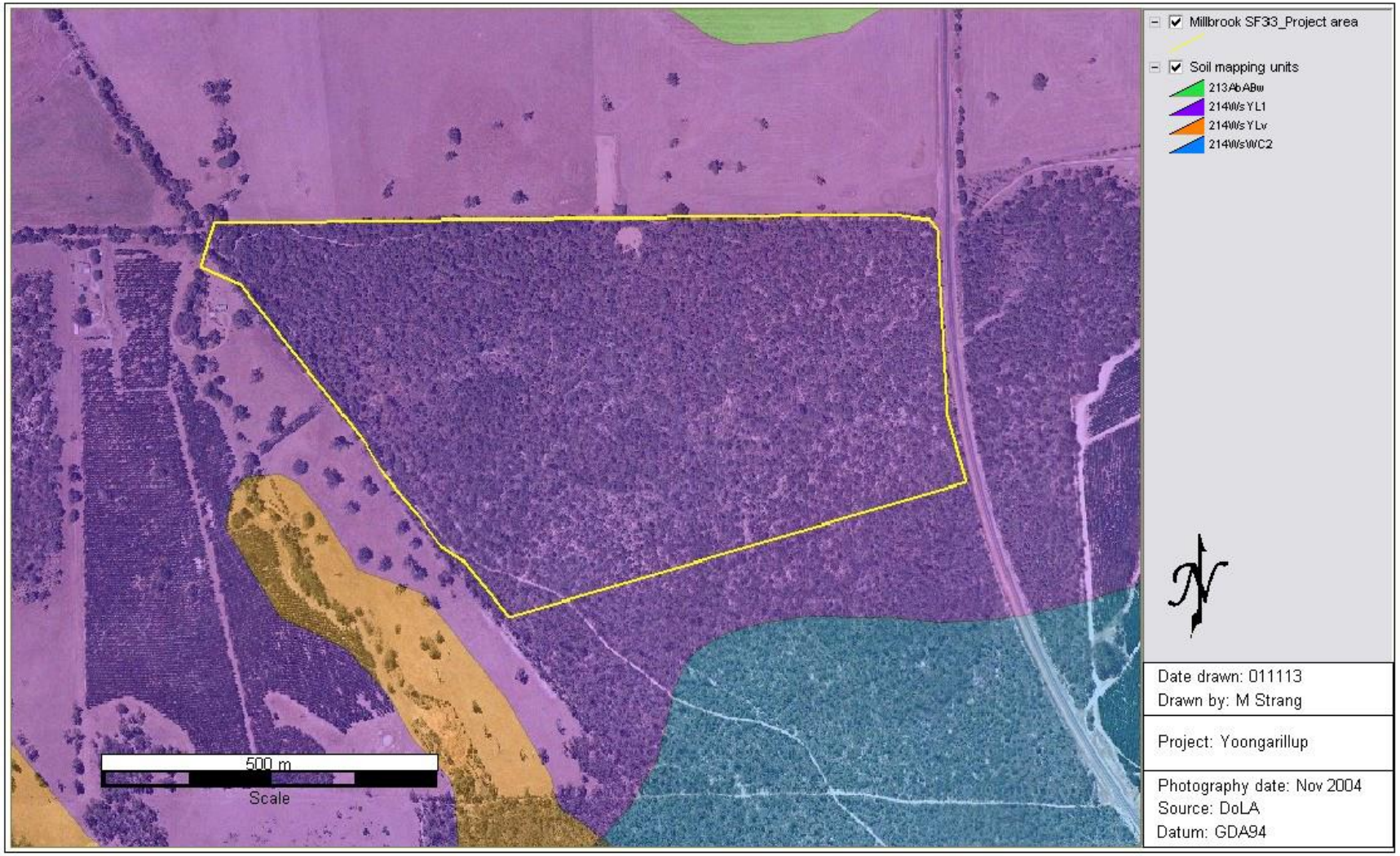

Figure 3. Soil mapping units (SMUs) occurring within and near to the Study Area.

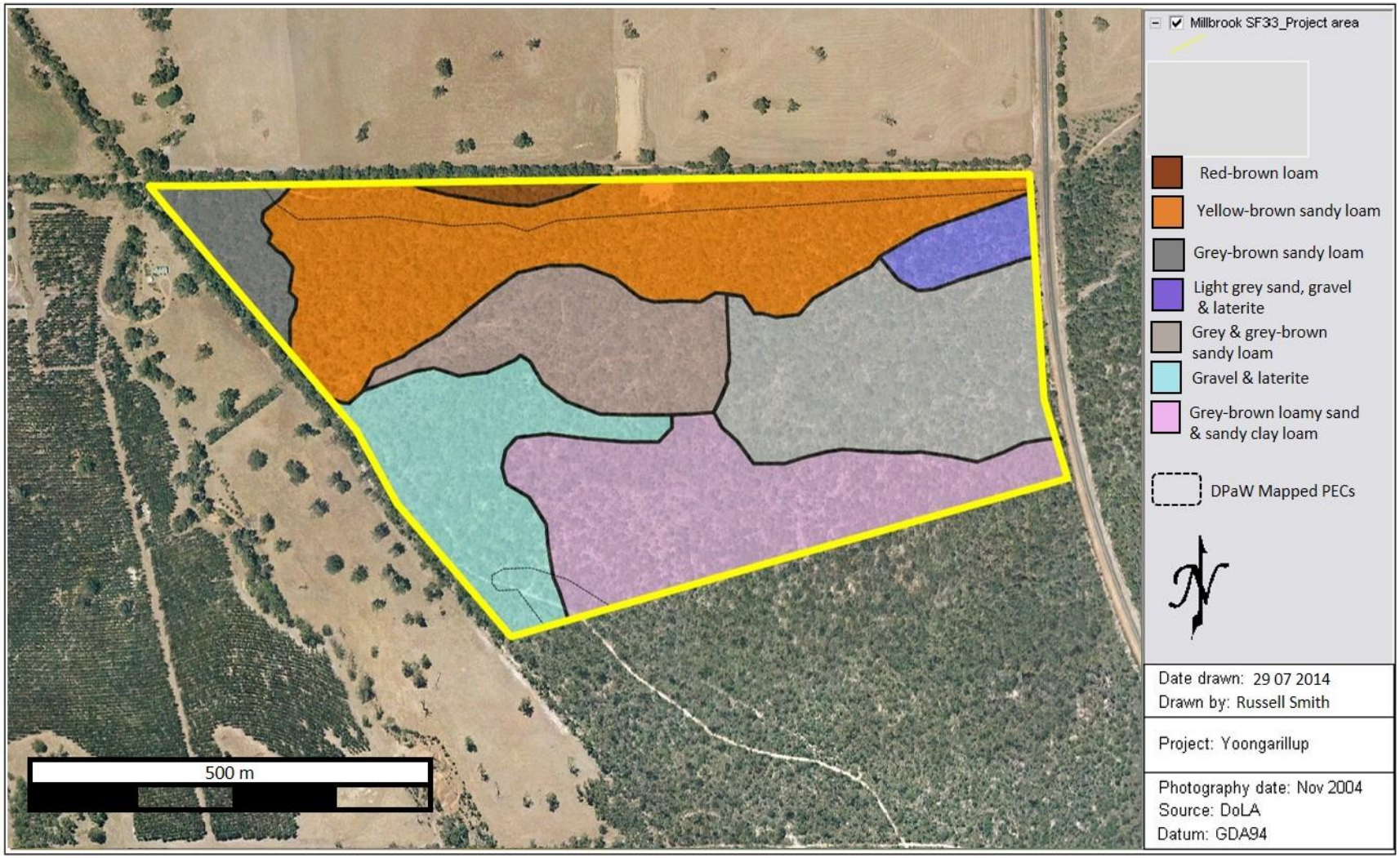

Figure 4. Surface soils in the Study Area based on observations during this survey.

1.6 Vegetation

The Study Area supports approximately 45.1 ha of remnant native vegetation. Utilising the Regional Forest Agreement (RFA) mapping undertaken by Mattiske and Havel (1998), and the Swan Coastal Plain (SCP) mapping of Heddle *et al.* (1980), the South West Biodiversity Project (SWBP) Mapping and Information Installment 2 (Molloy *et al.*, 2007) provides mapping of vegetation complexes in the portion of the South West region not covered by either Heddle (1980) or Mattiske and Havel (1998).

As shown in **Figure 5**, vegetation within the Study Area was mapped by the SWBP as supporting Yelverton Complex vegetation (**Table 2**).

Vegetation Complex	Vegetation Complex Code	Description
Yelverton	Yw	Woodland of *Allocasuarina fraseriana-Nuytsia floribunda-Agonis flexuosa-Banksia attenuata* on slopes and open forest of *Corymbia calophylla-Eucalyptus patens-Eucalyptus marginata* subsp. *marginata* on the lower slopes and woodland of *Eucalyptus rudis-Melaleuca rhaphiophylla* on valley floors in the humid zone.
Yelverton	Y	Woodland of *Eucalyptus marginata* subsp. *marginata-Corymbia calophylla-Allocasuarina fraseriana-Agonis flexuosa* and open woodland of *Corymbia calophylla* on low undulating uplands in the humid zone.

Table 2. Vegetation complexes within the Study Area.

In 2001, the Commonwealth of Australia stated National Targets and Objectives for Biodiversity Conservation, which recognised that the retention of 30%, or more, of the pre-clearing extent of each ecological community was necessary if Australia's biological diversity was to be protected. This level of recognition is in keeping with the targets set in the EPA's Position Statement on the 'Environmental protection of native vegetation in Western Australia: clearing of native vegetation, with particular reference to the agricultural area' (EPA 2000).

According to Molloy *et al.*(2007),30% of the pre-European extent of the Yelverton vegetation complex is remaining, however this Complex is poorly reserved with only 10% or less protected in formal reserves (Molloy *et al.,* 2007).

Figure 5. Vegetation complexes represented within the Study Area.

1.7 Threatened and Priority Ecological Communities

Ecological communities are defined by Western Australia's Department of Environment and Conservation (DEC) as "...naturally occurring biological assemblages that occur in a particular type of habitat. They are the sum of species within an ecosystem and, as a whole, they provide many of the processes which support specific ecosystems and provide ecological services." (DEC, 2010a).

A threatened ecological community (TEC) is one which is found to fit into one of the following categories; 'presumed totally destroyed', 'critically endangered', 'endangered' or 'vulnerable'. Possible threatened ecological communities that do not meet survey criteria are added to DEC's Priority Ecological Community Lists under Priorities 1, 2 and 3. Ecological Communities that are adequately known, 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 (DEC, 2010b). Threatened Ecological Communities can also be listed under the Environment Protection and Biodiversity Conservation Act 1999 (SEWPaC, 2010a).

Results of a DEC data search for threatened or priority ecological communities known to occur within 5 km of the Study Area are presented in **Table 3** and shown in **Figure 6** (DEC, 2013a). Communities listed under the Environment Protection and Biodiversity Conservation Act (*EPBC Act*) (1999) occurring within a 10 km radius of the Study Area, as detailed in a Protected Matters Search Tool query, are also noted (Department of Sustainability, Environment, Water, Population and Communities[1] (SEWPaC), 2012c). The complete Protected Matters Search Tool results are included in **Appendix 1.**

[1]Note: The Department of Sustainability, Environment, Water, Population and Communities (SEWPaC) is now called the Department of Environment.

Community Name	Community Description	Status (WA)	Status (*EPBC Act*)
Shrublands on dry clay flats SCP10a	Rapidly drying clay flats that generally have shallower microtopography than other clay pan community types or else have thin skeletal soils.	EN	CR
Herb rich saline shrublands in clay pans SCP07	Community occurs on heavy clay soils that are generally inundated from winter into mid-summer. This community is dominated by either *Melaleuca viminea*, *Melaleuca uncinata, Melaleuca cuticularis* or *Casuarina obesa* or a mixture of these species.	VU	CR
Shrublands on southern Swan Coastal Plain Ironstones (Busselton area) SCP10b	Rapidly drying clay flats, occurring on small areas of ironstone with thin skeletal soils in the Busselton area.	CR	EN
Southern wet shrublands, Swan Coastal Plain SCP02	Shrublands or open low woodlands restricted to small remnants of Busselton. These occur on seasonally inundated sandy clay soils.	EN	
Eucalyptus calophylla woodlands on heavy soils of the southern Swan Coastal Plain SCP1b	Consists largely of *Eucalyptus* (*Corymbia*) *calophylla* forests and woodlands of bushland remnants on the plain south of Capel.	VU	
Eucalyptus haematoxylon - *E. marginata* woodlands on Whicher foothills ('community type 1a')	Community occurs along the northern edge of State Forest along the base of the Whicher Range and is composed of *Eucalyptus* (*Corymbia*) *haematoxylon* – *Corymbia calophylla* - *Eucalyptus marginata* forests and woodlands. Taxa virtually restricted to the type include *Acacia varia* subsp. *varia*, *Agonis grandiflora* and *Xanthosia pusilla*.	P3	

Community Name	Community Description	Status (WA)	Status (*EPBC Act*)
Central Whicher Scarp Mountain Marri woodland (Whicher Scarp woodlands of grey/white sands community A1)	Located on Whicher Scarp mid slopes. The taxa that identify the group include: *Ricinocarpos cyanescens*, *Hibbertia ferruginea*, *Platysace filiformis*, *Conospermum capitatum* subsp. *glabratum*, *Thysanotus arbuscula*, *Schoenus brevisetis*, *Phlebocarya filifolia*, *Leucopogon glabellus*, *Pimelea rosea* subsp. *rosea*, *Adenanthos obovatus*, *Stylidium carnosum* and *Gompholobium capitatum*.	P1*[2]	
Central Whicher Scarp Jarrah woodland (Whicher Scarp woodlands of coloured sands and laterites community C1)	Occurs on coloured sands on moderate to gentle slopes of the Central Whicher Scarp. The community has strong representation of a less common group of southern taxa including: *Podocarpus drouynianus*, *Loxocarya cinerea*, *Allocasuarina fraseriana*, *Drosera stolonifera*, *Amperea ericoides*, *Thysanotus triandrus*, *Cyathochaeta equitans*, *Hibbertia quadricolor*, *Comesperma calymega*, *Lepidosperma pubisquameum*, *Conospermum paniculatum*, *Acacia preissiana* and *Hybanthus debilissimus*.	P1*	
Sabina River Jarrah and Marri woodland (Whicher Scarp community F1)	Community in Sabina River alluvial fan where the Sabina River meets the Swan Coastal Plain. It is characterised by a suite of wetland taxa of restricted occurrence in the Whicher Scarp: *Mirbelia dilatata*, *Lomandra pauciflora*, *Tremandra diffusa*, *Tremandra stelligera*, *Trymalium floribundum* subsp. *trifidum* and *Clematis aristata* var. *occidentalis*. Other significant taxa in the community are: *Hovea elliptica*, *Leucopogon verticillatus*, and *Darwinia citriodora*.	P1*	
Swan Coastal Plain Paluslope Wetlands	These wetlands are very wet all year round and are associated with areas of groundwater seepage from the sandy low hills at the base of the Whicher Scarp. At times these wetlands are contiguous with areas of	P1*	

[2]* indicates Whicher Scarp Floristic Community Types (Keighery *et al*., 2008)

	Pinjarra Plain wetlands, and the wetlands of the two landforms merge. Combinations of the following species are typically found in the type: *Melaleuca preissiana*, *Taxandria linearifolia*, *Taxandria fragrans*, *Melaleuca incana*, and *Cyathochaeta teretifolia*. Other species include: *Eucalyptus patens*, *Homalospermum firmum*, *Gahnia decomposita*, *Callistachys lanceolata*, *Hakea linearis*, *Melanostachya ustulata*, *Evandra aristata*, *Beaufortia sparsa*, *Callistemon glaucus* and *Pultenaea pinifolia*.		

Table 3.DEC and SEWPaC ecological community data search information (DEC 2013a, SEWPaC 2012c).

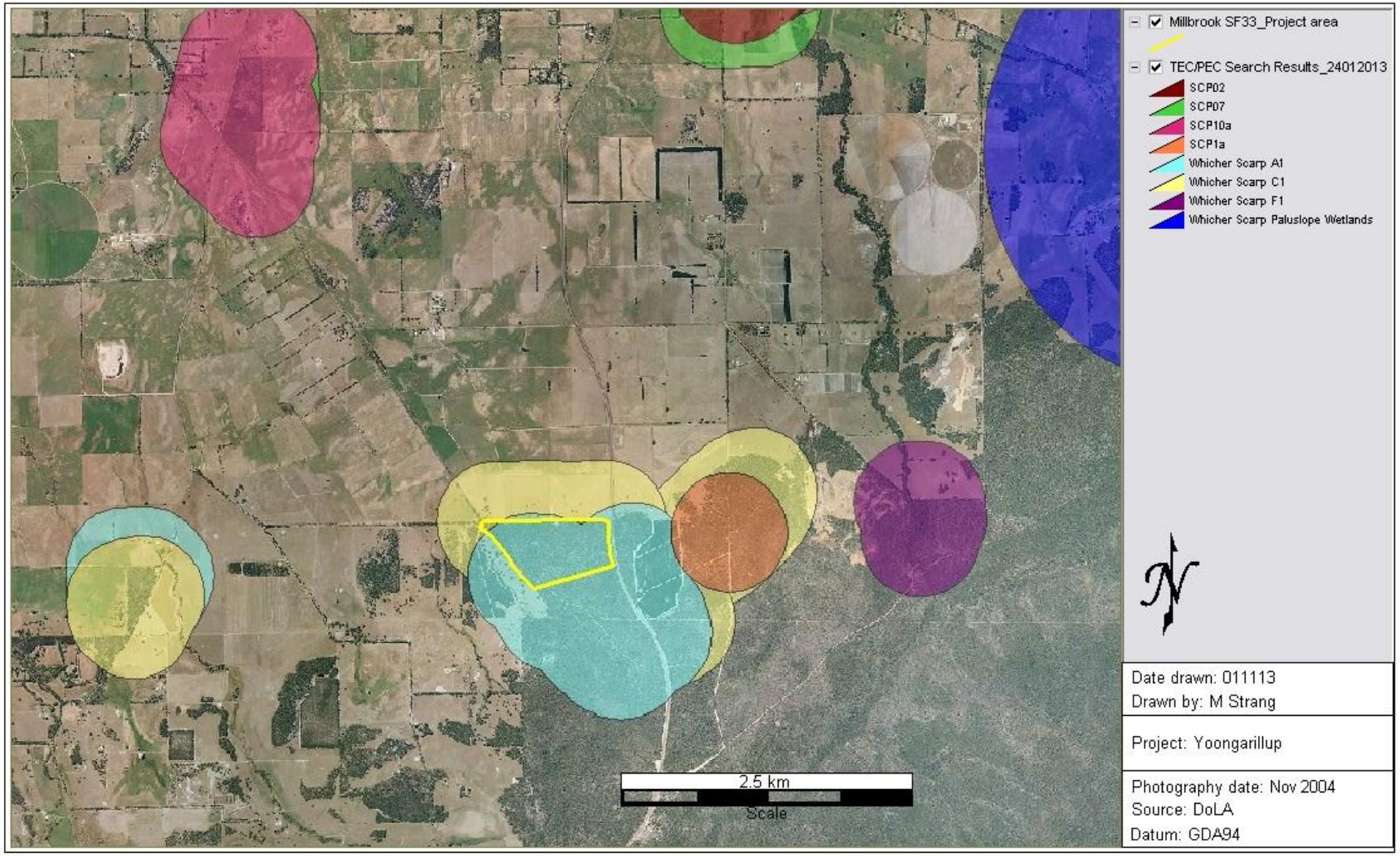

Figure 6. Threatened and Priority Ecological Communities occurring within and near to the Study Area.

1.8 Threatened and Priority Flora

Species of flora and fauna are defined as Declared Rare (Threatened) or Priority conservation status where their populations are restricted geographically or threatened by local processes. The DEC recognises these threats of extinction and consequently applies regulations towards population and species protection.

Threatened flora species are gazetted under Subsection 2 of Section 23F of the Wildlife Conservation Act 1950 ('*WC Act*') and therefore it is an offence to 'take' or damage threatened flora without Ministerial approval. Section 23F of the *WC Act* 1950-1980 defines 'to take' as "… to gather, pick, cut, pull up, destroy, dig up, remove or injure the flora or to cause or permit the same to be done by any means."Priority Flora are under consideration for declaration as '', but are in need of further survey (Priority One to Three) or require monitoring every 5-10 years (Priority Four). **Table 4** presents the categories of Declared Rare and Priority Flora as defined by the *WC Act* (DEC 2010b).

Threats of extinction of species are also recognised at a Federal Government level and are categorised according to the *EPBC Act* (SEWPaC, 2012a).

CONSERVATION CODE	CATEGORY
R	Taxa which have been adequately searched for and are deemed to be in the wild either rare, in danger of extinction, or otherwise in need of special protection and have been gazetted as such.
P1	Taxa which are known from one or a few (generally <5) populations which are under threat, either due to small population size, or being on lands under immediate threat. Such taxa are under consideration for declaration as 'threatened flora', but are in urgent need of further survey.
P2	Taxa which are known from one or a few (generally <5) populations, at least some of which are not believed to be under immediate threat. Such taxa are under consideration for declaration as 'threatened flora', but are in urgent need of further survey.
P3	Taxa which are known from several populations, and the taxa are not believed to be under immediate threat (i.e. not currently endangered), either due to the number of known populations (generally >5), or known populations being large, and either widespread or protected. Such taxa are under consideration for declaration as 'threatened flora', but are in need of further survey.
P4	Taxa which are considered to have been adequately surveyed and which, whilst being rare (in Australia), are not currently threatened by any identifiable factors. These taxa require monitoring every 5-10 years.

Table 4. Definitions of Declared Rare and Priority List flora under the WC Act.

Under the *EPBC Act*, a species may be listed in one of six categories; the definitions of these categories are summarised in **Table 4**.

Threatened or Priority flora occurring within 5km of the Study Area (DEC, 2013b) generated from DEC data search are listed in **Table 5.** Taxa listed under the *EPBC Act* (based on results of the Protected Matters Search Tool query (SEWPaC, 2013)) are listed in **Table 6**.

CATEGORY	DEFINITION
Extinct (Ex)	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 (ExW)	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 known only to survive in cultivation, in captivity or as a naturalised 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.
Critically Endangered (CE)	A native species is eligible to be included in the critically endangered category at a particular time if, at that time, it is facing an extremely high risk of extinction in the wild in the immediate future, as determined in accordance with the prescribed criteria.
Endangered (E)	A native species is eligible to be included in the endangered category at a particular time if, at that time (a) it is not critically endangered; and (b) it is facing a very high risk of extinction in the wild in the near future, as determined in accordance with the prescribed criteria.
Vulnerable (V)	A native species is eligible to be included in the vulnerable category at a particular time if, at that time (a) it is not critically endangered or endangered; and (b) it is facing a high risk of extinction in the wild in the medium term future, as determined in accordance with the prescribed criteria.
Conservation Dependent (CD)	A native species is eligible to be included in the conservation dependent category at a particular time if, at that time, 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 within a period of 5 years.

Table 5. Categories of Threatened Species under the EPBC Act.

SPECIES	*WC Act* STATUS (*EPBC Act status in brackets*)	FLOWERING	DESCRIPTION	HABITAT
Acacia flagelliformis	P4	Jul-Sep	Rush-like, erect or sprawling shrub, 0.3-0.75(-1.6) m high. Flowers yellow.	Sandy soils. Winter-wet areas.
Amperea micrantha	P2	Sep-Oct	Low, spreading, bushy perennial, herb, 0.1–0.3 m high. Flowers Brown.	Sandy soils.
Aponogeton hexatepalus	P4	Aug-Sep	Rhizomatous or cormous, aquatic perennial, herb, leaves floating. Flowers green, white.	Mud. Freshwater: ponds, rivers, claypans.
Banksia squarrosa subsp. *argillacea** [3]	T (V)	Jul-Aug	Erect, open, non-lignotuberous shrub, 1.2–4 m high. Flowers yellow.	White/grey sand, gravelly clay or loam. Winter-wet flats, clay flats
Bolboschoenus medianus	P1		Rhizomatous, perennial, grass-like or herb (sedge). Flowers red-brown.	Mud. In water and on river banks.
Boronia humifusa	P1	Sep	Low-growing, wiry perennial, herb, 0.1–0.2 m high. Flowers pink, red.	Gravelly clay loam over laterite. Jarrah-marri open forest
Boronia tetragona	P3	Oct-Dec	Perennial, herb, 0.3–0.7 m high, leaves sessile, entire, with papillate margins, branches quadrangular, sepals ciliate. Flowers pink, red	Black/white sand, laterite, brown sandy loam. Winter-wet flats, swamps, open

[3]* Species names followed by an asterisk are listed under the *EPBC Act* and known to occur within 10 km of the Study Area (SEWPaC, 2012c).

Caladenia busselliana	T	Sep-Oct	Tuberous, perennial, herb, 0.2–0.3 m high. Flowers green, yellow, cream.	Sandy loam. Winter-wet swamps
SPECIES	***WC Act* STATUS (*EPBC Act status in***	**FLOWERING**	**DESCRIPTION**	**HABITAT**
Caladenia huegelii	T	Aug-Oct	Tuberous, perennial, herb, 0.25-0.6 m high. Flowers green, cream, red.	Grey or brown sand, clay loam.
Caladenia speciosa	P4	Sep-Oct	Tuberous, perennial, herb, 0.35-0.6 m high. Flowers white, pink.	White, grey or black sand.
Caustis sp.Boyanup (G.S. McCutcheon 1706)	P3	-	Rhizomatous, clumped perennial, grass-like or herb (sedge), 0.7–1 m high.	White or grey sand.
Chamaescilla gibsonii	P3		Clumped tuberous, herb. Flowers blue.	Clay to sandy clay. Winter-wet flats, shallow water-filled claypans
Chamelaucium sp. C Coastal Plain*	T (V)	Oct-Dec		
Diuris drummondii	T	Nov-Dec	Tuberous, perennial, herb, 0.5-1.05 m high. Flowers yellow.	Low-lying depressions, swamps.
Eleocharis keigheryi	T	-	Rhizomatous, clumped perennial, grass-like or herb (sedge), to 0.4 m high. Flowers green.	Clay, sandy loam. Emergent in freshwater: creeks, claypans.
Eryngium sp. Ferox (G.J. Keighery 16034)	P3	Oct,Nov	Tuberous herb; flowers metallic blue.	Winter-wet flats

Franklandia triaristata	P4	Aug-Oct	Erect, lignotuberous shrub, 0.2-1 m high. Flowers white, cream, yellow , brown, purple.	White or grey sand.
SPECIES	***WC Act* STATUS (*EPBC Act status in***	**FLOWERING**	**DESCRIPTION**	**HABITAT**
Grevillea brachystylis subsp. *brachystylis*	P3	Aug-Nov	Much-branched, prostrate or decumbent, non-lignotuberous shrub, 0.2-0.5 m high, to 3 m wide. Flowers red	Black sand, sandy clay. Swampy situations.
Isopogon formosus subsp. *dasylepis*	P3	Jun,Sep-Dec	Low, bushy or slender, upright, non-lignotuberous shrub, 0.2–2 m high. Flowers pink, purple, red	Sand, sandy clay, gravelly sandy soils over laterite. Often swampy areas
Jacksonia gracillima	P3	Oct-Nov	Decumbent shrub - 20 cm high and 50 cm wide. Flowers standard orange-yellow; eye yellow with red halo; wings/keel red	Winter-wet flats
Lambertia rariflora subsp. *rariflora*	P4	Jan-Mar	Small tree or shrub, to 7 m high. Flowers green, yellow.	Red-brown clay soils, black organic loam, laterite. Near intermittent streams
Lasiopetalum membranaceum	P3	Oct-Nov	Multi-stemmed shrub, 0.2-1 m high. Flowers pink, blue, purple.	Sand over limestone.
Leucopogon sp. Busselton (D. Cooper 243) RN	P2	Aug-Sep	Slender, erect shrub to 70 cm. Flowers white.	*Pericalymma ellipticum* wet shrubland, Marri-Jarrah woodland
Logania wendyae	P1	Oct	Decumbent, dwarf shrub, to 0.17 m high.	Brown clay to sandy clay, laterite gravel
Meeboldina decipiens subsp. *decipiens*	P3		Erect, open perennial, grass-like or herb (sedge), 0.6 m high.	Sand & sandy peat. Swamps.

Mitreola minima	P3	Nov-Jan	Slender, erect annual, herb, 0.025–0.04 m high. Flowers White.	Grey sand. Peaty swampy areas.
SPECIES	***WC Act* STATUS (*EPBC Act status in***	**FLOWERING**	**DESCRIPTION**	**HABITAT**
Ornduffia submersa	P4	Sep-Oct	Tuberous emergent aquatic perennial dwarf shrub, height to 35 cm; flowers white; leaves floating on surface of water	Shallow water in wetlands.
Platytheca anasima	P2	Oct-Dec	Sprawling slender stemmed shrub with numerous stems from base; 70 cm tall x 100 cm wide. Leaves usually 6-whorled, elliptic	Jarrah/Marri/Sheoak/Mountain marri woodlands on white sand
Pultenaea skinneri	P4	Jul-Jan	Slender shrub, 1-2 m high. Flowers yellow, orange, red.	Sandy or clayey soils. Winter-wet depressions.
Schoenus benthamii	P3		Tufted perennial, grass-like or herb (sedge), 0.15-0.45 m high. Flowers brown.	White, grey sand, sandy clay. Winter-wet flats, swamps.
Stylidium leeuwinense	P4	Feb-May	Erect perennial, herb, 0.15–0.6 m high, Leaves adpressed to stem, lanceolate, 0.2-0.5 cm long, 0.6-1 mm wide, apex acute, margin hyaline or	Grey to black peaty sand. Winter-wet habitats and depressions. Shrubland
Stylidium striatum	P4	Oct-Nov	Rosetted perennial, herb, 0.15-0.55 m high, Leaves erect, oblanceolate to spathulate, 1.5-4 cm long, 1.5-6 mm wide, apex acute to	Brown clay loam over laterite. Hillslopes. Jarrah/Marri forest, Wandoo woodland

SPECIES	*WC Act* STATUS (*EPBC Act status in*	FLOWERING	DESCRIPTION	HABITAT
Synaphea hians	P3	Sep-Oct	Prostrate or decumbent shrub, 0.15-0.6 m high, to 1 m wide. Flowers yellow.	Sandy soils. Rises.
Synaphea odocoileops	P1	Aug-Oct	Tufted, compact shrub, 0.2–0.5 m high. Flowers yellow.	Brown-orange loam & sandy clay, granite. Swamps, winter-wet areas
Synaphea petiolaris subsp. *simplex*	P2	Sep-Oct	Tufted shrub, 0.1–0.6 m high. Flowers yellow.	Sandy soils. Flats, winter-wet areas.
Synaphea polypodioides	P3	Sep-Oct	Clumped shrub (subshrub), 0.35-0.4 m high. Flowers yellow.	Light brown loam, red-brown sandy loam, gravelly, brown sandy clay over laterite. In
Synaphea sp.Argyle (R. Butcher RB 1323)	P1	Oct		
Tetratheca parvifolia	P3	Oct	Small shrub, 0.2-0.3 m high. Flowers pink.	Jarrah, woodland, wandoo woodland, gravelly soils.
Thelymitra variegata	P3	Aug-Sep	Tuberous, perennial, herb, 0.1–0.35 m high. Flowers orange, red, purple, pink.	Sandy clay, sand, laterite.
Verticordia attenuata	P3	Jan	Shrub, 0.4–1 m high. Flowers pink.	White or grey sand. Winter-wet depressions

Table 6. List of Declared Rare and Priority flora known to occur within 5 km of the Study Area. (EPBC Act status is shown in brackets).

Based on an assessment of their preferred habitats, not all of the species listed in **Table 5** would potentially occur within the Study Area. For instance, aquatic or wetland taxa would not be expected in areas where there are no wetlands or standing water. All of the above species would have been flowering at the time of survey, except perhaps for *Diuris drummondii*, *Lambertia rariflora* subsp. *rariflora*, *Mitreola minima*, *Stylidium leeuwinense* and *Verticordia attenuata;* however, at the time of survey these species could be identified in the field without flowers.

SPECIES	COMMON NAME	STATUS	TYPE OF PRESENCE
Andersonia gracilis	Slender Andersonia	Endangered	Species or species habitat may occur within area
Banksia mimica	Summer Honeypot	Endangered	Species or species habitat known to occur within area
Banksia nivea subsp. *uliginosa*	Swamp Honeypot	Endangered	Species or species habitat known to occur within area
Banksia squarrosa subsp. *argillacea*	Whicher Range Dryandra	Vulnerable	Species or species habitat known to occur within area
Brachyscias verecundus	Ironstone Brachyscias	Critically Endangered	Species or species habitat may occur within area
Caladenia hoffmanii	Hoffman's Spider-orchid	Endangered	Species or species habitat likely to occur within area
Caladenia procera	Carbunup King Spider Orchid	Critically Endangered	Species or species habitat may occur within area
Caladenia winfieldii	Majestic Spider-orchid	Endangered	Species or species habitat may occur within area
Centrolepis caespitosa		Endangered	Species or species habitat likely to occur within area
Chamelaucium sp. C Coast Plain (R.D.Royce 4872)	Royce's Waxflower	Vulnerable	Species or species habitat known to occur within area
Darwinia foetida	Muchea Bell	Critically Endangered	Species or species habitat likely to occur within area
Darwinia whicherensis	Abba Bell	Endangered	Species or species habitat may occur within area
Daviesia elongata subsp. *elongata*	Long-leaved Daviesia	Vulnerable	Species or species habitat likely to occur within area

SPECIES	COMMON NAME	STATUS	TYPE OF PRESENCE
Diuris micrantha	Dwarf Bee-orchid	Vulnerable	Species or species habitat likely to occur within area
Drakaea elastica	Glossy-leaved Hammer-orchid, Praying Virgin	Endangered	Species or species habitat known to occur
Drosera fimbriata	Manypeaks Sundew	Vulnerable	Species or species habitat may occur within area
Eucalyptus phylacis	Meelup Mallee	Endangered	Species or species habitat may occur within area
Gastrolobium papilio	Butterfly-leaved Gastrolobium	Endangered	Species or species habitat may occur within area
Lambertia echinata subsp. *occidentalis*	Western Prickly Honeysuckle	Endangered	Species or species habitat may occur within area
Petrophile sp. Whicher Range (G.J.Keighery 11790) WA Herbarium	Laterite Petrophile	Endangered	Species or species habitat likely to occur within area
Sphenotoma drummondii		Endangered	Species or species habitat may occur within area
Synaphea stenoloba	Dwellingup Synaphea	Endangered	Species or species habitat may occur within area
Verticordia plumosa var. *vassensis*	Vasse Featherflower	Endangered	Species or species habitat known to occur within area

Table 7. EPBC Act listed species known or having the potential to occur or have habitat occurring within 10 km of the Study Area (SEWPaC 2013).

1.9 Ecological Linkages

Ecological linkages were defined in Molloy *et al*. (2009) in their report on the South West Regional Ecological Linkages (SWREL) Project as;

> "*A series of (both contiguous and non-contiguous) patches which, by virtue of their proximity to each other, act as stepping stones of habitat which facilitate the maintenance of ecological processes and the movement of organisms within, and across, a landscape*."

It is stressed in the above report, however, that the proximity value of an ecological linkage is not intended to replace the need to consider the other biodiversity conservation values of a patch of remnant vegetation. Regional Ecological Linkages link protected patches of regional significance by retaining the best (condition) patches available as stepping stones for flora and fauna between regionally significant areas. This increases the long-term viability of all the constituent areas (Molloy *et al*., 2009).

The *South West Regional Ecological Linkages Technical Report* (Molloy *et al*., 2009) identifies a regional ecological linkage axis line passing within 600 m to the southeast of the Study Area. As a result of the location of this axis line, all patches of remnant vegetation within the Study Area are assigned to proximity category '1c', which is the third highest category (**Figure 7**). As vegetation within the Study Area is contiguous with vegetation through which the axis line passes, it is likely to be considered as forming part of the regional ecological linkage.

The Molloy *et al*. (2009) report is the result of collaboration between the Western Australian Local Government Association's *South West Biodiversity Project* and the DEC's *Swan Bioplan* to provide a tool for the identification of ecological linkages and guidance for the protection of linkages through planning policy documents.

While there is no statutory basis for regional ecological linkages identified through the SWREL project, the importance of ecological linkages have been recognised as an environmental policy consideration in EPA and Planning policy over the last decade (EPA, 2009 and references therein). In its statement regarding the SWREL Project, the EPA stated that even though Ecological Linkages are just one measure of the conservation values of a patch of remnant vegetation it expected that:

> *In preparing plans and proposals for development, consideration will be given to both the site-specific biodiversity conservation values of patches of native vegetation, as well as the landscape function and core linkage significance of a patch in supporting the maintenance of ecological linkage* (EPA, 2009).

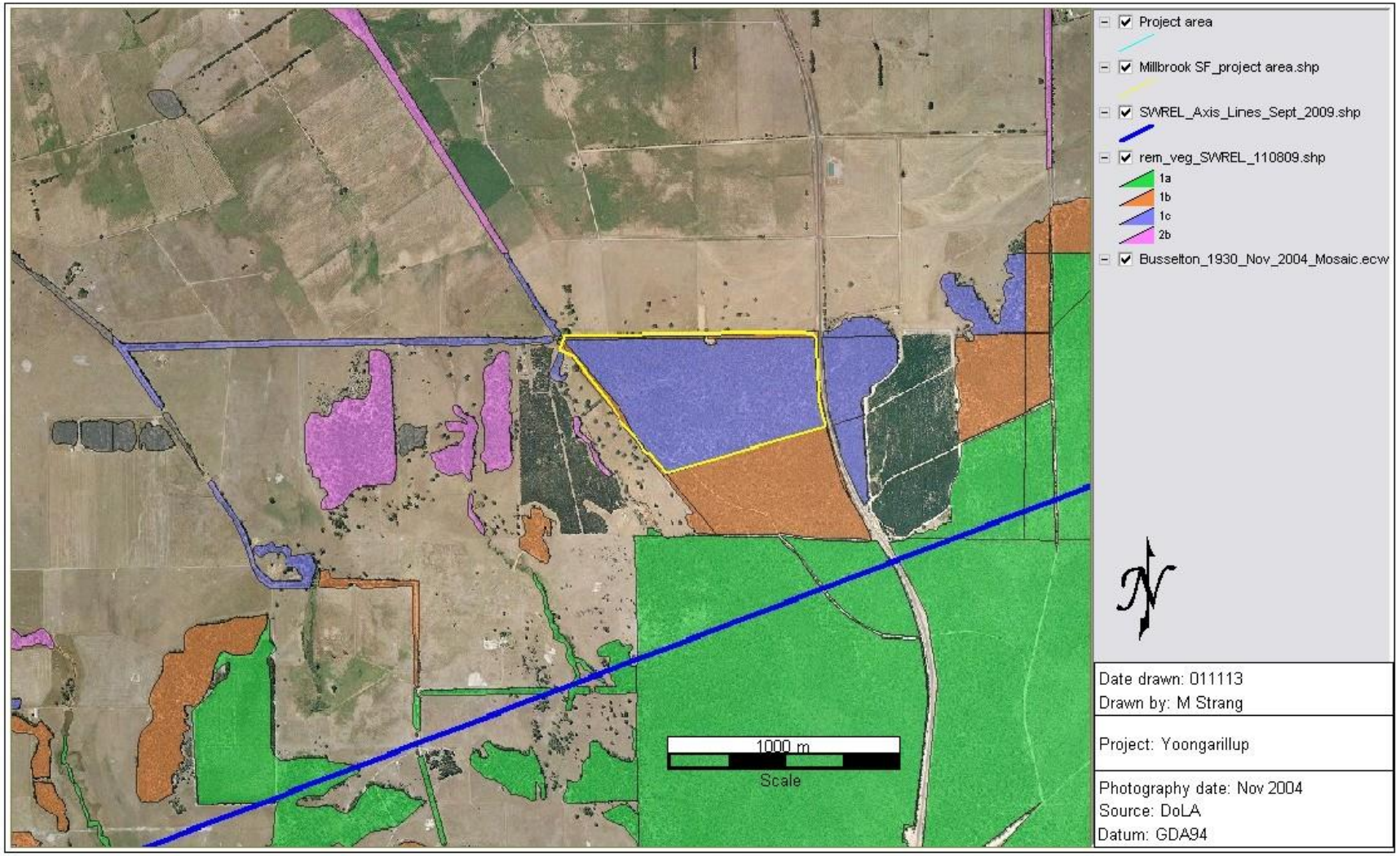

Figure 7. Regional ecological linkage map, showing the nearest linkage axis line passing to the southeast of the Study Area.

2 Methods

2.1 Floristic Quadrats

The Study Area was surveyed on foot by Russell Smith (senior botanist) and Melanie Strang (botanist/ecologist). Twenty one 10 m x 10 m quadrats were placed within the Study Area (**Figure 8**). These included a quadrat installed during the previous survey by Mattiske (2012a) (F 5-2), and WHICH03, a quadrat installed during the Swan Bioplan Survey (Keighery *et al*., 2008), which were re-surveyed. An attempt was made to site quadrats in relatively undisturbed vegetation. Every quadrat was surveyed twice – at the initial set-up (19th – 25th September 2012) and on 11thand 12th October 2012.

The following information was recorded for each quadrat:

- Each corner was marked by a steel fence dropper
- A GPS coordinate for the centre of the quadrat
- A description of the quadrat, including:
    - Soil colour and texture at 5 cm
    - Landscape position
    - Type and percentage surface rock
    - Litter and Logs/Debris cover (%)
    - A list of all vascular plant taxa together with a cover/abundance estimate
    - A photograph of the quadrat from the SW and NE corner

In addition to the 21 quadrats, recording of species composition and soil type was collected at fifty assessment points to assist with delineating boundaries for soil and vegetation type mapping.

Plant taxa not able to be identified in the field were collected or photographed for later identification.

Details of each quadrat, including list of taxa occurring in each are presented in Appendix Four.

2.2 Threatened flora survey

The Study Area was searched for threatened flora on 24thSeptember, 2nd October 2012. The search, which was undertaken in a grid pattern along transects 30 m – 40 m apart, targeted new occurrences of threatened and priority flora as well as re-confirming the locations of previously found occurrences (Mattiske Consulting, 2012b). Although locations of individuals of a species previously tentatively identified as the priority species *Jacksonia gracillima* (Mattiske Consulting, 2012b) were recorded, it has since been established that this taxon is, instead, a Whicher Scarp

form of the widespread common species *Jacksonia horrida*[4]. This Whicher Scarp form of *J. horrida* was recognized as being of conservation importance in Keighery *et al*. (2008).

2.3 Opportunistic records and taxonomy

As well as taxa that occurred in the floristic quadrats, species found opportunistically outside the quadrats but within the Study Area were recorded with the aim of compiling a complete list of vascular flora. As well as the survey dates mentioned in the previous two sections a final visit to the Study Area on 27th October 2012 to check for late flowering taxa. The taxonomy and conservation status of species identified during the surveys was checked against W.A. Herbarium databases (DEC, 2012c, 2012d). In addition, records on species composition and soil type was collected at fifty assessment points to assist with delineating boundaries for soil and vegetation type mapping.

[4]Andrew Webb, DEC, Busselton, personal communication 9/11/2012.

Figure 8. Floristic quadrat locations in the Study Area.

2.4 Analysis of Floristic Quadrat Data and Mapping

2.4.1 General Methodology

Multivariate analysis of floristic quadrat data (in the form of a 21 quadrat by 194 plant taxon matrix) was undertaken using PATN (Belbin, 2003) to compare quadrats within the Study Area. All taxa occurring within the 21 quadrats was used for the analysis.

In general, the method used for the analyses was to carry out a two-way classification (Agglomerative Hierarchical Fusion) of the presence/absence quadrat data of each. The flexible UPGMA classification strategy was used (β = -0.1), together with the Bray-Curtis site similarity measure. The default settings for number of groups to be produced by the classification (i.e. the 'cut-off level') was accepted in each case. The primary output of the classification was in the form of a dendrogram and two-way table of taxa and quadrats.

Floristic community groups from the Whicher Study (Keighery *et al*., 2008) were used for comparison with the quadrat groups produced by the multivariate analysis described above. Multivariate analysis was not chosen as the method for this comparison because of differences in the sampling effort (season of visit) and placement of quadrats between the Whicher Study and the survey described herein. The Whicher Survey quadrats were sited in the 'least disturbed vegetation available' (Keighery *et al*., 2008) whereas a large part of the Study Area away from the northern and eastern boundaries shows signs of previous partial clearing. Upland quadrats in the Whicher Study averaged 67 taxa whereas the average for the 21 quadrats in this study was 47 taxa.

Comparing sets of floristic quadrat data where there is a large discrepancy in average species richness can be problematic. Also, adding quadrats from a new survey to an existing survey data set (such as the Whicher Study quadrat data set) to produce a combined classification may tend to disrupt the original classification (Griffin, 2008). Another potentially confounding factor with regard to using multivariate analysis for comparisons between different survey data sets is that the 21 quadrats for the Study Area were concentrated within an area covering only 37 ha, whereas the 88 quadrats from the Whicher Study were spread over a distance of more than 50 km, with large areas of vegetation only lightly sampled. Problems in comparing quadrats from a localised area with data from a regional classification (in this case the Swan Coastal Plain study) were identified as a confounding factor by Bennett Environmental Consulting (2009) for the Tutunup area.

Instead of using multivariate analysis, a method of comparing the number of 'typical' (>75% frequency) and 'common' (50-75% frequency) taxa for the Whicher Study floristic community types (FCTs) with those for the quadrat groups from the Study Area was used. Excel tables listing the 'typical' and 'common' taxa were constructed to assist in this process. A similar method of

using 'diagnostic' species for determining new occurrences of threatened or restricted communities was used by Tozer (2003).

2.4.2 Vegetation Mapping

Vegetation units were defined and mapped primarily on a floristic basis, derived from the clustering of quadrats into groups by the multivariate analysis described in Section 2.4.1. Further interpretation of boundaries between vegetation units was provided by the 50 assessment points that were sited to provide further information on the distribution of vegetation and soils. Data and vegetation mapping from Mattiske (2012) was also used in describing vegetation units and mapping their boundaries. Vegetation units are described using a floristic/structural method based on Aplin (1979) and Muir (1977).

Vegetation condition mapping using the method of Keighery (1994) (**Table 8**) was based on observations made within the 21 floristic quadrats, at assessment points, and was complemented by interpretation of aerial photography.

Score	Description
Pristine (1)	Pristine or nearly so, no obvious signs of disturbance.
Excellent (2)	Vegetation structure intact, disturbance affecting individual species and weeds are non-aggressive species.
Very Good (3)	Vegetation structure altered, obvious signs of disturbance. For example, disturbance to vegetation structure caused by repeated fires, the presence of some more aggressive weeds, dieback, logging and grazing.
Good (4)	Vegetation structure significantly altered by very obvious signs of multiple disturbances. Retains basic vegetation structure or ability to regenerate it. For example, disturbance to vegetation structure caused by very frequent fires, the presence of some very aggressive weeds at high density, partial clearing, dieback and grazing.
Degraded (5)	Basic vegetation structure severely impacted by disturbance. Scope for regeneration but not to a state approaching good condition without intensive management. For example, disturbance to vegetation structure caused by frequent fires, the presence of very aggressive weeds, partial clearing, dieback and grazing.
Completely Degraded (6)	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 or shrubs.

Table 8. Vegetation condition ratings according to Keighery (1994).

2.5 Limitations of the survey

The limitations of this survey are outlined in **Table 9**.

Aspect	Constraint	Comment
Scope	No	The survey scope was prepared in consultation with the stakeholders and was designed to comply with EPA requirements.
Proportion of flora identified	Negligible	The survey was carried out over September/October - a period which experience has shown to be the prime flowering time for flora on the southern Swan Coastal Plain and Whicher Scarp. It is estimated that 90-95% of species in the remnant vegetation were identified.
Availability of contextual information	Minor	Comprehensive regional surveys of remnant vegetation, as well as more localised surveys, have been carried out on the Swan Coastal Plain and adjacent Whicher Scarp from which comparative data for multivariate analysis. However, because of extensive clearing for agriculture there is a paucity of data for nearby areas on the Swan Coastal Plain.
Completeness of the survey	Negligible	All areas of remnant vegetation were visited and floristic quadrats were placed so that all areas of vegetation in good or better condition were covered. Further assessments outside the spring season and extra floristic quadrats would add to the completeness of the survey but probably only marginally affect the conclusions presented.
Climate	Negligible	Winter/spring rainfall for the site was only 84% of the long-term mean, however September rainfall was 40% above the long-term average - overall it is considered that rainfall had negligible effect on flowering in the Study Area. (Rainfall based on the Yoongarillup station 5 km from the Study Area).
Access Problems	No	All parts of the Study Area were easily accessible.
Site Effects	Some	As noted in Section 4 the study area has previously been subject to partial clearing; this and past fires and infestation by *Phytophthora cinnamomi* have caused some change to vegetation structure and composition.
Competency and experience of consultants	No	The senior botanist Russell Smith has 20 years' experience of flora surveys in the south west of Western Australia; Melanie Strang has 14 years' experience in ecology and flora surveys in the Southwest.

Table 9. Limitations of the Survey.

3 Results and Discussion

3.1 Flora including threatened flora

Two hundred and thirty three species of vascular flora, including nineteen introduced species, were found in the Study Area. Mattiske (2012a) recorded 262 taxa over a substantially larger area. A list of the vascular flora recorded during the surveys is presented in **Appendix 2**, and a list of taxa by quadrat is presented in **Appendix 3**.

Two species of DRF, *Daviesia elongata* subsp. *elongata*and *Verticordia densiflora* var. *pedunculata*were recorded within the Study Area. *D. elongata* subsp. *elongata* is listed as 'vulnerable' and *V.densiflora* var. *pedunculata*[5] is listed as 'endangered' pursuant to section 179 of the *EPBC Act*. Two Priority listed species: *Acacia semitrullata* (P4) and *Conospermum paniculatum* (P3) were also found (**Table 10** and **Figure8**). Most of these plants had been found during the previous surveys (Mattiske, 2012a, 2012b). A species recorded by Mattiske (2012a) as potentially the Priority 3 species *Jacksonia gracillima* is now considered to be a Whicher Range variant of the common taxon *J. horrida*

The distribution of conservation significant taxa within the Study Area is presented in **Figure 9**. The Whicher Range variant of *Jacksonia horrida* (referred to as *Jacksonia* sp. Whicher (G.J. Keighery 9953) in the Whicher Study (see Section 2.2 above) is considered to have conservation significance. This taxon is quite widespread on the mid-slope in the eastern half of the Study Area.

The Whicher Range variant of *Crowea angustifolia* var. *angustifolia*, which is considered to be regionally significant (Keighery *et al*., 2008), was found near Sues Road on the eastern boundary of the Study Area. In addition, the populations of *Pityrodia bartlingii* and *Petrophile serruriae* located in the Study Area are considered to be regionally significant (Keighery *et al*., 2008).

Two other conservation significant species are known to occur within the Study Area but were not observed during the survey reported here. *Hibbertia lasiopus* was recorded by Mattiske Consulting (2012) and the Department of Parks and Wildlife has a record for *Schoenus* sp. Whicher (G.J.Keighery & B.J.Keighery 901) within the Study Area.

Of the nineteen introduced species, only one (**Zantedeschia aethiopica*), is a Declared Plant species pursuant to section 37 of the Agriculture and Related Resources Protection Act 1976, according to the Western Australian Department of Agriculture and Food (2011).

[5]This species had previously been misidentified as the common variety *V. densiflora* var. *caespitosa* (Mattiske, 2012a)

EASTING	NORTHING	TAXON	STATUS	NUMBER FOUND
353979.85	6262505.24	*Acacia semitrullata*	P4	1
353775.77	6262797.08	*Acacia semitrullata*	P4	2
353690.52	6262814.02	*Conospermum paniculatum*	P3	1
353628.50	6262766.42	*Conospermum paniculatum*	P3	1
353591.46	6262678.05	*Conospermum paniculatum*	P3	2
353564.85	6262752.00	*Conospermum paniculatum*	P3	1
353569.95	6262795.59	*Conospermum paniculatum*	P3	1
353532.05	6262787.82	*Conospermum paniculatum*	P3	1
353537.44	6262776.95	*Conospermum paniculatum*	P3	1
353609.69	6262604.19	*Conospermum paniculatum*	P3	1
353609.10	6262608.35	*Conospermum paniculatum*	P3	1
353510.52	6262762.45	*Conospermum paniculatum*	P3	1
353460.24	6262792.33	*Conospermum paniculatum*	P3	1
353372.82	6262735.03	*Conospermum paniculatum*	P3	1
353358.78	6262800.04	*Conospermum paniculatum*	P3	1
353321.37	6262772.75	*Conospermum paniculatum*	P3	1
353264.57	6262810.36	*Conospermum paniculatum*	P3	1
353553.97	6262816.16	*Conospermum paniculatum*	P3	1
353603.84	6262786.53	*Conospermum paniculatum*	P3	1
353644.22	6262782.13	*Conospermum paniculatum*	P3	2
353688.89	6262683.52	*Daviesia elongata* subsp. *elongata*	DRF (VU)	2
353597.93	6262804.97	*Daviesia elongata* subsp. *elongata*	DRF (VU)	2
353600.68	6262803.72	*Daviesia elongata* subsp. *elongata*	DRF (VU)	2
353774.77	6262768.87	*Daviesia elongata* subsp. *elongata*	DRF (VU)	1
353834.02	6262623.25	*Verticordia densiflora var. pedunculata*	DRF (EN)	1
353842.87	6262655.34	*Verticordia densiflora var. pedunculata*	DRF (EN)	3
353857.26	6262625.94	*Verticordia densiflora var. pedunculata*	DRF (EN)	2
353856.15	6262630.84	*Verticordia densiflora var. pedunculata*	DRF (EN)	1
353836.86	6262628.94	*Verticordia densiflora var. pedunculata*	DRF (EN)	1
353834.02	6262626.88	*Verticordia densiflora var. pedunculata*	DRF (EN)	1

Table 10. Locations of DRF and Priority Flora found within the Study Area in September/October 2012 (with EPBC Act listed species noted in brackets).

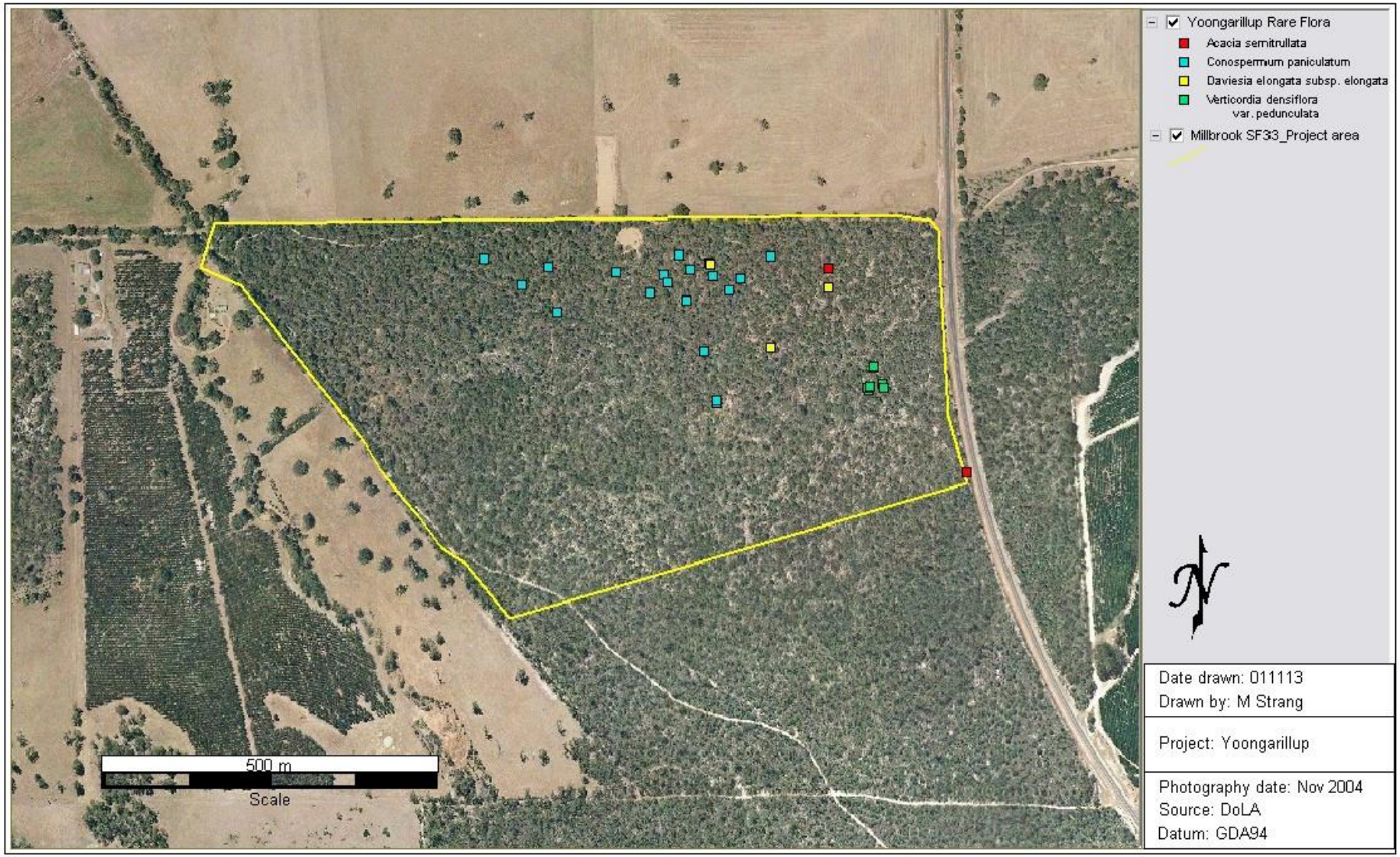

Figure 9. Distribution of DRF and Priority flora within the Study Area.

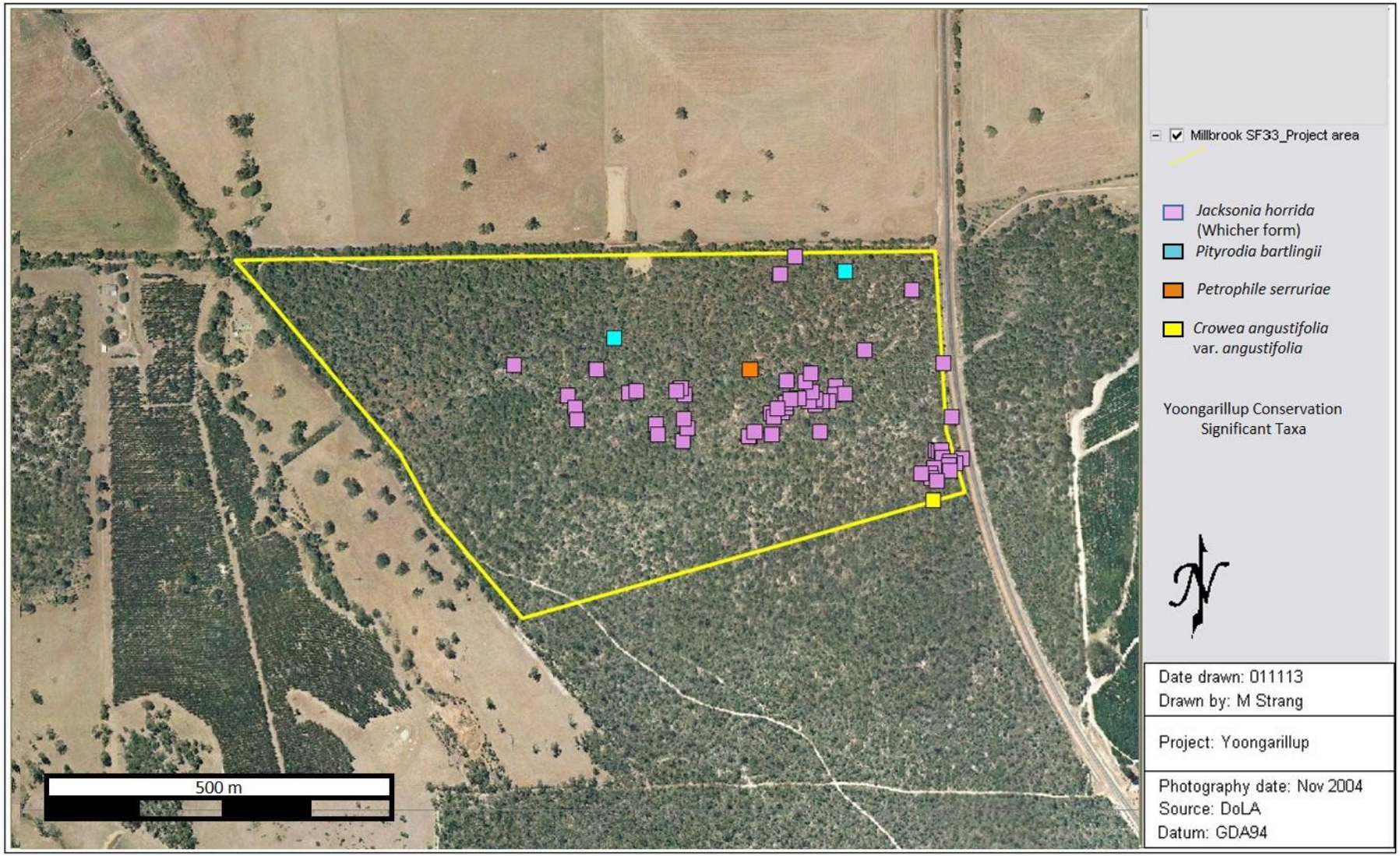

Figure 10. Conservation significant taxa in the Study Area.

3.2 Vegetation

3.2.1 Multivariate Analysis

The multivariate analysis produced four 'clusters' or groups of quadrats (**Figure 10**). The quadrats are given the same capital letter designation, i.e. 'A', 'B', 'C' and 'D'. The quadrat groups range in size from only one quadrat (Group 'D') to nine quadrats (Group 'A') – the most frequent species within each group are presented in **Table 11**.

As can be seen in **Figure 10**, there is substantial floristic variation within the quadrat groups, particularly within group A, with the three westernmost quadrats (YOONG15, YOONG16 and YOONG25) separated out from the other quadrats in the group. The variation within this vegetation unit is discussed further in section 3.2.2, below.

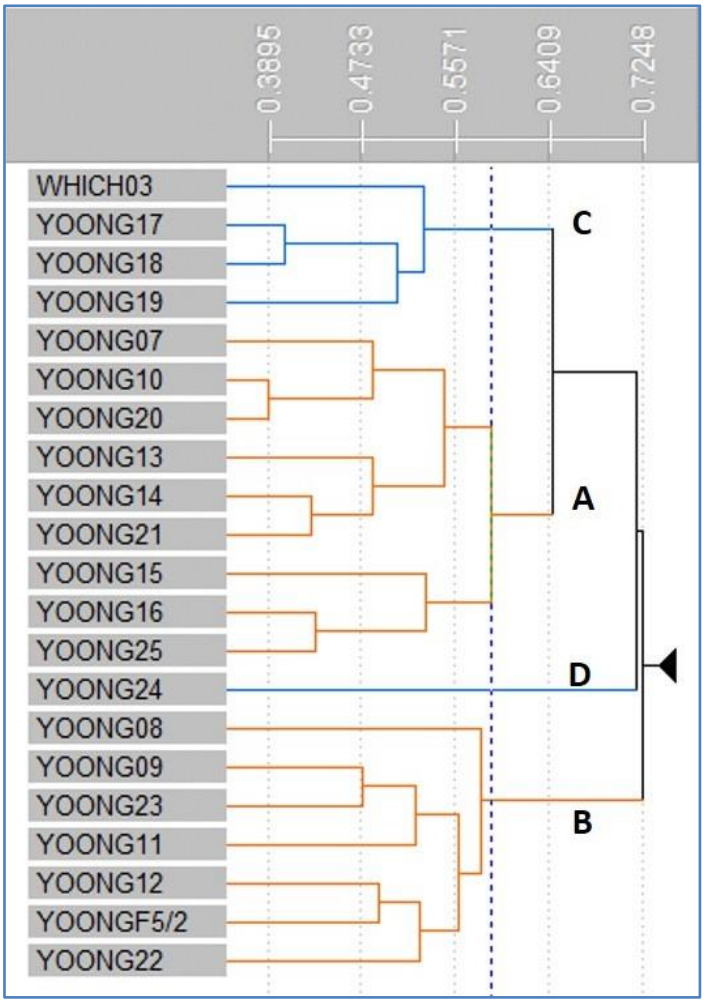

Figure 11. Dendrogram produced by the multivariate analysis of quadrat data from the Yoongarillup Study Area showing the four quadrat groups (A, B, C and D).

SPECIES	Group A	Group B	Group C	Group D
Number of Quadrats	**9**	**6**	**4**	**1**
Acacia extensa		57		
Acacia nervosa			50	
Acacia pulchella	67	71		
Adenanthos barbiger	89	57		*100*
Adenanthos meisneri		57		
Allocasuarina fraseriana				*100*
Amphipogon turbinatus				*100*
Anarthria prolifera	78	57	50	*100*
Arctotheca calendula		71		
Astroloma ciliatum			50	
Babingtonia camphorosmae		57	50	
Banksia dallanneyi var. *dallanneyi*	56	71	100	*100*
Banksia grandis	67	57		
Billardiera variifolia			50	
Boronia crenulata subsp. *pubescens*	56		50	
Burchardia congesta	67	86	50	
Caladenia flava		71	75	
Calothamnus sanguineus		57	50	
Chamaescilla corymbosa			50	
Conostephium pendulum		86		
Conostylis setigera subsp. *setigera*	67		100	*100*
Corymbia calophylla	78	57	100	
Corymbia haematoxylon		57		*100*
Dampiera linearis	67	57	50	
Dasypogon bromeliifolius	56	86	50	*100*
Dasypogon hookeri	78			*100*
Daviesia physodes		57		
Desmocladus fasciculatus		86	100	*100*
Drosera pallida		57	50	
Drosera pulchella			50	
Drosera stolonifera	56		50	
Elythranthera brunonis		71	50	
Eucalyptus marginata subsp. *marginata*	100	86	100	*100*
Gompholobium knightianum	100	57	50	
Gompholobium preissii	78		50	
Hakea amplexicaulis	67		50	
Hakea lissocarpha			50	
Hakea ruscifolia	78			
Hibbertia cunninghamii			100	*100*
Hibbertia commutata			75	
Hibbertia glomerata subsp. *glomerata*	56		75	
Hibbertia hypericoides	100	86	100	
Hovea chorizemifolia			75	
Hypocalymma angustifolium			50	
Hypocalymma robustum	89	86	100	*100*
Hypochaeris glabra	89	86	50	
Hypolaena exsulca		57	50	*100*
Kennedia coccinea			50	

SPECIES	Group A	Group B	Group C	Group D
Kingia australis			50	
Labichea punctata	67		75	*100*
Lagenophora huegelii			100	
Lechenaultia biloba			50	
Leucopogon conostephioides			75	
Leucopogon pulchellus		71		
Levenhookia pusilla		57	50	
Lindsaea linearis			50	*100*
Lomandra hermaphrodita	67		100	
Lomandra sericea			75	*100*
Lomandra sonderi				*100*
Loxocarya cinerea	67			
Melaleuca thymoides	67	57		
Mesomelaena tetragona		71	50	
Monotaxis occidentalis				*100*
Nuytsia floribunda				*100*
Opercularia apiciflora		57	100	
Patersonia umbrosa var. *xanthina*	67		75	*100*
Pentapeltis peltigera			75	
Philotheca spicata			50	*100*
Phlebocarya ciliata		57		
Platysace tenuissima			50	
Poa annua				*100*
Podocarpus drouynianus	67			
Pterostylis recurva			50	
Pterostylis vittata			75	
Quinetia urvillei		71		
Rhodanthe citrina		86		
Scaevola calliptera			50	*100*
Stirlingia latifolia	56	100		*100*
Stylidium amoenum				*100*
Stylidium calcaratum		71	50	
Stylidium ciliatum			50	
Synaphea whicherensis	67			
Tetraria octandra	67		100	*100*
Tetraria sp. Jarrah Forest (R. Davis 7391)	56		100	
Tetrarrhena laevis			50	
Thelymitra crinita			75	
Trachymene pilosa	78	71		
Ursinia anthemoides				*100*
Velleia trinervis			50	
Xanthorrhoea gracilis	100	86	100	*100*
Xanthorrhoea preissii			100	*100*
Xanthosia candida			50	
Xanthosia huegelii		57		
Xylomelum occidentale		86		

Table 11. Typical (>75%) and other common (50-75%) species for each of the vegetation units derived from the multivariate analysis of quadrat data (>50% occurrence). Taxa occurring in more than 75% of quadrats ('typical taxa') are high-lighted in green. Because only one quadrat was placed in vegetation unit D all species in that quadrat are listed.

3.2.2 Vegetation Units in the Study Area

Four vegetation units have been identified and mapped for the Study Area based on the quadrat groups derived from the multivariate analysis. These vegetation units are named according to the quadrat groups which helped to define them (e.g. 'vegetation unit A' is based on 'quadrat group A'). The vegetation units are described below and mapped in **Figure 12**. Information from the assessment point data and from the report by Mattiske (2012) was used to refine the descriptions and map the vegetation units.

Vegetation Unit A

Eucalyptus marginata, *Corymbia calophylla* open forest/woodland over *Banksia grandis* low open woodland over *Acacia pulchella*, *Adenanthos barbiger*, *Dasypogon hookeri*, *Hakea amplexicaulis*, *H. ruscifolia*, *Hibbertia hypericoides*, *Hypocalymma robustum*, *Labichea punctata*, *Melaleuca thymoides*, *Podocarpus drouynianus*, *Synaphea whicherensis*, *Xanthorrhoea gracilis*, shrubland/low shrubland over *Anarthria prolifera*, *Loxocarya cinerea*, *Mesomelaena tetragona*, *Tetrariaoctandra* open sedgeland and *Conostylis setigera* subsp. *setigera*, *Dampiera linearis*, *Hypochaeris glabra*, *Lomandra hermaphrodita*, *Patersonia umbrosa* var. *umbrosa* and *Trachymene pilosa* open herbs on grey-brown, yellow or yellow-brown ('orange') loamy sand.

Comments: There is an area of grey-brown sandy loam in the western portion of vegetation unit A, otherwise soils are mainly yellow-brown ('orange') loamy sand that is up to 2 m deep near the northern boundary. A small area of red-brown loam occurs along a shallow drainage line on the northern boundary within which quadrat YOONG25 is located. The southern limit of vegetation unit A is demarcated in places by a low slope of exposed laterite and gravel. A variant of this vegetation unit is found on the grey-brown sandy loam near the western boundary of the Study Area where species such as *Boronia crenulata*, *Tetraria* sp. Jarrah Forest (R. Davis 7391) and *Banksia dallanneyi* are a more frequent than they are on the yellow-brown loamy sands. Conversely species such as *Banksia attenuata*, *Mesomelaena tetragona* and *Synaphea whicherensis* are found on the yellow-brown loamy sands but are uncommon or absent from the grey-brown sandy loams.

Vegetation Unit B

Eucalyptus marginata, (*Corymbia calophylla*, *C. haematoxylon*) woodland over (*Banksia grandis*), (*Xylomelum occidentale*) open low woodland over *Acacia pulchella*, *Banksia dallanneyi* subsp. *dallanneyi*, *Conostephium pendulum*, *Dasypogon bromeliifolius*, *Hibbertia hypericoides*, *Hypocalymma robustum*, *Leucopogon pulchellus*, *Stirlingia latifolia*, *Xanthorrhoea gracilis* shrubland/low shrubland over *Desmocladus fascicularis*, *Mesomelaena tetragona* very open sedges and **Arctotheca calendula*, *Burchardia congesta*, *Caladenia flava*, *Elythranthera brunonis*, **Hypochaeris glabra*, *Quinetia urvillei*, *Rhodanthe citrina*, *Stylidium calcaratum* and *Trachymene pilosa* open herbs on grey-brown loamy sand to light grey sand.

Comments: This is the most widespread vegetation unit in the Study Area and is in places separated from unit A by a fringe of gravel and exposed laterite sloping to the north. Grey-brown sandy loam predominates in the western third and light grey sands in the eastern two thirds of this vegetation unit. The small tree *Corymbia haematoxylon* is largely confined to the western portion of this vegetation unit.

Vegetation Unit C

Eucalyptus marginata, *Corymbia calophylla* open forest over *Banksia dallanneyi* var. *dallanneyi*, *Hakea amplexicaulis*, *Hibbertia cunninghamii*, *H. commutata*, *H. hypericoides*, *Hovea chorizemifolia*, *Hypocalymma robustum*, *Labichea punctata*, *Leucopogon conostephioides*, *Xanthorrhoea preissii*, *X. gracilis* shrubland/low shrubland over *Desmocladus fasciculatus*, *Tetraria octandra*, *T*. sp. Jarrah Forest very open sedges and *Conostylis setigera* subsp. *setigera*, *Lagenophora huegelii*, *Lomandra sericea*, *L. hermaphrodita*, *Opercularia apiciflora*, *Patersonia umbrosa* var. *xanthina* and *Thelymitra crinita* open herbs on gravelly sand or grey brown loamy sand.

Comments: This vegetation unit is found in the south western portion of the Study Area and is situated on gravel and exposed laterite or grey-brown loamy sand over laterite.

Vegetation Unit D

Eucalyptus marginata, *Corymbia haematoxylon*, *Allocasuarina fraseriana* open forest over *Banksia grandis*, (*Persoonia elliptica*) open low woodland over *Dasypogon hookeri*, *D. bromeliifolius*, *Hibbertia hypericoides*, *H. glomerata*, *Labichea punctata*, *Stirlingia latifolia*, *Xanthorrhoea preissii*, *X. gracilis* shrubland/low shrubland over *Patersonia umbrosa* var. *xanthina* very open herbs on grey-brown or yellow-brown loamy sand and sandy clay loam.

Comments: This vegetation unit differs from the others in the Study Area in having a substantial representation of *Allocasuarina fraseriana* in the overstorey. There is also a small area of clay loam soils with dampland species such as *Kunzea recurva* and *Mirbelia dilatata* within this vegetation unit. Because only one quadrat from the current study was situated within this unit the vegetation description was derived with the assistance of information from the report by Mattiske Consulting (2012).

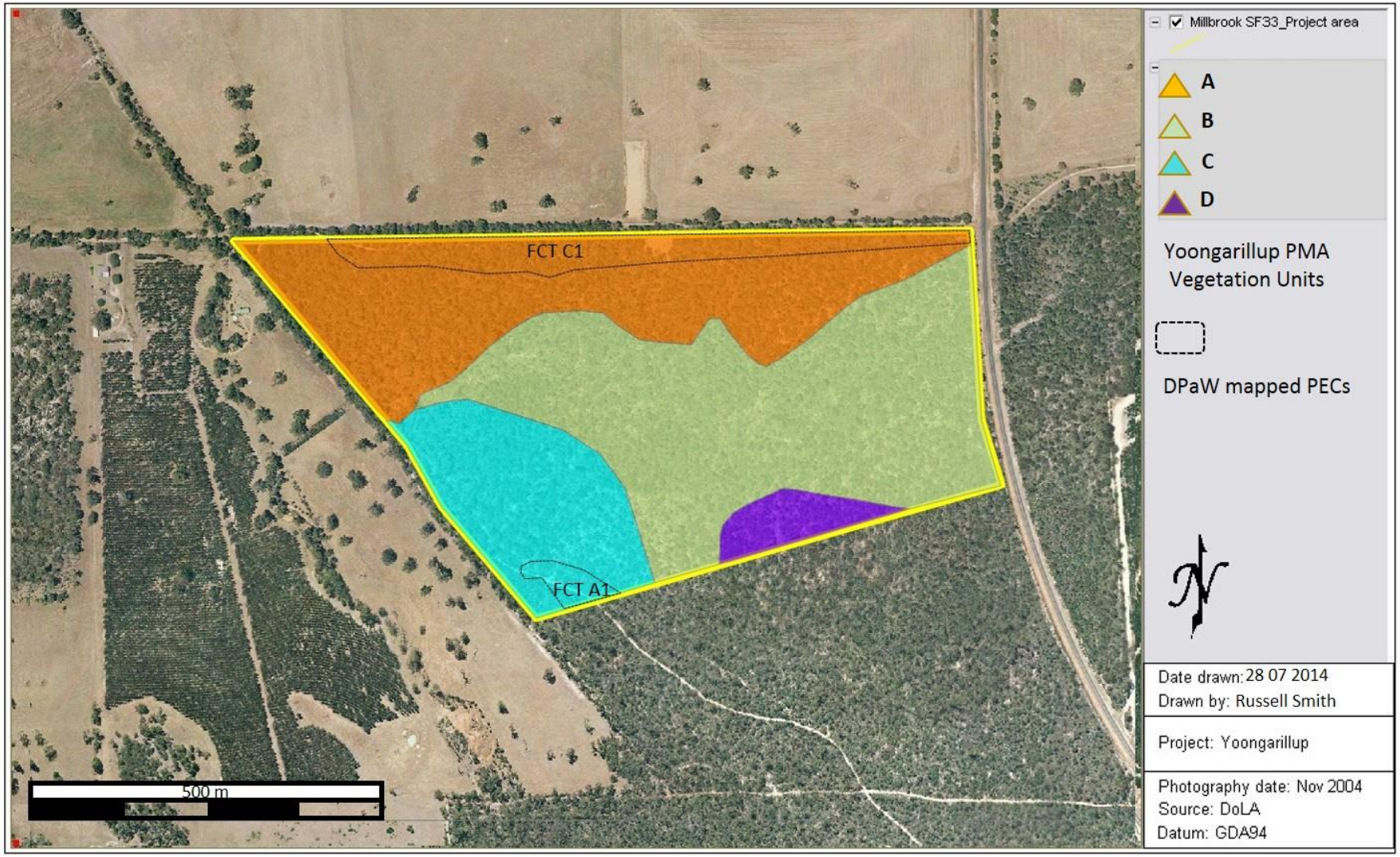

Figure 12. Vegetation units in the Study Area. The extent of the two priority ecological communities as mapped by the Department of Parks and Wildlife is also shown.

3.2.3 Comparison of Study Area Vegetation Units with Whicher Study Floristic Community Types

3.2.3.1 Vegetation units A and C

The Whicher Study (*A Flora Survey of the Whicher Scarp*) identified 20 subgroups or floristic community types following a multivariate analysis of 124 floristic quadrats (Keighery *et al*., 2008). Two of these floristic community types; FCT A1 ('Whicher Scarp woodlands of grey/white sands') and FCTC1 ('Central Whicher Scarp Jarrah woodland'), which have been recognised as priority 1 ecological communities are known to occur within the Study Area (**Figure 6**, above). The extent of the two priority ecological communities, A1 and C1, within the Study Area, has been mapped by the Department of Parks and Wildlife (DPaW) and is shown in **Figure 11**, above (DPaW, 2014).

The extent of floristic community type (FCT) C1 as mapped by DPaW (totalling 4.4 ha) coincides with the northern part of vegetation unit A. A small area (0.5 ha) of FCT A1 was mapped by DPaW in the south-western portion of the Study Area, adjacent to quadrat WHI03 and located within the boundary of vegetation unit C as mapped by the present study. The Whicher floristic community type, FCT C4 (Whicher Scarp/Blackwood Plateau Jarrah and Marri woodland), which is not a priority ecological community, is also known to occur within the Study Area (at quadrat WHI03), although its extent has not been mapped.

In order to determine how closely groups A and C from the multivariate analysis described in section 3.2.1 above (and which are mapped as vegetation units A and C) match floristic community types A1, C1 and C4 from the Whicher Study a comparison of the frequent and common taxa from each is presented in **Tables 12**and **13**below.

If species occurring in the Whicher Study communities are not typical (>75%) or common (50-75%) within vegetation units A and C but are present at a lower level the frequency is presented in italics.

Group A shares about 65% of its typical (>75% frequency) and common (50-75%) taxa (**Table11**) with FCT C1 (**Table 12**). Moreover, a total of 46 species recorded within at least one of the nine quadrats within group A is a typical or common species of FCT C1. This provides strong evidence to infer that vegetation unit A, which is based on the group A quadrats, represents an occurrence of the priority ecological community FCT C1 and that the extent of this priority ecological community within the Study Area is in fact larger than that mapped by DPaW and at least as large as the area mapped as 'yellow-brown' loamy sands (**Figure 12**) – FCT C1 typically occurring on 'coloured' or 'yellow' sands' (Keighery *et al*., 2008).

The floristic composition of quadrat group C, which includes an area mapped by DPaW as the priority ecological community FCT A1, is compared to both this community and another which is known to occur in the Study Area, FCT C4, in **Table 13**. Quadrat WHI03, which was surveyed as part of the Whicher Study and designated as FCT C4, is located within the area mapped as

vegetation unit C. However, the area mapped by DPaW as FCT A1 is well outside the area proposed to be mined.

Taxon	FCT C1	Group A	Taxon	FCT C1	Group A
Adenanthos barbiger	90.0	88.9	*Hovea chorizemifolia*	50.0	*44.4*
Agrostocrinum hirsutum	50.0	*22.2*	*Hovea trisperma*	90.0	*44.4*
Anarthria prolifera	70.0	77.8	*Hypocalymma robustum*	60.0	88.9
Banksia grandis	80.0	77.8	*Hypolaena exsulca*	50.0	*44.4*
Boronia crenulata	50.0	55.6	*Isopogon sphaerocephalus*	80.0	*33.3*
Bossiaea ornata	80.0	*11.1*	*Kingia australis*	70.0	
Burchardia congesta	70.0	66.7	*Labichea punctata*	70.0	66.7
Calothamnus sanguineus	60.0	*22.2*	*Lepidosperma squamatum*	60.0	
Chamaescilla corymbosa var. *corymbosa*	50.0	*33.3*	*Lomandra hermaphrodita*	90.0	66.7
Conostylis setigera subsp. *setigera*	70.0	66.7	*Lomandra sericea*	80.0	*33.3*
Corymbia haematoxylon	60.0	*22.2*	*Lomandra sonderi*	50.0	
Cyathochaeta equitans	50.0		*Loxocarya cinerea*	50.0	66.7
Dampiera linearis	100.0	66.7	*Mesomelaena tetragona*	90.0	*44.4*
Dasypogon hookeri	80.0	77.8	*Patersonia umbrosa* var. *xanthina*	90.0	66.7
Desmocladus fasciculatus	80.0	*44.4*	*Pentapeltis peltigera*	100.0	*44.4*
Banksia dallanneyi var. *dallanneyi*	100.0	55.6	*Philotheca spicata*	70.0	*11.1*
Eucalyptus marginata subsp. *marginata*	100.0	100.0	*Pterostylis recurva*	50.0	
Gompholobium knightianum	90.0	100.0	*Sphaerolobium medium*	50.0	*11.1*
Gompholobium polymorphum	70.0	*11.1*	*Stylidium amoenum* var. *amoenum*	60.0	*11.1*
Hakea amplexicaulis	80.0	66.7	*Tetraria capillaris*	50.0	55.6
Hakea cyclocarpa	50.0		*Tetraria octandra*	90.0	66.7
Hibbertia cunninghamii	90.0	*22.2*	*Tetratheca hirsuta*	50.0	
Hibbertia diamesogenos	50.0		*Xanthorrhoea gracilis*	90.0	100.0
Hibbertia glomerata	90.0	55.6	*Xanthorrhoea preissii*	60.0	*33.3*
Hibbertia hypericoides	100.0	100.0	*Xylomelum occidentale*	50.0	*11.1*
Hibbertia quadricolor	70.0	*44.4*			

Table 12. Comparison of the typical (>75% frequency) and common (50-75%) taxa of the priority ecological community FCT C1 (Keighery et al., 2008) with typical, common and other (>50% frequency) taxa of quadrat group A). Taxa occurring in more than 75% of quadrats ('typical taxa') are high-lighted in green.

Based on this comparison, quadrat group C is closer in composition to FCT C4 than FCT A1. Quadrat group C shares 16 typical or common taxa with FCT A1 compared to 25 typical or common taxa shared with FCT C4. Furthermore, quadrat group C contained in at least one of its quadrats 88% of the typical or common taxa of FCT C4, compared to only 55% of those for FCT A1. Based on this analysis vegetation in the area mapped as vegetation unit C in **Figure 12**, above, is more likely to be FCT C4 than the priority ecological community FCT A1.

However, vegetation unit C is based on only four quadrats and the surveying of more quadrats within this area is likely to confirm the presence of FCT A1 as mapped by DPaW.

Taxon	FCT A1	FCT C4	Group C	Taxon	FCT A1	FCT C4	Group C
Acacia extensa	57.1		*25*	*Lechenaultia biloba*		52.9	50
Acacia pulchella	57.1	82.4	*25*	*Jacksonia* sp. Whicher (G.J. Keighery 9953)	57.1		
Adenanthos meisneri	85.7			*Lepidosperma squamatum*	71.4		
Adenanthos obovatus	71.4			*Leucopogon glabellus*	100.0		
Anarthria prolifera	85.7		50	*Leucopogon microcarpus*	71.4		
Astroloma ciliatum		58.8		*Levenhookia pusilla*		70.6	50
Banksia attenuata	85.7			*Lomandra hermaphrodita*	85.7	58.8	100
Banksia dallanneyi var. *dallanneyi*		76.5	100	*Lomandra sericea*	85.7	76.5	75
Bossiaea ornata		52.9		*Loxocarya cinerea*	57.1		
Burchardia congesta	85.7		50	*Lyginia barbata*	57.1		
Calothamnus sanguineus	85.7		50	*Marianthus tenuis*		52.9	
Chamaescilla corymbosa		64.7	50	*Melaleuca thymoides*	100.0		
Conospermum capitatum subsp. *glabratum*	57.1			*Mesomelaena tetragona*		52.9	50
Conostephium pendulum	85.7			*Opercularia apiciflora*		70.6	100
Corymbia calophylla		94.1	100	*Patersonia umbrosa* var. *xanthina*		94.1	75
Corymbia haematoxylon	100.0		*25*	*Pentapeltis peltigera*		76.5	75
Dampiera linearis	100.0	70.6	50	*Petrophile linearis*	85.7		
Dasypogon bromeliifolius	100.0		50	*Philotheca spicata*	57.1	58.8	50
Desmocladus fasciculatus		64.7	100	*Phlebocarya ciliata*	71.4		
Drosera pallida	57.1		50	*Phlebocarya filifolia*	71.4		
Elythranthera brunonis	57.1		50	*Pimelea rosea* subsp. *rosea*	57.1		
Eucalyptus marginata subsp. *marginata*	85.7	100.0	100	*Platysace tenuissima*		76.5	50
Gompholobium capitatum	57.1			*Podocarpus drouynianus*	71.4		
Goodenia coerulea	57.1			*Pyrorchis nigricans*	57.1		
Gompholobium knightianum		52.9	*25*	*Ricinocarpos cyanescens*	57.1		
Hakea amplexicaulis		64.7	50	*Stirlingia latifolia*	100.0		
Hibbertia cunninghamii	57.1	70.6	100	*Stylidium calcaratum*		58.8	50
Hibbertia ferruginea	85.7			*Tetraria* sp. Jarrah Forest (R. Davis 7391)		76.5	100
Hibbertia hypericoides	100.0	94.1	100	*Tetraria octandra*		100.0	100
Hovea trisperma		52.9	25	*Tetrarrhena laevis*		76.5	50
Hypocalymma angustifolium		52.9	50	*Xanthorrhoea gracilis*		58.8	100
Hypocalymma robustum	85.7	70.6	100	*Xanthorrhoea preissii*	85.7	94.1	100
Hypochaeris glabra	71.4	58.8	50	*Xanthosia huegelii subsp. huegelii*	71.4		*25*
Hypolaena exsulca	100.0		50	*Xylomelum occidentale*	71.4		*25*
Lagenophora huegelii		70.6					

Table 13. Comparison of the typical (>75% frequency) and common (50-75%) taxa of the Whicher Study floristic community types FCT A1 (priority 1), FCT C4 with typical, common and other (>50% frequency) taxa of quadrat group C. Taxa occurring in more than 75% of quadrats ('typical taxa') are high-lighted in green.

3.2.3.2 Vegetation units B and D

A comparison of the floristic composition of quadrat group B was made with three Whicher Survey floristic community types known to occur within the Study Area or nearby in a similar landscape position, FCT A1 (Central Whicher Scarp Mountain Marri woodland), FCT C3 (Whicher Scarp Jarrah and Mountain Marri woodland on laterites) and FCT C4 (Whicher Scarp/Blackwood Plateau Jarrah and Marri woodland) (**Table 14**. The comparison is summarised below in table form:

Number of taxa in common between quadrat group B and three Whicher Survey floristic community types.

	Group B	
	Any Frequency	>50% Frequency
FCT A1	28	21
FCT C3	22	14
FCT C4	21	16

As can be seen from the table above, quadrat group B is closest in composition to FCT A1, sharing 28 taxa in total (i.e. species that occurred in at least one of the seven quadrats in this group), and 21 of its typical (>75% frequency) or common taxa with that floristic community type. However, although FCT A1 is the closest match of the three, there is considerable dissimilarity between quadrat group B and this floristic community type. Of the 41 common and typical taxa of group B (**Table 11**), only half of them are also common or typical taxa of FCT A1. In conclusion, quadrat group B, and vegetation unit B which is derived from it, may represent a variant of FCT A1 (which was represented by only seven quadrats in the Whicher Survey) or another floristic community altogether which was not sampled by that survey.

Because it is represented by only one quadrat a detailed comparison of quadrat group D is not presented. It shares some species with all three floristic community types discussed above (i.e. FCTs A1, C3 and C4), with the greatest similarity to FCT C3 where it shares 15 of the 45 typical or common species of that community.

Taxon	FCT A1	FCT C3	FCT C4	Group B	Taxon	FCT A1	FCT C3	FCT C4	Group B
Acacia extensa	57.1	63.6		57.1	*Hypolaena exsulca*	100.0			57.1
Acacia pulchella	57.1		82.4	71.4	*Isopogon sphaerocephalus*		100		*14.3*
Adenanthos barbiger		63.6		57.1	*Jacksonia* sp. Whicher (G.J. Keighery 9953)	57.1			*14.3*
Adenanthos meisneri	85.7			57.1	*Lagenophora huegelii*			70.6	*14.3*
Adenanthos obovatus	71.4				*Lechenaultia biloba*		63.6	52.9	*14.3*
Anarthria prolifera	85.7			57.1	*Lepidosperma squamatum*	71.4			
Astroloma ciliatum			58.8		*Leucopogon glabellus*	100.0			
Banksia attenuata	85.7				*Leucopogon microcarpus*	71.4			
Banksia bipinnatifida subsp. *multifida*		72.7			*Levenhookia pusilla*		54.5	70.6	57.1
Banksia dallanneyi var. *dallanneyi*		90.9	76.5	71.4	*Lomandra hermaphrodita*	85.7	54.5	58.8	
Bossiaea ornata		81.8	52.9		*Lomandra sericea*	85.7	100	76.5	
Burchardia congesta	85.7			85.7	*Loxocarya cinerea*	57.1			*14.3*
Calothamnus sanguineus	85.7			57.1	*Lyginia barbata*	57.1			*42.9*
Chamaescilla corymbosa			64.7	*14.3*	*Marianthus tenuis*		54.5	52.9	
Conospermum capitatum subsp. *glabratum*	57.1			*14.3*	*Melaleuca thymoides*	100.0			57.1
Conostephium pendulum	85.7			85.7	*Mesomelaena tetragona*			52.9	71.4
Conostylis setigera subsp. *setigera*		54.5			*Opercularia apiciflora*		81.8	70.6	57.1
Corymbia calophylla			94.1	57.1	*Patersonia babianoides*		54.5		
Corymbia haematoxylon	100.0	81.8		57.1	*Patersonia umbrosa* var. *xanthina*		90.9	94.1	
Dampiera linearis	100.0	54.5	70.6	57.1	*Pentapeltis peltigera*		54.5	76.5	
Dasypogon bromeliifolius	100.0			85.7	*Persoonia longifolia*		72.7		*42.9*
Daviesia preissii		63.6			*Petrophile linearis*	85.7			
Desmocladus fasciculatus		81.8	64.7	85.7	*Philotheca spicata*	57.1		58.8	
Drosera pallida	57.1			57.1	*Phlebocarya ciliata*	71.4			57.1
Elythranthera brunonis	57.1				*Phlebocarya filifolia*	71.4			
Eucalyptus marginata subsp. *marginata*	85.7	90.9	100.0	85.7	*Pimelea rosea subsp. rosea*	57.1			
Gompholobium capitatum	57.1				*Platysace tenuissima*		63.6	76.5	
Gompholobium knightianum		90.9	52.9	57.1	*Podocarpus drouynianus*	71.4			*42.9*
Gompholobium preissii		54.5			*Pyrorchis nigricans*	57.1			*28.6*
Goodenia coerulea	57.1				*Ricinocarpos cyanescens*	57.1			
Hakea amplexicaulis		81.8	64.7		*Scaevola calliptera*		63.6		
Hakea cyclocarpa		63.6			*Stirlingia latifolia*	100.0			100.0
Hakea lissocarpha		63.6			*Stylidium amoenum* var. *amoenum*		54.5		
Hibbertia commutata		63.6		*42.9*	*Stylidium calcaratum*			58.8	71.4
Hibbertia cunninghamii	57.1	100	70.6	*14.3*	*Styphelia tenuiflora*		72.7		
Hibbertia diamesogenos		54.5			*Tetraria octandra*		81.8	100.0	*14.3*
Hibbertia ferruginea	85.7				*Tetraria* sp. Jarrah Forest (R. Davis 7391)		63.6	76.5	*14.3*
Hibbertia glomerata		63.6		*14.3*	*Tetratheca hirsuta*		54.5		
Hibbertia hypericoides	100.0	100	94.1	85.7	*Tetrarrhena laevis*			76.5	
Hovea chorizemifolia		63.6			*Xanthorrhoea gracilis*		81.8	58.8	85.7
Hovea trisperma			52.9		*Xanthorrhoea preissii*	85.7	72.7	94.1	
Hypocalymma angustifolium			52.9		*Xanthosia ciliata*		81.8		
Hypocalymma robustum	85.7	100	70.6	85.7	*Xanthosia huegelii* subsp. *huegelii*	71.4	72.7		57.1
Hypochaeris glabra	71.4		58.8	85.7	*Xylomelum occidentale*	71.4			85.7

Table 14. Comparison of the typical (>75% frequency) and common (50-75%) taxa of the Whicher Study floristic community types FCT A1 (priority 1), FCT C3 and FCT C4 with typical, common and other (>50% frequency) taxa of quadrat group B. Taxa occurring in more than 75% of quadrats ('typical taxa') are high-lighted in green.

3.2.4 Regional Conservation Significance of the Vegetation in the Study Area

The conservation status and significance of vegetation of the Whicher Scarp landform was discussed by Keighery *et al*. (2008) and is summarised in EPA (2009). Amongst the conservation values highlighted are a restricted and distinct landform and associated soils, six unique vegetation complexes with two of them being highly restricted, a diverse suite of woodland floristic assemblages and a diverse and rich flora. Eight quadrat groups (five of which were subdivided) and 20 sub-groups or floristic community types (FCTs) were identified after multivariate analysis of 124 quadrats located within the Whicher Scarp landform. Five of these floristic community types have been listed as priority ecological communities, including two which are known to occur in the Study Area (FCT A1 and FCT C1) – both rated as Priority 1. FCT A1 is restricted to the south western part of the Study Area and will not be affected by the proposed mining.

Priority 1 ecological communities are described as;

"*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* (DEC, 2010a)."

The Whicher Study allocated 10 quadrats to FCT C1; these quadrats represent eight distinct occurrences, totaling about 54 ha[6]. One of the occurrences is situated on a small (9 ha) reserve, while the others are located within State forest or adjoining Crown reserve. All of the Whicher Study quadrats assigned to FCT C1 (bar one which is situated on the Swan Coastal Plain), are on the Whicher Scarp landform. Soil colour is usually coloured, but may be white or grey (Keighery *et al*., 2009, Table 9). The nine FCT C1 quadrats on the Whicher landform occur on five different soil phases (as mapped by Tille and Lantzke, 1990), with the majority (6) being located on the WsC2 (Whicher gentle slopes) and WsYL2 (Yelverton very gentle flats) soil phases (Keighery *et al*., 2009, Table 8) – the Study Area occurrence occurs on the 214WsYL1 – Yelverton flats phase.

New occurrences of FCT C1 (and also FCT A1 which occurs on much the same soil mapping phases) may be able to be found. However, because of the lack of a close correlation between soil phases as mapped by Tille and Lantzke (1990) and particular FCTs, soil mapping will be useful for defining new areas to target by on-ground surveys but the boundaries will not be able to be used to define the boundaries of the FCTs.

[6]V. English (DPaW), personal communication 19/08/2014.

3.2.5 Vegetation Condition

Most of the Study Area vegetation (97%) was rated as Very Good or Excellent condition, with only a small area on the northern boundary previously used as a sand pit being rated as Completely Degraded (**Figure 13**). The portion classified as Very Good rather than Excellent (about 73% of the Study Area), has previously been partly-cleared as evidenced by old windrows of fallen trees scattered throughout. Based on the size of the regrowth eucalypts, the clearing was probably during the period 1950 - 1965, perhaps in readiness for pine planting that was not proceeded with.

Parts of the previously cleared area are relatively species-poor, and there is evidence of heavy kangaroo grazing throughout much of the Study Area. A strip around the east and north sides of the Study Area shows no signs of previous clearing, and this was classed as Excellent condition. *Phytophthora* disease is present along the eastern boundary and part of the western boundary, evidenced by scattered deaths of *Eucalyptusmarginata* and *Xanthorrhoea* species (Moore Mapping, 2012). Scattered deaths of *Banksia grandis*, particularly near the southern boundary of the Study Areaare a result of drought, and dumping of domestic and farm refuse has been carried out in various places along tracks in the northern and western parts. The proportion and cover of introduced species is generally low throughout.

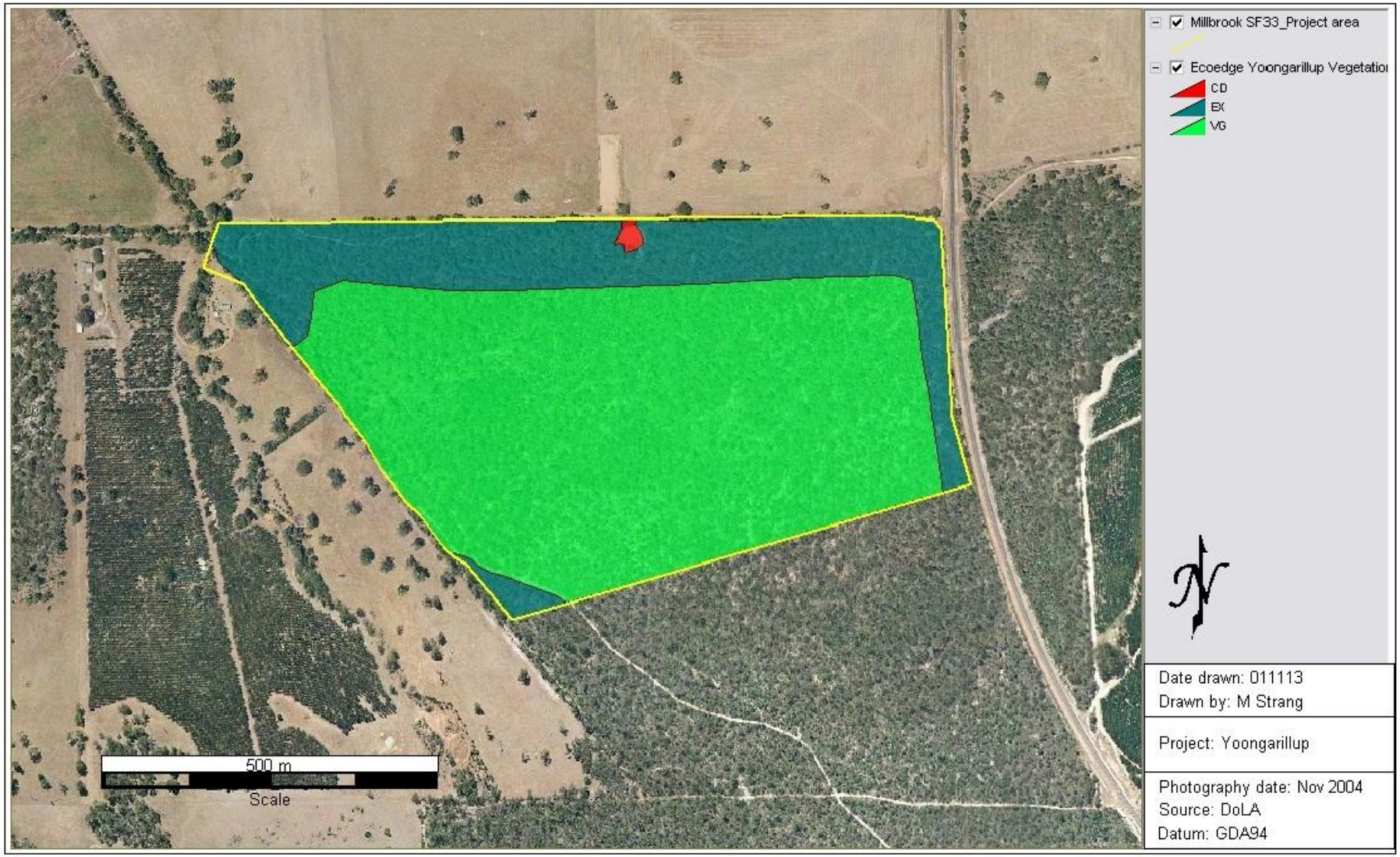

Figure 13. Vegetation condition of the Study Area.

4 Conclusions and Recommendations

Ecoedge was commissioned in August 2012 by Doral Mineral Sands Pty Ltd to undertake a flora and vegetation survey within their Yoongarillup Resource Zone. The survey took place in State Forest 33, Mining Lease M70-0459 (44 ha); the "Study Area". The main objectives of the survey were to confirm the presence of previously discovered threatened flora; to search for undiscovered occurrences; and to assess the vegetation in the Study Area, particularly with regard to the presence of priority ecological communities.

The threatened flora survey, carried out in late September and early October confirmed the presence of *Daviesia elongata* subsp. *elongata* (DRF, 'vulnerable'), and two Priority listed species: *Acacia semitrullata* (P4) and *Conospermum paniculatum* (P3). A new population of *Verticordia densiflora* var. *pedunculata* (DRF, 'endangered') was also found within the Study Area, this taxon had previously been misidentified as the common *Verticordia densiflora* var. *caespitosa*. Another taxon, provisionally identified as the Priority species *Jacksonia gracillima* following the previous survey of the Study Area, was instead confirmed as the conservation significant Whicher Range variety of the common species *J. horrida*.

Numbers of populations and individuals of *D. elongata* subsp. *elongata* and the two Priority species were similar to those found during the previous survey by Mattiske Consulting Pty Ltd.

Verticordia densiflora var. *pedunculata* was known previously from about ten populations with a total population size of about 500 plants (Department of Environment, 2014a). The main identified threats to the species are clearing and increasing degradation of road verges and small areas of remnant vegetation, and urban development in the Busselton region. In 2007, the total population size for *D. elongata* subsp. *elongata* was estimated to just over 1000 mature plants in eight populations (Department of Environment, 2014b). The subspecies is known from populations at seven locations, one of which has been split into subpopulations. Subpopulations are defined by differences in land tenure and management, as well as location. The population trend for the entire species appears to be one of decline.

Known populations are healthy and not immediately threatened. However, this subspecies is an obligate seeder (germinating following fire) and subpopulations are affected by altered fire regimes (WA DEC 2007). Population numbers decrease after resprouting as seedlings compete for light, moisture and resources (WA DEC 2007).

As well as being Declared Rare Flora pursuant to Schedule 1 of the *Wildlife Conservation Act 1950*, and protected under provisions of that Act, *D. elongata* subsp. *elongata* is also listed as 'vulnerable' and *V. densiflora* var. *pedunculata* is listed as 'endangered' pursuant to section 179 of the Commonwealth *EPBC Act 1999*. Listed threatened species are matters of national

environmental significance (protected matters) under the *EPBC Act*'s assessment and approval provisions.

Because they are both restricted to a relatively small geographical area and a small number of known populations, it is recommended that the populations of *D. elongata* subsp. *elongata* and *V. densiflora* var. *pedunculata* to be protected during the proposed mining operations.

Four taxa considered to be regionally significant by the DPaW were recorded in the Study Area, these being the Whicher Range variants of *Jacksonia horrida* and*Crowea angustifolia* var. *angustifolia*, and small populations of *Pityrodia bartlingii* and *Petrophile serruriae*, which are geographical outliers. In total, two hundred and thirty three taxa from 44 families were identified in the Study Area.

Twenty one 100 m^2 floristic quadrats were placed in the Study Area and following multivariate analysis four quadrat groups (A, B, C, and D) were derived.

These quadrat groups formed thebasis of four vegetation units (named after the quadrat groups), that were mapped in the Study Area. Information from fifty assessment points where floristic or soil information was collected, supplemented by information from the survey by Mattiske Consulting (2012) was used to determine the boundaries for the vegetation units.

The vegetation units were described in relation to structure and dominant taxa and a map is presented showing their distribution within the Study Area.

Vegetation unit 'A', an open forest or woodland of *Eucalyptus marginata* and *Corymbia calophylla*, situated in the northern part of the Study Area and covering about 14.7 hais mainly associated with 'coloured' (yellow, yellow-brown and red-brown) soil. In places the yellow sand is over 2 m deep as evidenced by a pit on the northern boundary previously used for sand extraction. The Department of Parks and Wildlife has mapped 4.4 ha of FCT C1 ('Central Whicher Scarp Jarrah woodland'), which is a priority 1 ecological community, in the northern part of the area mapped as vegetation unit A. Quadrat group A, which this vegetation unit is based on, shares about 65% of its typical and common taxa with FCT C1. Based on this evidence, and the fact that FCT C1 is already recognized as occurring within its boundaries it is inferred that vegetation unit A as mapped during the survey reported here represents an expanded extent of this priority ecological community.

It is recommended that the extent of vegetation unit A, at least that occurring on yellow-brown or yellow sands, is considered for inclusion in the DPaW database as an increase of the area mapped for the priority ecological community FCT C1 within the Study Area.

The affinities of vegetation unit B, which is the most extensive unit in the Study Area (18.8 ha) are less clear cut. Structurally it is a woodland of *Eucalyptus marginata*, with admixtures of *Corymbia calophylla* and *C. haematoxylon* and occurs mainly on grey-brown loamy sand to light grey sand with a small amount of laterite along its eastern boundary with vegetation unit A. Quadrat group B on which vegetation unit is based was compared in tabular form with three floristic community types known to occur within or close to the Study Area on similar soils (FCT A1, FCT C3 and FCT C4). Of these it was most similar to FCT A1 (Central Whicher Scarp Mountain Marri woodland), which is a priority 1 ecological community.

However, although FCT A1 is the closest match of the three there is considerable dissimilarity between quadrat group B and this floristic community type. Of the 41 common and typical taxa of group B only half of them are also common or typical taxa of FCT A1. While the area mapped as vegetation unit B may represent a variant of FCT A1 it may be another floristic community altogether which was not sampled by the Whicher Survey.

Vegetation unit C, a *Eucalyptus marginata* and *Corymbia calophylla* open forest on gravelly sand or grey brown loamy sand over laterite in the south-western part of the Study Area has a small area of the priority 1 ecological community FCT A1 that has been mapped within its boundary by the Department of Parks and Wildlife. Quadrat group C, on which vegetation unit C is based, was compared in tabular form with FCT A1 and another which is known to occur in the Study Area; FCT C4 (Whicher Scarp/Blackwood Plateau Jarrah and Marri woodland). Based on this comparison quadrat group C is closer in composition to FCT C4 than FCT A1. Quadrat group C shares 16 typical or common taxa with FCT A1 compared to 25 typical or common taxa shared with FCT C4. Based on this analysis vegetation in the area mapped as vegetation unit C in Figure 11, above, is more likely to be FCT C4 than the priority ecological community FCT A1. However, vegetation unit C is based on only four quadrats and the surveying of more quadrats within this area is likely to confirm the presence of FCT A1 as mapped by DPaW.

Vegetation unit D, which forms a *Eucalyptus marginata*, *Corymbia haematoxylon*, *Allocasuarina fraseriana* open forest, is situated on grey-brown or yellow-brown loamy sand and sandy clay loam at the southern boundary of the Study Area. It has a small area of sandy clay loam with wetland adapted species and is the only unit with a significant component of *A*. *fraseriana*. Only one quadrat was placed in vegetation unit D so the boundary of the unit was mapped using information from assessment points, as well as quadrat data from Mattiske Consulting (2012).

The vegetation in the Study Area is mainly in Very Good to Excellent condition, with effects of partial clearing carried out 40 to 50 years ago having only a marginal effect on species richness and weed invasion. Species-richness (α-diversity) as estimated by the total numbers of taxa per quadrat within the Study Area was moderately high with a mean of 47.2 taxa (range 31-65) for

the 21 quadrats. This was substantially lower than the mean 69.6 taxa (range 55-103) per quadrat for the Whicher Survey quadrats. The main reason that can be advanced for this discrepancy are that many of the quadrats in the current survey were sited in vegetation that showed evidence of previous disturbance. In contrast, the Whicher Survey quadrats were sited in the 'least disturbed vegetation available' (Keighery *et al*., 2008). In addition, there is little doubt that further taxa could be added to the list for each quadrat in the Study Area if further visits were carried out in summer and autumn.

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THREATENED AND PRIORITY SPECIES

SURVEY OF DRILL LINES WITHIN THE

MILLBROOK STATE FOREST

Prepared for

Doral Mineral Sands Pty Ltd

Prepared by

Mattiske Consulting Pty Ltd

March 2012

DOR1201/20/2012

Mattiske Consulting Pty Ltd

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This report is based on the scope of services defined by Doral Mineral Sands Pty Ltd, budgetary and time constraints imposed by Doral Mineral Sands Pty Ltd, the information supplied by Doral Mineral Sands Pty Ltd (and its agents), and the method consistent with the preceding.

DOCUMENT HISTORY

Report	Version	Prepared By	Reviewed By	Submitted to Client	
				Date	Copies
Internal Review	V1	LAC/FR	EMM	-	-
Draft Report released for Client Review	V2	LAC	EMM	13/3/12	Email
Final Report	V3	LAC	EMM	21/3/12	Email

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FIGURES

TABLES

1. SUMMARY

Mattiske Consulting Pty Ltd was commissioned in February 2012 by Doral Mineral Sands Pty Ltd to undertake an assessment of the proposed drill lines and drilling sites for threatened and priority flora, within Millbrook State Forest in the Yoongarillup Resource Zone (Figure 1).

One Threatened flora species, *Daviesia elongata* subsp. *elongata* pursuant to Schedule 1 of the *Wildlife Conservation Act 1950* and as listed by the Department of Environment and Conservation (2012b) and vulnerable pursuant to the *Environment Protection and Biodiversity Conservation Act 1999* and as listed by the Department of Sustainability. Environment, Water, Population and Communities (2012) was recorded from four locations on the proposed drill lines of the Millbrook state forest Survey area. A further *Davesia elongata* subsp. *elongata* population previously recorded by the Department of Environment and Conservation already known from outside the area was confirmed as present (Department of Environment and Conservation 2012b) in the recent field trip. A 50 metre circle has been placed around the populations of *Daviesia elongata* subsp. *elongata* near the proposed drill lines and drilling sites (Figure 2).

Three Priority flora species, as listed by the Department of Environment and Conservation (2012b) were recorded within the Millbrook State Forest survey area. Two Priority 3 and one Priority 4 Flora species were recorded within the Millbrook State Forest survey area.

2. BACKGROUND AND SCOPE

Mattiske Consulting Pty Ltd was commissioned in February 2012 by Doral Mineral Sands Pty Ltd to undertake an assessment of the proposed drill lines and drilling sites for any additional populations of threatened and priority flora along proposed drill lines, within Millbrook State Forest in the Yoongarillup Resource Zone (Figure 1).

The Yoongarillup Resource Zone survey area is located approximately 17 km south-east of Busselton. The resource area lies within the Whicher Scarp soil-landscape system (Keighery *et al.*, 2008), which includes the Department of Environment and Conservation managed land of the Whicher Forest block and Whicher Reference Area (Keighery *et al.*, 2008), and is immediately adjacent to the Whicher National Park.

The Whicher Scarp has been noted as being a distinct and naturally restricted landform with diverse flora containing local 'biodiversity hotspots' (Environmental Protection Authority 2009; Keighery *et al.*, 2008). These encompass distinctive and unique vegetation complexes including restricted and rare wetland communities (Environmental Protection Authority 2009: Keighery *et al.*, 2008). A high degree (46%) of native vegetation is intact in the area which has lead to unusual relictual habitats of plant communities and flora (Environmental Protection Authority 2009; Keighery *et al.*, 2008). Consequently this remnant vegetation meets the six criteria for regionally significant natural areas developed by the Bush Forever Program (Environment Protection Authority 2006).

Legend
Survey areas

Client: Doral

0 4km
Scale 1:250,000
MGA94 (Zone 50)
CAD Ref: g1956_f01.dgn
Date: Nov 2011 Rev: C A4

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PERTH BASIN TENEMENTS
LOCALITY
YOONGARILLUP RESOURCE ZONES

Figure: 1

353000mE 353200mE 353400mE 353600mE 353800mE

6262800mN 6262600mN 6262400mN

HADDON WEST

Millbrook State Forest

Whicher National Park

Sues Road

YS11_189 YS11_022 YS11_209 YS11_035 YS11_048 YS11_068
YS11_005 YS11_200 YS11_210 YS11_052 YS11_218
YS11_190 YS11_023 Cp YS11_036 De YS11_219 YS11_070
YS11_006 YS11_201 YS11_211 YS11_053 As Jg
YS11_191 YS11_037 YS11_071
YS11_007 YS11_024 De YS11_202 Cp YS11_054 YS11_220
YS11_192 YS11_038 YS11_212 Cp
YS11_008 YS11_025 YS11_203 YS11_055 YS11_073
YS11_193 YS11_039 YS11_213 YS11_221
YS11_009 YS11_026 Jg YS11_204 De YS11_057 YS11_222 YS11_075
YS11_194 YS11_040 YS11_214
YS11_010 YS11_027 YS11_205 YS11_059 YS11_223
YS11_195 YS11_042 YS11_215 Jg
YS11_011 YS11_028 YS11_206 Jg YS11_044 Cp YS11_216 YS11_061
YS11_196 Jg Jg Jg
YS11_012 YS11_029 YS11_207 Jg
YS11_197 YS11_046 YS11_217
YS11_031
YS11_013 YS11_208
YS11_198
YS11_032
YS11_015
YS11_199
YS11_016

YN001 YN002 YN003 YN004 YN005 YN006 YN007 YN008 YN009 YN010
YN011 YN012 YN013 YN014 YN015 YN016 YN017 YN018 YN019
YN020 YN021 YN022 YN023 YN024 YN025 YN026 YN027 YN028
YN029 YN030 YN031 YN032 YN033 YN034 YN035 YN036 YN037
YN038 YN039 YN040 YN041 YN042 YN043
YN044

Legend
- Survey Area
- Doral Proposed Access Track
- Doral Proposed Drill Hole
- MCPL Site

MCPL Flora Search Results
- Threatened Flora
- 50m Threatened Species Buffer
- Priority 3 Flora
- Priority 4 Flora

Species Abbreviations
- De Daviesia elongata subsp. elongata
- Cp Conospermum paniculatum
- Jg Jacksonia ?gracillima
- As Acacia semitrullata

Client: Doral

0 50m
Scale 1:3,000
MGA94 (Zone 50)
CAD Ref: g1956_f11.dgn
Date: Mar 2012 | Rev: C | A3

Mattiske Consulting Pty Ltd
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PERTH BASIN TENEMENTS
FLORA
YOONGARILLUP RESOURCE ZONES - STATE FOREST BLOCK

Figure: 2

3. OBJECTIVES

The aim of this drill line survey was to record the locations of threatened and priority flora within targeted areas of the Millbrook state forest. Specifically, the objectives include:

- collect and identify the threatened and priority flora on the proposed drill lines and drilling sites located in Millbrook State Forest
- review the conservation status of the vascular plant species recorded by reference to current literature and current listings by the Department of Environment and Conservation (2012b) and plant collections held at the Western Australian State Herbarium (Department of Environment and Conservation 2012b), and listed by the Department of Sustainability, Environment, Water, Population and Communities (2012) under the *Environment Protection and Biodiversity Conservation Act 1999*;
- record the populations of the threatened or priority taxa recorded along each proposed drill line;
- supply location data for all threatened or priority flora, to Doral Mineral Sands Pty Ltd; and
- prepare a report summarising the findings.

4. METHODS

A targeted search for threatened and priority flora along the proposed drill lines within Millbrook state forest was undertaken by six experienced botanists from Mattiske Consulting Pty Ltd on the 6th and 7th of March 2012. Maps of the drill lines to be surveyed were supplied by Doral Mineral Sands Pty Ltd. The length of each drill line was traversed including an area to 6 meters either side of the centre line to ensure thorough coverage of each area. The centre line of each drill line was marked with yellow flagging tape to define the actual area surveyed. The location of any suspected threatened taxa, as well as a 50 meter radius buffer around each location was marked with red flagging tape. Any potential priority taxa were flagged with pink tape.

The botanists involved in the survey were familiar with the taxa being searched for. The decision as to which taxa to search for was based on both, the species found in previous surveys (Mattiske 2012), and the results of a desktop report (Mattiske 2011) for threatened and priority flora which had previously been recorded in the area (Table 1). Any flora of questionable identity was collected, and treated in the field as a priority species, until subsequent positive identification could be made. The GPS location and populations of any significant taxa were recorded at each survey location. Plant populations were recorded within 5 m of a central point which designated the location of the plant population. The number of plants in each population was recorded.

All plant specimens collected during the field surveys were dried and frozen to eliminate pests in accordance with the requirements of the Western Australian Herbarium. The plant species were identified through comparisons with pressed specimens housed at the Western Australian Herbarium. Where appropriate, plant taxonomists with specialist skills were consulted. Nomenclature of the species recorded is in accordance with the Department of Environment and Conservation (2012b).

Table 1: Threatened and Priority Flora species previously recorded in and adjacent to the Yoongarillup survey area

Family	Species	State Conservation Status	Federal Conservation Status
Proteaceae	*Banksia mimica*	T	E
Myrtaceae	*Chamelaucium* sp. C Coastal Plain (R.D. Royce 4872)	T	VU
Fabaceae	*Daviesia elongata* subsp. *elongata*	T	VU
Myrtaceae	*Verticordia plumosa* var. *vassensis*	T	E
Fabaceae	*Gastrolobium* sp. Yoongarillup (S.Dilkes s.n. 1/9/1969)	1	-
Apiaceae	*Actinotus whicheranus*	2	-
Euphorbiaceae	*Amperea micrantha*	2	-
Rutaceae	*Boronia capitata* subsp. *gracilis*	2	-
Myrtaceae	*Eucalyptus relicta*	2	-
Asteraceae	*Blennospora doliiformis*	3	-
Cyperaceae	*Caustis* sp. Boyanup (G.S. McCutcheon 1706)	3	-
Restionaceae	*Chordifex gracilior*	3	-
Proteaceae	*Conospermum paniculatum*	3	-
Apiaceae	*Eryngium subdecumbens*	3	-
Proteaceae	*Grevillea brachystylis* subsp. *brachystylis*	3	-
Proteaceae	*Isopogon formosus* subsp. *dasylepis*	3	-
Restionaceae	*Lepyrodia heleocharoides*	3	-
Haloragaceae	*Myriophyllum echinatum*	3	-
Cyperaceae	*Schoenus benthamii*	3	-
Proteaceae	*Synaphea hians*	3	-
Malvaceae	*Thomasia laxiflora*	3	-
Fabaceae	*Acacia flagelliformis*	4	-
Fabaceae	*Acacia semitrullata*	4	-
Myrtaceae	*Calothamnus quadrifidus* subsp. *teretifolius*	4	-
Myrtaceae	*Chamelaucium* sp. Yoongarillup (G.J. Keighery 3635)	4	-
Proteaceae	*Lambertia rariflora* subsp. *rariflora*	4	-
Asparagaceae	*Laxmannia jamesii*	4	-
Menyanthaceae	*Ornduffia submerse*	4	-
Myrtaceae	*Verticordia lehmannii*	4	-

An assessment of the findings against a range of factors which may have had an impact on the outcomes of the present survey was made (Table 1). As indicated below there is a potential for some short-lived species to be absent or difficult to identify in the drier summer months.

Table 2: Potential Threatened and Priority flora Survey Limitations for Millbrook State forest March 2012

Potential Survey Limitation	Impact on Survey
Sources of information and availability of contextual information (*i.e.* pre-existing background versus new material)	**Not a constraint:** Adequate background information was available through recent studies of the proposed area. Existing vegetation of the area has historically been based on vegetation mapping by Beard.
Scope (*i.e.* what life forms, *etc.*, were sampled)	**Not a Constraint:** The scope was clear and the correct life forms were sampled accordingly
Proportion of flora collected and identified (based on sampling, timing and intensity)	**Not a constraint:** The proportion of flora collected and identified was adequate for a DRF and Priority Flora survey.
Completeness and further work which might be needed (was the relevant survey area fully surveyed?)	**Not a constraint:** All drill lines were surveyed in entirety to 6 m either side of the centre line indicated by Doral Mineral Sands Pty Ltd
Mapping reliability	**Not a constraint:** Previous mapping provided adequate background to the current survey.
Timing, weather, season, cycle	**Potential Constraint:** Some vascular plant species, which may be short-lived or difficult to locate without flowers, may have been missed in the recent assessment due to the timing of the survey; as the optimum period for sampling in the South West Provenance is noted as spring (EPA 2004). As some of the threatened and priority species are longer-lived perennial species that can be identified without flowers and fruit in many instances this was not considered a constraint.
Disturbances (fire flood, accidental human intervention, *etc*.)	**Not a constraint:** There was no recent disturbing processes within the area surveyed for the drill lines.
Intensity (in retrospect, was the intensity adequate?)	**Not a constraint:** The length of each drill line was traversed including an area to 6 meters either side of the centre line to ensure thorough coverage of each area.
Resources (were there adequate resources to complete the survey to the required standard?)	**Not a constraint:** Resources, in terms of time, equipment, support and personnel were adequate to undertake and complete the survey.
Access problems (*i.e.* ability to access survey area)	**Not a constraint:** No access problems were encountered during the surveys as the survey area was easily accessible from pre-existing tracks.
Experience levels (*e.g.* degree of expertise in plant identification to taxon level)	**Not a constraint:** Botanists have undertaken previous surveys in the wider area and were familiar with the flora and vegetation. Specimens were collected at every opportunity.

5. RESULTS

One Threatened flora species, *Daviesia elongata* subsp. *elongata,* pursuant to Schedule 1 of the *Wildlife Conservation Act 1950* and as listed by the Department of Environment and Conservation (2012b) and listed as vulnerable pursuant to the *Environment Protection and Biodiversity Conservation Act 1999* and as listed by the Department of Sustainability. Environment, Water, Population and Communities (2012) was recorded within the drill lines of the Millbrook state forest survey area (Figure 2).

Daviesia elongata subsp. *elongata*

Daviesia elongata subsp. *elongata* is a spreading shrub which grows from 40 cm to 1 m tall. The flowers are red or yellow/orange and appear predominantly in December but may also be found in January or February. Mattiske Consulting Pty Ltd found this species flowering in November (Mattiske 2012). This plant has been recorded growing on sandy soils and is restricted to the Jarrah Forest and Swan Coastal Plain on and around Whicher Range. It is known from 38 records from (Department of Environment and Conservation 2012a). This species is listed as vulnerable pursuant to section 179 of the *Environment Protection Biodiversity Conservation Act 1999* [Commonwealth] and the Department of Sustainability, Environment, Water, Population and Communities (2012). The seven known populations are healthy and not immediately threatened. However, this subspecies is an obligate seeder (germinating following fire) and subpopulations are affected by altered fire regimes (Department of Sustainability, Environment, Water, Population and Communities 2012). Population numbers decrease after re-sprouting as seedlings compete for light, moisture and resources (Department of Sustainability, Environment, Water, Population and Communities 2012). There were three locations found for this species along the drill lines of the Millbrook State Forest survey area and one location outside of the survey area (Table 3).There was a fourth location known from the previous mapping survey within the drill line survey area. This was also marked with a 50 meter radius buffer with red flagging tape (Table 3).

Three Priority flora species, as listed by the Department of Environment and Conservation (2012b) were recorded within the Millbrook State Forest survey area (Table 3). Two Priority 3 and one Priority 4 Flora species were recorded within the Millbrook State Forest survey area (Figure 2).

Conospermum paniculatum (Priority 3)

The Priority 3 species *Conospermum paniculatum,* is a spreading, open shrub, which grows from 0.3 to 1.25 m tall and produces blue/white flowers from July to November. *Conospermum paniculatum* (P3) is not a listed species under the *Environment Protection Biodiversity Conservation Act 1999,* as listed by the Department of Sustainability, Environment, Water, Population and Communities (2012). This species was recorded at seven survey locations within the Millbrook State Forest survey area. The GPS coordinates and population of Conospermum paniculatum (P3) recorded during the survey are set out in Table 3.

Jacksonia ? *gracillima* (Priority 3)

Jacksonia ? *gracillima* (P3) was inconclusively identified because sufficient flowering material was not available at the time of survey. *Jacksonia gracillima* (P3) is described as a low spreading shrub which produces orange flowers (Department of Environment and Conservation 2012b). This species in this area is part of a disjunct population. *Jacksonia* ?*gracillima* (P3) was recorded at seven survey locations within the Millbrook State Forest survey area, Table 3.

Acacia semitrullata (Priority 4)

The Priority 4 taxon, *Acacia semitrullata,* is a slender, erect, pungent shrub which grows to 70 cm tall and produces white/cream flowers between May and October (Department of Environment and Conservation 2012b). *Acacia semitrullata* (P4) is not a listed species under the *Environment Protection Biodiversity Conservation Act 1999,* as listed by the Department of Sustainability, Environment, Water, Population and Communities (2012). This species was recorded at one survey location within the Millbrook State Forest survey area. The GPS coordinates and population of *Acacia semitrullata* (P4) recorded during the survey are set out in Table 3.

TABLE 3: **Locations of Threatened and Priority Species found within Millbrook State forest in November and March 2012** (Note: T and P1 to P5 denote Priority Flora Species (Department of Environment and Conservation 2012b)

GDA94 50H			Conservation Status	Population No.
Easting	Northing	Confirmed Species		
354941	6262439	*Daviesia elongata* subsp. e*longata*	T	1
353687	6262687	*Daviesia elongata* subsp. e*longata*	T	2
353505	6262761	*Daviesia elongata* subsp. e*longata*	T	1
353593	6262808	*Daviesia elongata* subsp. e*longata*	T	1
353469	6262775	*Daviesia elongata* subsp. e*longata*	T	1
353609	6262604	*Conospermum paniculatum*	P3	4
353610	6262609	*Conospermum paniculatum*	P3	2
353370	6262739	*Conospermum paniculatum*	P3	2
353565	6262747	*Conospermum paniculatum*	P3	2
353628	6262767	*Conospermum paniculatum*	P3	1
353261	6262809	*Conospermum paniculatum*	P3	1
353351	6262818	*Conospermum paniculatum*	P3	5
353546	6262555	*Jacksonia* ? *gracillima*	P3	5
353646	6262575	*Jacksonia* ? *gracillima*	P3	4
353699	6262591	*Jacksonia* ? *gracillima*	P3	1
353684	6262599	*Jacksonia* ? *gracillima*	P3	5
353706	6262604	*Jacksonia* ? *gracillima*	P3	2
353716	6262610	*Jacksonia* ? *gracillima*	P3	1
353759	6262614	*Jacksonia* ? *gracillima*	P3	1
353710	6262615	*Jacksonia* ? *gracillima*	P3	1
353688	6262617	*Jacksonia* ? *gracillima*	P3	4
353749	6262621	*Jacksonia* ? *gracillima*	P3	1
353716	6262623	*Jacksonia* ? *gracillima*	P3	1
353770	6262625	*Jacksonia* ? *gracillima*	P3	3
353794	6262637	*Jacksonia* ? *gracillima*	P3	2
353894	6262796	*Jacksonia* ? *gracillima*	P3	1
353500	6262604	*Jacksonia* ? *gracillima*	P3	3
353394	6262687	*Jacksonia* ? *gracillima*	P3	16
353775	6262794	*Acacia semitrullata*	P4	3

6. DISCUSSION

The search of the Department of Environment and Conservation databases for the Yoongarillup Resource Zone identified four Threatened flora species pursuant to subsection (2) of section 23F of the *Wildlife Conservation Act 1950* (WA) and listed as Threatened pursuant to Schedule 1 of the *Environment Protection and Biodiversity Conservation (EPBC) Act 1999* (Commonwealth) occurring within or adjacent to the survey area. The search also identified one priority 1, four priority 2, twelve priority 3 and eight priority four flora as listed by the Department of Environment and Conservation (2012a) occurring within or adjacent to the Yoongarillup survey area

One Threatened flora species, *Daviesia elongata* subsp. *elongata* pursuant to Schedule 1 of the *Wildlife Conservation Act 1950* and as listed by the Department of Environment and Conservation (2012b) and vulnerable pursuant to the *Environment Protection and Biodiversity Conservation Act 1999* and as listed by the Department of Sustainability. Environment, Water, Population and Communities (2012) was recorded from a total of four locations within the drill lines of the Millbrook state forest Survey area. A further *Davesia elongata* subsp. *elongata* population previously recorded by the Department of Environment and Conservation already know from outside the area was confirmed as present (Table 3).

The *Daviesia elongata* subsp. *elongata* locations occur along three different drill lines. The fifty meter radius buffer zone for these locations overlap in one place resulting in an extended buffer zone (Figure 2).

Daviesia elongata subsp. *elongata* was not observed in flower during the drill line survey; however every effort was made to locate and record all plants during the assessment by having multiple teams and botanists walking in close proximity to ensure maximum coverage of the area.

Three Priority flora species, as listed by the Department of Environment and Conservation (2012b) were recorded within the Millbrook State Forest survey area. Two Priority 3 and one Priority 4 Flora species were recorded within the Millbrook State Forest survey area. All of these are perennial species; however additional flowering specimens of *Jacksonia* ? *gracillima* are needed to confirm the identification. By designating this species as a potential priority species, it was considered that this was a better approach and more conservative at this juncture.

7. ACKNOWLEDGEMENTS

The authors would like to thank Rebecca Dix from Doral Mineral Sands Pty Ltd for her assistance with this project.

8. LIST OF PERSONNEL

The following Mattiske Consulting Pty Ltd personnel were involved in this project:

Name	Position	Project Involvement	Flora Collection Permit
Dr E.M. Mattiske	Managing Director & Principal Ecologist	Planning, Management & Reporting	SL009839 201-1011
Ms Louisa Cockram	Experienced Botanist	Planning, fieldwork, plant identification, data interpretation and report preparation	SL009850
Ms Fiamma Rivera	Experienced Botanist	fieldwork, report preparation	SL009856
Ms Merise Hocking	Botanist	Fieldwork, plant identification	SL009844
Ms Felicity Hart	Botanist	fieldwork, plant identification	SL009853
Ms Hannah Anderson	Botanist	fieldwork, data interpretation	SL009862
Mr Raghulkishore Dorairaj	Botanist	Fieldwork	SL009848

9. REFERENCES

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Wildlife Conservation Act 1950

FLORA AND VEGETATION SURVEY

OF YOONGARILLUP RESOURCE ZONE

SURVEY AREA

Prepared for:

Doral Mineral Sands Pty Ltd

Prepared by:

Mattiske Consulting Pty Ltd

February 2012

DOR1101/009/12

Mattiske Consulting Pty Ltd

Disclaimer and Limitation

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DOCUMENT HISTORY

				Date	**Copies**
Internal Review	V1	JAE/LAC	EM	-	-
Draft Report	V2	JAE/LAC	EM	2/2/12	Email
Final Report	V3				

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TABLES

FIGURES

APPENDICES

1. SUMMARY

Mattiske Consulting Pty Ltd was commissioned in June 2011 by Doral Mineral Sands Pty Ltd to undertake a flora and vegetation survey of the Yoongarillup Resource Zone (Figure 1). This report merges the findings from the desktop assessment, the vegetation mapping sites and the permanent plots.

The Yoongarillup Resource Zone survey area is located approximately 17 km south-east of Busselton (Figure 2). The proposal area lies within the Whicher Scarp System which includes the Department of Environment and Conservation managed land of the Whicher Forest block and Whicher Reference Area (Keighery *et al.*, 2008), and is immediately adjacent to the Whicher National Park.

The Whicher Scarp has been noted as being a distinct and naturally restricted landform with diverse flora containing local 'biodiversity hotspots' (Environmental Protection Authority 2009; Keighery *et al.*, 2008). These encompass distinctive and unique vegetation complexes including restricted and rare wetland communities (Environmental Protection Authority 2009: Keighery *et al.*, 2008). A high degree (46%) of native vegetation is intact in the area which has lead to unusual relictual habitats of plant communities and flora (Environmental Protection Authority 2009). Consequently this remnant vegetation meets the six criteria for regionally significant natural areas (Environment Protection Authority 2006).

Flora

The search of DEC databases identified four Declared Threatened flora pursuant to subsection (2) of section 23F of the *Wildlife Conservation Act 1950* (WA) and listed as Threatened pursuant to Schedule 1 of the *Environment Protection and Biodiversity Conservation (EPBC) Act 1999* (Commonwealth) occurring within or adjacent to the survey area. The search also identified one priority 1, four priority 2, twelve priority 3 and eight priority four flora as listed by the Department of Environment and Conservation (2011c) occurring within or adjacent to the survey area

A total of 185 vascular plant taxa from 121 plant genera and 41 plant families were recorded within the Yoongarillup Resources Zone survey area following the initial vegetation mapping phase. Subsequent studies related to the plots increased the coverage to 262 vascular plant taxa from 142 genera and 46 families. The majority of taxa was recorded within the Fabaceae (33 taxa), Proteaceae (27 taxa), Poaceae (17 taxa), Myrtaceae (17 taxa), Asparagaceae (16 taxa), Cyperaceae (14 taxa), Orchidaceae (13 taxa) and Dilleniaceae (13 taxa) families. This number is based on the regular recording sites and the permanent plots over the areas of remnant vegetation.

One Threatened flora species (*Daviesia elongata* subsp. *elongata*) was recorded in the permanent plots and one potential Priority 3 species (*Jacksonia ?gracillima*) was recorded during the assessment of the vegetation mapping sites.

Vegetation

The vegetation on the site varies extensively in its current condition from grazed and previously cleared agricultural holdings to plantations to grazed remnant bushland areas to more intact State Forest areas. The survey area has been subdivided into four main areas, Catalino, Haddon East, Haddon West and State Forest. Of these the Haddon West is essentially clear of native vegetation, Haddon East and Catalino have small remnants left with some values and the State Forest is relatively undisturbed although there were signs of dieback (*Phytophthora cinnamomi*) impacts.

A total of six vegetation communities were defined on the basis of vegetation mapping recording sites, the permanent vegetation plot data, the analysis of these datasets and the interpretation of aerial photographs. The number of mapping units was modified after the establishment of the permanent plots on the basis of further interpretation.

One of the communities (F4) to the west of Sues Road also supported the listed Threatened flora species *Daviesia elongata* subsp. *elongata* within the State Forest area (*Wildlife Conservation Act* 1950, Department of Environment and Conservation 2011a). This species is also listed under the *Environment Protection and Biodiversity Conservation Act* (1999). This species has been recorded north-east along the Whicher Scarp and also has been recorded in areas south of the survey area (Department of Environment and Conservation (DEC) 2011g).

310000mE
320000mE
330000mE
340000mE
350000mE
360000mE
370000mE
6290000mN
6280000mN
6270000mN
6260000mN
Cape Naturaliste
Cape Naturaliste Lighthouse
GEOGRAPHE BAY
DUNSBOROUGH
Quindalup
BUSSELTON
Broadwater
Vasse
Marybrook
Busselton Aerodrome
Yallingup
Gunyulgup
Cape Clairault
Moses Rock
LEEUWIN-NATURALISTE NATIONAL PARK
Harmans
Metricup
Yelverton
Carbunup River
North Jindong
Jindong
Boallia
Chapman Hill
Ambergate
Yoongarillup
Yalyalup
Ludlow
Peppermint Grove
Capel
Tutunup
Abba
Happy Valley
STATE FOREST
HADDON EAST
HADDON WEST
STATE FOREST
CATALANO
Legend
Survey areas
Client:
Doral
Scale 1:250,000
MGA94 (Zone 50)
CAD Ref: g1956_f01.dgn
Date: Nov 2011
Rev: C
A4
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PERTH BASIN TENEMENTS
LOCALITY
YOONGARILLUP RESOURCE ZONES
Figure:
1

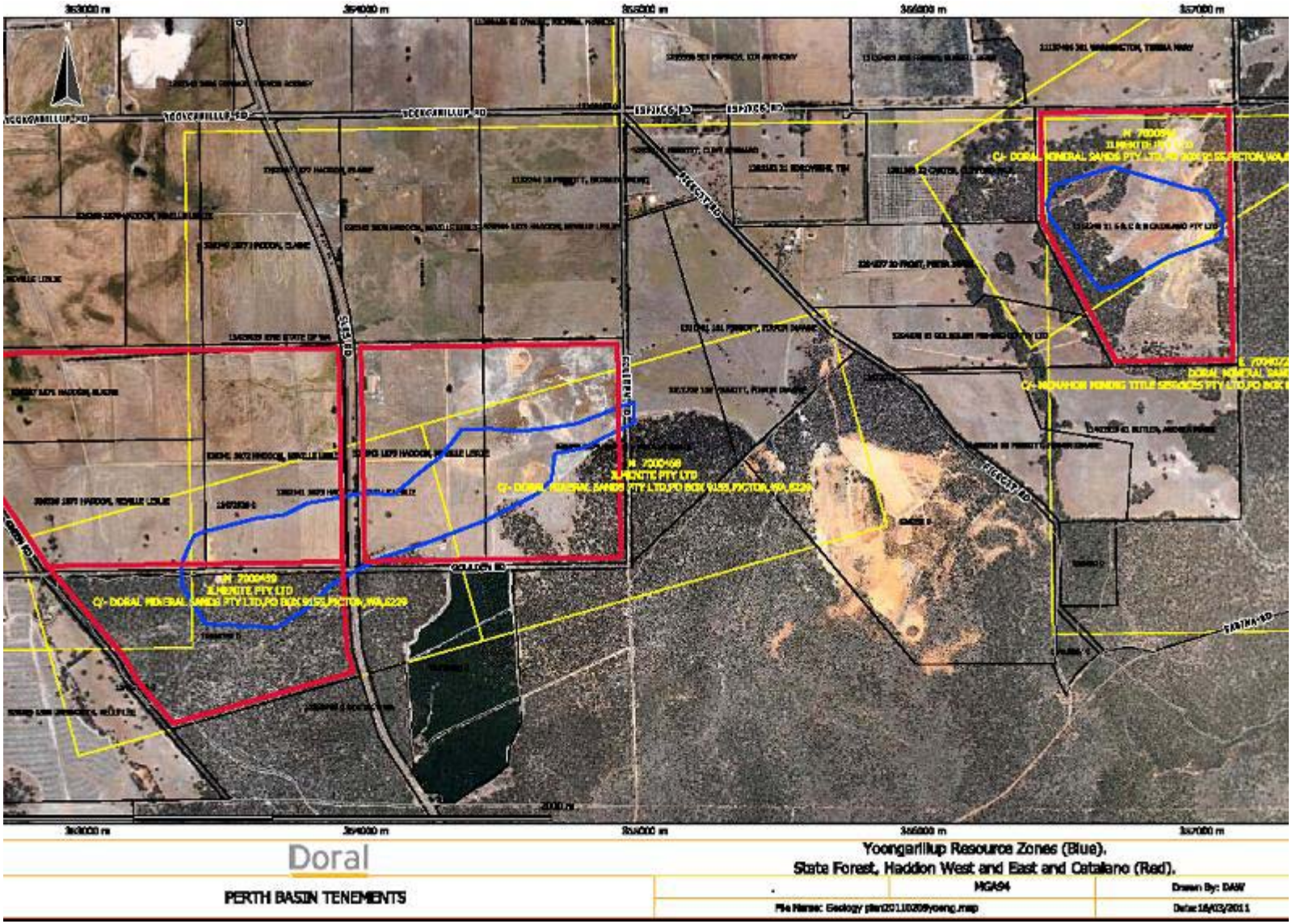


Figure 2: Aerial photograph of Yoongarillup Resource Zone (supplied by Doral)

The search of DEC databases identified five Threatened Ecological Communities (TECs) and five Priority Ecological Communities (PECs) occurring within or adjacent to the survey area near the Whicher Scarp. Of the six vegetation communities (excluding the cleared and plantation areas) as defined and mapped for the Yoongarillup survey areas, several communities have some dominant species in common (e.g. *Corymbia haematoxylon*) with the PEC's that are restricted to the Whicher Scarp. Despite detailed analyses which excluded weeds and singletons, there was little alignment with the DEC sites that occurred within 10km of the Yoongarillup area. Therefore there is a reliance on a few key species such as *Corymbia haematoxylon* and *Daviesia elongata* subsp. *elongata* (T) to concur that there are values in common.

Overall, the main botanical values (Threatened and Priority Species, Priority Ecological Communities and relatively intact native vegetation) occur primarily in the State Forest areas.

2. INTRODUCTION

Mattiske Consulting Pty Ltd was commissioned in June 2011 by Doral Mineral Sands Pty Ltd to undertake a flora and vegetation survey of the Yoongarillup Resource Zone (Figure 1). This report merges the findings from the desktop assessment, the vegetation mapping sites and the permanent plots.

2.1 Location and Scope of Proposal

The Yoongarillup Resource Zone survey area is located approximately 17 km south-east of Busselton (Figure 2). The proposal area lies within the Whicher Scarp System which includes the Department of Environment and Conservation managed land of the Whicher Forest block and Whicher Reference Area (Keighery *et al.*, 2008), and is immediately adjacent to the Whicher National Park.

The Whicher Scarp has been noted as being a distinct and naturally restricted landform with diverse flora containing local 'biodiversity hotspots' (Environmental Protection Authority 2009; Keighery *et al.*, 2008). These encompass distinctive and unique vegetation complexes including restricted and rare wetland communities (Environmental Protection Authority 2009: Keighery *et al.*, 2008). A high degree (46%) of native vegetation is intact in the area which has lead to unusual relictual habitats of plant communities and flora (Environmental Protection Authority 2009). Consequently this remnant vegetation meets the six criteria for regionally significant natural areas (Environment Protection Authority 2006).

2.2 Climate

Beard (1990) described the climate of the Menzies Botanical Subdistrict as warm Mediterranean, receiving 600-1200 mm of precipitation annually, with 5-6 dry months per year. Dell and Havel (1989) stated that there is a strong west to east gradient of decreasing rainfall totals in the Jarrah Forest, with nearly 1400 mm yr^{-1} occurring just east of the Scarp margin grading to below 600 mm yr^{-1} along the eastern boundary of the forest. The winter months between June and August experience the highest amounts of rainfall. The survey area has a mean annual rainfall of 839.7 mm (Bureau of Meteorology 2011). Mean monthly rainfall and temperature, in addition to monthly rainfall for the past 12 months are illustrated in Figure 3.

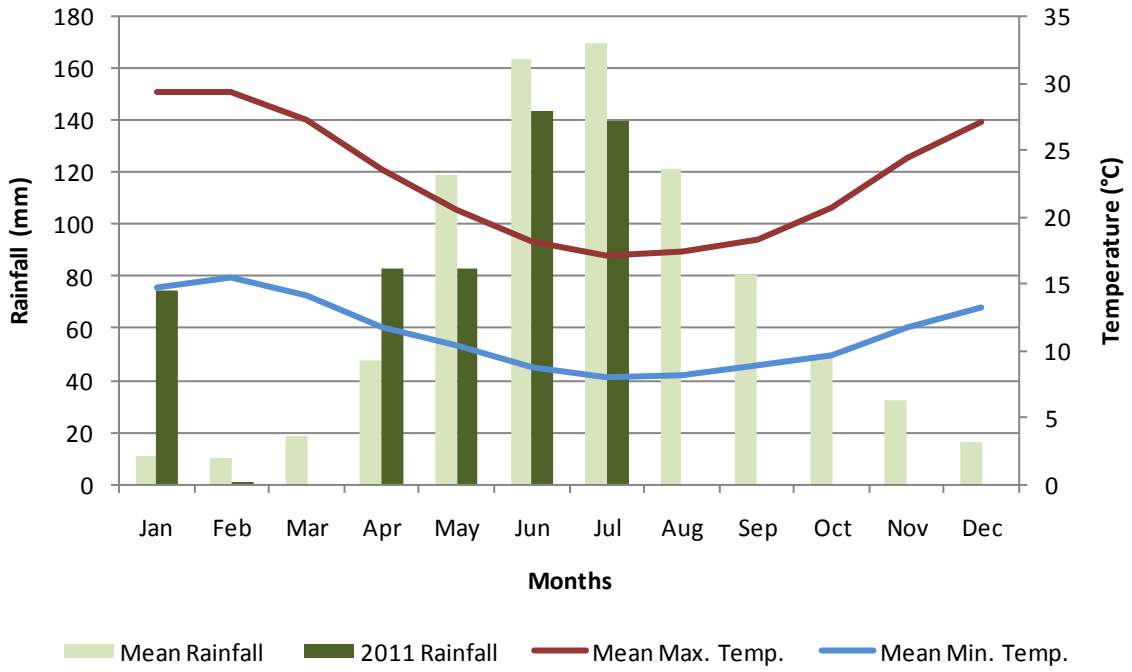


Figure 3: Mean temperature data (Busselton) and monthly rainfall (Yoongarillup) (Bureau of Meteorology 2011)

2.3 Soils and Topography

The survey area lies within the Whicher Scarp soil-landscape system (Department of Agriculture and Food 2004). Within this system, three phases have been mapped to occur in the survey area:

- **214WsWC2 –** Whicher gentle slopes phase
- **214WsYL1 –** Yelverton flats phase
- **214WsYL2 –** Yelverton very gentle flats phase

A Floristic Survey of the Whicher Scarp (Keighery *et al.* 2008) places the survey area in the Central Whicher Scarp. This is described as having moderate north facing slopes with areas of laterite capped rises and soils ranging from deep sands to sand, gravel, silt, clay and ironstone combinations.

2.4 Regional Vegetation

The Whicher Scarp is part of the Southern Jarrah Forest subregion, which is part of the Jarrah Forest Bioregion (Thackway and Cresswell 1995; Environment Australia 2000, Keighery *et al.*, 2008). The Pre-European vegetation study maps the survey area as medium woodland of *Eucalyptus marginata* and *Corymbia haematoxylon*. The Regional Forest Agreement Vegetation Complex mapping (Mattiske and Havel 1998) places the survey area in the Whicher Scarp Vegetation Complex. This is described as an open forest of *Eucalyptus marginata* subsp. *marginata – Corymbia calophylla* on escarpment with some *Corymbia haematoxylon*, *Banksia attenuata* and *Xylomelum occidentale* in the humid zone. Gibson *et al.* (1994) identified three floristic community types occurring on the Whicher Scarp namely, *Eucalyptus haematoxylon* (now *Corymbia haematoxylon*) – *E. marginata* woodlands on Whicher foothills, shrublands on southern Ironstones and southern *Banksia attenuata* woodlands.

The Whicher Scarp has been noted as being a distinct and naturally restricted landform with diverse flora containing local 'biodiversity hotspots' (Environmental Protection Authority 2009; Keighery *et al.*, 2008). These encompass distinctive and unique vegetation complexes including restricted and rare wetland communities (Environmental Protection Authority 2009: Keighery *et al.*, 2008). A high degree (46%) of native vegetation is intact in the area which has lead to unusual relictual habitats of plant communities and flora (Environmental Protection Authority 2009).

2.5 Western Australia's Flora – A Legislative Perspective

Western Australia has a unique and diverse flora, and is recognised as one of the world's 34 biodiversity hotspots (Myers *et al*. 2000). In this context, Western Australia possesses a high degree of species richness and endemism. This is particularly pronounced in the south-west region of the state. There are currently over 12,000 plant species known to occur within Western Australia (Department of Environment and Conservation 2011a), and scientific knowledge of many of these species is limited.

The legislative protection of flora within Western Australia is principally governed by three Acts. These are:

- The *Wildlife Conservation Act 1950*;
- The *Environmental Protection Act 1986*; and
- Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*.

The unique flora of Western Australia is potentially under threat due to historical clearing practices associated with agricultural, mining and human habitation activities. As a consequence of these historical clearing practices a number of flora species have become threatened or have the potential to become threatened as their habitat is impacted by human activity. In addition, some areas of the State have been affected by past clearing practices such that entire ecological communities are under threat. The following sections describe these threatened and priority flora and ecological communities, and outline the legislative protection afforded to them.

At the State level, the *Wildlife Conservation Act 1950* provides for taxa of native flora (and fauna) to be specially protected because they are subject to identifiable threats. Protection of these taxa has been identified as being warranted because they may become extinct, are threatened, or are otherwise in need of special protection. Ecological communities that are deemed to be threatened are afforded protection under the *Environmental Protection Act 1986*. Listings of threatened species and communities are reviewed annually by the Western Australian Threatened Species Scientific Committee (TSSC), which is a body appointed by the Minister for the Environment and supported by the Department of Environment and Conservation. The TSSC reviews threatened and specially protected flora (and fauna) listings on an annual basis. Recommendations for additions or deletions to the listings of specially protected flora (and fauna) are made to the Minister for the Environment by the TSSC, via the Director General of the Department of Environment and Conservation, and the WA Conservation Commission. Under Schedule 1 of the *Wildlife Conservation Act 1950*, the Minister for the Environment may declare that a class or description of flora to be threatened flora throughout the State, by notice published in the *Government Gazette*.

At the Commonwealth level, under the *Environment Protection and Biodiversity Conservation Act 1999*, a nomination process exists, to list a threatened species or ecological community. Additions or deletions to the lists of threatened species and communities are made by the Minister for Sustainability, Environment, Water, Populations and Communities, on advice from the Federal Threatened Species Scientific Committee. *Environment Protection and Biodiversity Conservation Act 1999* lists of threatened flora and ecological communities are published on the Department of Sustainability, Environment, Water, Populations and Communities website.

2.5.1 Threatened and Priority Flora

Flora within Western Australia that is considered to be under threat may be classed as either Threatened flora or priority flora. Where flora has been gazetted as declared threatened flora under the *Wildlife Conservation Act 1950*, it is an offence "to take" such flora without the written consent of the Minister. The *Wildlife Conservation Act 1950* states that "to take" flora includes to gather, pluck, cut, pull up, destroy, dig up, remove or injure the flora or to cause or permit the same to be done by any means.

Priority flora constitute species which are considered to be under threat, but for which there is insufficient information available concerning their distribution and/or populations to make a proper evaluation of their conservation status. Such species are considered to potentially be under threat, but do not have legislative protection afforded under the *Wildlife Conservation Act 1950*. The Department of Environment and Conservation categorises priority flora according to their conservation priority, using four categories, P1 to P4, to denote the conservation priority status of such species, with P1 listed species being the most threatened, and P4 the least. Priority flora species are regularly reviewed, and may have their priority status changed when more information on the species becomes available. Appendix A1 sets out definitions of both threatened and priority flora species (Department of Environment and Conservation 2011c).

At the Commonwealth level, under the *Environment Protection and Biodiversity Conservation Act 1999*, threatened species can be listed as extinct, extinct in the wild, critically endangered, endangered, vulnerable, or conservation dependent, by the Commonwealth Minister for Sustainability, Environment, Water, Population and Communities. Refer to Appendix A2 for a description of each of these categories of threatened species. Under the *Environment Protection and Biodiversity Conservation Act 1999*, a person must not take an action that has or will have a significant impact on a listed threatened species without approval from the Commonwealth Minister for Sustainability, Environment, Water, Population and Communities, unless those actions are not prohibited under the Act.

The current *Environment Protection and Biodiversity Conservation Act 1999* list of threatened flora may be found on the Department of Sustainability, Environment, Water, Population and Communities (2011a) website.

2.5.2 Threatened and Priority Ecological Communities

An ecological community is defined as a naturally occurring biological assemblage that occurs in a particular type of habitat composed of specific abiotic and biotic factors. At the State level, ecological communities may be considered as threatened once they have been identified as such by the Western Australian Threatened Ecological Communities Scientific Advisory Committee. A threatened ecological community is defined, under the *Environmental Protection Act 1986*, as an ecological community listed, designated or declared under a written law or a law of the Commonwealth as threatened, endangered or vulnerable. There are four State categories of threatened ecological communities, or TECs: presumed totally destroyed (PD); critically endangered (CR); endangered (EN); and vulnerable (VU) (Department of Environment and Conservation 2011d). A description of each of these categories of TECs is presented in Appendix A3. Threatened ecological communities are gazetted as such (Department of Environment and Conservation 2011e).

At the Commonwealth level, some Western Australian TECs are listed as threatened, under the *Environment Protection and Biodiversity Conservation Act 1999*. Under the *Environment Protection and Biodiversity Conservation Act 1999*, a person must not take an action that has or will have a significant impact on a listed threatened ecological community without approval from the Commonwealth Minister for the Sustainability, Environment, Water, Population and Communities, unless those actions are not prohibited under the Act. A description of each of these categories of TECs is presented in Appendix A4. The current *Environment Protection and Biodiversity Conservation Act 1999* list of threatened ecological communities can be located on the Department of Sustainability, Environment, Water, Population and Communities (2011b) website.

Ecological communities identified as threatened, but not listed as threatened ecological communities, can be classified as priority ecological communities (PECs). These communities are under threat, but there is insufficient information available concerning their distribution to make a proper evaluation of their conservation status. The Department of Environment and Conservation categorises priority ecological communities according to their conservation priority, using five categories, P1 to P5, to denote the conservation priority status of such ecological communities, with P1 communities being the most threatened and P5 the least. Appendix A5 sets out definitions of priority ecological communities (Department of Environment and Conservation 2011d). A list of current Priority Ecological Communities can be viewed at the Department of Environment and Conservation (2011f) website.

2.6 Declared Plant Species

The *Agriculture and Related Resources Protection Act 1976*, Section 35, makes provision for classes of plants to be listed as declared in respect of parts of, or the entire State. According to the *Agriculture and Related Resources Protection Act 1976*, a declared plant is defined as a plant belonging to a class of plants declared under section 35 of the Act to be declared plants and includes any part of such a plant and/or the product of such a plant.

The *Agriculture and Related Resources Protection Act 1976* provides for declared plants to be assigned to specific categories, P1 to P5, which determines the form of control which applies to the declared plant. Appendix A6 lists the categories of control codes for declared plants and the associated management requirements.

The current listing of declared plant species is available at the Department of Agriculture and Food website (Department of Agriculture and Food 2011).

2.7 Local and Regional Significance

Flora or Vegetation may be locally or regionally significant in addition to statutory listings by the State or Federal Government.

In regards to Flora; species, subspecies, varieties, hybrids and ecotypes may be significant other than as Declared Threatened Flora or Priority Flora, for a variety of reasons, including:

- a keystone role in a particular habitat for threatened species, or supporting large populations representing a significant proportion of the local regional population of a species;
- relic status
- anomalous features that indicate a potential new discovery;
- being representative of the range of a species (particularly, at the extremes of range, recently discovered range extensions, or isolated outliers of the main range);
- the presence of restricted subspecies, varieties, or naturally occurring hybrids;
- local endemism/a restricted distribution; and
- being poorly reserved (Environmental Protection Authority 2004).

Vegetation may be significant because the extent is below a threshold level and a range of other reasons, including:

- scarcity;
- unusual species;
- novel combinations of species;
- a role as a refuge;
- a role as a key habitat for threatened species or large populations representing a significant proportion of the local to regional total population of a species;
- being representative of the range of a unit (particularly, a good local and/or regional example of a unit in “prime” habitat, at the extremes of range, recently discovered range extensions, or isolated outliers of the main range);
- a restricted distribution (Environmental Protection Authority 2004).

Vegetation communities are locally significant if they contain Priority Flora species or contain a range extension of a particular taxon outside of the normal distribution. They may also be locally significant if they are very restricted to one or two locations or occur as small isolated communities. In addition, vegetation communities that exhibit unusually high structural and species diversity are also locally significant.

Vegetation communities are regionally significant where they are limited to specific landform types, are uncommon or restricted plant community types within the regional context, or support populations of Declared Threatened Flora.

Determining the significance of flora and vegetation may be applied at various scales, for example, a vegetation community may be nationally significant and governed by statutory protection as well as being locally and regionally significant.

The Whicher Scarp is noted as being a distinct and naturally restricted landform with diverse flora containing local 'biodiversity hotspots' (Environmental Protection Authority 2009; Keighery *et al.*, 2008). These encompass distinctive and unique vegetation complexes including restricted and rare wetland communities (Environmental Protection Authority 2009: Keighery *et al.*, 2008).

A high degree (46%) of native vegetation is intact in the area which has lead to unusual relictual habitats of plant communities and flora (Environmental Protection Authority 2009). Consequently this remnant vegetation meets the six criteria for regionally significant natural areas (Environment Protection Authority 2006).

3. OBJECTIVES

The survey aims were to undertake an assessment of the flora and vegetation within the Yoongarillup Resource Zone survey area. Specifically, the objectives include:

- Collect voucher specimens and identify the vascular plant species present;
- Review the conservation status of the vascular plant species recorded by reference to current literature and current listings by the Department of Environment and Conservation (2011a) and plant collections held at the Western Australian State Herbarium (Department of Environment and Conservation 2011a, 2011b), and listed on the Department of Sustainability, Environment, Water, Population and Communities (2011a) under the *Environment Protection and Biodiversity Conservation Act 1999*;
- Define and map the native vegetation communities and their condition;
- Establish and record representative quadrats in the respective communities to enable a comparison with the Whicher Scarp Floristic Communities;
- Review the TECs and PECs in the survey area;
- Assess dieback infestation extent present;
- Provide recommendations on the local and regional significance of the vegetation communities with specific reference to Whicher Scarp Floristic Community Types; and
- Prepare a report summarising the findings.

4. METHODS

The survey was conducted on a grid pattern of 100m x 100m over the Yoongarillup survey area. A total of 75 sites were surveyed. In addition 9 – 10m x 10m quadrats within the key less disturbed vegetation communities were recorded in the spring months of 2011 (November 2011).

The flora and vegetation was described and systematically sampled in accordance with Guidance Statement 51 (Environmental Protection Authority 2004). Flora unknown to botanists and suspected Declared Threatened and Priority species, including opportunistic sightings, were collected and the number of plants recorded.

For each site the following floristic and environmental parameters were noted: GPS location, topography, outcropping, soil type and colour, brief vegetation description, associated flora species, plant height and population numbers.

All plant specimens collected during the field surveys were dried and fumigated in accordance with the requirements of the Western Australian Herbarium. The plant species were identified through comparisons with pressed specimens housed at the Western Australian Herbarium. Where appropriate, plant taxonomists with specialist skills were consulted. Nomenclature of the species recorded is in accordance with the Department of Environment and Conservation (2011a; 2011c).

An assessment of the survey against a range of factors which may have had an impact on the outcomes of the present survey was made (Table 1). Based on this assessment, the present survey has not been subject to constraints which would affect the thoroughness of the survey, and the conclusions which have been formed.

Table 1: Potential Flora and Vegetation Survey Limitations for Survey Area

Potential Survey Limitation	Impact on Survey
Sources of information and availability of contextual information (*i.e.* pre-existing background versus new material)	**Not a constraint:** Adequate background information was available through recent studies of the proposed area. Existing vegetation of the area has historically been based on vegetation mapping by Beard.
Scope (*i.e.* what life forms, *etc.*, were sampled)	**Not a constraint:** Vascular plant species were adequately sampled.
Proportion of flora collected and identified (based on sampling, timing and intensity)	**Not a constraint:** The proportion of flora collected and identified was adequate for a DRF and Priority Flora survey.
Completeness and further work which might be needed (was the relevant survey area fully surveyed?)	**Not a constraint:** Sites were pre-selected using aerial photography to ensure all vegetation communities were sampled, with multiple replications. Additional sites were chosen in the field.
Mapping reliability	**Not a constraint:** Adequate coverage of the area was made during the present survey. High quality aerial maps were used for both the survey work and subsequent vegetation community mapping.
Timing, weather, season, cycle	**Not a constraint:** Surveys were conducted in spring as per specification from Department of Environment and Conservation. There were no interruptions to field work due to weather or timing issues. In addition, spring studies were undertaken on permanent sites.
Disturbances (fire flood, accidental human intervention, *etc.*)	**Not a constraint:** Plantation areas were not included in the survey. Some areas were disturbed near cleared farmland.
Intensity (in retrospect, was the intensity adequate?)	**Not a constraint:** Multiple replications of all vegetation communities were surveyed. In addition, representative sites within the less disturbed forest areas were recorded in the spring months of 2012.
Resources (were there adequate resources to complete the survey to the required standard?)	**Not a constraint:** Resources, in terms of time, equipment, support and personnel were adequate to undertake and complete the survey.
Access problems (*i.e.* ability to access survey area)	**Not a constraint:** No access problems were encountered during the surveys as the survey area was easily accessible by pre-existing tracks.
Experience levels (*e.g.* degree of expertise in plant identification to taxon level)	**Not a constraint:** Botanists have undertaken previous surveys in the wider area and were familiar with the flora and vegetation. Specimens were collected at every opportunity.

5. RESULTS

5.1 Desktop Survey

A desktop report was completed prior to the field survey. Key findings from this report (Mattiske Consulting Pty Ltd 2011) are summarized in the following text.

5.1.1 Flora

The flora desktop search identified 418 vascular plant taxa from 187 plant genera and 64 plant families that may potentially occur within the Yoongarillup survey area (Mattiske Consulting Pty Ltd 2011).

5.1.2 Threatened and Priority Flora

The search of DEC databases identified four Declared Threatened flora pursuant to subsection (2) of section 23F of the *Wildlife Conservation Act 1950* (WA) and listed as Threatened pursuant to Schedule 1 of the *Environment Protection and Biodiversity Conservation (EPBC) Act 1999* (Commonwealth) occurring within or adjacent to the survey area. The search also identified one priority 1, four priority 2, twelve priority 3 and eight priority four flora as listed by the Department of Environment and Conservation (2011c) occurring within or adjacent to the survey area (Table 2).

Table 2: Threatened and Priority Flora species previously recorded in and adjacent to the Yoongarillup survey area

Family	Species	State Conservation Status	Federal Conservation Status
Proteaceae	*Banksia mimica*	T	E
Myrtaceae	*Chamelaucium* sp. C Coastal Plain (R.D. Royce 4872)	T	VU
Fabaceae	*Daviesia elongata* subsp. *elongata*	T	VU
Myrtaceae	*Verticordia plumosa* var. *vassensis*	T	E
Fabaceae	*Gastrolobium* sp. Yoongarillup (S.Dilkes s.n. 1/9/1969)	1	-
Apiaceae	*Actinotus whicheranus*	2	-
Euphorbiaceae	*Amperea micrantha*	2	-
Rutaceae	*Boronia capitata* subsp. *gracilis*	2	-
Myrtaceae	*Eucalyptus relicta*	2	-
Asteraceae	*Blennospora doliiformis*	3	-
Cyperaceae	*Caustis* sp. Boyanup (G.S. McCutcheon 1706)	3	-
Restionaceae	*Chordifex gracilior*	3	-
Proteaceae	*Conospermum paniculatum*	3	-
Apiaceae	*Eryngium subdecumbens*	3	-
Proteaceae	*Grevillea brachystylis* subsp. *brachystylis*	3	-
Proteaceae	*Isopogon formosus* subsp. *dasylepis*	3	-
Restionaceae	*Lepyrodia heleocharoides*	3	-
Haloragaceae	*Myriophyllum echinatum*	3	-
Cyperaceae	*Schoenus benthamii*	3	-
Proteaceae	*Synaphea hians*	3	-
Malvaceae	*Thomasia laxiflora*	3	-

Table 2: Threatened and Priority Flora species previously recorded in and adjacent to the Yoongarillup survey area (continued)

Family	Species	State Conservation Status	Federal Conservation Status
Fabaceae	*Acacia flagelliformis*	4	-
Fabaceae	*Acacia semitrullata*	4	-
Myrtaceae	*Calothamnus quadrifidus* subsp. *teretifolius*	4	-
Myrtaceae	*Chamelaucium* sp. Yoongarillup (G.J. Keighery 3635)	4	-
Proteaceae	*Lambertia rariflora* subsp. *rariflora*	4	-
Asparagaceae	*Laxmannia jamesii*	4	-
Menyanthaceae	*Ornduffia submerse*	4	-
Myrtaceae	*Verticordia lehmannii*	4	-

- ***Banksia mimica*** **– Threatened - PROTEACEAE**
  A prostrate, lignotuberous shrub growing to 40 cm high. It produces yellow and brown flowers between December and February. This species is associated with white or grey sands over laterite and sandy loams (Department of Environment and Conservation 2011g). The Western Australian Herbarium holds 25 records in its collection, predominantly from the Swan Coastal Plain IBRA region of Western Australia.

- ***Chamelaucium*** **sp. C Coastal Plain (R.D. Royce 4872) – Threatened - MYRTACEAE**
  An erect, compact, perennial shrub to 1 metre high. It produces red and white flowers. This species is associated with grey and brown sand and loams over laterite and ironstone (Department of Environment and Conservation 2011g). The Western Australian Herbarium holds 27 records in its collection, from the interface of the Jarrah Forest and Swan Coastal Plain IBRA regions of Western Australia.

- ***Daviesia elongata*** **subsp.** ***elongata*** **– Threatened - FABACEAE**
  A spreading perennial shrub to 1 metre high. It produces red, yellow and orange flowers between December and February. This species is associated with sandy soils (Department of Environment and Conservation 2011g). The Western Australian Herbarium holds 27 records in its collection, from the interface of the Jarrah Forest and Swan Coastal Plain IBRA regions of Western Australia.

- ***Verticordia plumosa*** **var.** ***vassensis*** **– Threatened - MYRTACEAE**
  An erect, perennial shrub to 1 metre high. It produces pink flowers between September and February. This species is associated with seasonally wet white and grey sands (Department of Environment and Conservation 2011g). The Western Australian Herbarium holds 42 records in its collection, from the Swan Coastal Plain and Warren IBRA regions of Western Australia.

- ***Gastrolobium*** **sp. Yoongarillup (S.Dilkes s.n. 1/9/1969) - Priority 1 - FABACEAE**
  An erect perennial shrub to 1 metre high. It produces yellow and orange flowers (Department of Environment and Conservation 2011g). The Western Australian Herbarium holds four records in its collection, from the Swan Coastal Plain and Jarrah Forest IBRA regions of Western Australia.

- ***Actinotus whicheranus*** **- Priority 2 - APIACEAE**
  An erect, slender, perennial herb with flowering branches to 0.4 metres high. It produces white flowers between December and March. This species is associated with white sand over laterite (Department of Environment and Conservation 2011g). The Western Australian Herbarium holds ten records in its collection, from the Swan Coastal Plain and Jarrah Forest IBRA regions of Western Australia.

- ***Amperea micrantha*** **- Priority 2 - EUPHORBIACEAE**
  A low, spreading, bushy perennial herb to 0.3 metres high. It produces brown flowers between October and November. This species is associated with sandy soils (Department of Environment and Conservation 2011g). The Western Australian Herbarium holds 13 records in its collection, predominantly from the Swan Coastal Plain and Jarrah Forest IBRA regions of Western Australia.

- *Boronia capitata* **subsp.** *gracilis* **- Priority 2 - RUTACEAE**
  A slender perennial shrub to 0.6 metres high. It produces pink flowers between June and November. This species is associated with white, grey or black sands in winter-wet swamps and on hillslopes (Department of Environment and Conservation 2011g). The Western Australian Herbarium holds 22 records in its collection, from the Swan Coastal Plain, Warren and Jarrah Forest IBRA regions of Western Australia

- *Eucalyptus relicta* **- Priority 2 - MYRTACEAE**
  A mallee or tree, to 7 metres high with rough bark all the way to branchlets. It produces cream flowers between January and February. This species is associated with grey clay-loams on undulating upper slopes, along creeklines (Department of Environment and Conservation 2011g). The Western Australian Herbarium holds 22 records in its collection, from the Jarrah Forest IBRA region of Western Australia.

- *Blennospora doliiformis* **- Priority 3 - ASTERACEAE**
  An erect, annual herb to 15 cm high. It produces yellow flowers between October and November. This species is associated with grey or red clay soils over ironstone on seasonally wet flats (Department of Environment and Conservation 2011g). The Western Australian Herbarium holds 12 records in its collection, from the Swan Coastal Plain and Warren IBRA regions of Western Australia.

- *Caustis* **sp. Boyanup (G.S. McCutcheon 1706) - Priority 3 - CYPERACEAE**
  A rhizomatous, clumped perennial sedge to 1 metre high. This species is associated with white or grey sands on seasonally inundated flats (Department of Environment and Conservation 2011g). The Western Australian Herbarium holds 21 records in its collection, predominantly from the Swan Coastal Plain and Jarrah Forest IBRA regions of Western Australia.

- *Chordifex gracilior* **- Priority 3 - RESTIONACEAE**
  A rhizomatous, erect, perennial herb to 0.5 metres high. It produces brown flowers between September and December. This species is associated with peaty sands in swamps (Department of Environment and Conservation 2011g). The Western Australian Herbarium holds 28 records in its collection, from the Swan Coastal Plain, Warren and Jarrah Forest IBRA regions of Western Australia.

- *Conospermum paniculatum* **- Priority 3 - PROTEACEAE**
  A spreading, open shrub to 1.25 metres high. It produces blue and white flowers between July and November. This species is associated with sandy and clayey soils in swampy areas, plains and slopes (Department of Environment and Conservation 2011g). The Western Australian Herbarium holds 26 records in its collection, from the Swan Coastal Plain, Warren and Jarrah Forest IBRA regions of Western Australia.

- *Eryngium subdecumbens* **- Priority 3 - APIACEAE**
  A prostrate, perennial herb, up to 15 cm in height. It produces green and white flowers between October and November. This species is associated with grey sand and clay in seasonally wet flats, clay-pans, and swamps (Department of Environment and Conservation 2011g). The Western Australian Herbarium holds 26 records in its collection, from the Swan Coastal Plain IBRA region of Western Australia.

- *Grevillea brachystylis* **subsp.** *brachystylis* **- Priority 3 - PROTEACEAE**
  A much branched, prostrate or decumbent, non-lignotuberous shrub. It produces red flowers between August and November. This species is associated with sand and sandy clay in swampy areas and creek banks (Department of Environment and Conservation 2011g). The Western Australian Herbarium holds 29 records in its collection, from the Swan Coastal Plain and Jarrah Forest IBRA regions of Western Australia.

- *Isopogon formosus* **subsp.** *dasylepis* **- Priority 3 - PROTEACEAE**
  A low, bushy or slender, upright, non-lignotuberous shrub. It produces pink-purple or red flowers between June and December. This species is associated with sand, sandy clay, and gravelly sand over laterite. It is often found in swampy areas and creek banks (Department of Environment and Conservation 2011g). The Western Australian Herbarium holds 41 records in its collection, from the Swan Coastal Plain, Warren, and Jarrah Forest IBRA regions of Western Australia.

- *Lepyrodia heleocharoides* - **Priority 3 - RESTIONACEAE**
  A rhizomatous, slender, tufted perennial herb that is sedge like in appearance. It flowers in December and is associated with moist peaty sand. This species is associated with dry or seasonally inundated heath, swamps, or woodland (Department of Environment and Conservation 2011g). The Western Australian Herbarium holds 17 records in its collection, from the Swan Coastal Plain, and Jarrah Forest IBRA regions of Western Australia.

- *Myriophyllum echinatum* - **Priority 3 - HALORAGACEAE**
  An erect annual herb, 0.02 to 0.03 metres in height. It produces a red flower in November and is associated with clay and winter-wet flats (Department of Environment and Conservation 2011g). The Western Australian Herbarium holds 9 records in its collection, from the Swan Coastal Plain, and Jarrah Forest IBRA regions of Western Australia.

- *Schoenus benthamii* - **Priority 3 - CYPERACEAE**
  A tufted perennial, grass-like or herb sedge, from 0.15 to 0.45 metres in height. It produces a brown flower between October and November. This species is associated with white and grey sand and sandy clays in winter-wet flats and swamps (Department of Environment and Conservation 2011g). The Western Australian Herbarium holds 19 records in its collection, from the Swan Coastal Plain, and Jarrah Forest IBRA regions of Western Australia.

- *Synaphea hians* - **Priority 3 - PROTEACEAE**
  A prostrate or decumbent shrub, from 0.15-0.6 metres in height. It produces a yellow flower in July or between September and November. This species is associated with sandy soils on rises (Department of Environment and Conservation 2011g). The Western Australian Herbarium holds 43 records in its collection, from the Swan Coastal Plain, and Jarrah Forest IBRA regions of Western Australia.

- *Thomasia laxiflora* - **Priority 3 - MALVACEAE**
  A shrub with heights ranging from 0.25-0.45 metres. It produces a pink-purple flower between October and November. This species is associated with gravelly soils (Department of Environment and Conservation 2011g). The Western Australian Herbarium holds 33 records in its collection, from the Swan Coastal Plain, and Jarrah Forest IBRA regions of Western Australia.

- *Acacia flagelliformis* - **Priority 4 - FABACEAE**
  A rush-like, erect or sprawling shrub, from 0.3 to 0.75 metres in height. It produces a yellow flower between May and September. This species is associated with sandy soils in winter-wet areas (Department of Environment and Conservation 2011g). The Western Australian Herbarium holds 31 records in its collection, from the Swan Coastal Plain, and Jarrah Forest IBRA regions of Western Australia.

- *Acacia semitrullata* - **Priority 4 - FABACEAE**
  A slender, erect, pungent shrub, from 0.2 to 0.7 meters in height. It produces cream-white flowers between May and October. This species is associated with white and grey sand over laterite and clay, on sandplains and swampy areas (Department of Environment and Conservation 2011g). The Western Australian Herbarium holds 82 records in its collection, from the Swan Coastal Plain, Jarrah Forest, and Warren IBRA regions of Western Australia.

- *Calothamnus quadrifidus* **subsp.** *teretifolius* - **Priority 4 - MYRTACEAE**
  An erect, bushy, perennial shrub that is up to 2 metres in height. It produces a red flower and is often found on winter-wet flats, plains, and flats. This species is associated with white to grey sand, sandy loam and clayey sand. The Western Australian Herbarium holds 38 records in its collection, from the Swan Coastal Plain, Jarrah Forest, and Warren IBRA region of Western Australia.

- *Chamelaucium* **sp. Yoongarillup (G.J. Keighery 3635) - Priority 4 - MYRTACEAE**
  An erect shrub from 0.2 to 1 metre in height that produces a red flower. This species is associated with sand, sandy loams and clayey sands on slopes and flats. The Western Australian Herbarium holds 25 records in its collection, from the Swan Coastal Plain, Jarrah Forest, and Warren IBRA region of Western Australia.

- *Lambertia rariflora* **subsp.** *rariflora* **- Priority 4 - PROTEACEAE**
  A small tree or shrub, up to 7 metres in height. It produces a green or yellow-green flower from February to March or May. This species is associated with red-brown clay soils, black organic loam, and laterite near intermittent streams. The Western Australian Herbarium holds 12 records in its collection, from the South West, Jarrah Forest, and Warren IBRA region of Western Australia.

- *Laxmannia jamesii* - **Priority 4 - ASPARAGACEAE**
  A tufted, stilt rooted perennial herb from 0.05 to 0.2 metres in height. It produces a red and white flower from May to July. This species is associated with grey sand in winter-wet locations. The Western Australian Herbarium holds 42 records in its collection, from the Jarrah Forest and Warren IBRA regions of Western Australia.

- *Ornduffia submerse* **- Priority 4 - MENYANTHACEAE**
  An aquatic herb, with floating leaves and cream-white flowers. This species is associated with winter-wet areas on clay. The Western Australian Herbarium holds 48 records in its collection, from the Swan Coastal Plain, Jarrah Forest, and Warren IBRA regions of Western Australia.

- *Verticordia lehmannii* **- Priority 4 - MYRTACEAE**
  A slender shrub, from 0.2 to 1 metre in height. It produces a pink flower in January, April to June, and August to December. The Western Australian Herbarium holds 24 records in its collection, from the Swan Coastal Plain, Jarrah Forest and Warren IBRA regions of Western Australia.

5.1.3 Introduced (Exotic) Plant Species

A total of 34 introduced (exotic) taxa were listed from the desktop survey to potentially occur within the survey area (Appendix B in Mattiske Consulting Pty Ltd 2011). Of these taxa, **Zantedeschia aethiopica* is a Declared Plant species pursuant to section 37 of the *Agriculture and Related Resources Protection Act 1976* according to the Western Australian Department of Agriculture and Food (2011).

5.1.4 Threatened and Priority Ecological Communities

The search of DEC databases identified five Threatened Ecological Communities (TECs) and five Priority Ecological Communities (PECs) occurring within or adjacent to the survey area (Table 3; Figure 4) (Department of Environment and Conservation 2011e, 2011f).

Table 3: TECs and PECs located within and adjacent to the Yoongarillup survey area (Department of Environment and Conservation 2011e, 2011f)

Community	Conservation Status
Southern wet shrublands, Swan Coastal Plain	Endangered
Herb rich saline shrublands in clay pans	Vulnerable
Shrublands on dry clay flats	Endangered
Shrublands on southern Swan Coastal Plain Ironstones (Busselton area)	Critically Endangered
Eucalyptus calophylla woodlands on heavy soils of the southern Swan Coastal Plain	Vulnerable
Eucalyptus haematoxylon - E. marginata woodlands on Whicher foothills	Priority 3
Central Whicher Scarp Mountain Marri woodland	Priority 1*
Central Whicher Scarp Jarrah woodland	Priority 1*
Sabina River Jarrah and Marri woodland (Whicher Scarp community F1)	Priority 1*
Swan Coastal Plain Paluslope Wetlands	Priority 1*

* indicates Whicher Scarp Floristic Community Types (Keighery *et al.,* 2008)

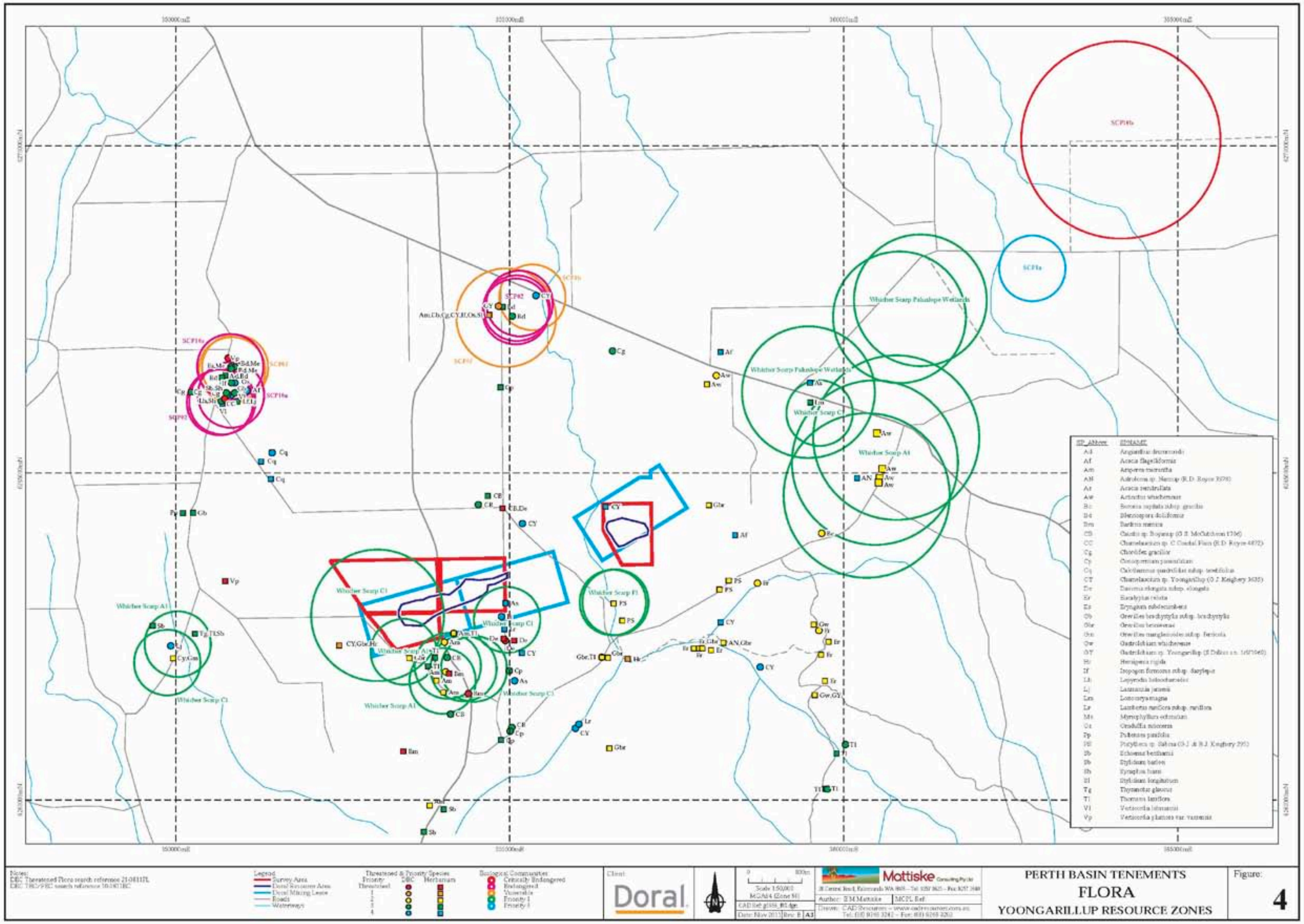
5.1.5 Local and Regional Significant Vegetation and Vegetation Complexes

Locally, a number of factors combine to prove the Whicher Scarp as an area of significant vegetation and vegetation complexes (Environmental Protection Authority 2006; Keighery *et. al.*, 2008). Keighery *et. al.* (2008) place the Yoongarillup survey area in the Central Whicher Scarp with respect to soil-landscape profile. Brief descriptions of characteristics of importance to community types of the Central Whicher Scarp Floristic Community Types are detailed in Table 4.

Table 4: Whicher Scarp Floristic Community Types with respect to Yoongarillup survey area (Keighery *et. al.*, 2008)

Floristic Group	Whicher Scarp Floristic Community Type	Description
A1	Central Whicher Scarp Mountain Marri woodland	Located on Whicher Scarp mid slopes.
C1	Central Whicher Scarp Jarrah woodland	Associated with coloured sands on moderate to gentle slopes; the strongest representation of less common group of southern sand taxa.
C2	Whicher Scarp Jarrah woodland of deep coloured sands	Scattered through Central and North Whicher Scarp on midslopes on deep, generally coloured sands rarely associated with laterites.
C3	Whicher Scarp Jarrah and Mountain Marri woodland on laterites	Found on sands often associated with gravel and/or exposed laterite in the Central and Northern Scarp at the interface with the Blackwood Plateau; often confined to upper laterite slopes.
C4	Whicher Scarp/Blackwood Plateau Jarrah and Marri woodland	Found in all sectors of Whicher Scarp and extends onto Blackwood Plateau; linked through a moderate representation of less common laterite species, and the absence of most sand taxa.
C5	Dardanup Jarrah and Mountain Marri woodland on laterite	Found on an unusual surface of quartzite and laterite in the Dardanup forest.
C6	Swan Coastal Plain Foothills Jarrah woodland on laterite	Disjunct community dominated by *Eucalypt marginata* subsp. *marginata* and associated with woodland dominated by *Eucalyptus lane-poolei*.

Department of Environment and Conservation details of Threatened and Priority Ecological Communities and Whicher Scarp Floristic Community Types are summarized in Figure 4. These results identify the presence of two Whicher Scarp Floristic Communities in close proximity to, and in part overlapping, the Yoongarillup Resource Zone: Central Whicher Scarp Mountain Marri woodland (A1) and Central Whicher Scarp Jarrah woodland (C1).



Whicher Scarp Paluslope Wetlands
Whicher Scarp C1
Whicher Scarp A1
Whicher Scarp F1
Doral
Mattiske
PERTH BASIN TENEMENTS
FLORA
YOONGARILLUP RESOURCE ZONES
Figure:
4

5.2 Field Survey

5.2.1 Flora

A total of 185 vascular plant taxa from 121 plant genera and 41 plant families were recorded within the Yoongarillup Resources Zone survey area following the initial vegetation mapping phase. Subsequent studies related to the plots increased the coverage to 262 vascular plant taxa from 142 genera and 46 families. The majority of taxa was recorded within the Fabaceae (33 taxa), Proteaceae (27 taxa), Poaceae (17 taxa), Myrtaceae (17 taxa), Asparagaceae (16 taxa), Cyperaceae (14 taxa), Orchidaceae (13 taxa) and Dilleniaceae (13 taxa) families (Appendix B). This number is based on the regular recording sites and the permanent plots over the areas of remnant vegetation.

One Threatened flora species (*Daviesia elongata* subsp. *elongata*) was recorded in the permanent plots and one potential Priority 3 species (*Jacksonia ?gracillima*) was recorded during the assessment of the vegetation mapping sites.

A listing of vascular plants recorded at each survey site is presented in Appendix C. A listing of vascular plants recorded at each recording sites is presented in Appendix D. A summary of species by community is presented in Appendix E.

5.2.2 Proportion of Flora Sampled

A species accumulation plot, based on accumulated species versus sites surveyed was prepared, using the field data. The species accumulation plot was used to provide an indication as to the level of adequacy of the survey effort. As the number of survey sites increases, and correspondingly the size of the area surveyed increases, there should be a diminishing number of new species recorded. At some point, the number of new species recorded becomes essentially asymptotic. When the number of new species being recorded for survey effort expended approaches this asymptotic value, the survey effort can be considered to be adequate.

The species accumulation curve (Figure 5), based on the species accumulation analysis of Colwell (2006) was used to evaluate the adequacy of sampling. The asymptotic value was determined using Michaelis-Menten modelling. Using this analysis, the incidence based coverage estimator of species richness (ICE, Chao 2004) was calculated to be 315. Based on this value, and the total of 262 species calculated using taxa identified across three areas designated for the Yoongarillup Resource Zone, approximately 83% of the flora species potentially present within the survey area were recorded.

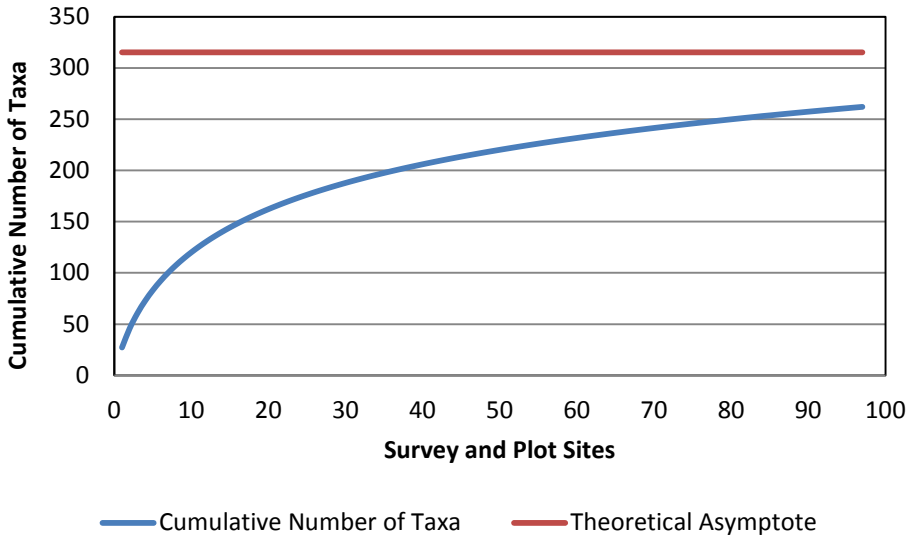


Figure 5: Averaged Randomised Species Accumulation Curve
Field survey data was used to calculate both a species accumulation curve and a theoretical maximum number of species (asymptotic value) within the survey area.

5.2.3 Threatened and Priority Flora

One Threatened flora species (*Daviesia elongata* subsp. *elongata*) was recorded in the plots established in the recent assessment of the Yoongarillup survey area. *Daviesia elongata* subsp*. elongata* is a spreading shrub which grows from 40 cm to 1 m tall. The flowers are red or yellow/orange and appear in summer (Dec-Feb). This plant has been recorded growing on sandy soils and is restricted to the Jarrah Forest and Swan Coastal Plain on and around Whicher Range. It is known from 27 collections in the WA Herbarium and 38 records from DEC Naturemap. This species is listed as vulnerable pursuant to section 179 of the *Environment Protection Biodiversity Conservation Act 1999* [Commonwealth] and the Department of Sustainability, Environment, Water, Population and Communities (2011). The seven known populations are healthy and not immediately threatened. However, this subspecies is an obligate seeder (germinating following fire) and subpopulations are affected by altered fire regimes (WA DEC 2007). Population numbers decrease after re-sprouting as seedlings compete for light, moisture and resources (WA DEC 2007). This species was located at one site to the west of Sues Road (see Figure 6).

One specimen with the potential to be Declared Priority 3 flora *Jacksonia ?gracillima* was collected during the mapping phase of the project. Flowering material was not available therefore the specimen was unable to be confirmed as the Priority pursuant to subsection (2) of section 23F of the *Wildlife Conservation Act 1950* and as listed by the Department of Environment and Conservation (2011h).

5.2.4 Introduced (Exotic) Plant Species

A total of 29 introduced (exotic) taxa were recorded within the Yoongarillup Resources Zone survey areas (Appendix B). Of these taxa, **Zantedeschia aethiopica* is a Declared Plant species pursuant to section 37 of the *Agriculture and Related Resources Protection Act 1976* according to the Western Australian Department of Agriculture and Food (2011). Localities and estimated population numbers of the four introduced species are listed in Table 5.

Table 5: Geographic locations of **Zantedeschia aethiopica* recorded within the Yoongarillup Resources Zone Survey Area

Survey Site	Geographic Location (GDA94_Zone50H)		Population
	Easting (mE)	Northing (mN)	
YN047	354700	6262899	1
YN049	354798	6263204	1
YN057	356900	6264500	8
YN058	356502	6264400	26-50
YN059	356593	6264401	5-10
YN060	356696	6264399	6-10

5.2.5 Vegetation

The vegetation communities defined and mapped (Mattiske Consulting Pty Ltd 2011) were modified slightly following more additional work in the spring months of 2011 and after the PRIMER analyses (Figures 6 and 7). The vegetation for the Yoongarillup Resources Zone survey areas are described based on the Structural Forms of Australian Vegetation (Beard, 1990), the cluster analysis of recording sites and permanent plots and interpretation of aerials. These communities are summarized below:

Woodlands and Forests

W1: Open Woodland of *Eucalyptus marginata – Corymbia calophylla – Corymbia haematoxylon – Allocasuarina fraseriana* over introduced herbs and grasses on disturbed flats and lower slopes with leached or brown sandy-loams and sandy-gravels.

F1: Open Forest of *Eucalyptus marginata – Corymbia calophylla – Banksia grandis - Corymbia haematoxylon – Xylomelum occidentale* over *Xanthorrhoea preissii, Podocarpus drouynianus, Hakea amplexicaulis, Hakea ruscifolia, Hibbertia hypericoides, Dasypogon hookeri, Dasypogon bromeliifolius* and *Kingia australis* over low herbs and grasses on lower and mid slopes with leached grey/brown sandy to sandy-loam soils.

F2: Open Forest of *Eucalyptus marginata – Allocasuarina fraseriana – Corymbia calophylla – Corymbia haematoxylon – Xylomelum occidentale* over *Podocarpus drouynianus, Hibbertia hypericoides, Xanthorrhoea gracilis, Hypocalymma robustum* and *Hakea amplexicaulis* over *Hypolaena exsulca* and *Loxocarya striata* low subshrubs and herbs on slopes with leached grey sands to sandy-gravels.

F3: Open Forest of *Corymbia calophylla - Eucalyptus marginata – Banksia grandis - Allocasuarina fraseriana* over *Hibbertia hypericoides, Xanthorrhoea preissii, Xanthorrhoea gracilis, Dasypogon hookeri, Dasypogon bromeliifolius, Kunzea recurva* and *Podocarpus drouynianus* on flats with leached grey and brown sands and sandy loams.

F4: Open Forest of *Eucalyptus marginate – Corymbia calophylla – Banksia grandis* over *Hibbertia hypericoides, Xanthorrhoea* species, *Dasypogon bromeliifolius, Dasypogon hookeri, Melaleuca thymoides, Podocarpus drouynianus, Hakea ruscifolia* and *Stirlingia latifolia* over *Hypolaena exsulca* on flats and lower slopes with yellow sandy loams.

F5: Open Forest of *Eucalyptus marginate – Corymbia calophylla – Xylomelum occidentale – Banksia grandis* over *Hibbertia hypericoides, Xanthorrhoea preissii, Dasypogon bromeliifolius, Podocarpus drouynianus, Melaleuca thymoides, Leucopogon pulchellus, Macrozamia riedlei, Hakea ruscifolia* and *Petrophile serruriae* on flats and lower slopes with leached grey to yellow sands.

CL: Cleared

PL: Plantations

5.2.6 Statistical Analysis of Vegetation Communities

Cluster analyses derived from a species-by-site resemblance matrix (Bray-Curtis similarity) grouped survey sites into discrete clusters based on species composition (dissimilarity/distance increased) (Clarke and Gorley, 2006). Singletons and weeds were excluded from final analysis. Hierarchical Clustering was used in conjunction with Analysis of Similarities (ANOSIM), Similarity Percentages (SIMPER), site descriptions, site photos and aerial photographs; combining these methods increased the understanding of site inter-relations and thus the ability to accurately delineate those sites based on species composition.

Cluster analysis separated the 75 sites and 9 plots into 4 main groupings; further sub-divisions of these groupings identified 6 statistically dissimilar vegetation community types (Global R = 0.551, Significance level of Global R = 0.1%) (Figure 6).

5.3 Vegetation Condition

The vegetation on the site varies extensively in its current condition from grazed and previously cleared agricultural holdings to plantations to grazed remnant bushland areas to more intact State Forest areas. The survey area has been subdivided into four main areas, Catalino, Haddon East, Haddon West and State Forest. Of these the Haddon West is essentially clear of native vegetation, Haddon East and Catalino have small remnants left with some values and the State Forest is relatively undisturbed although there were signs of dieback (*Phytophthora cinnamomi*) impacts.

The condition of the vegetation varied from completely degraded in the agricultural and plantation areas to very good (Figure 8). In view of patches of dying Jarrah, *Banksia grandis* and other indicator species, the presence of dieback disease (*Phytophthora cinnamomi*) has led to a downgrading of the wider polygons from excellent to very good (based on the condition rating of Keighery 1994), although there are some localized areas that are not infected (Figure 9).

5.4 Comparison with Threatened and Priority Ecological Communities

The search of DEC databases identified five Threatened Ecological Communities (TECs) and five Priority Ecological Communities (PECs) occurring within or adjacent to the survey area near the Whicher Scarp. Of the six vegetation communities (excluding the cleared and plantation areas) as defined and mapped for the Yoongarillup survey areas, several communities have some dominant species in common (e.g. *Corymbia haematoxylon*) with the PEC's that are restricted to the Whicher Scarp. Despite detailed analyses which excluded weeds and singletons, there was little alignment with the DEC sites that occurred within 10km of the Yoongarillup area. Therefore there is a reliance on a few key species such as *Corymbia haematoxylon* and *Daviesia elongata* subsp. *elongata* (T) to concur that there are values in common.

On the basis of the dominance and several key species there appears to be an alignment with some of the values in the Central Whicher Scarp Mountain Marri woodland (PEC – Priority 1), the Central Whicher Scarp Jarrah Woodland (PEC - Priority 1) and the Sabina River Jarrah and Marri Woodland (Whicher Scarp community F1) (PEC - Priority 1) as defined by the Department of Environment and Conservation (2011f) and Keighery *et al.* (2008).

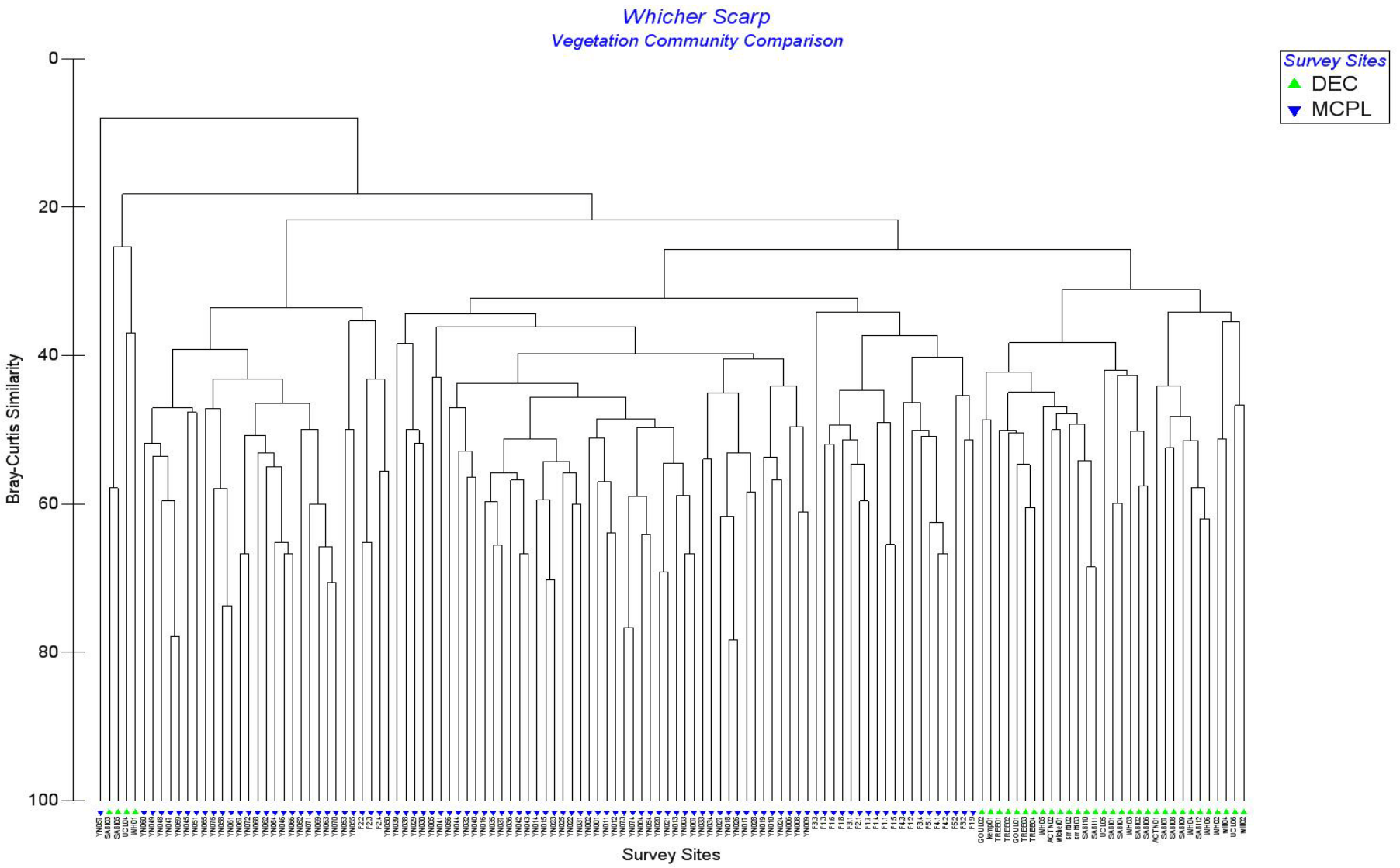
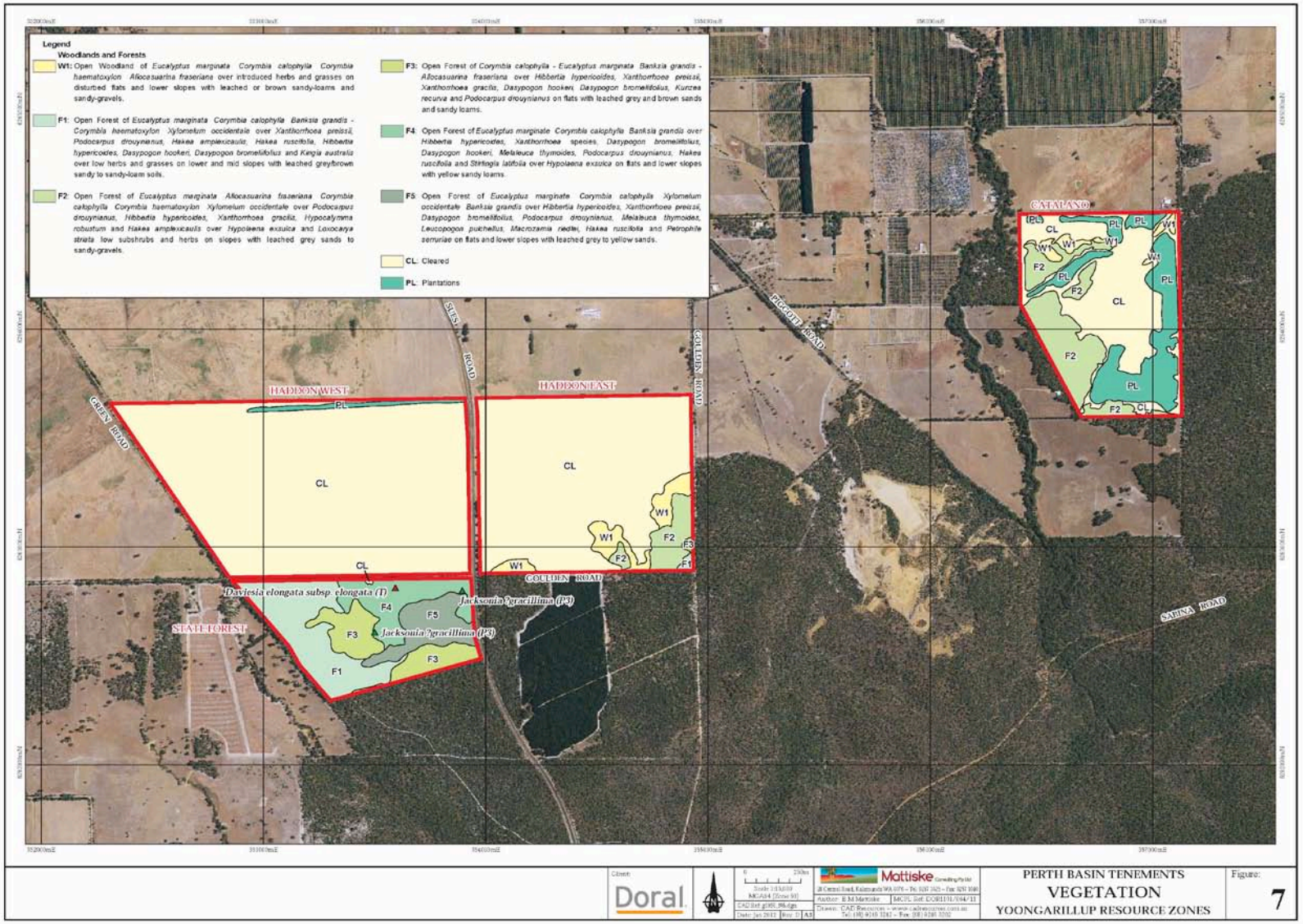
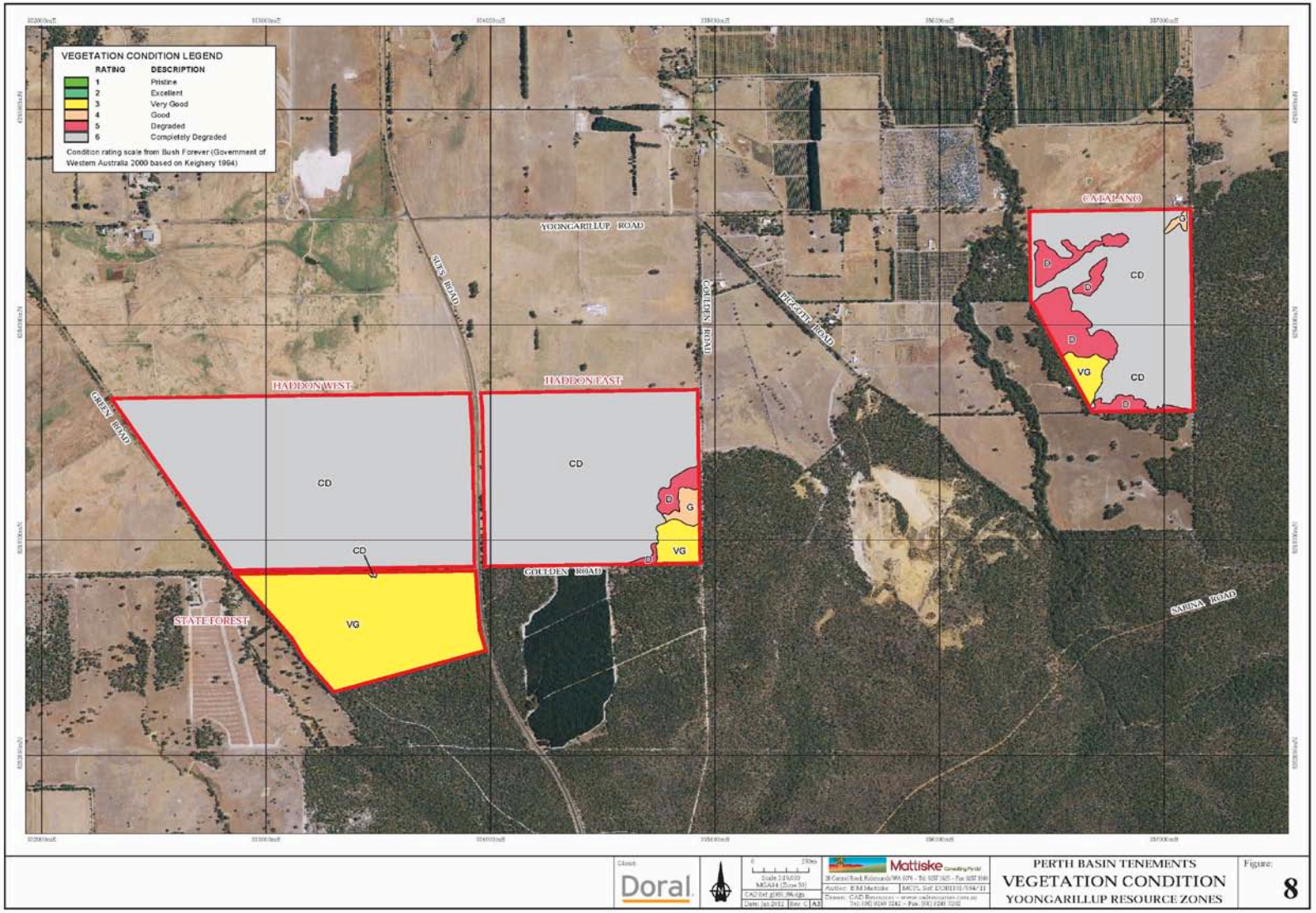
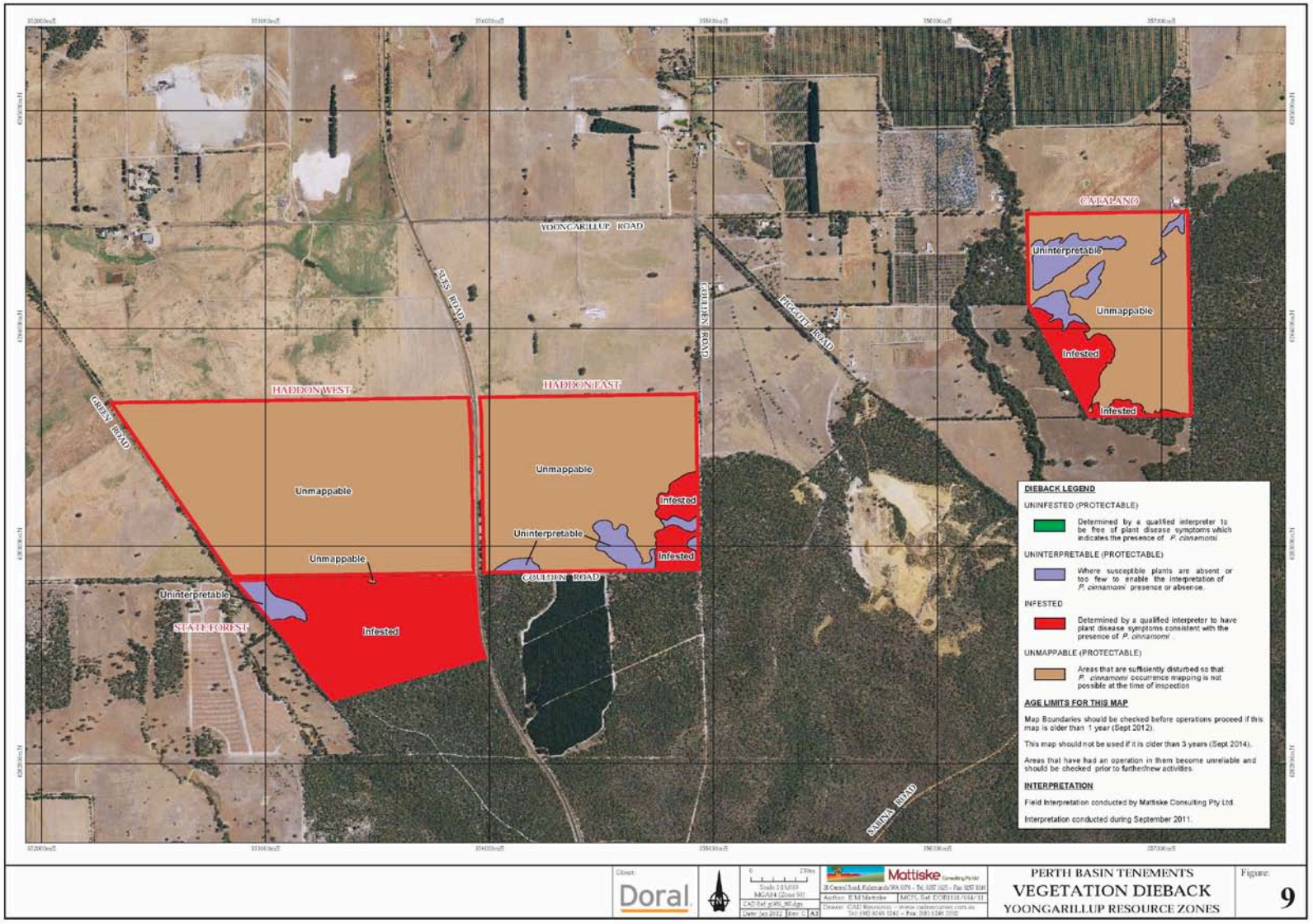


Figure 6: Dendrogram of the 75 survey sites and 9 permanent plots, using group average clustering from Bray-Curtis similarities on presence / absence data


Legend
Woodlands and Forests
W1: Open Woodland of Eucalyptus marginata Corymbia calophylla Corymbia haematoxylon Allocasuarina fraseriana over introduced herbs and grasses on disturbed flats and lower slopes with leached or brown sandy-loams and sandy-gravels.
F1: Open Forest of Eucalyptus marginata Corymbia calophylla Banksia grandis - Corymbia haematoxylon Xylomelum occidentale over Xanthorrhoea preissii, Podocarpus drouynianus, Hakea amplexicaulis, Hakea ruscifolia, Hibbertia hypericoides, Dasypogon hookeri, Dasypogon bromeliifolius and Kingia australis over low herbs and grasses on lower and mid slopes with leached greybrown sandy to sandy-loam soils.
F2: Open Forest of Eucalyptus marginata Allocasuarina fraseriana Corymbia calophylla Corymbia haematoxylon Xylomelum occidentale over Podocarpus drouynianus, Hibbertia hypericoides, Xanthorrhoea gracilis, Hypocalymma robustum and Hakea amplexicaulis over Hypolaena exsulca and Loxocarya striata low subshrubs and herbs on slopes with leached grey sands to sandy-gravels.
F3: Open Forest of Corymbia calophylla - Eucalyptus marginata Banksia grandis - Allocasuarina fraseriana over Hibbertia hypericoides, Xanthorrhoea preissii, Xanthorrhoea gracilis, Dasypogon hookeri, Dasypogon bromeliifolius, Kunzea recurva and Podocarpus drouynianus on flats with leached grey and brown sands and sandy loams.
F4: Open Forest of Eucalyptus marginata Corymbia calophylla Banksia grandis over Hibbertia hypericoides, Xanthorrhoea species, Dasypogon bromeliifolius, Dasypogon hookeri, Melaleuca thymoides, Podocarpus drouynianus, Hakea ruscifolia and Stirlingia latifolia over Hypolaena exsulca on flats and lower slopes with yellow sandy loams.
F5: Open Forest of Eucalyptus marginata Corymbia calophylla Xylomelum occidentale Banksia grandis over Hibbertia hypericoides, Xanthorrhoea preissii, Dasypogon bromeliifolius, Podocarpus drouynianus, Melaleuca thymoides, Leucopogon pulchellus, Macrozamia riedlei, Hakea ruscifolia and Petrophile serruriae on flats and lower slopes with leached grey to yellow sands.
CL: Cleared
PL: Plantations
HADDON WEST
HADDON EAST
CATALANO
GREEN ROAD
SIESS ROAD
GOULDEN ROAD
PICCOTT ROAD
SARINA ROAD
STATE FOREST
Daviesia elongata subsp. elongata (T)
Jacksonia ?gracillima (P3)
Jacksonia ?gracillima (P3)
Client: Doral
Mattiske
PERTH BASIN TENEMENTS
VEGETATION
YOONGARILLUP RESOURCE ZONES
Figure: 7


VEGETATION CONDITION LEGEND
RATING
DESCRIPTION
1 Pristine
2 Excellent
3 Very Good
4 Good
5 Degraded
6 Completely Degraded
Condition rating scale from Bush Forever (Government of Western Australia 2000 based on Keighery 1994)
YOONGARILLUP ROAD
SIMS ROAD
GOULDEN ROAD
BIGGOTT ROAD
CATALANO
HADDON WEST
HADDON EAST
GREEN ROAD
CD
VG
G
D
STATE FOREST
SABINA ROAD
Doral
Mattiske
PERTH BASIN TENEMENTS
VEGETATION CONDITION
YOONGARILLUP RESOURCE ZONES
Figure:
8


YOONGARILLUP ROAD
SIES ROAD
COULTHEN ROAD
PIGGOTT ROAD
GREEN ROAD
SADDLE ROAD
HADDON WEST
HADDON EAST
CATAPANO
STATE FOREST
Unmappable
Uninterpretable
Infested
DIEBACK LEGEND
UNINFESTED (PROTECTABLE)
Determined by a qualified interpreter to be free of plant disease symptoms which indicates the presence of P. cinnamomi
UNINTERPRETABLE (PROTECTABLE)
Where susceptible plants are absent or too few to enable the interpretation of P. cinnamomi presence or absence.
INFESTED
Determined by a qualified interpreter to have plant disease symptoms consistent with the presence of P. cinnamomi .
UNMAPPABLE (PROTECTABLE)
Areas that are sufficiently disturbed so that P. cinnamomi occurrence mapping is not possible at the time of inspection
AGE LIMITS FOR THIS MAP
Map Boundaries should be checked before operations proceed if this map is older than 1 year (Sept 2012).
This map should not be used if it is older than 3 years (Sept 2014).
Areas that have had an operation in them become unreliable and should be checked prior to furtherfnew activities.
INTERPRETATION
Field Interpretation conducted by Mattiske Consulting Pty Ltd.
Interpretation conducted during September 2011.
Client:
Doral
Mattiske
PERTH BASIN TENEMENTS
VEGETATION DIEBACK
YOONGARILLUP RESOURCE ZONES
Figure:
9

6. DISCUSSION AND CONCLUSION

The Whicher Scarp has been noted as being a distinct and naturally restricted landform with diverse flora containing local 'biodiversity hotspots' (Environmental Protection Authority 2009; Keighery *et al.*, 2008). These encompass distinctive and unique vegetation complexes including restricted and rare wetland communities (Environmental Protection Authority 2009: Keighery *et al.*, 2008). A high degree (46%) of native vegetation is intact in the area which has lead to unusual relictual habitats of plant communities and flora (Environmental Protection Authority 2009). Consequently this remnant vegetation meets the six criteria for regionally significant natural areas (Environment Protection Authority 2006). Consequently, detailed botanical work was undertaken through several approaches, by firstly undertaking detailed recordings on a regular recording grid basis and then through the establishment of replicated plots within the vegetation communities as defined to date. As the latter plots are 10m x 10m and align with previous studies on the Which Scarp, detailed analyses will be undertaken once the latter work is completed this month.

Flora

The search of DEC databases identified four Declared Threatened flora pursuant to subsection (2) of section 23F of the *Wildlife Conservation Act 1950* (WA) and listed as Threatened pursuant to Schedule 1 of the *Environment Protection and Biodiversity Conservation (EPBC) Act 1999* (Commonwealth) occurring within or adjacent to the survey area. The search also identified one priority 1, four priority 2, twelve priority 3 and eight priority four flora as listed by the Department of Environment and Conservation (2011c) occurring within or adjacent to the survey area

A total of 185 vascular plant taxa from 121 plant genera and 41 plant families were recorded within the Yoongarillup Resources Zone survey area following the initial vegetation mapping phase. Subsequent studies related to the plots increased the coverage to 262 vascular plant taxa from 142 genera and 46 families. The majority of taxa was recorded within the Fabaceae (33 taxa), Proteaceae (27 taxa), Poaceae (17 taxa), Myrtaceae (17 taxa), Asparagaceae (16 taxa), Cyperaceae (14 taxa), Orchidaceae (13 taxa) and Dilleniaceae (13 taxa) families (Appendix B). This number is based on the regular recording sites and the permanent plots over the areas of remnant vegetation.

One Threatened flora species (*Daviesia elongata* subsp. *elongata*) was recorded in the permanent plots and one potential Priority 3 species (*Jacksonia ?gracillima*) was recorded during the assessment of the vegetation mapping sites. Both of these species occur in the area to the west of Sues Road in the less disturbed State Forest areas.

Vegetation

The vegetation on the site varies extensively in its current condition from grazed and previously cleared agricultural holdings to plantations to grazed remnant bushland areas to more intact State Forest areas. The survey area has been subdivided into four main areas, Catalino, Haddon East, Haddon West and State Forest. Of these the Haddon West is essentially clear of native vegetation, Haddon East and Catalino have small remnants left with some values and the State Forest is relatively undisturbed although there were signs of dieback (*Phytophthora cinnamomi*) impacts on the flora and vegetation values.

A total of six vegetation communities were defined on the basis of vegetation mapping recording sites, the permanent vegetation plot data, the analysis of these datasets and the interpretation of aerial photographs. The number of mapping units was modified after the establishment of the permanent plots on the basis of further interpretation.

One of the communities (F4) to the west of Sues Road also supported the listed Threatened flora species *Daviesia elongata* subsp. *elongata* within the State Forest area (*Wildlife Conservation Act* 1950, Department of Environment and Conservation 2011a). *The Daviesia elongata* subsp*. elongata* is also listed under the *Environment Protection and Biodiversity Conservation Act* (1999). This species has been recorded north-east along the Whicher Scarp and also has been recorded in areas south of the survey area (Department of Environment and Conservation (DEC) 2011g).

The F4 community also supported the Priority flora species (*Jacksonia ?gracillima* P3). As such this re-enforces the significance of the State Forest areas from a conservation perspective. This latter comment is also apparent from the database search illustrating the range of Threatened and Priority flora species recorded near Sues Road and in the State Forest areas.

Of the six vegetation communities (excluding the cleared and plantation areas) as defined and mapped for the Yoongarillup survey areas, several communities have some dominant species in common (e.g. *Corymbia haematoxylon*) with the PEC's that are restricted to the Whicher Scarp. Despite detailed analyses which excluded weeds and singletons, there was little alignment with the DEC sites that occurred within 10km of the Yoongarillup area. On the basis of the dominance and several key species there appears to be an alignment with some of the values in the Central Whicher Scarp Mountain Marri woodland (PEC – Priority 1), the Central Whicher Scarp Jarrah Woodland (PEC - Priority 1) and the Sabina River Jarrah and Marri Woodland (Whicher Scarp community F1) (PEC - priority 1) as defined by the Department of Environment and Conservation (2011f) and Keighery *et al.* (2008).

7. LIST OF PERSONNEL

The following Mattiske Consulting Pty Ltd personnel were involved in this project:

Name	Position	Project Involvement
Dr E.M. Mattiske	Managing Director & Principal Ecologist	Planning, Management, Data Interpretation & Reporting
Mr T. Sleigh	Experienced Botanist	Desktop report preparation
Ms K. Tippur	Botanist	Desktop report preparation
Ms C. Whyte	Botanist	Fieldwork
Mrs T. Stebhens	Experienced Botanist	Fieldwork
Mr D. Panickar	Botanist	Fieldwork
Ms J. Ellery	Experienced Botanist	Assisting with report preparation

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APPENDIX A1: DEFINITION OF THREATENED AND PRIORITY FLORA SPECIES (Department of Environment and Conservation 2011a)

Conservation Code	Category
T	**Threatened Flora (Declared Rare Flora – Extant)** "Taxa which have been adequately searched for and are deemed to be in the wild either rare, in danger of extinction, or otherwise in need of special protection, and have been gazetted as such (Schedule 1 under the *Wildlife Conservation Act* 1950). Threatened Flora (Schedule 1) are further ranked by the Department according to their level of threat using IUCN Red List criteria: ■**CR:** Critically Endangered – considered to be facing an extremely high risk of extinction in the wild ■**EN:** Endangered – considered to be facing a very high risk of extinction in the wild ■**VU:** Vulnerable – considered to be facing a high risk of extinction in the wild."
P1	**Priority One – Poorly Known Species** "Species that are known from one or a few collections or sight records (generally less than five), all on lands not managed for conservation, e.g. agricultural or pastoral lands, urban areas, Shire, Westrail and Main Roads WA road, gravel and soil reserves, and active mineral leases and under threat of habitat destruction or degradation. Species may be included if they are comparatively well known from one or more localities but do not meet adequacy of survey requirements and appear to be under immediate threat from known threatening processes."
P2	**Priority Two – Poorly Known Species** "Species that are known from one or a few collections or sight records, some of which are on lands not under imminent threat of habitat destruction or degradation, e.g. national parks, conservation parks, nature reserves, State forest, vacant Crown land, water reserves, etc. Species may be included if they are comparatively well known from one or more localities but do not meet adequacy of survey requirements and appear to be under threat from known threatening processes."
P3	**Priority Three – Poorly Known Species** "Species that are known from collections or sight records from several localities not under imminent threat, or from few but widespread localities 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 localities but do not meet adequacy of survey requirements and known threatening processes exist that could affect them."
P4	**Priority Four – Rare 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 do not qualify for Conservation Dependent, but that are close to qualifying for Vulnerable. c.Species that have been removed from the list of threatened species during the past five years for reasons other than taxonomy."
P5	**Priority 5 – Conservation Dependent Species** "Species that are not threatened but are subject to a specific conservation program, the cessation of which would result in the species becoming threatened within five years."

APPENDIX A2: DEFINITION OF THREATENED FLORA SPECIES (*Environment Protection and Biodiversity Conservation Act 1999* [Commonwealth])

Category Code	Category
Ex	**Extinct** Taxa which at a particular time if, at that time, there is no reasonable doubt that the last member of the species has died.
ExW	**Extinct in the Wild** Taxa which is known only to survive in cultivation, in captivity or as a naturalised population well outside its past range; or 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.
CE	**Critically Endangered** Taxa which at a particular time if, at that time, it is facing an extremely high risk of extinction in the wild in the immediate future, as determined in accordance with the prescribed criteria.
E	**Endangered** Taxa which is not critically endangered and it is facing a very high risk of extinction in the wild in the immediate or near future, as determined in accordance with the prescribed criteria.
V	**Vulnerable** Taxa which is not critically endangered or endangered and is facing a high risk of extinction in the wild in the medium-term future, as determined in accordance with the prescribed criteria.
CD	**Conservation Dependent** Taxa which at a particular time if, at that time, 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 within a period of 5 years.

APPENDIX A3: DEFINITION OF THREATENED ECOLOGICAL COMMUNITIES (Department of Environment and Conservation 2011d)

Category Code	Category
PTD	**Presumed Totally Destroyed** 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: (i) records within the last 50 years have not been confirmed despite thorough searches or known likely habitats or; (ii) all occurrences recorded within the last 50 years have since been destroyed.
CE	**Critically Endangered** 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, meeting any one of the following criteria: (i) The estimated geographic range and distribution has been reduced by at least 90% and is either continuing to decline with total destruction imminent, or is unlikely to be substantially rehabilitated in the immediate future due to modification; (ii) The current distribution is limited ie. highly restricted, having very few small or isolated occurrences, or covering a small area; (iii) The ecological community is highly modified with potential of being rehabilitated in the immediate future.
E	**Endangered** 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. The ecological community must meet any one of the following criteria: (i) The estimated geographic range and distribution has been reduced by at least 70% and is either continuing to decline with total destruction imminent in the short term future, or is unlikely to be substantially rehabilitated in the short term future due to modification; (ii) The current distribution is limited ie. highly restricted, having very few small or isolated occurrences, or covering a small area; (iii) The ecological community is highly modified with potential of being rehabilitated in the short term future.
V	**Vulnerable** An ecological community will be listed as Vulnerable when it has been adequately surveyed and is not Critically Endangered or Endangered but is facing high risk of total destruction in the medium to long term future. The ecological community must meet any one of the following criteria: (i) The ecological community exists largely as modified occurrences that are likely to be able to be substantially restored or rehabilitated; (ii) The ecological community may already be modified and would be vulnerable to threatening process, and restricted in range or distribution; (iii) The ecological community may be widespread but has potential to move to a higher threat category due to existing or impending threatening processes.

APPENDIX A4: DEFINITION OF THREATENED ECOLOGICAL COMMUNITIES (Department of Sustainability, Environment, Water, Population and Communities 2011b)

Three categories exist for listing threatened ecological communities under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

Listing Category	Explanation of Category
Critically Endangered	If, at that time, it is facing an extremely high risk of extinction in the wild in the immediate future.
Endangered	If, at that time, it is not critically endangered and is facing a very high risk of extinction in the wild in the near future.
Vulnerable	If, at that time, it is not critically endangered or endangered, and is facing a high risk of extinction in the wild in the medium-term future.

APPENDIX A5: DEFINITION OF PRIORITY ECOLOGICAL COMMUNITIES (Department of Environment and Conservation 2011d)

Category Code	Category
P1	**Poorly-known ecological communities** Ecological communities with apparently few, small occurrences, all or most not actively managed for conservation (e.g. within agricultural or pastoral lands, urban areas, active mineral leases) and for which current threats exist.
P2	**Poorly-known ecological communities** Communities that are known from few small occurrences, all or most of which are actively managed for conservation (e.g. within national parks, conservation parks, nature reserves, State forest, un-allocated Crown land, water reserves, etc.) and not under imminent threat of destruction or degradation.
P3	**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 and inappropriate fire regimes.
P4	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.
P5	**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 A6: DEFINITION OF STANDARD CONTROL CODES FOR DECLARED PLANT SPECIES IN WESTERN AUSTRALIA (Department of Agriculture and Food 2011)

Control Code Requirement	Conditions
P1 Prohibits movement	The movement of plants or their seeds is prohibited within the State. This prohibits the movement of contaminated machinery and produce including livestock and fodder.
P2 Aim is to eradicate infestation	Treat all plants to destroy and prevent propagation each year until no plants remain. The infested area must be managed in such a way that prevents the spread of seed or plant parts on or in livestock, fodder, grain, vehicles and/or machinery.
P3 Aims to control infestation by reducing area and/or density of infestation	The infested area must be managed in such a way that prevents the spread of seed or plant parts within and from the property on or in livestock, fodder, grain, vehicles and/or machinery. Treat to destroy and prevent seed set all plants:- • within 100 metres inside of the boundaries of the infestation • within 50 metres of roads and highwater mark on waterways • within 50 metres of sheds, stock yards and houses Treatment must be done prior to seed set each year. Of the remaining infested area:- Where plant density is 1-10 per hectare treat 100% of infestation. Where plant density is 11-100 per hectare treat 50% of infestation. Where plant density is 101-1000 per hectare treat 10% of infestation. Properties with less than 2 hectares of infestation must treat the entire infestation. Additional areas may be ordered to be treated.
P4 Aims to prevent infestation spreading beyond existing boundaries of infestation.	The infested area must be managed in such a way that prevents the spread of seed or plant parts within and from the property on or in livestock, fodder, grain, vehicles and/or machinery. Treat to destroy and prevent seed set all plants:- • within 100 metres inside of the boundaries of the infested property • within 50 metres of roads and highwater mark on waterways • within 50 metres of sheds, stock yards and houses Treatment must be done prior to seed set each year. Properties with less than 2 hectares of infestation must treat the entire infestation. Additional areas may be ordered to be treated.
Special considerations	In the case of P4 infestations where they continue across property boundaries there is no requirement to treat the relevant part of the property boundaries as long as the boundaries of the infestation as a whole are treated. There must be agreement between neighbours in relation to the treatment of these areas.

APPENDIX A7: DEFINITION OF VEGETATION CONDITION SCALE (Keighery, 1994)

Condition Rating	Description
Pristine (1)	Pristine or nearly so, no obvious sign of disturbance.
Excellent (2)	Vegetation structure intact, disturbance affecting individual species and weeds are non-aggressive species.
Very Good (3)	Vegetation structure altered obvious signs of disturbance. For example, disturbance to vegetation structure caused by repeated fires, the presence of some more aggressive weeds, dieback, logging and grazing.
Good (4)	Vegetation structure significantly altered by obvious signs of multiple disturbances. Retains basic vegetation structure or ability to regenerate it. For example, disturbance to vegetation structure caused by very frequent fires, the presence of some very aggressive weeds at high density, partial clearing, dieback, grazing.
Degraded (5)	Basic vegetation structure severely impacted by disturbance. Scope for regeneration but not to a state approaching good condition without intensive management. For example, disturbance to vegetation structure caused by very frequent fires, the presence of very aggressive weeds, partial clearing, dieback and grazing.
Completely Degraded (6)	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 or shrubs.

APPENDIX B: VASCULAR PLANT SPECIES RECORDED IN VEGETATION MAPPING SITES AND PERMANENT PLOTS IN THE YOONGARILLUP SURVEY AREA

Note: * denotes introduced species; T - Threatened Flora, P1 - P5 denotes Priority Flora Species (DEC 2011a)

Family		Species	Vegeation Mapping Sites	Permanent Plots
LINDSAEACEAE		*Lindsaea linearis*	x	x
ZAMIACEAE		*Macrozamia riedlei*	x	x
PODOCARPACEAE		*Podocarpus drouynianus*		x
POACEAE	*	*Aira caryophyllea*		x
	*	*Aira* sp.		x
		Amphipogon amphipogonoides	x	x
		Amphipogon laguroides subsp. *laguroides*		x
	*	*Briza maxima*		x
	*	*Briza minor*		x
	*	*Briza* sp.	x	
	*	*Bromus* sp.	x	
	*	*Cynodon dactylon*	x	
	*	*Ehrharta* sp.	x	
	*	*Lolium* sp.		x
		Neurachne alopecuroidea	x	
	*	*Poa annua*	x	
		Tetrarrhena laevis	x	x
	*	*Vulpia myuros*		x
	*	*Vulpia* sp.	x	
	*	Poaceae sp.	x	x
CYPERACEAE		*Baumea vaginalis*	x	
		Cyathochaeta avenacea	x	
		Isolepis cernua var. *setiformis*	x	
	*	*Isolepis marginata*	x	
		Lepidosperma longitudinale		x
		Lepidosperma pubisquameum	x	
		Lepidosperma squamatum	x	
		Lepidosperma sp.		x
		Mesomelaena tetragona	x	x
		Schoenus brevisetis		x
		Schoenus discifer		x
		Tetraria capillaris		x
		Tetraria octandra	x	
		Cyperaceae sp.		x
ARACEAE	*	*Zantedeschia aethiopica*	x	
RESTIONACEAE		*Desmocladus asper*		x
		Desmocladus fasciculatus	x	x
		Hypolaena exsulca	x	x
		Lepyrodia macra		x
		Loxocarya cinerea	x	x
		Loxocarya striata	x	x
ANARTHRIACEAE		*Anarthria prolifera*	x	x
		Lyginia barbata		x
		Lyginia imberbis	x	

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Note: * denotes introduced species; T - Threatened Flora, P1 - P5 denotes Priority Flora Species (DEC 2011a)

Family	Species	Vegeation Mapping Sites	Permanent Plots
ASPARAGACEAE	*Chamaescilla corymbosa*	x	x
	Lomandra caespitosa	x	
	Lomandra hermaphrodita		x
	Lomandra integra	x	x
	Lomandra odora		x
	Lomandra pauciflora	x	
	Lomandra purpurea		x
	Lomandra sericea	x	x
	Lomandra sonderi	x	x
	Lomandra sp.		x
	Lomandra suaveolens		x
	Thysanotus dichotomus		x
	Thysanotus multiflorus		x
	Thysanotus patersonii	x	
	Thysanotus sparteus		x
	Thysanotus triandrus		x
DASYPOGONACEAE	*Baxteria australis*	x	
	Calectasia narragara	x	
	Dasypogon bromeliifolius	x	x
	Dasypogon hookeri	x	x
	Kingia australis	x	x
XANTHORRHOEACEAE	*Xanthorrhoea brunonis*	x	
	Xanthorrhoea gracilis	x	x
	Xanthorrhoea preissii	x	x
COLCHICACEAE	*Burchardia congesta*	x	x
HEMEROCALLIDACEAE	*Agrostocrinum hirsutum*		x
	Tricoryne elatior		x
	Tricoryne sp.		x
HAEMODORACEAE	*Anigozanthos bicolor*	x	
	Anigozanthos humilis subsp. *humilis*	x	
	Conostylis aculeata subsp. *cygnorum*	x	
	Conostylis aculeata subsp. *preissii*		x
	Conostylis candicans		x
	Conostylis setigera		x
	Conostylis setigera subsp. *setigera*	x	
	Haemodorum sp.	x	
	Phlebocarya ciliata	x	x
	Phlebocarya filifolia		x
IRIDACEAE	*Patersonia occidentalis*	x	x
	Patersonia pygmaea	x	
	Patersonia sp.		x
	Patersonia umbrosa var. *xanthina*	x	
	* *Romulea rosea*	x	x

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Note: * denotes introduced species; T - Threatened Flora, P1 - P5 denotes Priority Flora Species (DEC 2011a)

Family	Species	Vegeation Mapping Sites	Permanent Plots
ORCHIDACEAE	*Caladenia* sp.	x	
	Cyrtostylis sp.	x	
	* *Disa bracteata*	x	
	Diuris sp.	x	
	Drakaea sp.	x	
	Microtis sp.	x	
	Pterostylis recurva	x	
	Pterostylis sp.	x	
	Pterostylis sp. (aff. pyramidalis)	x	
	Pyrorchis nigricans	x	x
	Pyrorchis sp.	x	
	Thelymitra ?*macrophylla*	x	
	Orchidaceae sp.	x	
CASUARINACEAE	*Allocasuarina fraseriana*	x	x
	Allocasuarina humilis	x	
PROTEACEAE	*Adenanthos barbiger*	x	x
	Adenanthos meisneri	x	x
	Adenanthos obovatus		x
	Banksia attenuata	x	x
	Banksia bipinnatifida		x
	Banksia bipinnatifida subsp. *bipinnatifida*	x	x
	Banksia dallanneyi subsp. *sylvestris*	x	x
	Banksia dallanneyi var. *dallanneyi*	x	x
	Banksia grandis	x	x
	Banksia littoralis	x	
	Banksia sessilis var. *sessilis*	x	
	Grevillea bipinnatifida		x
	Grevillea quercifolia	x	x
	Grevillea trifida	x	x
	Hakea amplexicaulis	x	x
	Hakea lissocarpha	x	x
	Hakea ruscifolia	x	x
	Isopogon sphaerocephalus	x	x
	Persoonia elliptica	x	x
	Persoonia longifolia	x	x
	Petrophile linearis		x
	Petrophile serruriae	x	x
	Stirlingia latifolia	x	x
	Strangea stenocarpoides	x	x
	Synaphea gracillima		x
	Synaphea whicherensis	x	
	Xylomelum occidentale	x	x
SANTALACEAE	?*Exocarpos sparteus*	x	
LORANTHACEAE	*Nuytsia floribunda*	x	x
PHYTOLACCACEAE	* *Phytolacca octandra*	x	

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Note: * denotes introduced species; T - Threatened Flora, P1 - P5 denotes Priority Flora Species (DEC 2011a)

Family		Species	Vegeation Mapping Sites	Permanent Plots
PORTULACACEAE		*Calandrinia* sp.	x	
CARYOPHYLLACEAE	*	*Sagina apetala*	x	
	*	*Spergula arvensis*	x	
LAURACEAE		*Cassytha racemosa* forma *racemosa*		x
		Cassytha sp.		x
DROSERACEAE		*Drosera erythrorhiza*	x	
		Drosera macrantha subsp. *macrantha*	x	
		Drosera pallida	x	
		Drosera pulchella		x
		Drosera sp.	x	
		Drosera stolonifera	x	
PITTOSPORACEAE		*Billardiera floribunda*	x	
		Marianthus drummondianus	x	x
FABACEAE		*Acacia extensa*	x	x
		Acacia mooreana	x	
		Acacia pulchella	x	x
		Acacia pulchella var. *glaberrima*	x	
		Acacia pulchella var. *pulchella*	x	
		Acacia stenoptera		x
		Acacia urophylla		x
		Acacia sp.		x
		Bossiaea ornata	x	x
		Chorizema ilicifolium	x	
		Daviesia cordata	x	x
		Daviesia decurrens	x	
		Daviesia elongata subsp. *elongata* (T)		x
		Daviesia physodes	x	x
		Daviesia preissii	x	x
		Gompholobium knightianum	x	x
		Gompholobium marginatum	x	
		Gompholobium ovatum	x	x
		Gompholobium polymorphum		x
		Gompholobium preissii	x	x
		Hardenbergia comptoniana	x	
		Hovea chorizemifolia	x	x
		Hovea trisperma	x	x
		Jacksonia ?*gracillima* (P3)	x	
		Jacksonia ?*sternbergiana*	x	
		Jacksonia horrida		x
		Kennedia prostrata		x
		Labichea punctata	x	x
	*	*Lotus angustissimus*		x
	*	*Ornithopus* sp.	x	
		Sphaerolobium sp.	x	x
	*	*Trifolium subterraneum*	x	
	*	*Trifolium* sp.	x	

APPENDIX B: VASCULAR PLANT SPECIES RECORDED IN VEGETATION MAPPING SITES AND PERMANENT PLOTS IN THE YOONGARILLUP SURVEY AREA

Note: * denotes introduced species; T - Threatened Flora, P1 - P5 denotes Priority Flora Species (DEC 2011a)

Family	Species	Vegeation Mapping Sites	Permanent Plots
RUTACEAE	*Boronia crenulata* subsp. *pubescens*	x	x
	Boronia defoliata		x
POLYGALACEAE	*Comesperma calymega*		x
	Comesperma virgatum		x
EUPHORBIACEAE	*Amperea ericoides*		x
	Monotaxis occidentalis	x	
	Stachystemon virgatus	x	x
CELASTRACEAE	*Stackhousia monogyna*	x	x
RHAMNACEAE	*Trymalium ledifolium*	x	
ELAEOCARPACEAE	*Platytheca galioides*	x	
	Tetratheca setigera		x
DILLENIACEAE	*Hibbertia amplexicaulis*	x	x
	Hibbertia aurea	x	
	Hibbertia commutata	x	x
	Hibbertia diamesogenos		x
	Hibbertia furfuracea		x
	Hibbertia glomerata		x
	Hibbertia glomerata subsp. *glomerata*	x	x
	Hibbertia hypericoides	x	x
	Hibbertia lasiopus	x	
	Hibbertia perfoliata	x	
	Hibbertia pilosa		x
	Hibbertia quadricolor	x	
	Hibbertia vaginata	x	x
THYMELAEACEAE	*Pimelea angustifolia*	x	
	Pimelea lehmanniana subsp. *nervosa*		x
MYRTACEAE	*Babingtonia camphorosmae*	x	x
	Calothamnus sanguineus	x	x
	Calothamnus sp.		x
	Corymbia calophylla	x	x
	Corymbia haematoxylon	x	x
	Eucalyptus marginata	x	x
	* *Eucalyptus* sp. (Planted)	x	
	Hypocalymma angustifolium	x	x
	Hypocalymma robustum	x	x
	Kunzea recurva	x	
	Kunzea rostrata		x
	Melaleuca thymoides	x	x
	Melaleuca trichophylla	x	x
	Pericalymma ellipticum var. *ellipticum*		x
	Pericalymma spongiocaule	x	
	Verticordia densiflora		x

APPENDIX B: VASCULAR PLANT SPECIES RECORDED IN VEGETATION MAPPING SITES AND PERMANENT PLOTS IN THE YOONGARILLUP SURVEY AREA

Note: * denotes introduced species; T - Threatened Flora, P1 - P5 denotes Priority Flora Species (DEC 2011a)

Family	Species	Vegeation Mapping Sites	Permanent Plots
ARALIACEAE	*Trachymene pilosa*	x	x
APIACEAE	*Pentapeltis peltigera*	x	x
	Platysace tenuissima	x	x
	Xanthosia candida	x	x
	Xanthosia huegelii		x
ERICACEAE	*Astroloma drummondii*	x	x
	Conostephium pendulum	x	
	Leucopogon pendulus		x
	Leucopogon polymorphus		x
	Leucopogon propinquus	x	x
	Leucopogon pulchellus	x	x
	Leucopogon sp. Margaret River (J. Scott 207)	x	
	Lysinema ?pentapetalum		x
	Styphelia tenuiflora	x	
LOGANIACEAE	*Logania serpyllifolia*	x	
	Phyllangium paradoxum	x	x
LAMIACEAE	*Hemigenia pritzelii*		x
	Pityrodia bartlingii	x	
RUBIACEAE	*Opercularia apiciflora*	x	x
	Opercularia echinocephala	x	x
CAMPANULACEAE	*Lobelia tenuior*		x
GOODENIACEAE	*Dampiera linearis*		x
	Goodenia eatoniana	x	
	Lechenaultia biloba	x	x
	Scaevola calliptera	x	x
	Scaevola sp.	x	
	Velleia trinervis	x	
STYLIDIACEAE	*Levenhookia pusilla*		x
	Stylidium amoenum		x
	Stylidium amoenum var. *amoenum*	x	
	Stylidium carnosum	x	x
	Stylidium ciliatum	x	x
	Stylidium repens		x
	Stylidium scandens		x
ASTERACEAE	* *Arctotheca calendula*	x	x
	* *Hypochaeris glabra*	x	x
	* *Hypochaeris radicata*		x
	Lagenophora huegelii	x	x
	Quinetia urvillei	x	
	Rhodanthe citrina		x
	Trichocline spathulata	x	
	* *Ursinia anthemoides*	x	x

APPENDIX C: VASCULAR PLANT SPECIES AT EACH VEGETATION MAPPING SITE ON THE YOONGARILLUP SURVEY AREA, 2011

Note: * denotes introduced species; T denotes Threatened Flora Species; P1, P2, P3, P4 and P5 denote Priority Flora Species (DEC, 2011a)

Species	YN001	YN002	YN003	YN004	YN005	YN006	YN007	YN008	YN009	YN010	YN011	YN012	YN013	YN014	YN015	YN016	YN017	YN018	YN019	YN020	YN021	YN022	YN023	YN024	YN025	YN026	YN027	YN028	YN029	YN030	YN031	YN032	YN033	YN034	YN035	YN036	YN037	YN038	YN039
**Arctotheca calendula*	x						x												x					x						x					x	x			
**Briza* sp.											x																												
**Bromus* sp.																																							
**Cynodon dactylon*																																							
**Disa bracteata*																																							
**Ehrharta* sp.																																							
**Eucalyptus* sp. (Planted)																																							
**Hypochaeris glabra*	x	x		x							x	x	x	x	x		x	x		x	x		x			x	x		x	x	x	x			x	x	x		
**Isolepis marginata*																			x					x															
**Ornithopus* sp.				x			x															x																	
**Phytolacca octandra*																																							
**Poa annua*		x																																					
*Poaceae sp.																																							
**Romulea rosea*													x		x								x	x															
**Sagina apetala*																																					x		
**Spergula arvensis*																								x															
**Trifolium* sp.				x																																		
**Trifolium subterraneum*																																							
**Ursinia anthemoides*	x													x									x	x						x					x		x		
**Vulpia* sp.														x																									
**Zantedeschia aethiopica*																																							
Acacia extensa	x		x							x		x		x				x			x					x		x					x	x					
Acacia mooreana																																					x		
Acacia pulchella	x																																		x				
Acacia pulchella var. *glaberrima*				x		x		x	x	x				x	x				x				x	x											x				
Acacia pulchella var. *pulchella*													x				x				x					x		x										
Adenanthos barbiger			x	x	x	x	x			x				x	x			x					x		x	x		x					x					
Adenanthos meisneri										x						x			x																			
Allocasuarina fraseriana					x	x							x	x	x			x			x	x	x															
Allocasuarina humilis																										x													
Amphipogon amphipogonoides																																							
Anarthria prolifera	x	x						x	x		x					x		x	x							x	x		x	x		x				x		
Anigozanthos bicolor									x																									x					
Anigozanthos humilis subsp. *humilis*																							x	x															
Astroloma drummondii													x																					x					
Babingtonia camphorosmae																		x	x								x	x						x					x
Banksia attenuata														x		x																							
Banksia bipinnatifida subsp. *bipinnatifida*																																						x	x
Banksia dallanneyi subsp. *sylvestris*					x				x	x						x								x	x														
Banksia dallanneyi var. *dallanneyi*	x	x	x	x			x				x	x			x		x	x					x			x	x		x	x	x	x	x		x			x	
Banksia grandis	x		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x			x	x	x	x	x		x		x	x	x	x	x	x	x	x		

APPENDIX C: VASCULAR PLANT SPECIES AT EACH VEGETATION MAPPING SITE ON THE YOONGARILLUP SURVEY AREA, 2011

Note: * denotes introduced species; T denotes Threatened Flora Species; P1, P2, P3, P4 and P5 denote Priority Flora Species (DEC, 2011a)

Species	YN001	YN002	YN003	YN004	YN005	YN006	YN007	YN008	YN009	YN010	YN011	YN012	YN013	YN014	YN015	YN016	YN017	YN018	YN019	YN020	YN021	YN022	YN023	YN024	YN025	YN026	YN027	YN028	YN029	YN030	YN031	YN032	YN033	YN034	YN035	YN036	YN037	YN038	YN039
Banksia littoralis																				x	x																		
Banksia sessilis var. *sessilis*						x																																	
Baumea vaginalis								x	x	x									x											x									
Baxteria australis								x											x																				
Billardiera floribunda				x																					x						x								
Boronia crenulata subsp. *pubescens*	x	x	x	x			x				x	x	x	x	x	x				x	x										x	x	x		x	x			
Bossiaea ornata				x	x	x											x								x													
Burchardia congesta	x				x					x	x													x															
Caladenia sp.				x				x					x			x						x							x		x	x			x	x			
Calandrinia sp.																																							
Calectasia narragara																											x												
Calothamnus sanguineus																					x			x		x		x					x	x	x				
Chamaescilla corymbosa		x		x									x				x						x	x					x					x	x				x
Chorizema ilicifolium	x																																						x
Conostephium pendulum										x						x	x	x								x	x							x	x		x		
Conostylis aculeata subsp. *cygnorum*																			x																				
Conostylis setigera subsp. *setigera*		x						x		x						x	x		x	x	x			x	x			x					x	x			x	x	x
Corymbia calophylla	x	x	x	x		x	x		x		x	x	x	x	x	x	x	x	x	x	x	x	x		x	x		x	x	x	x	x	x	x	x	x	x	x	x
Corymbia haematoxylon										x																	x		x								x		
Cyathochaeta avenacea											x	x																				x	x	x		x		x	
Cyrtostylis sp.				x																																			
Dasypogon bromeliifolius					x					x	x				x	x	x	x					x	x	x	x	x	x		x				x	x	x	x	x	
Dasypogon hookeri	x	x	x		x	x	x	x	x		x	x	x		x	x	x			x	x	x	x		x			x		x	x	x			x	x	x		
Daviesia cordata				x																																			
Daviesia decurrens																																							
Daviesia physodes										x							x	x							x			x											
Daviesia preissii			x										x							x	x																		x
Desmocladus fasciculatus		x	x							x			x		x	x						x	x	x	x			x			x	x		x	x		x	x	x
Diuris sp.																																							
Drakaea sp.																																							
Drosera erythrorhiza	x	x				x			x	x	x		x	x	x	x		x	x			x	x	x		x	x										x	x
Drosera macrantha subsp. *macrantha*																																							
Drosera pallida		x	x										x				x	x								x	x												
Drosera sp.						x		x	x	x				x	x	x			x			x	x	x	x				x	x	x		x				x		
Drosera stolonifera			x	x	x		x	x		x			x			x	x		x	x	x	x	x		x		x	x						x					
Eucalyptus marginata	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
?Exocarpos sparteus																																							
Gompholobium knightianum		x																																					
Gompholobium marginatum																																							x
Gompholobium ovatum		x			x										x																x								x
Gompholobium preissii		x											x					x								x													

APPENDIX C: VASCULAR PLANT SPECIES AT EACH VEGETATION MAPPING SITE ON THE YOONGARILLUP SURVEY AREA, 2011

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Species	YN001	YN002	YN003	YN004	YN005	YN006	YN007	YN008	YN009	YN010	YN011	YN012	YN013	YN014	YN015	YN016	YN017	YN018	YN019	YN020	YN021	YN022	YN023	YN024	YN025	YN026	YN027	YN028	YN029	YN030	YN031	YN032	YN033	YN034	YN035	YN036	YN037	YN038	YN039
Goodenia eatoniana																																							
Grevillea quercifolia					x		x	x					x																										
Grevillea trifida			x	x	x	x	x	x	x		x	x					x			x								x				x	x	x				
Haemodorum sp.																						x																	
Hakea amplexicaulis	x	x	x	x	x		x	x	x		x	x	x							x	x						x	x	x	x		x			x	x	x		x
Hakea lissocarpha																				x	x																		x
Hakea ruscifolia	x	x	x	x			x	x	x		x	x	x	x	x	x	x			x	x				x	x		x						x	x		x		
Hardenbergia comptoniana					x																																		
Hibbertia amplexicaulis			x				x						x								x	x					x		x						x				x
Hibbertia aurea						x																																	
Hibbertia commutata					x			x		x					x	x														x		x				x			x
Hibbertia glomerata subsp. *glomerata*		x				x		x	x	x			x			x	x			x								x							x	x		
Hibbertia hypericoides	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	
Hibbertia lasiopus			x										x				x	x		x								x										
Hibbertia perfoliata																																x	x						
Hibbertia quadricolor																																x							
Hibbertia vaginata							x	x						x	x	x						x	x	x							x				x		x		
Hovea chorizemifolia			x																	x																		
Hovea trisperma	x	x	x		x						x				x	x		x	x	x	x	x				x			x		x			x	x		x	x	
Hypocalymma angustifolium																																x							x
Hypocalymma robustum		x	x	x	x		x		x	x	x	x	x	x	x	x	x	x	x		x	x	x	x	x	x	x	x		x	x	x	x	x	x	x		
Hypolaena exsulca		x	x			x		x	x	x			x	x				x	x					x		x												
Isolepis cernua var. *setiformis*	x																																						
Isopogon sphaerocephalus		x	x		x					x																												
Jacksonia ?gracillima (P3)										x														x															
Jacksonia ?sternbergiana																										x													
Kingia australis																														x			x						x
Kunzea recurva	x			x			x				x				x						x	x	x		x														
Labichea punctata																																			x				
Lagenophora huegelii												x																x	x								x	
Lechenaultia biloba								x	x																			x										x
Lepidosperma pubisquameum	x																																						
Lepidosperma squamatum																			x																				
Leucopogon propinquus			x																	x	x										x							
Leucopogon pulchellus										x				x			x	x	x							x	x	x							x				
Leucopogon sp. Margaret River (J. Sco	x	x			x				x								x									x	x			x									
Lindsaea linearis																								x				x									x		
Logania serpyllifolia					x																																		
Lomandra caespitosa											x																		x	x		x						x	x
Lomandra integra																																							
Lomandra pauciflora					x																																		

APPENDIX C: VASCULAR PLANT SPECIES AT EACH VEGETATION MAPPING SITE ON THE YOONGARILLUP SURVEY AREA, 2011

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Species	YN001	YN002	YN003	YN004	YN005	YN006	YN007	YN008	YN009	YN010	YN011	YN012	YN013	YN014	YN015	YN016	YN017	YN018	YN019	YN020	YN021	YN022	YN023	YN024	YN025	YN026	YN027	YN028	YN029	YN030	YN031	YN032	YN033	YN034	YN035	YN036	YN037	YN038	YN039
Lomandra sericea							x																					x							x	x	x		
Lomandra sonderi																																x	x	x				x	
Loxocarya cinerea				x	x	x		x	x	x	x			x																	x		x				x	
Loxocarya striata																																							
Lyginia imberbis																		x								x	x												
Macrozamia riedlei				x					x	x							x	x	x	x	x	x		x	x	x	x	x	x	x		x	x	x					
Marianthus drummondianus																															x								
Melaleuca thymoides			x			x	x	x	x	x		x	x	x	x		x	x		x	x		x			x	x	x						x			x		
Melaleuca trichophylla																											x												
Mesomelaena tetragona					x	x										x									x								x			x		
Microtis sp.																																							
Monotaxis occidentalis						x																																	
Neurachne alopecuroidea																																		x					x
Nuytsia floribunda																										x				x									
Opercularia apiciflora									x								x															x		x					
Opercularia echinocephala	x																												x									x	
Orchidaceae sp.	x										x					x		x					x	x					x										
Patersonia occidentalis		x	x								x	x	x					x		x	x					x		x	x	x							x	x
Patersonia pygmaea																											x												
Patersonia umbrosa var. *xanthina*										x																													
Pentapeltis peltigera	x	x	x				x																								x				x	x	x		
Pericalymma spongiocaule																			x					x															
Persoonia elliptica		x						x																															
Persoonia longifolia												x						x				x	x			x	x	x		x		x	x	x				x	x
Petrophile serruriae																	x								x		x						x	x	x				
Phlebocarya ciliata														x								x														x			
Phyllangium paradoxum														x									x													x			
Pimelea angustifolia		x																																					
Pityrodia bartlingii								x	x							x	x																						
Platysace tenuissima					x																																		
Platytheca galioides																										x	x												
Podocarpus drouynianus	x	x	x	x			x		x	x	x	x	x	x				x		x		x		x	x	x		x		x	x	x	x	x			x		
Pterostylis recurva								x		x																														
Pterostylis sp.																										x							x						
Pterostylis sp. (aff. *pyramidalis*)																					x	x																	
Pyrorchis nigricans		x											x					x			x																		
Pyrorchis sp.																																							
Quinetia urvillei														x				x						x	x	x	x												
Scaevola calliptera																											x	x						x					
Scaevola sp.				x										x																									
Sphaerolobium sp.		x			x																																		

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Stachystemon virgatus																	x																						
Stackhousia monogyna							x										x	x								x	x		x	x		x						x	
Stirlingia latifolia						x	x	x		x			x					x					x	x		x		x					x		x	x	x		
Strangea stenocarpoides							x																					x											
Stylidium amoenum var. *amoenum*		x				x									x										x			x			x					x		
Stylidium carnosum																									x														
Stylidium ciliatum		x									x									x		x								x			x						
Styphelia tenuiflora					x								x							x													x	x					
Synaphea whicherensis					x	x										x	x											x											
Tetraria octandra		x							x		x								x																			x	
Tetrarrhena laevis																																x		x					
Tetratheca setigera																	x																						
Thelymitra ?macrophylla						x																																	
Thysanotus patersonii																			x																				
Trachymene pilosa								x							x									x	x				x	x			x	x					
Trichocline spathulata																																	x						
Trymalium ledifolium													x							x									x	x		x							x
Velleia trinervis																																							
Xanthorrhoea brunonis																											x	x											
Xanthorrhoea gracilis			x	x	x		x	x	x	x			x	x	x	x			x			x	x	x	x						x				x	x	x		x
Xanthorrhoea preissii	x	x	x	x	x	x	x		x	x			x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Xanthorroea gracilis												x																											
Xanthosia candida																													x			x						x	
Xylomelum occidentale		x						x		x	x						x	x	x		x	x	x	x		x	x	x		x	x	x	x				x	x	

APPENDIX C: VASCULAR PLANT SPECIES AT EACH VEGETATION MAPPING SITE ON THE YOONGARILLUP SURVEY AREA, 2011

Note: * denotes introduced species; T denotes Threatened Flora Species; P1, P2, P3, P4 and P5 denote Priority Flora Species (DEC, 2011a)

Species	YN040	YN041	YN042	YN043	YN044	YN045	YN046	YN047	YN048	YN049	YN050	YN051	YN052	YN053	YN054	YN055	YN056	YN057	YN058	YN059	YN060	YN061	YN062	YN063	YN064	YN065	YN066	YN067	YN068	YN069	YN070	YN071	YN072	YN073	YN074	YN075
**Arctotheca calendula*	x					x			x	x		x	x		x			x													x			x	
**Briza* sp.																																				
**Bromus* sp.																		x																		
**Cynodon dactylon*																		x																		
**Disa bracteata*									x																											
**Ehrharta* sp.						x		x											x	x																
**Eucalyptus* sp. (Planted)																		x																		
**Hypochaeris glabra*	x				x		x	x	x	x	x	x	x		x	x	x	x	x	x	x	x	x	x	x	x	x		x	x	x	x	x	x	x	x
**Isolepis marginata*																																				
**Ornithopus* sp.															x			x					x													
**Phytolacca octandra*						x						x																								
**Poa annua*																																				
*Poaceae sp.									x	x											x	x								x	x					
**Romulea rosea*	x				x	x	x	x	x	x		x		x	x			x	x	x				x			x									x
**Sagina apetala*																																				
**Spergula arvensis*																																				
**Trifolium* sp.																	x	x				x													x	
**Trifolium subterraneum*						x		x	x	x										x	x															
**Ursinia anthemoides*										x		x						x	x			x				x									x	x
**Vulpia* sp.																																				
**Zantedeschia aethiopica*								x		x									x	x	x	x														
Acacia extensa															x																					
Acacia mooreana																																				
Acacia pulchella	x																																			
Acacia pulchella var. *glaberrima*				x											x																				
Acacia pulchella var. *pulchella*																																				
Adenanthos barbiger	x	x	x	x																																
Adenanthos meisneri																																				
Allocasuarina fraseriana		x	x	x		x	x	x	x	x	x	x	x									x		x	x		x	x	x	x	x	x	x	x	x	
Allocasuarina humilis																																				
Amphipogon amphipogonoides											x																									
Anarthria prolifera																																				
Anigozanthos bicolor	x																																			
Anigozanthos humilis subsp. *humilis*					x																															
Astroloma drummondii																																				
Babingtonia camphorosmae	x	x																																		
Banksia attenuata																																				
Banksia bipinnatifida subsp. *bipinnatifida*																																				
Banksia dallanneyi subsp. *sylvestris*																																				
Banksia dallanneyi var. *dallanneyi*	x		x	x	x										x																			x	x	
Banksia grandis	x	x	x	x										x		x								x					x		x	x		x	x	x

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Banksia littoralis		x																																		
Banksia sessilis var. *sessilis*																																				
Baumea vaginalis																	x																			
Baxteria australis																																				
Billardiera floribunda																																				
Boronia crenulata subsp. *pubescens*	x		x	x	x						x				x		x																x			
Bossiaea ornata																																				
Burchardia congesta										x														x												
Caladenia sp.	x		x				x					x	x		x		x						x		x		x	x	x				x	x	x	
Calandrinia sp.																x										x										
Calectasia narragara																																				
Calothamnus sanguineus	x	x																																		
Chamaescilla corymbosa					x					x		x			x		x		x		x	x	x	x				x	x	x	x		x	x	
Chorizema ilicifolium																x																				
Conostephium pendulum			x																					x												
Conostylis aculeata subsp. *cygnorum*																																				
Conostylis setigera subsp. *setigera*				x											x															x					
Corymbia calophylla	x		x	x	x			x	x	x	x	x	x	x	x	x	x			x	x		x	x	x	x	x	x		x	x		x	x	x	
Corymbia haematoxylon		x				x	x	x		x									x		x	x		x	x	x	x		x	x	x	x		x		x
Cyathochaeta avenacea	x	x															x								x											
Cyrtostylis sp.																																				
Dasypogon bromeliifolius	x	x		x																										x						
Dasypogon hookeri	x	x	x	x	x												x																			
Daviesia cordata																																				
Daviesia decurrens																x																				
Daviesia physodes																																				
Daviesia preissii																										x									x	
Desmocladus fasciculatus	x				x												x									x	x		x	x					
Diuris sp.																	x																			
Drakaea sp.																											x									
Drosera erythrorhiza											x	x	x															x		x	x	x		x		
Drosera macrantha subsp. *macrantha*																																x				
Drosera pallida										x	x																		x							
Drosera sp.	x			x	x					x			x				x													x						
Drosera stolonifera				x									x		x								x	x			x			x	x		x	x	x	
Eucalyptus marginata	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
?Exocarpos sparteus				x																																
Gompholobium knightianum																																				
Gompholobium marginatum																																				
Gompholobium ovatum				x																																
Gompholobium preissii																																				

APPENDIX C: VASCULAR PLANT SPECIES AT EACH VEGETATION MAPPING SITE ON THE YOONGARILLUP SURVEY AREA, 2011

Note: * denotes introduced species; T denotes Threatened Flora Species; P1, P2, P3, P4 and P5 denote Priority Flora Species (DEC, 2011a)

Species	YN040	YN041	YN042	YN043	YN044	YN045	YN046	YN047	YN048	YN049	YN050	YN051	YN052	YN053	YN054	YN055	YN056	YN057	YN058	YN059	YN060	YN061	YN062	YN063	YN064	YN065	YN066	YN067	YN068	YN069	YN070	YN071	YN072	YN073	YN074	YN075
Goodenia eatoniana			x										x																							
Grevillea quercifolia		x																																		
Grevillea trifida	x										x			x	x	x																	x	x	
Haemodorum sp.				x																																
Hakea amplexicaulis	x		x		x		x	x		x				x	x	x	x									x			x					x	x	x
Hakea lissocarpha																						x														
Hakea ruscifolia	x																x																			
Hardenbergia comptoniana																																				
Hibbertia amplexicaulis	x														x																					
Hibbertia aurea																																				
Hibbertia commutata	x				x										x		x																	x		
Hibbertia glomerata subsp. *glomerata*		x	x	x									x																					x		
Hibbertia hypericoides	x	x	x	x	x					x	x		x	x	x	x					x			x		x		x		x	x	x	x	x	x	x
Hibbertia lasiopus																																				
Hibbertia perfoliata		x									x															x					x	x				
Hibbertia quadricolor	x																x																			
Hibbertia vaginata				x											x																					
Hovea chorizemifolia							x						x										x											x	x	
Hovea trisperma		x	x	x	x						x																							x		
Hypocalymma angustifolium																																				
Hypocalymma robustum	x			x	x		x				x				x	x																x	x	x	x	x
Hypolaena exsulca										x							x							x						x		x				
Isolepis cernua var. *setiformis*																																				
Isopogon sphaerocephalus																																				
Jacksonia ?gracillima (P3)																																				
Jacksonia ?sternbergiana																																				
Kingia australis					x																x															
Kunzea recurva	x	x											x		x																			x	x	
Labichea punctata			x	x																																
Lagenophora huegelii					x																															
Lechenaultia biloba																																				
Lepidosperma pubisquameum																																				
Lepidosperma squamatum														x																						
Leucopogon propinquus	x																																			
Leucopogon pulchellus																																				
Leucopogon sp. Margaret River (J. Sco	x	x																																		
Lindsaea linearis	x	x	x	x	x																															
Logania serpyllifolia																																				
Lomandra caespitosa																x										x									
Lomandra integra																															x					
Lomandra pauciflora																									x											

APPENDIX C: VASCULAR PLANT SPECIES AT EACH VEGETATION MAPPING SITE ON THE YOONGARILLUP SURVEY AREA, 2011

Note: * denotes introduced species; T denotes Threatened Flora Species; P1, P2, P3, P4 and P5 denote Priority Flora Species (DEC, 2011a)

Species	YN040	YN041	YN042	YN043	YN044	YN045	YN046	YN047	YN048	YN049	YN050	YN051	YN052	YN053	YN054	YN055	YN056	YN057	YN058	YN059	YN060	YN061	YN062	YN063	YN064	YN065	YN066	YN067	YN068	YN069	YN070	YN071	YN072	YN073	YN074	YN075
Lomandra sericea			x										x																							
Lomandra sonderi		x														x																				
Loxocarya cinerea														x		x																				
Loxocarya striata												x	x		x																					
Lyginia imberbis																																				
Macrozamia riedlei											x												x			x		x	x	x			x			
Marianthus drummondianus																																				
Melaleuca thymoides															x		x												x						x	x
Melaleuca trichophylla																																				
Mesomelaena tetragona	x																																			
Microtis sp.																							x													
Monotaxis occidentalis																																				
Neurachne alopecuroidea	x																																			
Nuytsia floribunda	x								x																											
Opercularia apiciflora	x										x																									
Opercularia echinocephala																																				
Orchidaceae sp.			x							x	x		x											x						x	x					
Patersonia occidentalis																x	x																			
Patersonia pygmaea																																				
Patersonia umbrosa var. *xanthina*														x																						
Pentapeltis peltigera	x		x	x										x			x										x						x			
Pericalymma spongiocaule																																				
Persoonia elliptica				x												x																				
Persoonia longifolia												x									x			x					x		x		x	x	x	
Petrophile serruriae																																				
Phlebocarya ciliata			x	x											x																					
Phyllangium paradoxum																																				
Pimelea angustifolia																																				
Pityrodia bartlingii																																				
Platysace tenuissima											x																				x					
Platytheca galioides																																				
Podocarpus drouynianus		x		x			x	x			x		x	x	x	x	x		x	x		x	x		x	x	x	x	x	x	x	x	x		x
Pterostylis recurva																																				
Pterostylis sp.					x																		x													
Pterostylis sp. (aff. *pyramidalis*)											x		x																							
Pyrorchis nigricans																																				
Pyrorchis sp.					x											x																				
Quinetia urvillei										x																										
Scaevola calliptera																	x																			
Scaevola sp.																																				
Sphaerolobium sp.																																				

APPENDIX C: VASCULAR PLANT SPECIES AT EACH VEGETATION MAPPING SITE ON THE YOONGARILLUP SURVEY AREA, 2011

Note: * denotes introduced species; T denotes Threatened Flora Species; P1, P2, P3, P4 and P5 denote Priority Flora Species (DEC, 2011a)

Species	YN040	YN041	YN042	YN043	YN044	YN045	YN046	YN047	YN048	YN049	YN050	YN051	YN052	YN053	YN054	YN055	YN056	YN057	YN058	YN059	YN060	YN061	YN062	YN063	YN064	YN065	YN066	YN067	YN068	YN069	YN070	YN071	YN072	YN073	YN074	YN075
Stachystemon virgatus																																				
Stackhousia monogyna																																				
Stirlingia latifolia	x	x																																		
Strangea stenocarpoides		x												x																						
Stylidium amoenum var. *amoenum*			x										x																							
Stylidium carnosum																																				
Stylidium ciliatum																												x								
Styphelia tenuiflora		x																										x								
Synaphea whicherensis																																				
Tetraria octandra	x				x																															
Tetrarrhena laevis					x																															
Tetratheca setigera																																				
Thelymitra ?macrophylla																																				
Thysanotus patersonii																																				
Trachymene pilosa		x														x	x									x								x	x	
Trichocline spathulata																										x										
Trymalium ledifolium																																				
Velleia trinervis																																x				
Xanthorrhoea brunonis																																				
Xanthorrhoea gracilis			x	x							x			x	x		x					x	x	x	x	x										x
Xanthorrhoea preissii	x	x	x	x	x			x	x	x		x			x	x																				
Xanthorroea gracilis																																				
Xanthosia candida																																				
Xylomelum occidentale	x	x			x		x		x				x		x	x	x		x					x	x				x		x	x	x	x	x	x

APPENDIX D: VASCULAR PLANT SPECIES AT EACH PERMAMENT PLOT ON THE YOONGARILLUP SURVEY AREA, 2011

Note: * denotes introduced species; T denotes Threatened Flora Species; P1, P2, P3, P4 and P5 denote Priority Flora Species (DEC, 2011a)

Species	F1-1	F1-2	F1-3	F1-4	F1-5	F1-6	F1-7	F1-8	F1-9	F2-1	F2-2	F2-3	F2-4	F3-1	F3-2	F3-3	F3-4	F4-1	F4-2	F4-3	F5-1	F5-2
**Aira caryophyllea*			x	x			x		x		x	x		x			x	x			x	x
**Aira* sp.									x					x	x							
**Arctotheca calendula*																					x	
**Briza maxima*			x	x			x							x								
**Briza minor*			x				x															
**Hypochaeris glabra*			x	x		x		x	x	x	x	x	x				x	x	x			x
**Hypochaeris radicata*							x							x								
**Lolium* sp.																					x	
**Lotus angustissimus*			x									x										
**Romulea rosea*										x									x			
**Ursinia anthemoides*				x																		
**Vulpia myuros*											x	x							x		x	
Acacia extensa							x		x												x	x
Acacia pulchella		x	x	x	x	x	x		x	x				x			x	x	x	x	x	x
Acacia sp.																x						
Acacia stenoptera																				x		
Acacia urophylla	x																					
Adenanthos barbiger		x				x	x	x	x					x		x	x	x	x		x	x
Adenanthos meisneri									x						x				x			
Adenanthos obovatus																	x					
Agrostocrinum hirsutum		x	x	x														x				
Allocasuarina fraseriana		x						x		x	x	x	x			x						
Amperea ericoides															x							
Amphipogon amphipogonoides	x			x									x	x						x	x	
Amphipogon laguroides subsp. *laguroides*									x													
Anarthria prolifera									x	x				x	x	x		x	x	x	x	x
Astroloma drummondii																		x				
Babingtonia camphorosmae																		x				x
Banksia attenuata									x													
Banksia bipinnatifida	x			x																		
Banksia bipinnatifida subsp. *bipinnatifida*					x																	
Banksia dallanneyi subsp. *sylvestris*									x					x								
Banksia dallanneyi var. *dallanneyi*	x	x				x	x	x	x	x				x				x	x	x	x	x
Banksia grandis		x	x				x			x		x		x	x	x	x	x	x	x	x	
Boronia crenulata subsp. *pubescens*	x	x	x		x	x	x	x		x				x						x		
Boronia defoliata		x															x		x			

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Species	F1-1	F1-2	F1-3	F1-4	F1-5	F1-6	F1-7	F1-8	F1-9	F2-1	F2-2	F2-3	F2-4	F3-1	F3-2	F3-3	F3-4	F4-1	F4-2	F4-3	F5-1	F5-2
Bossiaea ornata						x	x			x				x				x				
Burchardia congesta		x	x												x			x	x			
Calothamnus sanguineus		x			x				x					x	x							x
Calothamnus sp.	x			x													x	x	x			
Cassytha racemosa forma racemosa																						x
Cassytha sp.																		x			x	
Chaemacilla corymbosa	x									x												
Comesperma calymega							x	x		x	x	x										
Comesperma virgatum							x															
Conostylis aculeata subsp. *preissii*									x													x
Conostylis candicans																			x			
Conostylis setigera	x			x	x			x						x		x		x				
Corymbia calophylla		x	x	x		x					x	x	x					x	x		x	x
Corymbia haematoxylon	x							x	x							x	x					x
Cyperaceae sp.										x	x					x						
Dampiera linearis	x	x	x			x			x	x						x	x	x	x			
Dasypogon bromeliifolius		x	x						x					x	x	x	x	x	x	x	x	
Dasypogon hookeri		x						x	x					x		x	x	x			x	
Daviesia cordata							x															
Daviesia elongata subsp. *elongata* (T)																				x		
Daviesia physodes																		x	x			x
Daviesia ?preissii					x																	
Daviesia preissii	x			x						x				x								
Desmocladus asper															x							
Desmocladus fasciculatus	x	x	x		x				x					x	x	x	x	x	x		x	x
Drosera pulchella																	x					
Eucalyptus marginata	x	x	x	x	x	x	x	x		x	x	x	x	x	x	x		x		x	x	x
Gompholobium knightianum	x	x	x	x	x	x	x	x						x				x		x		
Gompholobium ovatum																						x
Gompholobium polymorphum			x	x		x	x			x						x		x	x	x	x	
Gompholobium preissii				x			x	x		x				x	x							
Grevillea bipinnatifida						x																
Grevillea pteridifolia																				x		
Grevillea trifida			x				x			x	x	x		x								x
Hakea amplexicaulis	x		x	x	x	x	x	x		x				x			x					
Hakea lissocarpha				x																		

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Species	F1-1	F1-2	F1-3	F1-4	F1-5	F1-6	F1-7	F1-8	F1-9	F2-1	F2-2	F2-3	F2-4	F3-1	F3-2	F3-3	F3-4	F4-1	F4-2	F4-3	F5-1	F5-2
Hakea ruscifolia			x			x		x	x	x							x	x	x	x		
Hemigenia pritzelii																			x			
Hibbertia amplexicaulis	x	x	x	x	x	x	x	x		x	x	x	x	x			x			x	x	
Hibbertia commutata			x			x													x	x		
Hibbertia diamesogenos	x	x								x						x	x		x	x	x	
Hibbertia furfuracea							x															
Hibbertia glomerata		x												x		x						
Hibbertia glomerata subsp. *glomerata*			x	x													x	x	x		x	
Hibbertia hypericoides	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		x	x	x	x	x	x
Hibbertia pilosa		x			x		x	x					x	x			x					x
Hibbertia vaginata									x						x							
Hovea chorizemifolia	x		x		x	x	x			x	x		x									
Hovea trisperma				x		x																
Hypocalymma angustifolium	x				x										x							
Hypocalymma robustum		x		x		x	x		x	x	x		x	x	x		x	x	x		x	x
Hypolaena exsulca							x	x	x	x				x	x			x	x	x	x	x
Isopogon sphaerocephalus			x	x	x			x									x			x		
Jacksonia horrida									x						x				x			
Kennedia prostrata					x		x	x														
Kingia australis		x														x	x	x				
Kunzea rostrata						x																
Labichea punctata	x									x		x	x	x			x			x		
Lagenophora huegelii	x			x		x						x										
Lechenaultia biloba	x			x	x			x		x			x	x			x			x		
Lepidosperma longitudinale		x					x			x							x					
Lepidosperma sp.								x														
Lepyrodia macra		x																				
Leucopogon pendulus				x														x				
Leucopogon polymorphus																			x			
Leucopogon propinquus	x		x	x	x		x	x						x	x		x				x	x
Leucopogon pulchellus																						x
Levenhookia pusilla	x	x		x		x			x	x		x		x			x	x	x		x	x
Lindsaea linearis		x															x		x			
Lobelia tenuior														x	x				x			x
Lomandra hermaphrodita		x	x		x	x	x	x		x			x	x								x
Lomandra integra		x						x	x					x	x							

APPENDIX D: VASCULAR PLANT SPECIES AT EACH PERMAMENT PLOT ON THE YOONGARILLUP SURVEY AREA, 2011

Note: * denotes introduced species; T denotes Threatened Flora Species; P1, P2, P3, P4 and P5 denote Priority Flora Species (DEC, 2011a)

Species	F1-1	F1-2	F1-3	F1-4	F1-5	F1-6	F1-7	F1-8	F1-9	F2-1	F2-2	F2-3	F2-4	F3-1	F3-2	F3-3	F3-4	F4-1	F4-2	F4-3	F5-1	F5-2
Lomandra odora						x		x														
Lomandra purpurea			x														x					
Lomandra sericea		x									x	x		x		x						
Lomandra sonderi		x													x							
Lomandra sp.								x				x	x			x						
Lomandra suaveolens		x													x							
Loxocarya cinerea														x								
Loxocarya striata			x	x			x	x	x	x	x				x			x		x	x	
Lyginia ?imberbis															x							x
Lyginia barbata									x													
Lysinema ?pentapetalum																x						
Macrozamia riedlei				x			x			x			x						x		x	
Marianthus drummondianus				x		x																
Melaleuca thymoides			x				x		x	x					x		x	x	x	x	x	
Melaleuca trichophylla																						x
Mesomelaena tetragona			x			x		x									x	x	x	x		
Nuytsia floribunda																			x			
Opercularia apiciflora	x			x	x	x	x	x		x				x		x					x	x
Opercularia echinocephala										x	x						x					
Patersonia occidentalis			x	x			x	x												x		
Patersonia sp.	x				x	x				x				x	x	x	x	x	x			x
Pentapeltis peltigera		x	x			x		x		x		x				x			x	x	x	
Pericalymma ellipticum var. *ellipticum*				x													x	x	x		x	
Persoonia elliptica			x													x						
Persoonia longifolia			x				x			x	x	x		x					x			x
Petrophile linearis										x										x		
Petrophile serruriae	x																	x	x		x	
Phlebocarya ciliata									x													
Phlebocarya filifolia															x							
Phyllangium paradoxum												x		x	x							x
Pimelea lehmanniana subsp. *nervosa*	x							x			x					x						
Platysace tenuissima			x	x	x		x	x	x			x	x							x		
Poaceae sp.																						x
Podocarpus drouynianus						x	x		x	x		x	x	x	x		x		x	x	x	
Pyrorchis nigricans							x															
Rhodanthe citrina				x											x			x	x			x

APPENDIX D: VASCULAR PLANT SPECIES AT EACH PERMAMENT PLOT ON THE YOONGARILLUP SURVEY AREA, 2011

Note: * denotes introduced species; T denotes Threatened Flora Species; P1, P2, P3, P4 and P5 denote Priority Flora Species (DEC, 2011a)

Species	F1-1	F1-2	F1-3	F1-4	F1-5	F1-6	F1-7	F1-8	F1-9	F2-1	F2-2	F2-3	F2-4	F3-1	F3-2	F3-3	F3-4	F4-1	F4-2	F4-3	F5-1	F5-2
Scaevola calliptera						x				x												x
Schoenus brevisetis									x					x								
Schoenus discifer		x																				
Sphaerolobium sp.			x				x															
Stachystemon virgatus										x												
Stackhousia monogyna							x													x		
Stirlingia latifolia		x		x					x						x		x	x	x	x	x	x
Strangea stenocarpoides																			x	x	x	
Stylidium amoenum		x																x		x		
Stylidium carnosum		x																				
Stylidium ciliatum	x	x		x	x									x	x							
Stylidium repens				x					x					x	x							
Stylidium scandens															x							x
Synaphea gracillima						x	x	x	x													
Tetraria capillaris	x	x	x	x	x	x	x	x		x	x	x		x		x						
Tetrarrhena laevis						x	x	x								x						
Tetratheca setigera				x																	x	
Thysanotus dichotomus															x							
Thysanotus multiflorus							x		x	x												
Thysanotus sparteus			x			x	x											x	x			
Thysanotus triandrus							x															
Trachymene pilosa									x	x	x			x	x						x	x
Tricoryne elatior								x	x					x	x	x						
Tricoryne sp.																				x		
Verticordia densiflora																						x
Xanthorrhoea gracilis	x	x	x	x	x	x	x	x	x	x				x		x		x	x	x	x	x
Xanthorrhoea preissii	x	x	x	x	x		x	x	x	x				x	x	x	x	x	x	x	x	x
Xanthosia candida			x				x	x														
Xanthosia huegelii																						x
Xylomelum occidentale				x							x	x	x	x	x		x					x

APPENDIX E: VASCULAR PLANT SPECIES BY VEGETATION COMMUNITY AT YOONGARILLUP SURVEY AREAS, 2011

Note: * denotes introduced species; T denotes Threatened Flora Species; P1, P2, P3, P4 and P5 denote Priority Flora Species (DEC, 2011a)

Species	Vegetation Community						
	F1	F2	F3	F4	F5	PL	W1
Acacia extensa	x		x	x	x		
Acacia mooreana			x				
Acacia pulchella	x	x	x	x	x		
Acacia pulchella var. *glaberrima*	x		x	x			
Acacia pulchella var. *pulchella*	x				x		
Acacia stenoptera				x			
Acacia urophylla	x						
Acacia sp.			x				
Adenanthos barbiger	x		x	x	x		
Adenanthos meisneri	x		x	x			
Adenanthos obovatus			x				
Agrostocrinum hirsutum	x			x			
**Aira caryophyllea*	x	x	x	x	x		
**Aira* sp.	x		x				
Allocasuarina fraseriana	x	x	x	x	x		x
Allocasuarina humilis					x		
Amperea ericoides			x				
Amphipogon amphipogonoides	x	x	x	x	x		x
Amphipogon laguroides subsp. *laguroides*	x						
Anarthria prolifera	x	x	x	x	x		
Anigozanthos bicolor	x			x	x		
Anigozanthos humilis subsp. *humilis*	x		x	x			
**Arctotheca calendula*	x	x	x	x	x	x	x
Astroloma drummondii	x			x	x		
Babingtonia camphorosmae	x			x	x		
Banksia attenuata	x		x	x			
Banksia bipinnatifida	x						
Banksia bipinnatifida subsp. *bipinnatifida*	x						
Banksia dallanneyi subsp. *sylvestris*	x		x	x			
Banksia dallanneyi var. *dallanneyi*	x	x	x	x	x		
Banksia grandis	x	x	x	x	x		
Banksia littoralis	x						
Banksia sessilis var. *sessilis*				x			
Baumea vaginalis	x			x			
Baxteria australis				x			
Billardiera floribunda	x		x	x			

APPENDIX E: VASCULAR PLANT SPECIES BY VEGETATION COMMUNITY AT YOONGARILLUP SURVEY AREAS, 2011

Note: * denotes introduced species; T denotes Threatened Flora Species; P1, P2, P3, P4 and P5 denote Priority Flora Species (DEC, 2011a)

Species	Vegetation Community						
	F1	F2	F3	F4	F5	PL	W1
Boronia crenulata subsp. *pubescens*	x	x	x	x	x		x
Boronia defoliata	x		x	x			
Bossiaea ornata	x	x	x	x	x		
**Briza maxima*	x		x				
**Briza minor*	x						
**Briza* sp.	x						
**Bromus* sp.						x	
Burchardia congesta	x	x	x	x			
Caladenia sp.	x	x	x	x	x		x
Calandrinia sp.		x					
Calectasia narragara					x		
Calothamnus sanguineus	x		x	x	x		
Calothamnus sp.	x		x	x			
Cassytha racemosa forma racemosa					x		
Cassytha sp.				x	x		
Chamaescilla corymbosa	x	x	x	x	x		x
Chorizema ilicifolium	x	x					
Comesperma calymega	x	x					
Comesperma virgatum	x						
Conostephium pendulum		x	x	x	x		
Conostylis aculeata subsp. *cygnorum*				x			
Conostylis aculeata subsp. *preissii*	x				x		
Conostylis candicans				x			
Conostylis setigera	x		x	x			
Conostylis setigera subsp. *setigera*	x	x	x	x	x		
Corymbia calophylla	x	x	x	x	x		x
Corymbia haematoxylon	x	x	x	x	x		x
Cyathochaeta avenacea	x	x	x		x		
**Cynodon dactylon*						x	
Cyperaceae sp.		x	x				
Cyrtostylis sp.	x						
Dampiera linearis	x	x	x	x			
Dasypogon bromeliifolius	x	x	x	x	x		
Dasypogon hookeri	x		x	x	x		
Daviesia cordata	x						
Daviesia decurrens		x					

APPENDIX E: VASCULAR PLANT SPECIES BY VEGETATION COMMUNITY AT YOONGARILLUP SURVEY AREAS, 2011

Note: * denotes introduced species; T denotes Threatened Flora Species; P1, P2, P3, P4 and P5 denote Priority Flora Species (DEC, 2011a)

Species	Vegetation Community						
	F1	F2	F3	F4	F5	PL	W1
Daviesia elongata subsp. *elongata* (T)				x			
Daviesia physodes				x	x		
Daviesia preissii	x	x	x				
Desmocladus asper			x				
Desmocladus fasciculatus	x	x	x	x	x		
**Disa bracteata*							x
Diuris sp.	x						
Drakaea sp.		x					
Drosera erythrorhiza	x	x	x	x	x		x
Drosera macrantha subsp. *macrantha*		x					
Drosera pallida	x	x			x		x
Drosera pulchella			x				
Drosera stolonifera	x	x	x	x	x		
Drosera sp.	x	x	x	x	x		
**Ehrharta* sp.							x
Eucalyptus marginata	x	x	x	x	x		x
**Eucalyptus* sp. (Planted)						x	
?*Exocarpos sparteus*			x				
Gompholobium knightianum	x		x	x			
Gompholobium marginatum	x						
Gompholobium ovatum	x		x	x	x		
Gompholobium polymorphum	x	x	x	x	x		
Gompholobium preissii	x	x	x		x		
Goodenia eatoniana		x	x				
Grevillea bipinnatifida	x						
Grevillea quercifolia	x			x			
Grevillea trifida	x	x	x	x	x		x
Haemodorum sp.			x				
Hakea amplexicaulis	x	x	x	x	x		x
Hakea lissocarpha	x						x
Hakea ruscifolia	x	x	x	x	x		
Hardenbergia comptoniana				x			
Hemigenia pritzelii				x			
Hibbertia amplexicaulis	x	x	x	x	x		
Hibbertia aurea				x			
Hibbertia commutata	x	x	x	x	x		

APPENDIX E: VASCULAR PLANT SPECIES BY VEGETATION COMMUNITY AT YOONGARILLUP SURVEY AREAS, 2011

Note: * denotes introduced species; T denotes Threatened Flora Species; P1, P2, P3, P4 and P5 denote Priority Flora Species (DEC, 2011a)

Species	Vegetation Community						
	F1	F2	F3	F4	F5	PL	W1
Hibbertia diamesogenos	x	x	x	x	x		
Hibbertia furfuracea	x						
Hibbertia glomerata	x		x				
Hibbertia glomerata subsp. *glomerata*	x	x	x	x	x		
Hibbertia hypericoides	x	x	x	x	x		x
Hibbertia lasiopus	x				x		
Hibbertia perfoliata	x	x			x		x
Hibbertia pilosa	x	x	x		x		
Hibbertia quadricolor	x				x		
Hibbertia vaginata	x		x	x			
Hovea chorizemifolia	x	x					
Hovea trisperma	x	x	x	x	x		x
Hypocalymma angustifolium	x		x		x		
Hypocalymma robustum	x	x	x	x	x		x
**Hypochaeris glabra*	x	x	x	x	x	x	x
**Hypochaeris radicata*	x		x				
Hypolaena exsulca	x	x	x	x	x		
Isolepis cernua var. *setiformis*	x						
**Isolepis marginata*				x			
Isopogon sphaerocephalus	x		x	x			
Jacksonia ?gracillima (P3)				x			
Jacksonia ?sternbergiana					x		
Jacksonia horrida	x		x	x			
Kennedia prostrata	x						
Kingia australis	x		x	x	x		x
Kunzea recurva	x	x	x	x			
Kunzea rostrata	x						
Labichea punctata	x	x	x	x			
Lagenophora huegelii	x	x					
Lechenaultia biloba	x	x	x	x			
Lepidosperma longitudinale	x	x	x				
Lepidosperma pubisquameum	x						
Lepidosperma squamatum		x		x			
Lepidosperma sp.	x						
Lepyrodia macra	x						
Leucopogon pendulus	x			x			

APPENDIX E: VASCULAR PLANT SPECIES BY VEGETATION COMMUNITY AT YOONGARILLUP SURVEY AREAS, 2011

Note: * denotes introduced species; T denotes Threatened Flora Species; P1, P2, P3, P4 and P5 denote Priority Flora Species (DEC, 2011a)

Species	Vegetation Community						
	F1	F2	F3	F4	F5	PL	W1
Leucopogon polymorphus				x			
Leucopogon propinquus	x		x		x		
Leucopogon pulchellus			x	x	x		
Leucopogon sp. Margaret River (J. Scott 207)	x			x	x		
Levenhookia pusilla	x	x	x	x	x		
Lindsaea linearis	x		x	x	x		
Lobelia tenuior			x	x	x		
Logania serpyllifolia				x			
**Lolium* sp.					x		
Lomandra caespitosa	x	x			x		
Lomandra hermaphrodita	x	x	x		x		
Lomandra integra	x	x	x				
Lomandra odora	x						
Lomandra pauciflora		x		x			
Lomandra purpurea	x		x				
Lomandra sericea	x	x	x	x	x		
Lomandra sonderi	x	x	x		x		
Lomandra suaveolens	x		x				
Lomandra sp.	x	x	x				
**Lotus angustissimus*	x	x					
Loxocarya cinerea	x	x	x	x	x		
Loxocarya striata	x	x	x	x	x		x
Lyginia barbata	x						
Lyginia imberbis			x		x		
Lysinema ?pentapetalum			x				
Macrozamia riedlei	x	x	x	x	x		x
Marianthus drummondianus	x		x				
Melaleuca thymoides	x	x	x	x	x		
Melaleuca trichophylla					x		
Mesomelaena tetragona	x		x	x	x		
Microtis sp.		x					
Monotaxis occidentalis				x			
Neurachne alopecuroidea	x				x		
Nuytsia floribunda	x			x	x		x
Opercularia apiciflora	x	x	x	x	x		x
Opercularia echinocephala	x	x	x				

APPENDIX E: VASCULAR PLANT SPECIES BY VEGETATION COMMUNITY AT YOONGARILLUP SURVEY AREAS, 2011

Note: * denotes introduced species; T denotes Threatened Flora Species; P1, P2, P3, P4 and P5 denote Priority Flora Species (DEC, 2011a)

Species	Vegetation Community						
	F1	F2	F3	F4	F5	PL	W1
Orchidaceae sp.	x	x	x	x	x		x
**Ornithopus* sp.	x	x	x	x		x	
Patersonia occidentalis	x	x		x	x		
Patersonia pygmaea					x		
Patersonia umbrosa var. *xanthina*		x		x			
Patersonia sp.	x	x	x	x	x		
Pentapeltis peltigera	x	x	x	x	x		
Pericalymma ellipticum var. *ellipticum*	x		x	x	x		
Pericalymma spongiocaule				x			
Persoonia elliptica	x	x	x	x			
Persoonia longifolia	x	x	x	x	x		x
Petrophile linearis		x		x			
Petrophile serruriae	x		x	x	x		
Phlebocarya ciliata	x		x				
Phlebocarya filifolia			x				
Phyllangium paradoxum		x	x		x		
**Phytolacca octandra*							x
Pimelea angustifolia	x						
Pimelea lehmanniana subsp. *nervosa*	x	x	x				
Pityrodia bartlingii				x	x		
Platysace tenuissima	x	x		x			x
Platytheca galioides					x		
**Poa annua*	x						
Poaceae sp.					x		
*Poaceae sp.		x					x
Podocarpus drouynianus	x	x	x	x	x		x
Pterostylis recurva				x			
Pterostylis sp.	x	x			x		
Pterostylis sp. (aff. pyramidalis)	x	x	x				x
Pyrorchis nigricans	x				x		
Pyrorchis sp.	x	x					
Quinetia urvillei		x	x	x	x		
Rhodanthe citrina	x		x	x	x		
**Romulea rosea*	x	x	x	x		x	x
**Sagina apetala*			x				
Scaevola calliptera	x	x			x		

APPENDIX E: VASCULAR PLANT SPECIES BY VEGETATION COMMUNITY AT YOONGARILLUP SURVEY AREAS, 2011

Note: * denotes introduced species; T denotes Threatened Flora Species; P1, P2, P3, P4 and P5 denote Priority Flora Species (DEC, 2011a)

Species	Vegetation Community						
	F1	F2	F3	F4	F5	PL	W1
Scaevola sp.	x		x				
Schoenus brevisetis	x		x				
Schoenus discifer	x						
**Spergula arvensis*				x			
Sphaerolobium sp.	x			x			
Stachystemon virgatus		x			x		
Stackhousia monogyna	x			x	x		
Stirlingia latifolia	x		x	x	x		
Strangea stenocarpoides	x	x		x	x		
Stylidium amoenum	x			x			
Stylidium amoenum var. *amoenum*	x	x	x	x	x		
Stylidium carnosum	x			x			
Stylidium ciliatum	x	x	x		x		
Stylidium repens	x		x				
Stylidium scandens			x		x		
Styphelia tenuiflora	x	x		x	x		
Synaphea gracillima	x						
Synaphea whicherensis				x	x		
Tetraria capillaris	x	x	x				
Tetraria octandra	x			x			
Tetrarrhena laevis	x		x		x		
Tetratheca setigera	x				x		
Thelymitra ?macrophylla				x			
Thysanotus dichotomus			x				
Thysanotus multiflorus	x	x					
Thysanotus patersonii				x			
Thysanotus sparteus	x			x			
Thysanotus triandrus	x						
Trachymene pilosa	x	x	x	x	x		
Trichocline spathulata		x			x		
Tricoryne elatior	x		x				
Tricoryne sp.				x			
**Trifolium subterraneum*		x					x
**Trifolium* sp.	x	x				x	x
Trymalium ledifolium	x				x		
**Ursinia anthemoides*	x	x	x	x		x	x

APPENDIX E: VASCULAR PLANT SPECIES BY VEGETATION COMMUNITY AT YOONGARILLUP SURVEY AREAS, 2011

Note: * denotes introduced species; T denotes Threatened Flora Species; P1, P2, P3, P4 and P5 denote Priority Flora Species (DEC, 2011a)

Species	Vegetation Community						
	F1	F2	F3	F4	F5	PL	W1
Velleia trinervis		x					
Verticordia densiflora					x		
**Vulpia myuros*		x		x	x		
**Vulpia* sp.			x				
Xanthorrhoea brunonis					x		
Xanthorrhoea gracilis	x	x	x	x	x		x
Xanthorrhoea preissii	x	x	x	x	x		x
Xanthosia candida	x				x		
Xanthosia huegelii					x		
Xylomelum occidentale	x	x	x	x	x		x
**Zantedeschia aethiopica*		x					x