VASSE FELIX

Level 2 Flora and Vegetation Survey

LOT 30 TOM CULLITY DRIVE, WILYABRUP

FEBRUARY 2013

ekologica PTY LTD

and

ngh environmental

CONTENTS

TABLES

FIGURES

EXECUTIVE SUMMARY

A Level Two Flora and Vegetation Assessment (EPA, 2006) was conducted on Lot 30 (DP 46641), Tom Cullity Drive, Wilyabrup for the proponents Vasse Felix Pty Ltd. The study area encompasses Stages two to six of a mix of remnant vegetation (Stages two to five) and paddock trees (Stage six). Stage one (1.42 ha) was recently cleared and is not included in this assessment.

The assessment was carried out on 30 October 2012 with a follow-up inspection on 19 November 2012. There were three components to the assessment: (1) a general search for rare flora, (2) the recording of notes on vegetation composition, structure and condition at a number of releve sites, and (3) the installation of two marked floristic quadrats.

One hundred and fifty two species of vascular flora were found within the study area, of which 130 were native species. This number of native species in the remnant vegetation surveyed represents a relatively high species-diversity. No plant taxa gazetted as Declared Rare Flora pursuant to subsection (2) of section 23F of the WC Act or listed as Endangered under the EPBC Act were located. Additionally, no Priority Flora as defined by the Department of Conservation and Land Management (2012) were located within the study area.

Two noted environmental weeds, *Acacia longifolia* and *Genista monspessulana*, both leguminous shrubs, were present in the study area but these are not on the Department of Food and Agriculture's list of Declared Plants.

No clear patterns were seen in the remnant vegetation and while the dominant understorey species varied across the site this was not in a way that allowed the mapping of boundaries between vegetation types. The remnant vegetation is comprised of jarrah – marri open forest. Although two floristic quadrats were placed within the remnant vegetation there is a lack of other floristic data for the Margaret River Plateau to compare it with using multivariate analysis.

Of the remnant vegetation that was able to be assessed in the study area - stage three and some of stage two had been recently burned so could not be assessed – 58% was rated as "Very Good" condition, and a further 12% was in "Good" condition. Because it is rated as category 1b this remnant vegetation has some importance in helping to maintain connectivity between the major regional ecological linkages of the Margaret River Plateau.

The remnant vegetation on Lot 30 represents about 0.18% of the remaining area of the Cowaramup (C2) vegetation complex, which is considered to be poorly conserved.

1 INTRODUCTION

1.1 BACKGROUND

Vasse Felix Pty Ltd seek to identify flora and vegetation values within Lot 30 (DP 46641) Tom Cullity Drive, Wilyabrup. To identify onsite opportunities and constraints, enable appropriate land use planning and support any future clearing permit applications (including the requirement for Federal referral) for the expansion of viticulture, a Level 2 flora and vegetation survey is required.

The study area encompasses stages two to six of a mix of remnant vegetation (stages two to five) and paddock trees (stage six) primarily along the southern boundary of the allotment. Stage one (1.42ha) was recently cleared under permit CPS 5063/1, as approved by the Department of Environment and Conservation (DEC) pursuant to the *Environmental Protection (Clearing of Native Vegetation) Regulations 2004*. On this basis it is not included in this survey.

1.2 LOCATION

Lot 30 is located approximately 30 km southwest of Busselton, six kilometres northwest of Cowaramup, within the City of Busselton local government area. The study area is inland approximately five kilometres from the Indian Ocean (Figure 1-1). The study area detailing Stages two to six is shown in Figure 1-2.

Notes:
Satellite image from ESRI online (Bing Maps Hybrid, accessed 2012)

Figure 1-1 Locality map

The study area can be broken down into four Stages (two to six) shown in the table below.

Table 1-1 Area (ha) of stages two to six

Stage	Area (ha)
Two	1.88
Three	1.41
Four	2.32
Five	3.04
Six	8.15
Total	16.80

Figure 1-2 Study area (Stages in yellow text)

1.3 PROJECT SCOPE

nghenvironmental were engaged by the proponent to prepare this Level 2 flora and vegetation survey within stages two to six shown in Figure 1-2. The survey will specifically involve the following:

A licensed and experienced botanist will undertake a spring (2012) flora and vegetation survey for stages two to six. The survey will include the following:

Desktop Assessment

- Desktop / background survey: Relevant databases would be searched (DEC and EPBC Act), to identify any Declared Rare, Priority or other significant flora, Threatened Ecological Communities (TECs) and Priority Ecological Communities (PECs) that may occur locally.

Field Inspection (early spring)

- Conduct the first stage of a Level 2 flora and vegetation survey to ascertain the conservation values of remnant native vegetation in the survey area, in particular
    - Describe and map vegetation types (dominant species/structure)
    - Install two vegetation quadrats (100 m^2)
    - Describe and map vegetation condition (method of Keighery, 1994)
    - Produce an interim list of flora occurring within the survey area

Field inspection (mid spring)

- Conduct a spring survey for rare flora (DFR, PF) and record and mark the location of any rare flora found in the field
- Re-survey vegetation quadrats
- Produce a final list of flora within the survey area (including weeds)
- Compile quadrat species lists

In addition, this report provides advice on whether the project should be referred under the EPBC Act. Practical and achievable mitigation measures to reduce potential biodiversity impacts and avoid significant impact to flora and vegetation, in particular threatened or priority listed species and communities are also be provided.

1.4 LEGISLATIVE FRAMEWORK

This fauna survey is designed to meet the requirements of the following relevant State and Commonwealth legislation:

- *Environmental Protection Act 1986* (EP Act),
- *Wildlife Conservation Act 1950* (WC Act),
- Federal *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act).

WC Act

Species of fauna, flora and ecological communities are afforded Declared Rare or Priority conservation status where their populations are restricted geographically or threatened by local processes. The Department of Environment and Conservation (DEC) administers this Act. DEC recognises these threats of extinction and consequently applies regulations towards population and species protection. The Western Australian Minister for the Environment regularly gazettes a notice where taxa are listed as protected and classified as Schedule 1 through to Schedule 4 according to their conservation status or need for protection. The most recent was issued on 6 November 2012 and included a number of status revisions.

The DEC also produces a list of priority species that have not been assigned statutory protection under the WC Act, but are under consideration as 'Scheduled' taxa, and are in urgent need of further survey or regular monitoring, and although not currently threatened may become so in the future.

EPBC Act

In accordance with Federal legislation, the EPBC Act also provides a list of matters of 'National Environmental Significance' (NES), which includes significant fauna, flora and communities. Any proposal that is likely to result in a significant impact to any matters of NES will require referral to the Department of Sustainability, Environment, Water, Population and Communities (SEWPAC) for assessment in accordance with the EPBC Act.

1.5 GUIDELINES

The assessment also considers the following guidelines:

- 'Environmental Protection of Native Vegetation in Western Australia' Position Statement No. 2, EPA (2000),
- Commonwealth 'Matters of National Environmental Significance – Significant impact guidelines 1.1 *Environmental Protection and Biodiversity Conservation Act 1999*, Department of the Environment, Water, Heritage and the Arts (DEWHA)', (2009),
- EPA Guidance Statement No. 51 '*Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia*'
- 'Terrestrial Biological Surveys as an Element of Biodiversity Protection. Position Statement No. 3', EPA (2002).

2 APPROACH

2.1 DESKTOP REVIEW

2.1.1 Database searches

Prior to field surveys, desktop reviews were undertaken to determine the potential presence of flora, vegetation and communities listed under the WC Act or EPBC Act matters of NES or afforded priority status (by the DEC).

These involved searches of the following to develop an understanding of the ecological values of the site and assist in identifying the likelihood of threatened, migratory or priority listed fauna occurring within the study area:

- NatureMap and Florabase online databases (which includes compiled records from DEC, WA Herbarium and others) for conservation significant flora and communities within 10km of the study area (NatureMap, 2012).
- The SEWPAC Protected Matters Search Tool for matters of NES within 5km of the study area (SEWPAC, 2012).
- Atlas of Living Australia (regularly updated with other database records) (ALA, 2012).

- Soils (DAFWA 2004), Pre-European Vegetation (DAFWA, 2005) from Beard Vegetation Associations, Mattiske and Havel vegetation complexes (1998), EPP and geomorphic wetlands and other open source datasets (SLIP, 2012) for baseline information.
- Analysis of aerial photography (Nearmap 2012, accessed 13.09.2012)

2.1.2 Review of available literature

No record was found of surveys in the vicinity of the subject site.

2.2 FIELDWORK

2.2.1 Flora

The survey was carried out on 30 October 2012 with a follow-up inspection on 19 November 2012. There were three components to the assessment: (1) a general search for rare flora, (2) the recording of notes on vegetation composition, structure and condition at a number of releve sites, and (3) the installation of two marked floristic quadrats. The survey for rare flora was carried out using the random meander method of Cropper (1993). Stage three of the study area was not able to be surveyed because it had been burnt off a few days before the survey. The total area of remnant vegetation searched within stages two, four, five and six was approximately 6.7 ha.

A description of the dominant species and vegetation structure within approximately 10 m of the observer (i.e. a "releve") was recorded at 10 points to document changes in floristic composition and structure. In addition vegetation condition was recorded for the releves and another 34 assessment points within the survey area using the method of Keighery (1994) (Table 2-1). In addition, general views at most assessment points were photographed to assist with later description of vegetation structure and condition.

Two 10 m x 10 m floristic quadrats were installed – one in each of stage four and stage five of the study area. The methods used were generally as per Keighery (1994).

Taxa not able to be identified with certainty in the field were photographed and collected for later identification. Taxonomy and conservation status was checked against DEC (2012a, 2012b).

Table 2-1 Vegetation condition classes from Keighery (1994) which were used for this assessment

Condition	Description
Pristine	Pristine or nearly so, with no obvious signs of disturbance.
Excellent	Vegetation structure intact, disturbance affecting individual species and weeds are non-aggressive species.
Very good	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	Vegetation structure significantly altered by very obvious signs of multiple disturbances. Retains basic vegetation structure or the 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.

Condition	Description
Degraded	Basic vegetation structure severely impacted by disturbance. Scope for regeneration but not to a state approach 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	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.

2.3 MAPPING

Mapping was carried out using ArcGIS 10 software. Field data was collected with a handheld GPS. Base layers were digitised from PDF layers provided by the client unless noted on relevant maps. All maps are shown in GDA (MGA) 94 zone 50 coordinate system.

2.4 LIMITATIONS

In accordance with the EPA Guidance Statement No. 56, potential limitations of the surveys have been considered below:

Competency	Suitability qualified and licensed individuals carried out the survey work, Russell Smith, Botanist, Ekologica Pty Ltd (20 years experience in flora surveys). Competency was not a limitation of this assessment.
Access	All areas requiring survey were accessible by vehicle and foot. Access was not a limitation of this assessment.
Vegetation mapping	Vegetation condition was mapped based on the field visit and aerial photo interpretation, at approximately 1: 3,000 scale. Existing vegetation mapping was not a limitation.
Timing	The field surveys were undertaken in early and late spring. The preceding winter months were drier than average and this is likely to have reduced the germination and growth of annual and ephemeral species. This is not considered to have impacted adversely on the search for rare flora and timing is not considered a limitation to the flora assessment.
Scope	A Level 2 flora and vegetation survey was undertaken with two field visits. Field information was supplemented with a desktop review. Any field visit represents a snap shot of conditions and species present on site. Without regular surveys over a longer period of time, the scope is a limitation to assessment in terms of accurately recording the suite of species present at a site. These limitations are partly overcome by the precautionary approach, below.
Precautionary approach	As it is difficult to rule out the presence of any particular species without rigorous scientific surveys, a precautionary approach has been adopted. That is, if suitable habitat is present and desktop assessment has determined the species could occur in the area, the species has been assumed to have potential to utilise habitat with the proposal area. This approach is not a limitation to this assessment.

3 DESKTOP REVIEW

3.1 ENVIRONMENTAL CONTEXT

3.1.1 Interim Biogeographic Regionalisation of Australia (IBRA) values

The Interim Biogeographic Regionalisation for Australia (IBRA) classifies Australia's landscapes into 89 large geographically distinct bioregions based on common climate, geology, landform, native vegetation and species information. IBRA also provides for the national and regional planning framework for the systematic development of a comprehensive, adequate and representative (CAR) National Reserve System, endorsed by all levels of government as a key tool for identifying land for conservation under Commonwealth's Australia's Strategy for the National Reserve System 2009-2030 (SEWPAC, 2012).

According to the latest IBRA update (7), the subject site is located within the WAR01 sub-region of the Warren bioregion (Environment Australia, 2000). This is described by Hearn et al (2002) as "dissected undulating country of the Leeuwin Complex, Southern Perth Basin (Blackwood Plateau), South-West intrusions of the Yilgarn Craton and western parts of the Albany Orogen with loamy soils supporting Karri forest, laterites supporting Jarrah-Marri forest, leached sandy soils in depressions and plains supporting low Jarrah woodlands and paperbark/sedge swamps, and Holocene marine dunes with *Agonis flexuosa* and Banksia woodlands and heaths".

The high rainfall and low evaporation and plant transpiration within the bioregion contributes to high forests, perennial rivers and wetlands making it unique within WA, and has subsequently assisted in the development of highly endemic flora and (invertebrate) fauna.

3.1.2 Brief land use summary

Lot 30 has a history of grazing, and more recently of viticulture It also contains a residence and there are numerous access tracks through the remnant vegetation. Approximately two fifths of the Lot contains vineyards, two fifths contains remnant vegetation and the remaining fifth is cleared paddock with intermittent paddock trees. Stages two to six account for approximately half of the remnant vegetation within Lot 30.

3.1.3 Landforms, soils and climate

Soils within the study area are mapped as predominately Cowaramup Uplands System (216Co) 'Loamy gravels, duplex sandy gravels, semi-wet and wet soils' occurring on the 'Lateritic plateau with broad swampy depressions' landform. Wilyabrup Valleys System (216Wv) soils 'Loamy gravels, duplex sandy gravels and loamy earths' over the 'Major valleys landform', also occurs in the northern half of Stage 2 (DAFWA, 2004).

Local climate is classified as Warm Mediterranean, with winter dominant rainfall ranging between 600 and 1000mm annually (Environment Australia, 2000).

3.1.4 Botanical Region

The study area is situated in the Menzies Subdistrict of the Darling Botanical District of the South West Botanical Province as defined by Beard (1981).The Darling Botanical District is the high-rainfall forest zone of the extreme south-west, most of which has a long-term annual rainfall of more than 1000 mm.

3.2 ENVIRONMENTAL VALUES

3.2.1 Vegetation

Pre-European Vegetation at the subject site has been mapped at a broad scale by DAFWA (2005) adapted from 1:250,000 mapping carried out by J.S. Beard between the late 1960's to early 1980's. The vegetation of the study area is part of the Chapman system mapped as Vegetation association Chapman 3; Medium forest; Jarrah and Marri.

The subject site also occurs within two Mattiske and Havel (1998) vegetation complexes, Cowaramup C2 and a small area of Wilyabrup W2 corresponding with the changes in soils type, over the northern half of stage 2. These are described below.

- Cowaramup C2: Open forest of *Eucalyptus marginata subsp. marginata-Corymbia calophylla-Banksia grandis* on lateritic uplands in perhumid and humid zones.
- Wilyabrup W2: Open forest of *Corymbia calophylla-Allocasuarina decussata-Agonis flexuosa* on deeply incised valleys in perhumid and humid zones.

The EPA supports a threshold level of 30% of the pre-clearing extent of the vegetation type as recommended in the National Objectives Targets for Biodiversity Conservation; below which species loss appears to accelerate exponentially at an ecosystem level. Below 10% of the original extent then the vegetation type would be considered to be endangered, and clearing which would put the threat level into the class should be avoided (EPA, 2000). The EPA, (2006) also set a target of 15% of pre-European extent for each ecological community to be protected in a comprehensive, adequate and representative reserve system.

The significance of clearing a particular Vegetation Association/complex can be determined by comparing current with pre-European extents (Government of Western Australia, 2011, and Shepherd, 2007), as shown in the tables below.

Table 3-1 Post European vegetation Beard association 3 Jarrah and Marri extent remaining and reserved at different scales (Government of Western Australia, 2011)

Scale	Pre-European Extent (ha)	Current Extent (ha)	% Remaining	Current Extent Protected for Conservation (ha)	% Current Extent Protected for Conservation
State	2661405.07	1844285.31	69.30	1477881.03	80.13
IBRA	250262.60	198873.43	79.47	169814.89	85.39
City of Busselton	53,189.11	34,648.77	65.14	27,803.24	80.24

Beard association 3 Jarrah and Marri, is well above both the 15% reserved and 30% pre-European thresholds.

Table 3-2 Post European vegetation extent remaining and reserved for vegetation within the Warren IBRA Bioregion and the Southwest Forest Region portion of the Jarrah Forest and Warren IBRA Bioregions (Shepherd 2007)

RFA code	RFA name	PreEuropean Vegetation (ha)	Current Vegetation (ha)	% Vegetation Remaining	Current Vegetation in DEC Tenure (ha)	% Remaining of Current Vegetation in DEC Tenure
C2	Cowaramup	12878.86	4731.03	36.73%	831.50	6.46
W2	Wilyabrup	3,526.59	1,200.53	34.04%	0	0

Cowaramup (C2) and Wilyabrup (W2), highlighted in Table 3-2 and shown in Appendix B, both contain more than 30% of their Pre European extents however they are well below the 15% reserve target with 6.46% and 0.00% respectively reserved in DEC tenure.

3.2.2 Flora

A review of the Atlas of Living Australia (ALA 2012) shows a total of 574 taxa recorded within 10km of the subject site. This list is unlikely to be exhaustive.

Threatened flora

The database search identified 30 priority flora taxa and a single threatened species *Caladenia excelsa* that have been recorded within 10km of the subject site (Naturemap 2012); refer to Appendix A. The closest significant flora records are over three kilometres away, though this is likely to be in part due to low survey effort. As well as threatened under the WC Act 1950, *Caladenia excelsa,* Giant Spider-orchid, is also listed as endangered under the EPBC Act 1999. Although only listed as a priority 4 species by DEC, *Drosera fimbriata* is listed is also listed under the EPBC Act (Vulnerable). Three additional species are also identified by the EPBC reporting tool as potentially having suitable habitat nearby, though they have not been recorded locally (with 10km).

3.2.3 Threatened and Priority Ecological Communities

A search of Naturemap (2012) does not identify any threatened or priority ecological communities within the vicinity (five kilometres) of the site.

3.2.4 DEC lands

The subject site is not located near any DEC lands. The closest is the coastal Leeuwin-Naturaliste National Park over four kilometres away to the west.

4 FIELDWORK RESULTS

4.1 FLORA

One hundred and fifty two species of vascular flora from 43 genera were identified within the study area, of which twenty two taxa from nine genera were naturalized taxa (Appendix C). The genus with the highest representation was the Fabaceae (with 24 species) followed by the Poaceae, with 14 species, most of which were introduced.

4.1.1 Weeds

Two noted environmental weeds, *Acacia longifolia* and *Genista monspessulana*, both leguminous shrubs, were present in the study area. None of the introduced taxa are on the list of Declared Plants (Department of Agriculture and Food, 2011).

4.2 THREATENED OR PRIORITY FLORA

No plant taxa gazetted as Declared Rare Flora pursuant to subsection (2) of section 23F of the WC Act or listed under the EPBC Act were located. Additionally, no Priority Flora as defined by the Department of Conservation and Land Management (2012) were located within the study area.

4.3 VEGETATION TYPE

No clear patterns were seen in the remnant vegetation and while the dominant understorey species varied across the site this was not in a way that allows the mapping of boundaries between vegetation types. Floristic data for the ten releves and two quadrats is presented in Appendices D and E, respectively, and the locations of the releves and quadrats is shown in Figure 4-3.

The original vegetation of the study area is an open forest of *Eucalyptus marginata* and *Corymbia calophylla* with an understorey of shrubs to about the two metre height with a ground-storey of grasses, herbs and sedges. The open forest is still predominantly intact in stages four and five, while in stage two the overstorey has been opened up around the edges for a firebreak and weeds have invaded the understorey following prescribed burning over the last few years. As noted above stage three could not be assessed because of recent prescribed burning.

The character of the remnant vegetation is described below a structural method based on Muir (1977) and Aplin (1979) and illustrated in Figure 4-1 and Figure 4-2.

Quadrat WILY01

Eucalyptus marginata, *Corymbia calophylla* open forest over *Hibbertia hypericoides*, *Acacia myrtifolia*, *Logania serpyllifolia*, *Hovea chorizemifolia*, *Xanthorrhoea gracilis* open heath/low open heath over *Tetrarrhena laevis*, *Amphipogon amphipogonoides*, **Briza maxima* very open grassland over a mixed herbland including *Caladenia flava*, *Agrostocrinum hirsutum*, *Tricoryne spathulata*, *Lomandra purpurea* and *Lagenophora huegelii*, and *Tetraria octandra*, *T. sp. Jarrah Forest*, *Lepidosperma leptostachyum* open sedgeland on gravelly red-brown sandy loam.

Quadrat WILY02

Eucalyptus marginata, *Corymbia calophylla* open forest over *Xanthorrhoea preissii* tall open shrubland over *Hibbertia hypericoides*, *Scaevola calliptera*, *Dampiera linearis*, *Hakea lissocarpha*, *Banksia dallanneyi*, *Gompholobium ovatum*, *Xanthorrhoea gracilis* open heath/low open heath and *Tetrarrhena laevis*, *Amphipogon amphipogonoides, Austrostipa semibarbata* open grassland, and a mixed herbland including *Burchardia congesta*, *Patersonia occidentalis*, *P. umbrosa* var. *xanthina*, *Agrostocrinum hirsutum*, *Thelymitra macrophylla*, and *Tetraria octandra*, *Cyathochaeta avenacea*, *Lepidosperma leptostachyum* open sedgeland on gravelly yellow-brown loamy sand.

Figure 4-1 Quadrat WILY01

Figure 4-2 Quadrat WILY02

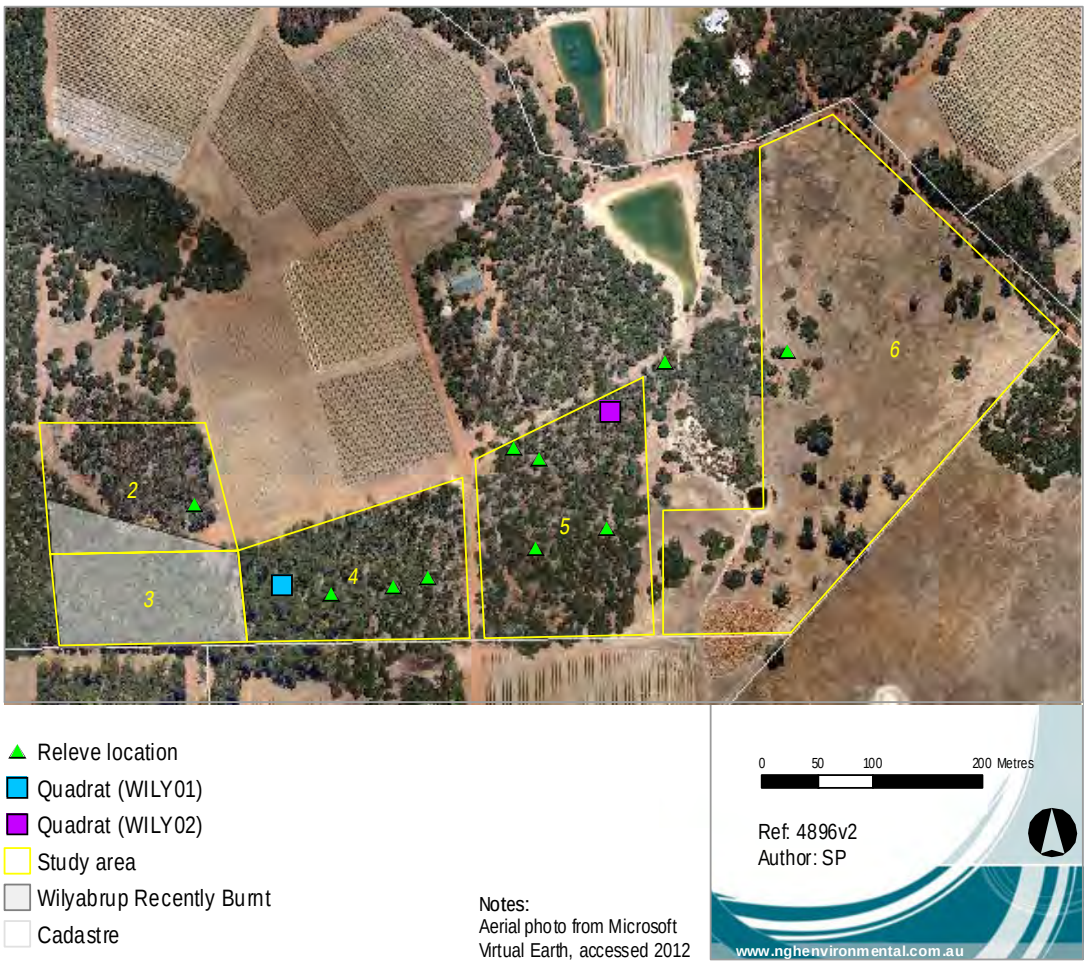

Figure 4-3 Quadrat and releve locations

4.4 THREATENED OR PRIORITY ECOLOGICAL COMMUNITIES

The vegetation within the study area does not resemble a Threatened or Priority Ecological Community.

4.5 VEGETATION CONDITION

Of the total area of remnant vegetation in the study area (stages two-six), amounting to 8.25 ha, 58% was in "Very Good" condition, 12% was in "Good" condition, 7% was in "Degraded" condition and 20% (representing all of stage three and some of stage two) was not assessed. Only 0.21 ha (2.6%) of the 8.15 ha contained in stage six was considered to be remnant vegetation, the remainder being pasture with scattered trees. Vegetation condition within the study area is mapped in Appendix B.

Degradation of the remnant vegetation within the study area has apparently been due to past land clearing activities (notably in stage six) and the construction of fire-breaks around the "blocks" of bush that comprise the "stages" – particularly around stage two. There also has been invasion of the vegetation in stage two by annual weeds apparently as a consequence of prescribed burning carried out over recent years. Invasion of the vegetation along the southern edge of stages four and five by annual weeds, and also by the shrub **Genista monspessulana* is also apparent.

4.6 REGIONAL ECOLOGICAL LINKAGES

The remnant vegetation on Lot 30 is categorized as a "1b" ecological linkage (Molloy *et al*., 2009). That is, it touches or is within 100 m of remnant vegetation which in turn touches or is within 100 m of a Regional Ecological Linkage. Therefore it has importance in maintaining ecological connectivity between the ecological linkages running north south to the east between Margaret River National Park and Yelverton National Park and to the west along the coast through Leeuwin-Naturaliste National Park.

4.7 CONSERVATION SIGNIFICANCE OF THE REMNANT VEGETATION

The remnant vegetation in the study area is part of the Cowaramup (C2) complex (Mattiske and Havel, 1998). According to Molloy *et al*. (2007) this vegetation complex has been extensively alienated for dairying and more recently has been further impacted by vineyards, rural sub-division and tourism. Only 35.7% of the pre-European extent remains of which 6.4% is in reserves. It is therefore considered to be poorly-reserved, the target level of reservation for ecological communities being 15% (EPA, 2006). The amount of remnant vegetation in the study area represents approximately 0.18% of the remaining area of the Cowaramup (C2) vegetation complex. Just over 77% of the remaining area of Cowaramup (C2) vegetation is on private property, much of which is probably degraded by livestock grazing.

There has been no regional vegetation survey for the Margaret River Plateau, on which the study area is situated, as there has been for the southern Swan Coastal Plain (Gibson *et al*., 1994), Busselton Plain (Webb *et al*., 2009) or Whicher Scarp (Keighery *et al*., 2008) so contextual information for determining the regional rarity of particular floristic community types (such as in the study area) is lacking. Consequently, even though floristic data has been collected for two quadrats in the study area there is a paucity of other floristic quadrat data from the Margaret River Plateau with which to compare it.

The 6.5 ha of remnant vegetation which was assessed within the study area had 130 native species, which represents a relatively high species-diversity compared to other areas of remnant vegetation in the in the jarrah-marri forest of south-western Australia (R. Smith, unpublished).

5 CONCLUSIONS

One hundred and fifty two species of vascular flora were found within the study area, of which 130 were native species. This number of native species in the remnant vegetation surveyed represents a relatively high species-diversity. No plant taxa gazetted as Declared Rare Flora pursuant to subsection (2) of section 23F of the WC Act or listed under the EPBC Act were located. Additionally, no Priority Flora as defined by the Department of Conservation and Land Management (2012) were located within the study area.

Two noted environmental weeds, *Acacia longifolia* and *Genista monspessulana*, both leguminous shrubs, were present in the study area but these are not on the Department of Food and Agriculture's list of Declared Plants.

No clear patterns were seen in the remnant vegetation and while the dominant understorey species varied across the site this was not in a way that allowed the mapping of boundaries between vegetation types. The remnant vegetation is comprised of jarrah – marri open forest. Although two floristic quadrats were placed within the remnant vegetation there is a lack of other floristic data for the Margaret River Plateau to compare it with using multivariate analysis.

Of the remnant vegetation that was able to be assessed in the study area - stage three had been recently burned so could not be assessed – 58% was rated as "Very Good" condition, and a further 12% was in "Good" condition. Because it is rated as category 1b this remnant vegetation has some importance in helping to maintain connectivity between the major regional ecological linkages of the Margaret River Plateau.

The remnant vegetation on Lot 30 represents about 0.18% of the remaining area of the Cowaramup (C2) vegetation complex, which is considered to be poorly conserved.

6 REFERENCES

Aplin, T.E.H. (1979). The flora. In: Environment and Science. Ed: B.J. O'Brien. University of WA Press, Perth.

Atlas of Living Australia,(ALA), (2012), http://regions.ala.org.au/ accessed 10.12.2012

Beard, J.S., (1975) *The vegetation survey of Western Australia*, 30, 3: 179-187

Beard, J.S. (1981) Vegetation survey of Western Australia, Swan 1:1,000,000. Vegetation series, explanatory notes to Sheet 7. UWA. Press, Perth.

Department of Environment and Conservation (DEC) (2010) Threatened Fauna (Specially Protected Fauna Notice 2012(2) - 6 November 2012 http://www.dec.wa.gov.au/management-and-protection/threatened-species/listing-of-species-and-ecological-communities.html

Department of Agriculture and Food Western Australia (DAFWA), (2004), Schoknecht, N., Tille, P. and Purdie, B., (2004) Soil -landscape mapping in south-western Australia.

Department of Agriculture and Food (DAF). 2011. Agriculture and Related Resources Protection Act 1976; Declared Plants, January 2011. http://www.agric.wa.gov.au/PC_93088.html

Department of Environment and Conservation (DEC) (2012). Listing of species and ecological communities. http://www.dec.wa.gov.au/content/view/852/2010/

Environment Australia (2000) Revision of the Interim Biogeographic Regionalisation of Australia (IBRA) Summary Report. Department of Environment and Heritage, Canberra on 12/12/2012 http://www.anra.gov.au/topics/vegetation/assessment/wa/ibra-warren.html

EPA (2006) Level of Assessment for Proposals affecting Natural Area within the System 6 Region and Swan Coastal Plain Portion of the System 1 Region. Environmental Protection Authority Guidance Statement No. 10, June 2006, Perth.

Hearn, R., Williams, W. and Comer, S. (2002) A Biodiversity Audit of Western Australia's 53 Biogeographical Subregions , pp. 637-655

Mattiske, E.M. and Havel, J.J., 1998. Vegetation Complexes of the South-west Forest Region of Western Australia. Maps and report prepared as part of the Regional Forest Agreement. Western Australia for the Department of Conservation and Land Management and Environment Australia. Western Australia.

Molloy, S., O'Connor, T., Wood, J. and Wallrodt, S. (2007). Reservation levels of vegetation complexes and systems with reserve status as at June 2006. Local Government Biodiversity Planning Guidelines: Addendum to the South West Biodiversity Project Area, Western Australian Local Government Association, West Perth.

Muir, B.G. (1977). Biological Survey of the Western Australian Wheatbelt. Part II. Vegetation and habitat of Bendering Reserve. Records of the West Australian Museum, Supplement No. 3.

Naturemap (2012) Department of Environment and Conservation and Western Australian Museum database website, http://naturemap.dec.wa.gov.au, accessed on 10.12.2012

APPENDIX A DATABASE SEARCHES

NatureMap
Mapping Western Australia's biodiversity

NatureMap Species Report

Created By Guest user on 12/12/2012

Kingdom Plantae
Conservation Status Conservation Taxon (T, X, IA, S, P1-P5)
Current Names Only Yes
Core Datasets Only Yes
Method 'By Circle'
Centre 115°03' 05" E,33°48' 33" S
Buffer 10km

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
1.	3386	*Acacia inops*		P3	
2.	3567	*Acacia subracemosa*		P3	
3.	32078	*Banksia sessilis var. cordata*		P4	
4.	16313	*Boronia anceps*		P3	
5.	11612	*Boronia capitata subsp. gracilis*		P3	
6.	17804	*Boronia tetragona*		P3	
7.	3708	*Bossiaea disticha*		P4	
8.	13852	*Caladenia abbreviata*		P3	
9.	13619	*Caladenia excelsa*		T	
10.	19338	*Chamaescilla gibsonii*		P3	
11.	16245	*Cyathochaeta teretifolia*		P3	
12.	7446	*Dampiera heteroptera*		P3	
13.	3096	*Drosera fimbriata (Manypeaks Sundew)*		P4	
14.	13512	*Eucalyptus rudis subsp. cratyantha*		P4	
15.	6162	*Gonocarpus pusillus*		P4	
16.	14011	*Grevillea brachystylis subsp. brachystylis*		P3	
17.	18436	*Grevillea manglesioides subsp. ferricola*		P3	
18.	6868	*Hemigenia rigida*		P1	
19.	1296	*Johnsonia inconspicua*		P3	
20.	1302	*Laxmannia jamesii (James' Paperlily)*		P4	
21.	17702	*Leptomeria furtiva*		P2	
22.	1086	*Lepyrodia heleocharoides*		P3	
23.	17693	*Meeboldina thysanantha*		P3	
24.	12077	*Pimelea ciliata subsp. longituba*		P3	
25.	4179	*Pultenaea pinifolia*		P3	
26.	16937	*Synaphea decumbens*		P3	
27.	33282	*Tetraria sp. Nannup (P.A. Jurjevich 1133)*		P1	
28.	5085	*Thomasia laxiflora*		P3	
29.	1334	*Thysanotus glaucus*		P4	
30.	1336	*Thysanotus isantherus*		P3	
31.	17481	*Xyris maxima*		P2	

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

[1] For NatureMap's purposes, species flagged as endemic are those whose records are wholely contained within the search area. Note that only those records complying with the search criterion are included in the calculation. For example, if you limit records to those from a specific datasource, only records from that datasource are used to determine if a species is restricted to the query area.

APPENDIX B VEGETATION COMPLEXES AND CONDITION

Vegetation complex and condition

Lot 30, Tom Cullity Drive, Wilyabrup
FAUNA AND HABITAT ASSESSMENT

Study area
Cadastre
Vegetation condition [2]
Very Good
Good
Degraded
Not Assessed
Vegetation complex [1]
Cowaramup
Wilyabrup

Notes:
[1] Mattiske and Havel (1998)
[2] Vegetation condition (Keighery 1994) based on Ekologica fieldwork (2012)
Aerial photo from Microsoft Virtual Earth, accessed 2012

0 25 50 100 Metres

A3 @ 1:3500
Ref: 4896v2
Author: SP

ngh environmental

www.nghenvironmental.com.au

APPENDIX C VASCULAR FLORA FOUND IN THE SURVEY AREA

FAMILY NAME	LATIN NAME	VERNACULAR	NATURALISED
Amaranthaceae	*Ptilotus manglesii*	Pom Poms	
Apiaceae	*Daucus glochidiatus*	Australian Carrot	
	Pentapeltis peltigera		
	Platysace tenuissima		
	Xanthosia candida		
Araceae	*Zantedeschia aethiopica*	Arum Lily	*
Araliaceae	*Trachymene pilosa*	Native Parsnip	
Asparagaceae	*Chamaescilla corymbosa*	Blue Squill	
	Lomandra nigricans		
	Lomandra purpurea	Purple Mat Rush	
	Lomandra sericea	Silky Mat Rush	
	Thysanotus multiflorus	Many-flowered Fringe Lily	
	Thysanotus patersonii		
	Thysanotus thyrsoideus		
Asteraceae	*Arctotheca calendula*	Cape Weed	*
	Cotula turbinata	Funnel Weed	*
	Craspedia variabilis		
	Hypochaeris radicata	Flat Weed	*
	Lagenophora huegelii		
	Sonchus asper	Rough Sowthistle	*
	Sonchus oleraceus	Common Sowthistle	*
	Trichocline spathulata	Native Gerbera	
Campanulaceae	*Isotoma hypocrateriformis*	Woodbridge Poison	
	Lobelia rhombifolia	Tufted Lobelia	
	Lobelia tenuior	Slender Lobelia	
Caryophyllaceae	*Petrorhagia velutina*	Velvet Pink	*
Celastraceae	*Stackhousia monogyna*		
	Tripterococcus brunonis	Winged Stackhousia	
Colchicaceae	*Burchardia congesta*		
Cyperaceae	*Cyathochaeta avenacea*		
	Lepidosperma leptostachyum		
	Lepidosperma pubisquameum		
	Lepidosperma squamatum		
	Tetraria octandra		
	Tetraria sp. Jarrah Forest (R. Davis 7391)		
Dilleniaceae	*Hibbertia amplexicaulis*		
	Hibbertia commutata		
	Hibbertia cuneiformis	Cutleaf Hibbertia	
	Hibbertia cunninghamii		
	Hibbertia hypericoides	Yellow Buttercups	
Elaeocarpaceae	*Tetratheca hirsuta*	Black Eyed Susan	
	Tremandra stelligera		

FAMILY NAME	LATIN NAME	VERNACULAR	NATURALISED
Ericaceae	*Astroloma ciliatum*	Candle Cranberry	
	Astroloma pallidum	Kick Bush	
	Leucopogon capitellatus		
	Leucopogon conostephioides		
	Leucopogon propinquus		
Fabaceae	*Acacia browniana*		
	Acacia celastrifolia	Glowing Wattle	
	Acacia longifolia		*
	Acacia myrtifolia		
	Acacia pulchella	Prickly Moses	
	Bossiaea linophylla		
	Bossiaea ornata	Broad Leaved Brown Pea	
	Daviesia horrida	Prickly Bitter-pea	
	Daviesia preissii		
	Genista monspessulana	Montpellier Broom	*
	Gompholobium knightianum		
	Gompholobium ovatum		
	Gompholobium polymorphum		
	Hardenbergia comptoniana	Native Wisteria	
	Hovea chorizemifolia	Holly-leaved Hovea	
	Hovea elliptica	Tree Hovea	
	Hovea stricta		
	Kennedia coccinea	Coral Vine	
	Labichea punctata	Lance-leaved Cassia	
	Lotus angustissimus	Narrowleaf Trefoil	*
	Mirbelia dilatata	Holly-leaved Mirbelia	
	Sphaerolobium medium		
	Templetonia retusa	Cockies Tongues	
	Trifolium campestre	Hop Clover	*
Goodeniaceae	*Dampiera linearis*	Common Dampiera	
	Goodenia eatoniana		
	Lechenaultia biloba	Blue Leschenaultia	
	Scaevola calliptera		
	Scaevola glandulifera	Viscid Hand-flower	
	Velleia trinervis		
Haemodoraceae	*Conostylis setigera*	Bristly Cottonhead	
	Haemodorum laxum		
Hemerocallidaceae	*Agrostocrinum hirsutum*		
	Caesia micrantha	Pale Grass-lily	
	Caesia occidentalis		
	Stypandra glauca	Blind Grass	
Iridaceae	*Patersonia occidentalis*	Purple Flag	

FAMILY NAME	LATIN NAME	VERNACULAR	NATURALISED
	Patersonia umbrosa var. *xanthina*	Yellow Flags	
Juncaceae	*Juncus gregiflorus*		
	Juncus pallidus	Pale Rush	
Lauraceae	*Cassytha racemosa*	Dodder Laurel	
Loganiaceae	*Logania serpyllifolia*		
Myrtaceae	*Agonis flexuosa*	Peppermint	
	Corymbia calophylla	Marri	
	Eucalyptus marginata	Jarrah	
	Hypocalymma angustifolium	White Myrtle	
	Hypocalymma strictum		
	Kunzea recurva		
Orchidaceae	*Caladenia attingens*		
	Caladenia ferruginea	Rusty Spider Orchid	
	Caladenia flava	Cowslip Orchid	
	Diuris longifolia	Common Donkey Orchid	
	Elythranthera brunonis	Purple Enamel Orchid	
	Pterostylis recurva	Jug Orchid	
	Pyrorchis nigricans	Red beaks	
	Thelymitra crinita	Blue Lady Orchid	
	Thelymitra macrophylla		
Orobanchaceae	*Orobanche minor*	Lesser Broomrape	*
Oxalidaceae	*Oxalis pes-caprae*	Soursob	*
Pittosporaceae	*Billardiera variifolia*		
Poaceae	*Amphipogon amphipogonoides*		
	Amphipogon debilis		
	Austrostipa compressa		
	Austrostipa semibarbata		
	Briza maxima	Blowfly Grass	*
	Briza minor	Shivery Grass	*
	Bromus diandrus	Great Brome	*
	Bromus hordeaceus	Soft Brome	*
	Holcus lanatus	Yorkshire Fog	*
	Lolium rigidum	Wimmera Ryegrass	*
	Microlaena stipoides	Weeping Grass	
	Neurachne alopecuroidea	Foxtail Mulga Grass	
	Poa annua	Winter Grass	*
	Tetrarrhena laevis	Forrest Ricegrass	
Podocarpaceae	*Podocarpus drouynianus*	Wild Plum	
Polygalaceae	*Comesperma calymega*	Blue-spike Milkwort	
	Comesperma virgatum	Milkwort	
Polygonaceae	*Acetosella vulgaris*		*
Proteaceae	*Banksia bipinnatifida*		

FAMILY NAME	LATIN NAME	VERNACULAR	NATURALISED
	Banksia dallanneyi	Couch Honeypot	
	Banksia grandis	Bull Banksia	
	Grevillea quercifolia	Oak-leaf Grevillea	
Proteaceae	*Hakea amplexicaulis*	Prickly Hakea	
	Hakea lissocarpha	Honey Bush	
	Persoonia longifolia	Snottygobble	
	Synaphea gracillima		
Ranunculaceae	*Clematis pubescens*	Common Clematis	
Restionaceae	*Desmocladus fasciculatus*		
	Desmocladus flexuosus		
	Loxocarya cinerea		
Rhamnaceae	*Trymalium ledifolium*		
Rubiaceae	*Opercularia hispidula*	Hispid Stinkweed	
Rutaceae	*Philotheca spicata*	Pepper and Salt	
Solanaceae	*Solanum linnaeanum*		*
	Solanum nigrum	Black Berry Nightshade	*
Stylidiaceae	*Levenhookia pusilla*	Midget Stylewort	
	Stylidium amoenum	Lovely Triggerplant	
	Stylidium calcaratum	Book Triggerplant	
	Stylidium rhynchocarpum	Black-beaked Triggerplant	
	Stylidium schoenoides	Cow Kicks	
Thymelaeaceae	*Pimelea lanata*		
	Pimelea spectabilis	Bunjong	
Xanthorrhoeaceae	*Xanthorrhoea gracilis*	Graceful Grass Tree	
	Xanthorrhoea preissii	Grass tree	
Zamiaceae	*Macrozamia riedlei*	Zamia	

APPENDIX D RELEVE BY SPECIES TABLE

SPECIES	820	836	838	884	888	894	895	896	901	903
Acacia browniana							+			
Acacia myrtifolia		+	+							
Acacia pulchella		+				+				
Agonis flexuosa									+	+
Agrostocrinum hirsutum					+					
Arctotheca calendula	+									
Austrostipa semibarbata			+							
Banksia grandis				+	+					
Bossiaea ornata		+		+		+		+	+	
Briza maxima					+					
Briza minor	+									
Bromus diandrus	+									
Burchardia congesta	+					+				
Caladenia attingens			+							
Caladenia flava	+									
Comesperma virgatum							+			
Conostylis setigera								+		
Corymbia calophylla	+	+	+	+	+	+	+	+	+	+
Daucus glochidiatus									+	
Daviesia horrida							+			
Desmocladus fasciculatus								+		
Eucalyptus marginata	+	+	+	+	+	+	+	+	+	
Gompholobium ovatum				+						
Goodenia eatoniana						+				
Hakea amplexicaulis		+		+				+	+	
Hakea lissocarpha							+	+	+	+
Hibbertia amplexicaulis	+									
Hibbertia commutata			+							
Hibbertia hypericoides	+	+	+	+	+	+	+	+	+	+
Holcus lanatus										+
Hovea chorizemifolia		+								
Hovea elliptica				+	+					
Hypocalymma angustifolium			+							
Hypochaeris radicata	+									+
Kunzea recurva										+
Lagenophora huegelii	+					+				
Lechenaultia biloba	+	+	+			+	+			
Lepidosperma leptostachyum		+				+			+	
Lepidosperma squamatum			+	+						
Leucopogon conostephioides									+	
Leucopogon propinquus								+		
Lomandra purpurea	+					+				

SPECIES	820	836	838	884	888	894	895	896	901	903
Opercularia hispidula	+									
Patersonia occidentalis								+	+	
Patersonia umbrosa* var. *xanthina		+	+					+		
Persoonia longifolia			+							
Petrorhagia velutina			+							
Philotheca spicata		+					+			
Pimelea lanata			+							
Pimelea spectabilis							+	+		
Scaevola calliptera									+	
Solanum linnaeanum										+
Stylidium amoenum					+					
Tetraria octandra					+			+	+	
***Tetraria* sp. Jarrah Forest (R. Davis 7391)**		+				+	+	+	+	
Tetratheca hirsuta		+		+						
Thysanotus multiflorus					+					
Trachymene pilosa	+									
Xanthorrhoea gracilis			+	+	+	+	+	+	+	
Xanthorrhoea preissii					+	+	+	+		+
Xanthosia candida		+								

APPENDIX E FLORISTIC QUADRAT DATA

Quadrat: WILY01

Location: Lot 30, Harman's South Road, Wilyabrup		**Latitude/Longitude:** 6257025 m N; 319517 m E	
Landscape Position: Upper Slope		**Soil Type:** red-brown gravelly sandy loam	
Litter: 70%		**Debris:** 10%	
Species	**Cover**	**Species**	**Cover**
Trees		**Herbs**	
Eucalyptus marginata	4	*Caladenia flava*	1
Corymbia calophylla	1	*Agrostocrinum hirsutum*	1
		Tricoryne spathulata	1
Shrubs		*Lomandra purpurea*	1
Acacia myrtifolia	2	*Thelymitra macrophylla*	1
Hibbertia hypericoides	4	*Burchardia congesta*	1
Logania serpyllifolia	1	*Lagenophora huegelii*	1
Hovea chorizemifolia	1	*Cassytha racemosa*	1
Xanthorrhoea gracilis	1	*Opercularia echinata*	1
Dampiera linearis	1	*Xanthosia candida*	1
Tetratheca hirsuta	1	*Patersonia umbrosa* var. *xanthina*	1
Lechenaultia biloba	1	*Platysace tenuissima*	1
Pentapeltis peltigera	1	*Thelymitra crinita*	1
Hibbertia cunninghamii	1	*Thysanotus thyrsoideus*	1
Pimelea spectabilis	1	*Lomandra sericea*	1
Billardiera variifolia	1		
Comesperma virgatum	1	**Sedges/Restiads/Rushes**	
		Tetraria octandra	3
Grasses		*Tetraria capillaris*	3
Tetrarrhena laevis	3	*Lepidosperma leptostachyum*	1
Amphipogon amphipogonoides	1	*Lepidosperma squamatum*	1
**Briza maxima*	1	*Desmocladus fascicularis*	1
Microlaena stipoides	1		
Austrostipa compressa	1		

Quadrat: WILY02

Location: Lot 30, Harman's South Road, Wilyabrup		**Latitude/Longitude:** 6257025 m N; 319517 m E	
Landscape Position: Mid Slope		**Soil Type:** yellow-brown gravelly loamy sand	
Litter: 50%		**Debris:** 10%	
Species	**Cover**	**Species**	**Cover**
		Grasses	
Trees		*Austrostipa semibarbata*	1
Eucalyptus marginata	4	*Neurachne alopecuroidea*	1
Corymbia calophylla	2		
		Herbs	
Shrubs		*Burchardia congesta*	1
Xanthorrhoea preissii	2	*Patersonia occidentalis*	1
Hibbertia hypericoides	5	*Agrostocrinum hirsutum*	1
Scaevola calliptera	3	*Ptilotus manglesii*	1
Dampiera linearis	1	*Thelymitra macrophylla*	1
Hakea lissocarpha	1	*Caladenia flava*	1
Banksia dallanneyi	1	*Caesia micrantha*	1
Gompholobium ovatum	1	*Lomandra integra*	1
Xanthorrhoea gracilis	1	*Conostylis setigera*	1
Tetratheca hirsuta	1	*Lagenophora huegelii*	1
Hibbertia cunninghamii	1	*Caladenia ferruginea*	1
Acacia pulchella	1	*Patersonia umbrosa* var. *xanthina*	1
Leucopogon capitellatus	1	*Thelymitra crinita*	1
Comesperma virgatum	1	*Platysace tenuissima*	1
Sphaerolobium medium	1	*Lomandra purpurea*	1
Goodenia eatoniana	1		
		Sedges/Restiads/Rushes	
Grasses		*Cyathochaeta avenacea*	1
Tetrarrhena laevis	1	*Lepidosperma leptostachyum*	1
Amphipogon amphipogonoides	1	*Tetraria octandra*	2
Austrostipa compressa	1	*Tetraria capillaris*	1
		Loxocarya cinerea	1
		Lepidosperma squamatum	1