# LEVEL 2 VEGETATION SURVEY FOR LOTS 13, 14, 18 BARFIELD ROAD & 48-51 ROWLEY ROAD, HAMMOND PARK

## DEPARTMENT OF HOUSING

## GOLD ESTATES HOLDINGS PTY LTD

Prepared by:

**Ecoscape (Australia) Pty Ltd**

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# Summary

## Hammond Park Vegetation Survey

A Level 2 Flora and Vegetation survey of approximately 33ha on Lots 13, 14 and 18 Barfield Road and Lots 48-51 Rowley Road, Hammond Park was conducted in October 2008. The survey was conducted in accordance with Ecoscape's interpretation of the EPA's requirements for a Level 2 survey as outlined in Guidance Statement No. 51 – *Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessments in Western Australia* (EPA 2004).

A desktop survey has determined that there are no significant environmental constraints in respect to:

- The site is not associated with any Environmentally Sensitive or Protected Areas.
- The site is not within a Public Drinking Water Source Area, with the groundwater 6-22m below the surface, marginal salinity and contamination risk is classified as low.
- The site is located on the transition of the Spearwood Sands and Bassendean Sands.

The flora and vegetation survey has determined that:

- The site is within Beard Vegetation Association '*Banksia* low woodland' in the Bassendean System.
- The Heddle Vegetation Complex is Bassendean – Central and South, which is listed in *EPA Guidance Statement No 10* (2006) as having 27% remaining on the Swan Coastal Plain (in 2002), with 0.7% reserved. As more than 400ha of this complex remains it is not considered significant.
- There are no Threatened Ecological Communities or Priority Ecological Communities identified from the site.
- The *inferred* Floristic Community Type is SCP23a – Central *Banksia attenuata – B. menziesii* woodlands, which is Well Reserved and Low Risk.
- The site is only associated with only one vegetation community, *Banksia* spp. and *Allocasuarina fraseriana* Low Woodland.
- A total of 149 vascular plant species were found, including 31 weeds. Nine of these weeds were *high* risk according the EWSWA, with *Zantedeschia aethiopica* (arum lily) a Declared Plant, for which control is recommended.
- No Declared Rare or Priority-listed Flora species were recorded.
- *Laxmannia grandiflora*, listed as a significant flora species of the Swan Metropolitan Area by *Bush Forever*, was scattered throughout the site. *Laxmannia grandiflora* is not listed by DEC as a DRF or Priority species.
- The vegetation was mostly in *excellent* condition, but ranged from *excellent* to *completely degraded* areas associated with houses, sand mining or livestock grazing.

The Level 2 Flora and Vegetation survey did not identify any significant flora or vegetation constraints or impediments to the future urban development of the site.

# 1.0 Introduction

**Hammond Park Vegetation Survey**

## 1.1 Background

Lots 13, 14 and 18 Barfield Road and Lots 48-51 Rowley Road, Hammond Park are owned by the Department of Housing and their joint venture partner Gold Estates Holdings Pty Ltd.

The land is currently zoned as Urban Deferred under the Metropolitan Region Scheme and as Development Zone under the City of Cockburn Town Planning Scheme No.3. Planning for the landholding is at a preliminary stage, however the owners have contracted Ecoscape to undertake a Level 2 Flora and Vegetation survey of the site.

## 1.2 Project Objectives

This assessment, which included desktop and a spring flora survey, investigated:

- environmental aspects, including:
    - physical context of the site
    - biological context of the site
- desktop assessment of vegetation, including:
    - nearby threatened flora species
    - nearby Threatened Ecological Communities
    - regional significance of vegetation
- field assessment of vegetation, including:
    - mapping vegetation communities
    - floristic community type analysis (recording vegetation in quadrats for later analysis and comparison with Threatened Ecological Community data)
    - vegetation condition mapping
    - a targeted survey for threatened flora species.

The vegetation and flora assessment was undertaken accordance with Ecoscape's interpretation of the Environmental Protection Authority Guidance Statement No. 51 – *Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessments in Western Australia* (EPA 2004) definition of Level 2, and EPA Position Statement No 2 – *Environmental Protection of Native Vegetation in Western Australia* (EPA 2000), which includes both desktop and reconnaissance field survey.

## 1.3 Study Area

The study area, which comprises of Lots 13, 14 and 18 Barfield Road and Lots 48-51 Rowley Road, Hammond Park, is situated approximately 25km south of the Perth CBD, in the City of Cockburn. The Lots are bounded by Frankland Avenue to the west, rural-residential properties to the north, Barfield Road to the east and Rowley Road to the south. **Figure 1** shows the location of the study area.


***Figure 1: Location of the Study Area (Gold Estates)***

The study area is approximately 33 hectares and comprises largely uncleared bushland. Lots 13, 14, 18 and 51 contain residences and sheds, Lot 14 has areas of clearing associated with soil extraction and dumping, and Lot 18 is grazed by horses.

# 2.0 Environment



The following sources of information were examined to gather background information on the study area.

## 2.1 Physical Context of Project Area

### 2.1.1 Climate

The South-West of Western Australia has a Mediterranean climate (BOM 2008) of mild, wet winters and warm to hot, dry summers (American Meteorology Society (AMS) 2008).

According to climate data from the Bureau of Meteorology (BOM) recording station located at Jandakot Airport (approximately 10 km north of the study area) mean maximum temperatures range between 31.2˚C in February and 17.8˚ C in July, and mean minimum temperatures between 16.8˚ C in February and 6.9˚ C in July-August. Mean annual rainfall for the station is 842.2 mm, falling predominantly in the May to August period (BOM 2008).

### 2.1.2 Topography, Geology and Soil

Churchward and McArthur (1980), Biggs *et al.* (1980) and DAFWA (2007) were reviewed to determine landform and soil types in the study area.

According to Churchward and McArthur (1980), the study area is located at the transition of the Spearwood and Bassendean Dune Systems of the Swan Coastal Plain. Both systems are of Aeolian origin, with the Spearwood System overlying the older Bassendean System that lies to the east (McArthur and Bettenay 1960). The Spearwood Dunes consist of a core of Tamala Limestone with a hard capping of calcite (cap-rock) overlain by a variable depth of yellow to brown sands. The Bassendean Dunes consist of low hills and intervening swampy areas, with iron or humus podzols (McArthur 1991).

A search of the soil-landscape maps (DAFWA 2007) revealed that the Spearwood S1b and Bassendean B1 soil phases occur within the study area. The Spearwood S1b phase is characterised by dune ridges with deep siliceous yellow brown sands or pale sands with yellow-brown subsoil and slopes up to 15%. The Bassendean B1 phase has extremely low to very low relief dunes, undulating sandplain and discrete sand rises, with deep bleached grey sands sometimes with a pale yellow B horizon or a weak iron-organic hardpan at depths generally greater than 2 m.

### 2.1.3 Groundwater Hydrology

**Groundwater**

The online *Perth Groundwater Atlas* (DOW 2008) was consulted to determine if the area is located within a Perth Drinking Water Supply Area (PDWSA), the depth to groundwater, salinity and groundwater contamination risk.

Information contained in the *Perth Groundwater Atlas* (DOW 2008) indicates that:

- the site is not included in a Public Drinking Water Source Area;
- the depth to groundwater varies from 6m to 22m below ground level;
- watertable level varies from 18 to 21 AHD (Australian Height Datum);
- salinity varies from 500-1000 Total Dissolved Salts (mg/L), which is classed as marginal; and
- groundwater contamination risk is classified as low (groundwater quality and quantity likely to be acceptable for garden use).

# 2.2 Biological Context of the Project Area

## 2.2.1 Bioregional Context

The study area is within the Swan Coastal Plain (SWA) IBRA (Interim Biogeographic Regionalisation of Australia) Region (Commonwealth of Australia 2008a) and in the Swan Coastal Plain 2 (SWA2 – Swan Coastal Plain) subregion (Mitchell, Williams & Desmond 2002). The Swan Coastal Plain is characterised by a low-lying coastal plain, mainly covered by woodlands. *Banksia* and Jarrah-*Banksia* woodlands are the usual vegetation of the dune systems, including the Bassendean system.

## 2.2.2 Vegetation

### *Vegetation Units*

Beard (1981) was consulted to determine the vegetation units in the study area, which were mapped primarily by the structure of the vegetation and dominant species.

Beard (1981) has determined the vegetation to be part of the Bassendean System that stretches discontinuously for the whole length of the Swan Coastal Plain. It is broadly described as *Banksia* low woodland dominated by *Banksia attenuata, B. menziesii*, *B. ilicifolia*, *Eucalyptus todtiana* and *Nuytsia floribunda*, with *Allocasuarina fraseriana* joining the tree layer south of Gingin, and *Eucalyptus marginata* replacing *Eucalyptus todtiana* south of Lake Gnangara. In this case, Beard (1981) vegetation association 1001, medium very sparse woodland; jarrah, with low woodland; *Banksia* & *Allocasuarina*, was the only mapped unit within the study area.

### *Regional Significance of Vegetation*

There are two main methods used to describe the regional significance of vegetation on the Swan Coastal Plain: the Vegetation Complexes of Heddle *et al.* (1980) and the Floristic Community Types (FCTs) of Gibson *et al.* (1994).

Whilst FCTs are more mosaic in nature than units or complexes, the classifications are equivalent in that they are both regional classifications that divide the region into roughly an equal number of classes. As would be expected there are some associations between FCTs and complexes (i.e. some FCTs tend to occur in particular complexes), but there is **no** hierarchical structure in which complexes are either FCTs or complexes would be considered finer or broader classifications.

Both classifications are referred to because vegetation units and complexes are useful in determining the degree to which vegetation types have been cleared at a regional scale and Threatened Ecological Communities, on the Swan Coastal Plain, are defined in terms of FCTs.

**Vegetation Complexes**

Heddle *et al.* (1980) divided the Swan Coastal Plain into medium to large areas based on soil and landform units, with the vegetation within these areas defined in terms of floristic composition, growth-form dominance, species composition and stratal structure. The Heddle Vegetation Complexes are used to estimate areas of remaining vegetation, and determine (in part) if an area is below a predetermined percentage for which clearing is not permitted (EPA 2006).

According to Heddle *et al.* (1980), only the Bassendean (Central and South) Vegetation Complex occurs within the study area. The complex is described as ranging from woodland of *Eucalyptus marginata – Allocasuarina fraseriana – Banksia* spp., to low woodland of *Melaleuca* spp. and sedgelands on moister sites.

*EPA Guidance Statement No 10* (2006), using 2002 data, lists this vegetation complex as having 27% the original extent remaining, but only 0.7% in secure tenure (**Table 1**). A key commitment in the Urban Bushland Strategy (Government of Western Australia 1995) is to retain at least 10% or 400ha, whichever is the largest, of each complex. This criteria has been met with Bassendean Central and South Vegetation Complex.

***Table 1: Vegetation Complexes remaining on the Swan Coastal Plain (SCP)***

| | | Remaining on SCP | | Remaining on SCP in Secure Tenure | |
|---|---|---|---|---|---|
| **Vegetation Complex** | **Total pre-1750 extent (ha)** | **Area (ha)** | **% Original Area** | **Area (ha)** | **% Original Area** |
| Bassendean Complex – Central And South | 87477.0 | 23624.0 | 27.0 | 572.0 | 0.7 |

**Floristic Community Types**

Gibson *et al.* (1994) divided the Swan Coastal Plain into small to medium areas on the basis of groups of plants that occur together.

Floristic Community Types are used to define TECs on the Swan Coastal Plain. The extent of an FCT is not mapped in the same way as Vegetation Complexes or Vegetation Units, thus their presence cannot be determined by desktop assessment. Floristic Community Type classification is *inferred* by statistically analysing the results of quadrats recorded during the field survey.

## *Threatened Ecological Communities and Priority Ecological Communities*

A search for nearby Threatened Ecological Communities (TECs) and Priority Ecological Communities (PECs) in the Department of Environment and Conservation (DEC) databases

was undertaken. Definitions and criteria of the DEC's TECs and PECs are in **Table A2.1** in **Appendix 2**.

TECs may also be listed under the federal *Environment Protection and Biodiversity Conservation Act (1999)* (Commonwealth of Australia). The EPBC Act database search (Commonwealth of Australia 2008b) was used to determine if any of the TECs listed by the DEC or found during the field survey were federally listed.

Four TECs are known to occur in the vicinity of the study area:

- SCP 26a '*Melaleuca huegelii - Melaleuca acerosa* (currently *M. systena*) shrublands on limestone ridges, which is *Endangered* according to DEC criteria.
- SCP 10a – Shrublands on dry clay flats (*Endangered*).
- SCP 08 – Herb rich shrublands in clay pans (*Vulnerable*).
- SCP 30a – '*Callitris preissii* (or *Melaleuca lanceolata*) forests and woodlands, Swan Coastal Plain (*Vulnerable*).

Two *Priority 3* Ecological Communities also occur near the study area:

- SCP 24 – Northern Spearwood shrublands and woodlands.
- SCP 29a – Coastal shrublands on shallow sands.

None of the above TEC/PECs were encountered during the field survey of the study area and subsequent analysis (see section **3.1.3**).

### 2.2.3 Flora

#### *Conservation Significant Flora*

The DEC's Threatened Flora databases were searched for records of occurrences of threatened flora located within an approximate 10km radius of the study area. **Table A2.2** in **Appendix 2** shows the DEC's threatened flora conservation codes and definitions.

Declared Rare Flora species may also be listed under the *Environment Protection and Biodiversity Conservation Act (1999)* (Commonwealth of Australia). The EPBC Act 1999 database search (Commonwealth of Australia 2008b) was also investigated to determine if any of the threatened flora listed by the DEC or found during the field survey were federally listed.

The DEC's database search found eight species of threatened flora within 10km of the site: these are listed below in **Table 2.**

***Table 2: DEC Threatened Flora Database Search Results***

| *Species* | Federal listing | State listing | Description | Soils | Flowering | Vegetation |
|---|---|---|---|---|---|---|
| *Anthotium junciforme* | | P4 | Perennial herb | Sandy clay, clay | Nov–Mar | *Melaleuca* woodlands/shrublands, sedgelands |
| *Aotus cordifolia* | | P3 | Shrub | Peaty soils | Aug–Jan | *Melaleuca* woodlands/shrublands, *Taxandria* shrublands |
| *Caladenia huegelii* | En | R | Perennial herb | Sand, clay loam | Sep–Oct | Jarrah, *Banksia, Melaleuca* Woodland |
| *Cyathochaeta teretifolia* | | P3 | Perennial herb (sedge) | Grey sand, sandy clay, swamps | - | *Melaleuca preissiana*, Jarrah woodland |
| *Dodonaea hackettiana* | | P4 | Shrub or tree | Sand, limestone | Jul–Oct | Woodland, shrubland |
| *Drakaea elastica* | En | R | Perennial herb | Sand, near swamps | Oct-Nov | *Kunzea* shrubland, *Banksia* woodland |
| *Eremaea asterocarpa* subsp. *brachyclada* | | P1 | Shrub | Sand | Oct | - |
| *Tripterococcus paniculatus* | | P1 | Perennial herb | Peaty sand | Oct-Nov | Woodland, shrubland, heath |
| *Verticordia lindleyi* subsp. *lindleyi* | | P4 | Shrub | Sand, sandy clay | May/Nov–Jan | Shrubland, woodland |

## 2.2.4 Environmentally Sensitive Areas

**Protected Areas**

The Department of the Environment, Water, Heritage and the Arts (DEWHA) *Protected Matters Search Tool* (Commonwealth of Australia) was used to search for areas listed under the EPBC Act as Protected Areas. Areas such as wetlands and heritage sites are listed under the EPBC Act (Commonwealth of Australia 1999).

There are no protected areas within the study area. It is however, located within the same catchments as the Becher Point wetlands, and Peel-Yalgorup system, and within 10km of the Forrestdale and Thomsons Lakes, all of which are Ramsar sites (Commonwealth of Australia 2008b).

**Bush Forever**

Bush Forever sites are regionally significant areas of natural vegetation within the Perth Metropolitan Region. The Western Australian Government, the Western Australian Planning Commission (WAPC), the EPA and other key environmental agencies have endorsed Bush Forever and the sites are set aside for protection (WAPC 2004).

The *Directory of Bush Forever Sites* (Government of Western Australia 2000) was consulted for sites within and near the study area, and for inclusion in Perth's Greenways.

No Bush Forever sites are located within or immediately adjacent to the study area. The nearest sites, Mandogalup Road Bushland, Mandogalup (Site 268) and Harry Waring Marsupial Reserve, Wattleup (site 391), are located approximately 1km to the south-west and north-west, respectively. Other sites within a 3km radius include Hope Valley (Site 267); Wandi Nature Reserve and Anketell Road Bushland (Site 347), Wandi/Oakford (Site 347); Thomsons Lake Nature Reserve and Adjacent Bushland, Beeliar (Site 391); Wattelup Lake and Adjacent Bushland, Wattleup/Mandogalup (Site 393); and Lyon Road Bushland, Banjup (Site 492).

**Other Conservation Areas**

The State Cadastral Database (DLI 2005) was examined to determine if the study area contains or is close to other conservation areas.

No conservation areas, in additional to those previously mentioned as being protected under Bush Forever, are located in the vicinity of the study area.

# 3.0 Flora and Vegetation

**Hammond Park Vegetation Survey**

## 3.1 Vegetation

### 3.1.1 Survey Methodology and Botanical Survey Limitations

Ecoscape staff members Senior Botanist Lyn Atkins (Flora Licence SL007981), with Environmental Scientist Jared Nelson (Flora Licence SL008351) or Senior Environmental Scientist Markus Mikli (Flora Licence SL007639), surveyed the study area on October 14th, 15th, and November 7th, 2008.

The 2008 winter-spring rainfall was approximately 81% of the long-term average for the season (May-September average rainfall 667.3mm, 2008 rainfall 542.8mm for Jandakot, approximately 10km north (BOM 2008)). Despite August being approximately 100mm drier than average (BOM 2008), there was no discernable effect of this dry period on the health and flowering of any species observed on the study area, therefore there are negligible limitations in relation to ephemeral species' presence or the ability to recognise them.

The field survey was undertaken during the optimal flowering period of the two Declared Rare Flora (DRF) species identified by the DEC as likely to occur on site, *Caladenia huegelii* and *Drakaea elastica* (**Table 2**). Most of the other species listed in **Table 2** would also have been flowering at the time of the survey and would have been recognisable at this time. Therefore there are no significant constraints in relation to recognising these species during the field survey.

The site was surveyed for approximately 14hrs (30 hours total) by two surveyors, except Lot 18 which was only surveyed by one person. Two surveyors, one with over twenty years of botanical experience including on the Swan Coastal Plain, surveyed the site at approximately 20m spacing, with additional time spent surveying areas of *Kunzea glabrescens* thicket, which is the known habitat of *Drakaea elastica* (DRF). Opportunistic observations of flora species and three 10m x 10m relevés (unmarked floristics quadrats) were recorded during the survey. Within the relevés, all flora species, a vegetation community description and condition assessment were recorded.

The survey is anticipated to have covered over 95% of the study area, and therefore there is no or negligible constraint on the proportion of the study area that was surveyed or in relation to the competency of the surveyors.

A Statement of Botanical Survey Limitations table is included in **Table A2.4** in **Appendix 2**.

### 3.1.2 Vegetation Communities

Vegetation Communities were mapped and described using the methodology of Muir (1977), with all species recorded from 10m x 10m unmarked floristics quadrats. This data was used for comparison with the FCT dataset of Gibson *et al.* (1994), to enable accurate assessment of the conservation status of vegetation communities found on site.

Only one vegetation community was recorded for the site, which could be described as *Banksia* spp. – *Allocasuarina fraseriana* Low Woodland. There was variation in density of the various species within the community, which is reflected in the descriptions of the three floristics quadrats recorded on the site. The floristics quadrat descriptions are:

- *Banksia attenuata* and *Allocasuarina fraseriana* Low Woodland A over *Xanthorrhoea preissii, A. humilis* and *Stirlingia latifolia* Open Dwarf Scrub C over *Hibbertia hypericoides, Petrophile linearis* and *Calytrix fraseri* Dwarf Scrub D, in *excellent* condition.
- *Banksia menziesii, B. attenuata, B. ilicifolia* and *Allocasuarina fraseriana* Low Woodland A over *Eremaea pauciflora, Stirlingia latifolia* and *Xanthorrhoea preissii* Dwarf Scrub C over *Hibbertia hypericoides, Leucopogon conostephioides, Eremaea asterocarpa* subsp. *asterocarpa* and *Conostephium pendulum* Dwarf Scrub D, in *excellent* condition.
- *Banksia attenuata, B. ilicifolia, Allocasuarina fraseriana* and *B. menziesii* Low Woodland A over *Kunzea glabrescens* Scrub over *Xanthorrhoea preissii* and *A. humilis* Open Low Scrub A over *Stirlingia latifolia* and *Hemiandra pungens* Open Dwarf Scrub D, in *very good* condition.

Images of the floristics quadrat sites are provided in **Plates 1-3** in **Appendix 4**.

As there is only one vegetation community, no map has been produced to illustrate this.

### 3.1.3 Floristic Community Type Analysis

The results of FCT analysis are shown in **Table 3**, which show that the quadrats recorded on the study area show affinities with two FCTS: SCP21a – Central *Banksia attenuata – Eucalyptus marginata* woodlands, and SCP23a – Central *Banksia attenuata – B. menziesii* woodlands. Both of these communities are Well Reserved and Low Risk.

All of the communities have been *inferred* as belonging to SCP23a – Central *Banksia attenuata – B. menziesii* woodlands (results shaded in **Table 3**). The analysis has *inferred* SCP23a rather than SCP21a because of the lack of *Eucalyptus marginata* in the quadrats, although it was present on the site, and the higher cumulative frequency scores which weights species according to how commonly they are associated within a given FCT.

***Table 3: FCT Analysis***

| Quadrat | FCT | Total Ssp. No. in Quadrat | Species Richness | | | Cumulative Frequency | Reservation Status | Conservation Status | DEC Criteria |
|---|---|---|---|---|---|---|---|---|---|
| | | | Total in FCT Data | No. of FCT Spp | % of FCT Spp | | | | |
| Q1 | SCP21a – Central *Banksia attenuata-Eucalyptus marginata* woodlands | 40 | 54.6 | 29 | 53.11 | 1247 | Well Reserved | Low Risk | - |
| Q1 | SCP23a – Central *Banksia attenuata-B. menziesii* woodlands | 40 | 62.8 | 29 | 46.18 | 1825 | Well Reserved | Low Risk | - |
| | | | | | | | | | |
| Q2 | SCP21a – Central *Banksia attenuata-Eucalyptus marginata* woodlands | 36 | 54.6 | 19 | 34.8 | 826 | Well Reserved | Low Risk | - |
| Q2 | SCP23a – Central *Banksia attenuata-B. menziesii* woodlands | 36 | 62.8 | 19 | 30.25 | 1167 | Well Reserved | Low Risk | - |
| | | | | | | | | | |
| Q3 | SCP21a – Central *Banksia attenuata-Eucalyptus marginata* woodlands | 50 | 54.6 | 29 | 53.11 | 1296 | Well Reserved | Low Risk | - |
| Q3 | SCP23a – Central *Banksia attenuata-B. menziesii* woodlands | 50 | 62.8 | 30 | 47.77 | 1709 | Well Reserved | Low Risk | - |

### 3.1.4 Vegetation Condition

Vegetation condition was mapped and assessed using the Keighery (1994) Bushland Condition Scale (in **Table A2.3,** in **Appendix 2**). Small areas of isolated disturbance (e.g. rubbish dumped along firebreaks, **Plate 4** in **Appendix 3** and dumped car, **Plate 5**) and firebreaks were not mapped as a separate vegetation condition.

The vegetation condition of the study area ranged from *excellent* to *completely degraded* condition:

- Most of the study area is in *excellent* condition, with few weeds and little sign of human disturbance, although there are some areas of tree death or stress, to which a cause could not be attributed (**Plate 6**).
- Areas of *very good* condition vegetation are associated with fencelines, through the centre of Lots 49 and 50 Frankland Avenue (possibly an old track) and around houses. These areas are weedy, mostly veldt grass (**Ehrharta calycina*), but retain most of their native species.
- *Good* condition vegetation is weeder than *very good* condition vegetation and has fewer and more sparse, native species. The area on the north of Lot 14 Barfield Road had been burnt approximately 5 years previously.
- *Degraded* condition vegetation is either grazed by horses (Lot 18 Barfield Road, **Plate 7**) or has otherwise been disturbed. There is little native vegetation in these areas.
- Areas that are associated with houses, gardens and other areas of high disturbance including the sandpit on Lot 14 Barfield Road, are *completely degraded*. There are virtually no native species in these areas.

# 3.2 Flora

## 3.2.1 Flora Inventory

All vascular plant species that were observed in the floristics quadrats and during the survey for conservation significant flora are listed in **Table A3.1** in **Appendix 3**. Plants associated with garden areas or otherwise obviously planted along Frankland Avenue were not included in the inventory.

In total, 149 vascular plant species were recorded from the study area, including 32 introduced species (weeds).

POACEAE (the grass family) was represented by 14 species including 11 weeds, PAPILIONACEAE (the peas) has 12 species including three weeds, ORCHIDACEAE (orchids) has 11 species, ASTERACEAE (the daisy family) has 10 species including six weeds, and PROTEACEAE (the protea family) has 10 species.

The weeds recorded include 10 species that have been rated as *high* risk according to the Environmental Weed Strategy for Western Australia (EWSWA) (CALM 1999), and one that is a Declared Plant (DAFWA 2008) (**Table A3.1**). Weeds that are *high* risk are those that have the ability to invade bushland that is in *good* to *excellent* condition, have a wide current or potential distribution, and have the ability to change the structure, composition and function of ecosystems, often forming monocultures (CALM 1999). The Declared Plant *Zantedeschia aethiopica* (Arum Lily), which is classed as *P1*, prohibiting movement of plants or their seeds within the state, and *P4* which prevents the spread of infestation from the property on or in livestock, fodder, grain, vehicles and/or machinery, should be controlled on site.

## 3.2.2 Conservation Significant Flora

A grid survey for Declared Rare and Priority flora, at 20m spacing surveying 10m either side of a walked line, was conducted at the time of the field survey.

No Declared Rare Flora listed under the Western Australian *Wildlife Conservation Act* (1950) or species listed under the Commonwealth *EPBC Act* (1999) were located in the study area, nor any DEC Priority- listed species.

An orchid species in the study area was initially thought to have been *Caladenia huegelii*, which is a DRF species. The species was not collected as it is illegal to knowingly collect DRF species unless a specific permit has been obtained to do so, so several photographs were taken (**Plate 8**). Photographs were forwarded to Dr Andrew Brown (DEC orchid specialist) who confirmed the specimen was *Caladenia arenicola*, which is not a threatened species.

*Eremaea asterocarpa* (**Plate 9**) was a common component of the understorey. The DEC database search identified *E. asterocarpa* subsp. *brachyclada*, which is a Priority 1 subspecies, as occurring within 10km of the site. Despite consulting the relevant taxonomic text (Hnatiuk 1993) no determination to subspecies could be made. A voucher specimen was submitted to be the Western Australian Herbarium Reference Collection. Mike Hislop (DEC) examined the voucher specimen and has advised Ecoscape (email, 23rd December, 2008) that Perth-based collections of *E. asterocarpa* should be referred to as *E. asterocarpa*

subsp. *asterocarpa*. Therefore this collection does not represent the Priority-listed subspecies.

*Laxmannia grandiflora* is listed as a significant flora species in the *Bush Forever* Directory (Government of Western Australia 2000), as being a significant population (code 's') and being a population disjunct from their known geographic range (code 'd'). This species' normal distribution is north-west, south-west and east of Perth, mostly in the jarrah forest and wheatbelt. *Laxmannia grandiflora* is not listed as either a DRF or Priority species by the DEC. *Laxmannia grandiflora* subsp. *grandiflora* was a sparsely distributed but common component of the understorey in the study area, occurring in two of the three floristic quadrats recorded for the site.

# 4.0 Conclusions & Recommendations

**Hammond Park Vegetation Survey**

## 4.1 Environment

In summary:

- The site is not associated with any Environmentally Sensitive or Protected Areas, with the nearest conservation areas (Bush Forever sites) situated approximately 1km distant.
- The site is not within a Public Drinking Water Source Area, with the groundwater 6-22m below the surface, marginal salinity and contamination risk is classified as low.
- The site is located on the transition of the Spearwood Sands and Bassendean Sands

There are no significant environmental constraints identified as a result of the desktop environmental assessment of site.

## 4.2 Flora and Vegetation

In summary:

- The site is within Beard Vegetation Association '*Banksia* low woodland' in the Bassendean System.
- The Heddle Vegetation complex is Bassendean – Central and South, which is listed in *EPA Guidance Statement No 10* (2006) as having 27% remaining on the Swan Coastal Plain (in 2002), with 0.7% reserved. As more than 400ha of this Vegetation Complex remains on the Swan Coastal Plain, it is not considered significant.
- The DEC has recorded four Threatened Ecological Communities and two Priority Ecological Communities within 10km of the site. None were identified during the field survey and subsequent analysis.
- Ecoscape's statistical analysis has *inferred* the Floristic Community Type on the study site to be SCP23a – Central *Banksia attenuata – B. menziesii* woodlands, which is Well Reserved and Low Risk (Gibson *et al* 1994).
- One vegetation community was recorded for the site: *Banksia* spp. and *Allocasuarina fraseriana* Low Woodland.
- A total of 149 vascular plant species were found in the survey area including 31 weeds. Nine of these weeds were *high* risk according the Environmental Weed Strategy for Western Australia, with *Zantedeschia aethiopica* (arum lily) a Declared Plant.
- The DEC has recorded two Declared Rare and seven Priority Flora species within 10km of the site. No Declared Rare or Priority Listed Flora species were recorded during the field survey that was conducted when most species would have been flowering, which maximised the chances of observing and identifying them.
- An undetermined subspecies of *Eremaea asterocarpa* was a common component of the understorey. *Eremaea asterocarpa* subsp. *brachyclada* is a P1 species. A voucher specimen was submitted to be the Western Australian Herbarium Reference Collection. DEC Mike Hislop Duty Botanist examined the voucher specimen and has advised Ecoscape (email, 23rd December, 2008) that Perth-based

collections of *E. asterocarpa* should be referred to as *E. asterocarpa* subsp. *asterocarpa*. Therefore this collection does not represent the Priority-listed subspecies.

- *Laxmannia grandiflora*, which is listed as a significant flora species in the Perth Metropolitan Area by *Bush Forever*, but is not a DRF or Priority-listed species, was scattered throughout the site.
- The vegetation ranged from *completely degraded* to *excellent* condition. *Degraded* and *completely degraded* areas were associated with houses, sand mining or livestock grazing. Most of the study area was in *excellent* condition.

The flora and vegetation assessment of the study area identified suitable foraging habitat (ie *Banksia* woodland) for the vulnerable Commonwealth *Environment Protection and Biodiversity Conservation Act* (1999) (EPBC) listed Carnaby's Black Cockatoo. However, it is unlikely to provide suitable nesting habitat due to the absence of suitable hollow forming trees. Clearing of *Banksia* Woodland may constitute a significant impact on Carnaby's Black Cockatoo due to the loss of suitable foraging habitat. Given the potential for the clearing of the study area to impact on a matter of national environmental significance (NES) under the EPBC Act, it is recommended that further assessment be undertaken to investigate for evidence of Carnaby's utilising the study area as feeding habitat, and that consideration be given to referring the development proposal to the Commonwealth Department of Environment, Water, Heritage and the Arts (DEWHA) for assessment.

Weed control of Arum lily is recommended to be undertaken.

The Level 2 Flora and Vegetation survey did not identify any significant flora and vegetation constraints to the future urban development of the study area.

## 4.3 Application of Clearing Principles

The *Environmental Protection Act 1986* (Government of Western Australia) specifies that clearing native vegetation is prohibited unless a clearing permit is granted by the DEC, or the clearing is for an exempt purpose. Exemptions include industry licences and approvals, if vegetation is assessed as a factor by the DEC.

DEC has responsibility for the administration, assessment and approval of clearing permit applications relating to all activities except mining. There are Ten Clearing Principles defined in the *Environmental Protection Act* (1986) that must be addressed in a clearing application. A discussion of the ten clearing principles, as applied to native vegetation, is in the subsections below.

### 4.3.1 (a) Native vegetation should not be cleared if it comprises a high level of biological diversity

Clearing and developing this area is **unlikely to be at variance** with this principle.

In terms of flora, the survey of the site revealed a moderate level of biological diversity, with the species richness of the sampled quadrats lower than the mean species richness expected according to Gibson *et al* (1994). The comparison between our data and the number of species in the equivalent inferred FCT is shown in **Table 3**.

Ecoscape recorded a total of 149 vascular species in the surveyed vegetated part of the study area. These are listed in **Appendix 3**.

Fauna and other biological processes were not specifically included in this assessment.

### 4.3.2 (b) Native vegetation should not be cleared if it comprises the whole or part of, or is necessary for the maintenance of, a significant habitat for fauna indigenous to Western Australia

A fauna survey was not included in the scope of works for this project, however the flora and vegetation survey conducted for the study area identified vegetation that is considered suitable foraging habitat for the EPBC protected vulnerable listed Carnaby's Black Cockatoo.

### 4.3.3 (c) Native vegetation should not be cleared if it includes or is necessary for the continued existence of, rare flora

Clearing and developing this area is **unlikely to be at variance** with this principle.

No Declared Rare Flora species listed under the Western Australian *Wildlife Conservation Act* (1950) or the Commonwealth *EPBC Act* (Australian Government 1999) were identified during the survey.

### 4.3.4 (d) Native vegetation should not be cleared if it comprises the whole or part of, or is necessary for the maintenance of a threatened ecological community

Clearing and developing this area is **unlikely to be at variance** with this principle.

No TECs were identified on the study area, and the *inferred* FCT (SCP23a – Central *Banksia attenuata – B. menziesii* woodlands, **Table 3**) is considered Well Reserved and Low Risk.

### 4.3.5 (e) Native vegetation should not be cleared if it is significant as a remnant of native vegetation in an area that has been extensively cleared

Developing this area is **unlikely to be at variance** with this principle.

The significance of the vegetation has been assessed in terms of Vegetation Complex. **Table 1** shows that 27% of the Bassendean – Central and South complex is uncleared (in 2002), with 0.7% reserved.

### 4.3.6 (f) Native vegetation should not be cleared if it is growing, or in association with, an environment associated with a watercourse or wetland

Developing this area is **unlikely to be at variance** with this principle.

There are no wetlands or watercourses within the study area.

### 4.3.7 (g) Native vegetation should not be cleared if the clearing of the vegetation is likely to cause appreciable land degradation

Potential land degradation was not assessed as part of the flora and vegetation survey of the site.

### 4.3.8 (h) Native vegetation should not be cleared if the clearing of the vegetation is likely to have an impact on the environmental values of any adjacent or nearby conservation area

Clearing and developing this area is **unlikely to be at variance** with this principle.

The area does not include any conservation areas. The nearest conservation areas are approximately 1km from the study area.

### 4.3.9 (i) Native vegetation should not be cleared if the clearing of the vegetation is likely to cause deterioration in the quality of surface or underground water

Clearing and developing this area is **unlikely to be at variance** with this principle.

The study area is located on the transition between the Spearwood and Bassendean sands, which are free-draining in upland areas, and are therefore not likely to have significant runoff that would impact on surface water. The site forms a basin depression, but does not have any wetlands associated with it, and any surface runoff from hard surface areas (roads and roofs) would need to be managed within the site. Appropriate water management practices will prevent any impact on surface water quality.

Groundwater is marginal and is classed as Low Risk, and, with appropriate management of surface water, is unlikely to be affected by development of the site.

The study area is not located within any Public Drinking Water Source Area.

### 4.3.10 (j) Native vegetation should not be cleared if the clearing of the vegetation is likely to cause, or exacerbate, the incidence or intensity of flooding

Clearing and developing this area is **unlikely to be at variance** with this principle.

There is not expected to be any impact on the incidence of flooding arising from development of this area with the application of standard water management practices.

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## Hammond Park Vegetation Survey


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# Appendix One: Definitions and Criteria

## Hammond Park Vegetation Survey

***Table A2.1: Definitions and Criteria for Threatened Ecological Communities and Priority Ecological Communities***

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

| Criteria | Definition |
|---|---|
| | B) Current distribution is limited, and one or more of the following apply (i, ii or iii):<br>i) geographic range and/or number of discrete occurrences, and/or area occupied is highly restricted and the community is currently subject to known threatening processes which are likely to result in total destruction throughout its range in the short term future (within approximately 20 years);<br>ii) there are few occurrences, each of which is small and/or isolated and all or most occurrences are very vulnerable to known threatening processes;<br>iii) there may be many occurrences but total area is small and all or most occurrences are small and/or isolated and very vulnerable to known threatening processes.<br>C) The ecological community exists only as very modified occurrences that may be capable of being substantially restored or rehabilitated if such work begins in the short-term future (within approximately 20 years). |
| **Vulnerable (VU)** | An ecological community that has been adequately surveyed and is found to be declining and/or has declined in distribution and/or condition and whose ultimate security has not yet been assured and/or a community that is still widespread but is believed likely to move into a category of higher threat in the near future if threatening processes continue or begin operating throughout its range.<br><br>An ecological community will be listed as Vulnerable when it has been adequately surveyed and is not Critically Endangered or Endangered but is facing a high risk of total destruction or significant modification in the medium to long-term future. This will be determined on the basis of the best available information by it meeting any one or more of the following criteria (A, B or C):<br>A) The ecological community exists largely as modified occurrences that are likely to be capable of being substantially restored or rehabilitated.<br>B) The ecological community may already be modified and would be vulnerable to threatening processes, is restricted in area and/or range and/or is only found at a few locations.<br>C) The ecological community may be still widespread but is believed likely to move into a category of higher threat in the medium to long term future because of existing or impending threatening processes. |
| **Priority Ecological Communities** | |
| **Priority One** | 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. Communities may be included if they are comparatively well-known from one or more localities but do not meet adequacy of survey requirements, and/or are not well defined, and appear to be under immediate threat from known threatening processes across their range. |
| **Priority Two** | 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, unallocated Crown land, water reserves, etc.) and not under imminent threat of destruction or degradation. Communities may be included if they are comparatively well known from one or more localities, but do not meet adequacy of survey requirements, and / or are not well defined, and appear to be under threat from known threatening processes. |
| **Priority Three** | 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;<br>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;<br>iii. Communities made up of large, and/or widespread occurrences, that may or may not be represented in the reserve system, but are under threat of modification across much of their range from processes such as grazing by domestic and/or feral stock, and inappropriate fire regimes.<br>Communities may be included if they are comparatively well known from several localities, but do not meet adequacy of survey requirements and / or are not well defined, and known threatening processes exist that could affect them. |
| **Priority Four** | Ecological communities that are adequately known, rare but not threatened or meet criteria for Near Threatened, or that have been recently removed from the threatened list. These communities require regular monitoring.<br>a. ***Rare***. Ecological communities known from few occurrences that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection, but could be if present circumstances change These communities are usually represented on conservation lands.<br>b. ***Near Threatened***. Ecological communities that are considered to have been adequately surveyed and that do not qualify for Conservation Dependent, but that are close to qualifying for Vulnerable.<br>c. Ecological communities that have been removed from the list of threatened communities during the past five years. |
| **Priority Five** | *Conservation Dependent Ecological Communities*<br>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. |

(DEC 2008)

***Table A2.2: DEC Conservation Codes and Definitions***

| Conservation Code | | Definition |
|---|---|---|
| **X** | **Declared Rare Flora - Presumed Extinct** | Taxa which have not been collected, or otherwise verified, over the past 50 years despite thorough searching, or of which all known wild populations have been destroyed more recently, and have been gazetted as such, following approval by the Minister for the Environment, after recommendation by the State's Endangered Flora Consultative Committee |
| **R** | **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, following approval by the Minister for the Environment, after recommendation by the State's Endangered Flora Consultative Committee. ( = Threatened Flora = Endangered + Vulnerable) |
| **P1** | **Priority One - Poorly Known** | 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, e.g. road verges, urban areas, farmland, active mineral leases, etc., or the plants are under threat, e.g. from disease, grazing by feral animals, etc. May include taxa with threatened populations on protected lands. Such taxa are under consideration for declaration as 'rare flora', but are in urgent need of further survey |
| **P2** | **Priority Two - Poorly Known** | 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 (i.e. not currently endangered). Such taxa are under consideration for declaration as 'rare flora', but are in urgent need of further survey |
| **P3** | **Priority Three - Poorly Known** | Taxa which are known from several populations, at least some of which are not believed to be under immediate threat (i.e. not currently endangered). Such taxa are under consideration for declaration as 'rare flora', but are in need of further survey |
| **P4** | **Priority Four - Rare** | 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 A2.3: Keighery Bushland Condition Scale***

| Condition | Description |
|---|---|
| **Pristine** | No obvious signs of disturbance |
| **Excellent** | Vegetation structure intact, disturbance only affecting individual species and weeds are non-aggressive species |
| **Very Good** | Vegetation structure altered, obvious signs of disturbance e.g. repeated fires, aggressive weeds, dieback, logging and grazing. |
| **Good** | Vegetation structure altered, obvious signs of disturbance. Retains basic vegetation structure or ability to regenerate it. The presence of very aggressive weeds at high density, partial clearing, dieback, logging and grazing. |
| **Degraded** | Basic vegetation structure severely impacted by disturbance. Requires intensive management. The presence of very aggressive weeds at high density, partial clearing, dieback, logging and grazing. |
| **Completely Degraded** | Vegetation structure is no longer intact and the area is completely or almost completely without native flora. 'Parkland Cleared'. |

***Table A2.4: Statement of Botanical Limitations***

| Possible Limitations | Constraints (Yes/No); Significant, Moderate or Negligible | Comment |
|---|---|---|
| Competency/experience of the consultant conducting the survey | No constraints | Senior Botanist and Senior Environmental Scientist with extensive survey experience and taxonomic skills, Environmental Scientist with good observation skills and adequate reference material at hand to recognise threatened flora species. |
| Proportion of the flora identified | Negligible constraints | Approximately 30 person-hours spent on site. Some species were not identified to species level, however none were likely to be threatened flora. |
| Proportion of the task achieved and further work that may need to be undertaken | No constraints | Estimated 95% of total likely floristic suite recorded. No additional survey considered necessary. |
| Timing/weather/season/cycle | Negligible constraints | 81% of average seasonal rainfall |
| Intensity of survey (e.g. In retrospect was the intensity adequate?) | Negligible constraints | Vegetation was intensively surveyed, with small species similar to potential DRF species observed during the field survey, indicating it was very unlikely that threatened species were overlooked. |
| Completeness (e.g. Was relevant area fully surveyed?) | Negligible constraints | Over 95% of area surveyed. A small area of Banksia woodland with *Kunzea glabrescens* understorey was intensively surveyed for *Drakaea elastica*, with none located |
| Resources (e.g. Degree of expertise available for plant identification) | No constraints | Problematic subspecies currently with DEC awaiting determination. Potential DRF species identified by relevant authority. Other plant identification completed in field and in-house. |
| Remoteness and/or access problems | No constraints | Site traversed on foot |
| Availability of contextual (e.g. bioregional) information for the survey area | No constraints | Perth region is generally well surveyed and well-known. |

# Appendix Two: Flora List

**Hammond Park Vegetation Survey**

***Table A3.1: Flora Species List***

| FAMILY | SPECIES | Q1 | Q2 | Q3 | Site |
|---|---|---|---|---|---|
| AIZOACEAE | **Carpobrotus edulis* | | | | x |
| | *Caesia micrantha* | x | | x | x |
| | *Chamaescilla corymbosa* | | | x | x |
| | *Corynotheca micrantha* | | | | x |
| | *Laxmannia grandiflora* | | x | x | x |
| | *Sowerbaea laxiflora* | | | | x |
| | *Thysanotus patersonii* | x | | | x |
| | *Thysanotus* sp. | | | x | x |
| ANTHERICACEAE | *Tricoryne elatior* | | | x | x |
| APIACEAE | *Trachymene pilosa* | x | x | x | x |
| ARACEAE | **Zantedeschia aethiopica* | | | | x |
| ASPHODELACEAE | **Asphodelus fistulosus* | | | | x |
| | **Arctotheca calendula* | | | | x |
| | **Dimorphotheca ecklonis* | | | | x |
| | **Hedypnois rhagadioloides* | | | | x |
| | **Hypochaeris glabra* | | | x | x |
| | *Podolepis gracilis* | | | | x |
| | *Podotheca gnaphalioides* | | x | | x |
| | *Rhodanthe corymbosa* | | | | x |
| | *Siloxerus humifusus* | | | | x |
| | **Sonchus oleraceus* | | | | x |
| ASTERACEAE | **Ursinia anthemoides* | | x | | x |
| BORYACEAE | *Borya sphaerocephala* | | x | | x |
| BRASSICACEAE | **Brassica tournefortii* | | | | x |
| | **Wahlenbergia capensis* | | x | | x |
| CAMPANULACEAE | *Wahlenbergia preissii* | | | | x |
| | *Allocasuarina fraseriana* | x | x | x | x |
| CASUARINACEAE | *Allocasuarina humilis* | x | | x | x |
| COLCHICACEAE | *Burchardia congesta* | x | x | x | x |
| | *Caustis dioica* | | | | x |
| | *Cyathochaeta avenacea* | | | x | x |
| | *Lepidosperma pubisquameum* | | | x | x |
| | *Mesomelaena pseudostygia* | | | | x |
| | *Schoenus clandestinus* | | x | x | x |
| | *Schoenus curvifolius* | x | | x | x |
| CYPERACEAE | *Schoenus* sp. | | | | x |
| | *Calectasia narragara* | | | | x |
| | *Dasypogon bromeliifolius* | | | x | x |
| DASYPOGONACEAE | *Lomandra preissii* | | | | x |
| | *Hibbertia huegelii* | | | | x |
| | *Hibbertia hypericoides* | x | x | | x |
| DILLENIACEAE | *Hibbertia racemosa* | x | | x | x |
| DROSERACEAE | *Drosera erythrorhiza* | x | | | x |

| FAMILY | SPECIES | Q1 | Q2 | Q3 | Site |
|---|---|---|---|---|---|
| | *Drosera macrantha* | | | | x |
| | *Drosera menziesii* | x | x | x | x |
| | *Drosera zonaria* | | | x | x |
| | *Astroloma pallidum* | | | | x |
| | *Conostephium pendulum* | x | | | x |
| | *Conostephium preissii* | | x | | x |
| | *Leucopogon conostephioides* | x | | x | x |
| | *Leucopogon parviflorus* | | | | x |
| EPACRIDACEAE | *Lysinema ciliatum* | | | | x |
| | **Euphorbia peplus* | | | | x |
| | *Phyllanthus calycinus* | | | | x |
| EUPHORBIACEAE | **Ricinus communis* | | | | x |
| GERANIACEAE | **Pelargonium capitatum* | | | | x |
| | *Dampiera linearis* | x | x | x | x |
| | *Goodenia caerulea* | | | | x |
| GOODENIACEAE | *Scaevola canescens* | | x | | x |
| | *Anigozanthos humilis* | | x | | x |
| | *Anigozanthos manglesii* | x | | | x |
| | *Conostylis aculeata* | x | | x | x |
| | *Conostylis juncea* | | | | x |
| | *Conostylis setigera* | | x | x | x |
| | *Conostylis* sp. | x | | | x |
| HAEMODORACEAE | *Phlebocarya ciliata* | | | x | x |
| | **Freesia alba x leichtlinii* | | | x | x |
| | **Gladiolus caryophyllaceus* | x | x | x | x |
| | *Patersonia occidentalis* | x | x | | x |
| IRIDACEAE | **Watsonia meriana* | | | | x |
| LAMIACEAE | *Hemiandra pungens* | | | x | x |
| LAURACEAE | *Cassytha racemosa* | | | | x |
| LORANTHACEAE | *Nuytsia floribunda* | x | | x | x |
| | *Acacia pulchella* | | | x | x |
| MIMOSACEAE | *Acacia stenoptera* | x | | x | x |
| MOLLUGINACEAE | *Macarthuria australis* | | | | x |
| | *Calytrix fraseri* | x | x | | x |
| | *Eremaea asterocarpa* | x | | x | x |
| | *Eremaea pauciflora* | x | | | x |
| | *Eucalyptus marginata* | | | | x |
| | *Hypocalymma robustum* | x | x | | x |
| | Indet. | x | | | x |
| | *Kunzea glabrescens* | | | x | x |
| MYRTACEAE | *Kunzea micrantha* | | | | x |
| | *Caladenia arenicola* | | | | x |
| | *Caladenia discoidea* | | | | x |
| | *Caladenia flava* | | | x | x |
| | *Caladenia* sp. | | | x | x |
| | *Diuris brumalis* | | | | x |
| | *Diuris magnifica* | | | | x |
| | *Microtis* sp. | | | | x |
| | *Pterostylis recurva* | | | | x |
| | *Pterostylis vittata* | | | x | x |
| | *Thelymitra crinita* | | | x | x |
| ORCHIDACEAE | *Thelymitra macrophylla* | | | | x |

| FAMILY | SPECIES | Q1 | Q2 | Q3 | Site |
|---|---|---|---|---|---|
| | *Bossiaea eriocarpa* | x | x | x | x |
| | *Daviesia nudiflora* | | | | x |
| | *Daviesia triflora* | x | x | | x |
| | *Gastrolobium linearifolium* | | | | x |
| | *Gompholobium confertum* | | | | x |
| | *Gompholobium tomentosum* | x | | x | x |
| | *Hovea pungens* | | | | x |
| | *Hovea trisperma* | x | | x | x |
| | *Jacksonia furcellata* | | | | x |
| | **Lathyrus tingitanus* | | | | x |
| | **Lupinus cosentinii* | | | | x |
| PAPILIONACEAE | **Trifolium campestre* | | | | x |
| | **Aira cupaniana* | | | | x |
| | *Amphipogon turbinatus* | x | x | x | x |
| | *Austrodanthonia sp.* | | x | | x |
| | *Austrostipa compressa* | | | | x |
| | **Avena barbata* | | | | x |
| | **Briza maxima* | x | x | x | x |
| | **Bromus diandrus* | | | | x |
| | **Bromus* sp. | | | | x |
| | **Cynodon dactylon* | | | | x |
| | **Ehrharta calycina* | | | | x |
| | **Eragrostis curvula* | | | | x |
| | **Lagurus ovatus* | | | | x |
| | **Lolium rigidum* | | | | x |
| POACEAE | **Vulpia myuros* | | x | | x |
| PORTULACACEAE | *Calandrinia granulifera* | | | | x |
| PRIMULACEAE | **Anagallis arvensis* | | | | x |
| | *Adenanthos cygnorum* | | | | x |
| | *Banksia attenuata* | x | x | x | x |
| | *Banksia dallanneyi* | | x | | x |
| | *Banksia ilicifolia* | x | | x | x |
| | *Banksia menziesii* | x | | x | x |
| | *Grevillea paniculata* | | | | x |
| | *Persoonia saccata* | | | | x |
| | *Petrophile linearis* | x | x | | x |
| | *Stirlingia latifolia* | x | x | x | x |
| PROTEACEAE | *Synaphea spinulosa* | | | | x |
| | *Desmocladus fasciculatus* | | x | | x |
| | *Desmocladus flexuosus* | | x | x | x |
| | *Hypolaena exsulca* | | | x | x |
| | *Lyginia barbata* | x | | | x |
| RESTIONACEAE | *Lyginia imberbis* | | x | x | x |
| RUBIACEAE | *Opercularia vaginata* | | | | x |
| RUTACEAE | *Philotheca spicata* | | | | x |
| SANTALACEAE | *Leptomeria empetriformis* | | | | x |
| STACKHOUSIACEAE | *Stackhousia monogyna* | | | | x |
| | *Levenhookia stipitata* | | x | | x |
| | *Stylidium brunonianum* | x | x | x | x |
| | *Stylidium piliferum* | | | x | x |
| | *Stylidium repens* | | | | x |
| STYLIDIACEAE | *Stylidium schoenoides* | | | | x |

| FAMILY | SPECIES | Q1 | Q2 | Q3 | Site |
|---|---|---|---|---|---|
| THYMELAEACEAE | *Pimelea lehmanniana* | | | | x |
| XANTHORRHOEACEAE | *Xanthorrhoea preissii* | x | x | x | x |
| ZAMIACEAE | *Macrozamia riedlei* | | | | x |
| **TOTAL** | | **40** | **36** | **50** | **149** |

* = introduced (weed) species

***Table A3.2: Weed Ratings***

| Species | EWSWA rating | Declared Plant Class |
|---|---|---|
| *Aira cupaniana* | moderate | - |
| *Anagallis arvensis* | moderate | - |
| *Arctotheca calendula* | moderate | - |
| *Asphodelus fistulosus* | mild | - |
| *Avena barbata* | moderate | - |
| ***Brassica tournefortii*** | **high** | - |
| *Briza maxima* | moderate | - |
| ***Bromus diandrus*** | **high** | - |
| *Bromus sp.* | - | - |
| *Carpobrotus edulis* | moderate | - |
| *Cynodon dactylon* | moderate | - |
| *Dimorphotheca ecklonis* | low | - |
| ***Ehrharta calycina*** | **high** | - |
| ***Eragrostis curvula*** | **high** | - |
| *Euphorbia peplus* | moderate | - |
| *Freesia alba x leichtlinii* | **high** | |
| *Gladiolus caryophyllaceus* | moderate | - |
| *Hedypnois rhagadioloides* | moderate | - |
| *Hypochaeris glabra* | mild | - |
| ***Lagurus ovatus*** | **high** | - |
| *Lathyrus tingitanus* | low | - |
| *Lolium rigidum* | low | - |
| ***Lupinus cosentinii*** | **high** | - |
| ***Pelargonium capitatum*** | **high** | - |
| *Ricinus communis* | low | - |
| *Sonchus oleraceus* | moderate | - |
| *Trifolium campestre* | moderate | - |
| *Ursinia anthemoides* | moderate | - |
| *Vulpia myuros* | moderate | - |
| *Wahlenbergia capensis* | moderate | - |
| ***Watsonia meriana*** | **high** | - |
| ***Zantedeschia aethiopica*** | **high** | P1,P4 |

# Appendix Three: Images

**Hammond Park Vegetation Survey**

***Plate 1: Quadrat 1***

***Plate 2: Quadrat 2***

***Plate 3: Quadrat 3***

***Plate 4: Rubbish dumped near the firebreak between Lots 49 and 50, Frankland Avenue***

***Plate 5: Dumped car, opposite Wattleup Road on Lot 49 Frankland Avenue***

***Plate 6: Tree deaths near the centre of Lot 49 Frankland Avenue***

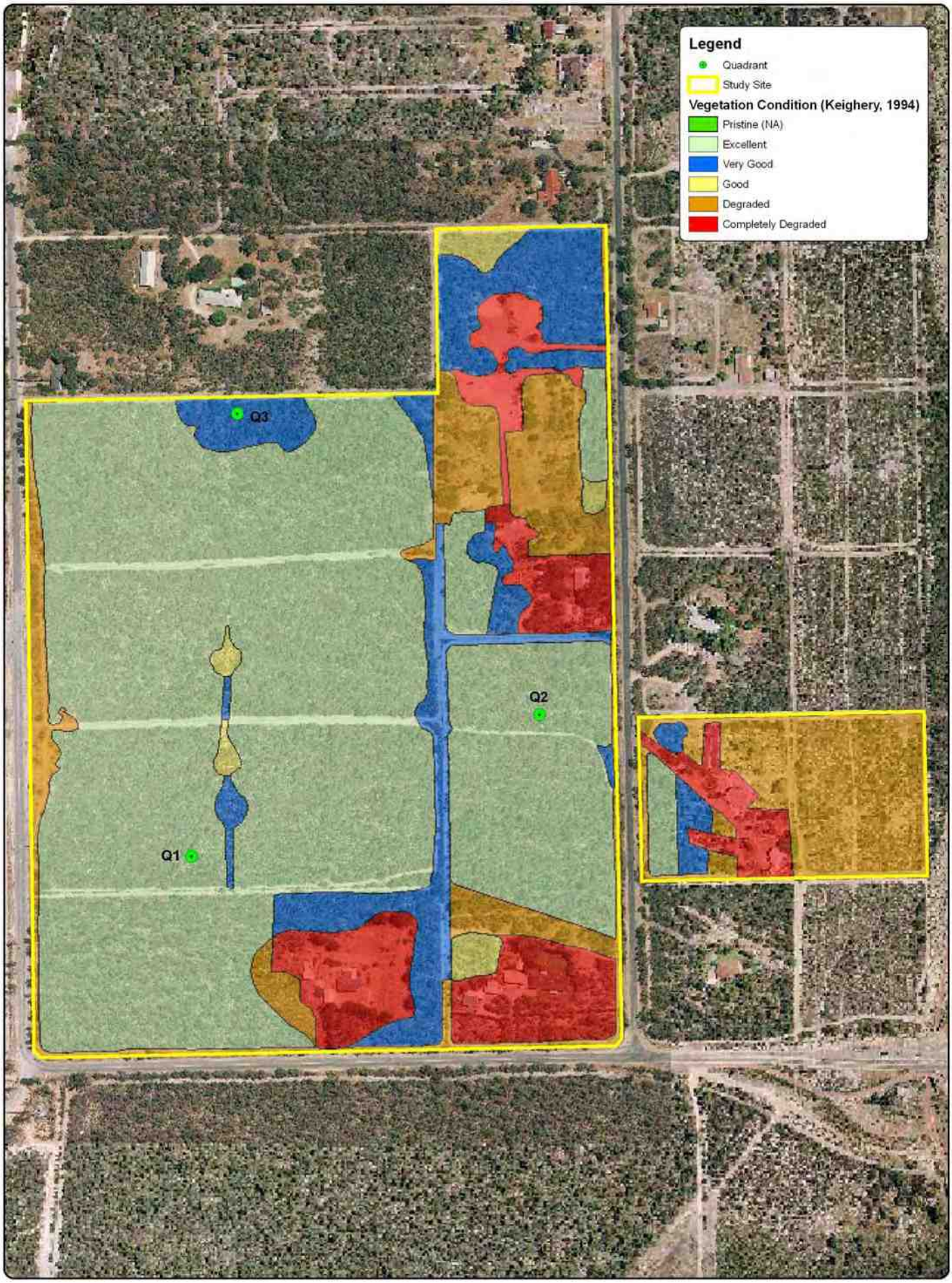
***Plate 7: Grazed area of Lot 18 Barfield Road***

***Plate 8: Caladenia arenicola***

***Plate 9: Eremaea asterocarpa subsp. asterocarpa, a common understorey species***

# Appendix Four:
# Map

**Hammond Park Vegetation Survey**




**Map 1**

Dec 2008

*Vegetation & Spring Flora Survey for Banfield Road &Rowley Road, Hammond Park*

## Vegetation Condition

prepared for Gold Estates Holdings Pty Ltd

0 50 100 150 Meters

1:4,500 @ A4

Project No. 2182-08

ecoscape