Level 2 Flora & Vegetation Survey for the Proposed Marillana Airstrip and Camp

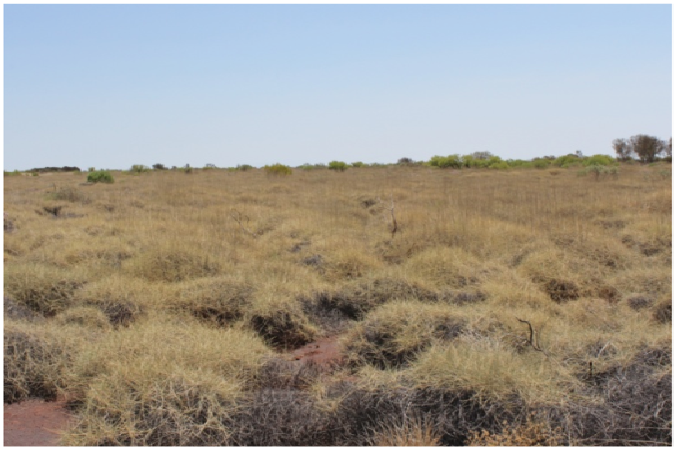
Tenements: M47/1414

Prepared For

brockman resources.

September 2011

Final



Prepared by:
Botanica Consulting
PO Box 2027
Boulder WA 6432
90930024

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Prepared by:
Lauren Padmore
Environmental Consultant
Botanica Consulting

Reviewed by:
Andrea Williams
Director
Botanica Consulting

Approved by:
Jim Williams
Director
Botanica Consulting

Index Page #

Tables

Figures

Plates

Appendices

Executive Summary

Botanica Consulting (BC) was commissioned by Brockman Resources Limited to undertake a Level 2 flora and vegetation survey of the proposed Marillana Airstrip and Camp project area located in the Pilbara region of Western Australia. The survey area is located approximately 109 km north-west of the township of Newman, WA and lies approximately 8 km south of the Fortescue Marsh Environmentally Sensitive Area. The survey was conducted from the 26th to 28th September 2011 covering an area of approximately 72ha. Thirteen quadrats were established within the survey area.

No Declared Rare Flora or Priority Flora species were recorded during the spring survey.

Four broad vegetation communities were identified within the survey area, *Acacia pteraneura* open low woodland over sparse scrub of *Acacia bivenosa*, *Eucalyptus odontocarpa/Hakea lorea* very open shrub mallee over *Triodia basedowi*i dense hummock grassland, *Acacia pteraneura* open low woodland over *Triodia basedowii* mid-dense hummock grassland and *Acacia victoriae* open low shrub over open dwarf scrub of *Frankenia ambita*.

These vegetation communities were represented by a total of 21 Families, 41 Genera and 75 Species (including sub-species and variants). The data recorded from the quadrat survey was used in a PATN analysis to group quadrats with similar species compositions. Results of the PATN analysis revealed that many of the vegetation communities differed visually from the PATN results. This was in part due to the sparse density of the upper storey species. Within the *Acacia pteraneura* open low woodland over *Triodia basedowii* mid-dense hummock grassland vegetation community, a number of quadrats did not contain the dominant upper storey species even though they shared similar mid and lower storey species. This resulted in the PATN analysis splitting the vegetation community. Several of the vegetation communities also shared enough mid and lower storey species so that a number of the quadrats from each vegetation community were consolidated together.

None of the vegetation communities have National Environmental Significance as defined by the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*. No Threatened Ecological Communities pursuant to Commonwealth legislation or listed by the Department of Environment and Conservation were recorded within the survey area. The entire survey area is however located within the buffer zone of the Fortescue Marsh (Marsh Land System) Priority 1 Ecological Community. The south-east extremity of the survey area is also located within the buffer zone of the Fortescue Valley Sand Dunes Priority 3 Ecological Community.

Based on Trudgen's vegetation health rating scale (1991), all four of the vegetation communities were given a health rating of 'good'. Two weed species were identified within the survey area, *Cenchrus ciliaris* (Buffel Grass) and *Portulaca oleracea* (Purslane). According to the Department of Food and Agriculture these species are not recorded as declared plants (DAFWA, 2011).

1 Introduction

1.1 Project Description

Brockman Resources Pty Ltd (Brockman) proposes to develop the Marillana Iron Ore Project which consists of a 700-750 Mt iron ore mine, processing facility and associated infrastructure located within the Pilbara, Western Australia. The Project is located within mining lease M47/1414 and is located approximately 109 km north-west of the township of Newman. It covers 9.6ha of the Fortescue Valley, borders the Hamersley Range and lies approximately 15 km south of the Fortescue Marsh. It is intersected by distributaries of the Weeli Wolli Creek delta. A regional map of the survey area can be seen in Figure 1.

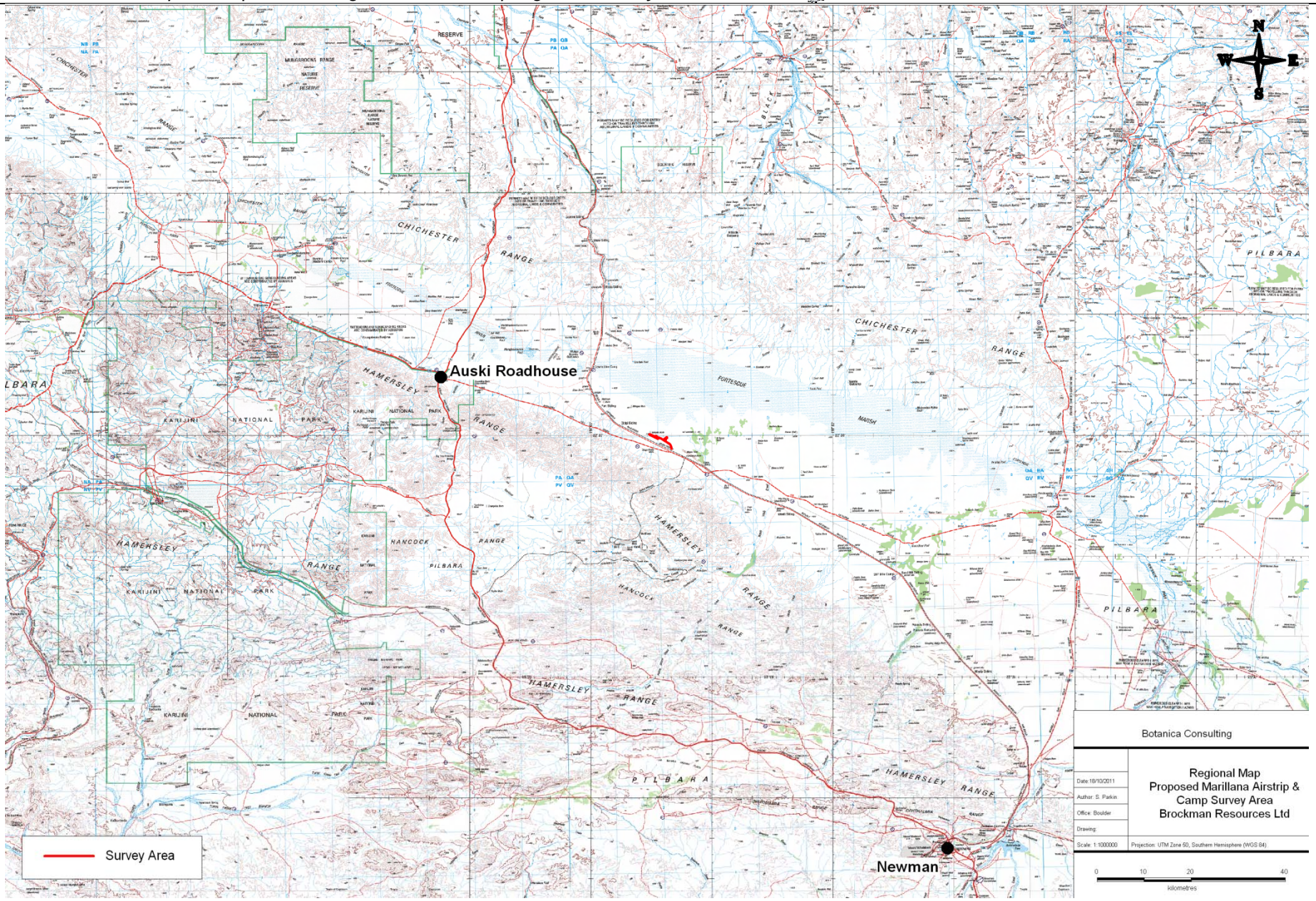

Figure 1: Regional map of the survey area

1.2 Previous relevant flora surveys

Ecologia Environment, Marillana Vegetation and Flora Report, 2009

Ecologia Environment was commissioned by Brockman to undertake a two-phase survey of the vegetation and flora of its Marillana project area. A total of 137 quadrats were assessed over both phases.

Eight vegetation units were identified; *Eucalyptus victrix* and *Acacia citrinoviridis* low woodland, *Acacia tumida* and *Grevillea wickhamii* tall shrubland, *Acacia aneura* low woodland, over *Acacia synchronicia* tall shrubland, over *Cenchrus* spp. tussock grassland, *Acacia aneura* low open forest, *Acacia citrinoviridis, Corymbia hamersleyana, Acacia aneura* and *Acacia pruinocarpa* open woodland, over *Acacia* spp. tall shrubland, over **Cenchrus* spp. closed tussock grassland, *Acacia dictyophleba* tall shrubland, over *Triodia schinzii* open hummock grassland, *Acacia* spp. medium to high open shrubland, over *Triodia basedowii* and *Triodia schinzii* hummock grassland and *Corymbia hamersleyana* isolated low trees, over *Eucalyptus gamophylla* mallee woodland, over *Acacia* spp. and *Grevillea wickhamii* tall shrubland, over *Triodia basedowii* hummock grassland.

A total of 302 taxa resulted from the combined records for both phases of the survey. These taxa included 42 families and 116 genera.

Database searches indicate that no threatened ecological communities occur within 50 km of the Marillana survey area. One State-listed Priority Ecological Community (PEC) occurs within the survey area, the Priority 3 *'Vegetation of sand dunes of the Hamersley Range and Fortescue Valley'*. In addition, the Weeli Wolli Spring PEC occurs within 50 km of the survey area and the Fortescue Marsh PEC is approximately 15 km north of the survey area; both are Priority 1 Ecological Communities.

The Marillana survey area is located approximately 9km south-east of the current survey area.

Ecologia Environment, Munjina-Roy Hill Road Realignment VCP Flora Survey, 2011

Ecologia Environment was commissioned by Brockman to undertake a flora and fauna survey of a proposed realignment of the Roy Hill-Munjina Road. The data will be used to support a Vegetation Clearance Permit (VCP) Application.

The survey was conducted by two botanists and a zoologist over two days in June 2011. Nine 0.25ha quadrats were surveyed to characterise the vegetation structure and the area was searched using a series of transects distanced 50 metres apart. The biodiversity of the area was considered to be moderate and consistent with the biodiversity of areas elsewhere in the Pilbara in which similar vegetation is present. The fauna habitats of the area are considered to be common within the Pilbara.

No vegetation type present was anticipated to be of significance to the native fauna in the Pilbara region. Although three avian species of conservation status were recorded, the Bush Bustard, Stone Curlew and Rainbow Bee Eater, the relatively narrow corridor of clearance is unlikely to impact the survival of local populations, due to their mobility.

The Study Area lies within the buffer zone of the Priority 1 PEC Fortescue Marsh and the Priority 3 Fortescue Sand Dunes, however the vegetation present is not representative of either of these PEC's. The alignment passes within approximately 250 m of the Sand Dunes at its nearest location, however no direct or indirect impacts to this community are anticipated.

The Munjina-Roy Hill Road Realignment survey area is located approximately 5km east of the current survey area.

2 Regional Biophysical Environment

2.1 Regional Environment

The survey area lies within the Fortescue Botanical District of the Eremaean Province of WA. The Fortescue Botanical District consists of predominantly tree and shrub-steppe communities with *Eucalyptus* trees, *Acacia* shrubs and *Triodia* species. Some Mulga occurs in valleys and there are short-grass plains on alluvia (Beard, 1990). The Eremaean Province is further divided into subregions, based on the Interim Biogeographic Regionalisation of Australia (IBRA), with the Proposed Marillana Airstrip and Camp survey area being located in the Fortescue Plains subregion (PIL2) (Kendrick, 2001).

2.2 Topography & Soils

The IBRA places the survey area within the Fortescue Plains subregion (PIL2) of the Pilbara region (Figure 2). The subregion is comprised of alluvial plains and river frontage with deeply incised gorge systems in the western part of the drainage. An extensive calcrete aquifer feeds numerous permanent springs in the central Fortescue, supporting large permanent wetlands (Kendrick, 2001). Beard (1990) describes the topography of the region as a mountainous region rising to 1250m. Soils are chiefly hard alkaline red on plains and pediments with shallow and skeletal soils on the ranges. Beard (1990) also describes the underlying geology as a basement of Archaean granite and volcanics, overlain by massive deposits of Proterozoic sediments and volcanics.

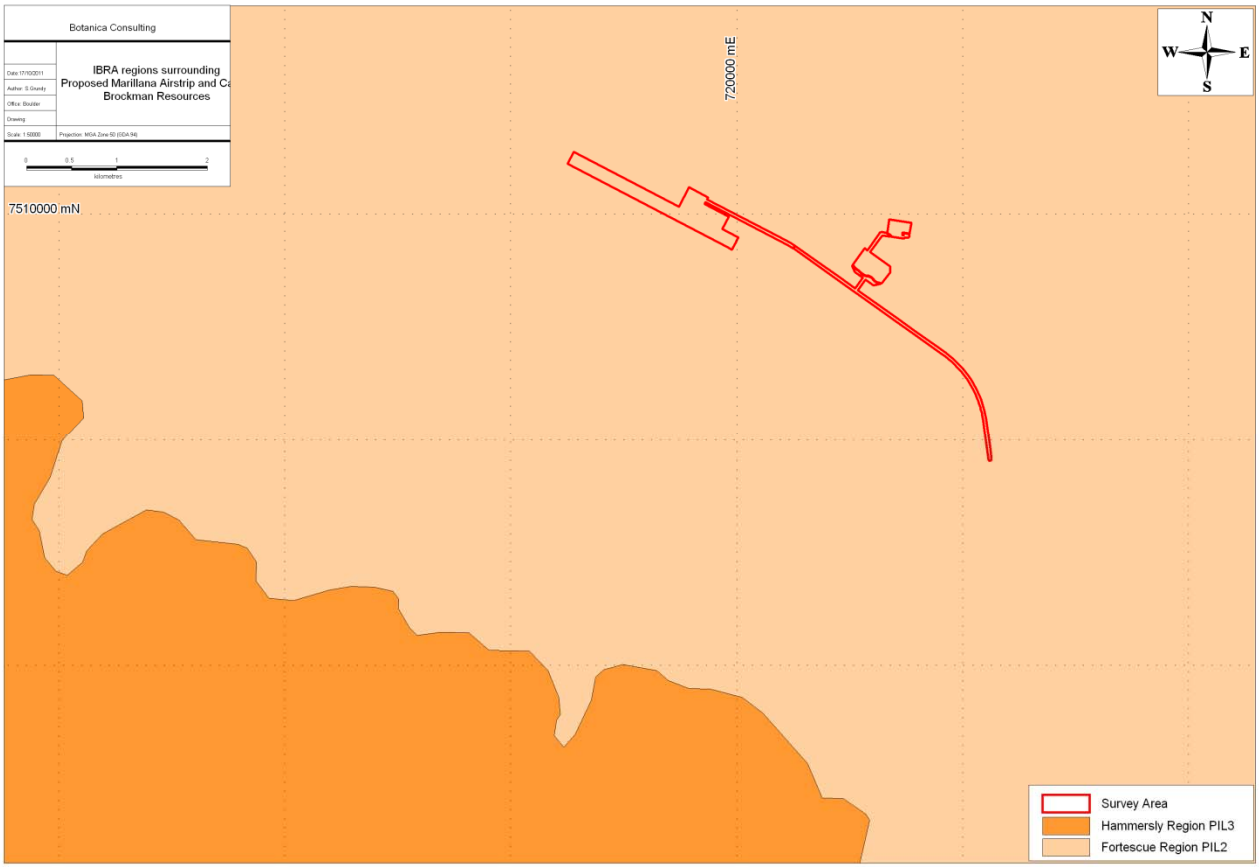

Figure 2: Map of IBRA regions in the vicinity of the Proposed Marillana Airstrip & Camp Survey Area

2.3 Vegetation

The Fortescue Botanical District is predominantly tree and shrub-steppe communities with *Eucalyptus* trees, *Acacia* shrubs, *Triodia pungens* and *T. wiseana* (Beard, 1990). The Fortescue Plains subregion vegetation consists of extensive salt marsh, mulga-bunch grass and short grass communities on alluvial plains. River gum woodlands fringe the drainage lines with extensive stands of river gum and cadjeput *Melaleuca* woodlands supported the permanent springs (Kendrick, 2001).

The DAFWA GIS file (2007) indicates that the survey area is within the Fortescue Valley 278 Pre-European Beard vegetation association. The extent of this association as described by the DAFWA is shown in Table 1.

Table 1: Remaining Beard Vegetation Associations within Western Australia (DAFWA, 2007)

Veg association	Pre-European Extent (ha)	Current Extent (ha)	Pre-European extent remaining (%)	% of Current extent within DEC managed lands	Vegetation Description (Beard, 1990)
Fortescue Valley 111	430,134.61	430,134.61	100	3.10	Hummock grasslands, shrub steppe; Eucalyptus gamophylla over hard spinifex

Areas retaining less than 30% of their pre-European vegetation extent generally experience exponentially accelerated species loss, while areas with less than 10% are considered “endangered”.

None of these vegetation associations is below the 30% threshold and the proposed Marillana Airstrip and Camp (PMAC) project will not significantly reduce the extent of either association.

2.4 Climate

The climate of the Fortescue Plains subregion is characterised as an arid tropical climate with mainly summer rainfall and annual rainfall of approximately 250-300mm (Beard, 1990; Kendrick, 2001). Rainfall data for the Marillana rainfall station (#5009) located approximately 27.5km south-east of the PMAC survey area is shown in Figure 3 (Bureau of Meteorology, BOM, 2011).

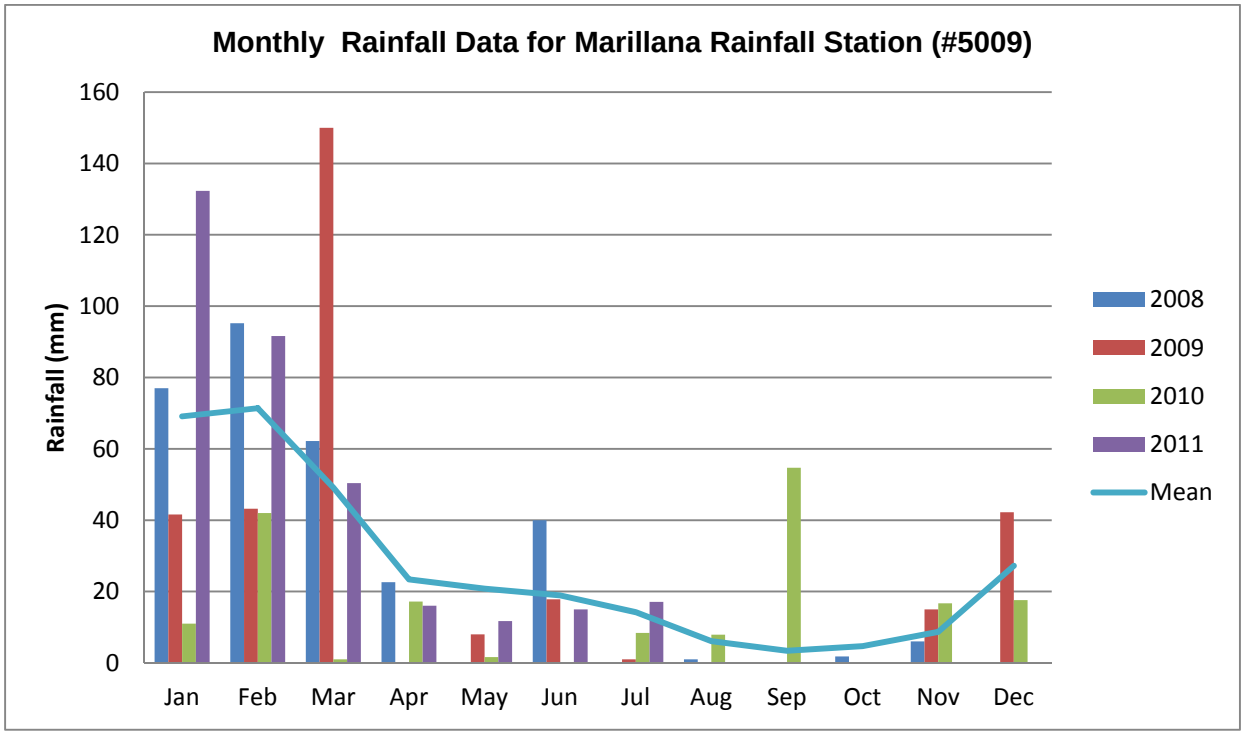

Figure 3: Total monthly rainfall for Marillana Rainfall Station (#5009) from Jan 2008 to July 2011 (BOM, 2011).

2.5 Land Use

Based on the findings from its 2002 biodiversity audit the Department of Conservation and Land Management (CALM) identified the dominant land uses of the PIL2 IBRA subregion as Grazing native pastures, unallocated crown reserves, conservation and Aboriginal land (lease) (Kendrick, 2001).

2.6 Survey Objectives

The objectives of the survey undertaken were to:

- Compile a broad scale vegetation community flora map and species list of the survey area (Appendix 3);
- Document and map locations of any Declared Rare or Priority listed flora species located; (Appendix 2 and 5);

- Assess the regional and local conservation status of plant species and ecological communities within the survey area;
- Identify and map occurrences of any "Declared and Environmental" weeds within the survey area; and
- Provide plot based data as per Guidance Statement 51 (Environmental Protection Authority, EPA, 2004).

3 Survey Methodology

3.1 Desktop Assessment

Prior to the field survey, a combined search of the DEC's Declared Rare and Priority Flora databases (DEC, 2011a) was undertaken and the results are provided in Appendix 5. These significant flora species were examined on the Western Australian Herbarium's (WAHERB) web page prior to the survey to familiarise staff with their appearance.

Locations of DRF and Priority Flora species were overlaid on aerial photography of the area (Appendix 2). Vegetation descriptions and available images of the Priority Flora were also obtained from Florabase.

Priority Flora and their respective vegetation types were targeted and all occurrences were traversed on foot specifically looking for the threatened flora associated with that vegetation description.

Table 2 represents the definitions of Declared Rare and Priority ratings under the *Wildlife Conservation Act (1950)* as extracted from Florabase (WAHERB, 2011).

Table 2: **Definitions of Rare and Priority Flora Species (WAHERB, 2011)**

T: Schedule 1 Threatened Flora under the *Wildlife Conservation Act 1950*
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.
X: Declared Rare flora – Presumed Extinct Taxa
Taxa which have been adequately searched for and there is no reasonable doubt that the last individual has died, and have been gazetted as such.
1: Priority One – Poorly known Species
Species that are known from one or a few collections or sight records (generally less than five), all on lands not managed for conservation, e.g. agricultural or pastoral lands, urban areas, Shire, Westrail and Main Roads WA road, gravel and soil reserves, and active mineral leases and under threat of habitat destruction or degradation. Species may be included if they are comparatively well known from one or more localities but do not meet adequacy of survey requirements and appear to be under immediate threat from known threatening processes.
2: Priority Two – Poorly Known Species
Species that are known from one or a few collections or sight records, some of which are on lands not under imminent threat of habitat destruction or degradation, e.g. national parks, conservation parks, nature reserves, State forest, vacant Crown land, water reserves, etc. Species may be included if they are comparatively well known from one or more localities but do not meet adequacy of survey requirements and appear to be under threat from known threatening processes.
3: Priority Three – Poorly known Species
Species that are known from collections or sight records from several localities not under imminent threat, or from few but widespread localities with either large population size or significant remaining areas of apparently suitable habitat, much of it not under imminent threat. Species may be included if they are comparatively well known from several localities but do not meet adequacy of survey requirements and known threatening processes exist that could affect them.
4: Priority Four – Rare, Near Threatened and other species in need of monitoring
1. Rare. Species that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection, but could be if present circumstances change. These species are usually represented on conservation lands. 2. Near Threatened. Species that are considered to have been adequately surveyed and that do not qualify for Conservation Dependent, but that are close to qualifying for Vulnerable. 3. Species that have been removed from the list of threatened species during the past five years for reasons other than taxonomy.
5: Priority 5 – Conservation Dependent Species
Species that are not threatened but are subject to a specific conservation program, the cessation of which would result in the species becoming threatened within five years.

3.2 Sampling and Analysis Methods

BC was commissioned by Brockman to conduct a Level 2 quadrat based flora and vegetation survey of 72ha, within the Marillana Iron Ore Project area for the proposed airstrip, access road and mining camp location. The fieldwork was carried out in spring from the 26th to 28th September 2011 which is the optimum time for flora surveys. The objective of the survey was to document all observed "Declared Rare and Priority Flora" species encountered and the occurrences of any "Environmental or Declared Weeds" observed within or adjacent to the survey area. The survey area was accessed by 4WD and traversed by two people on foot. Figure 4 shows a map of the areas traversed throughout the survey.

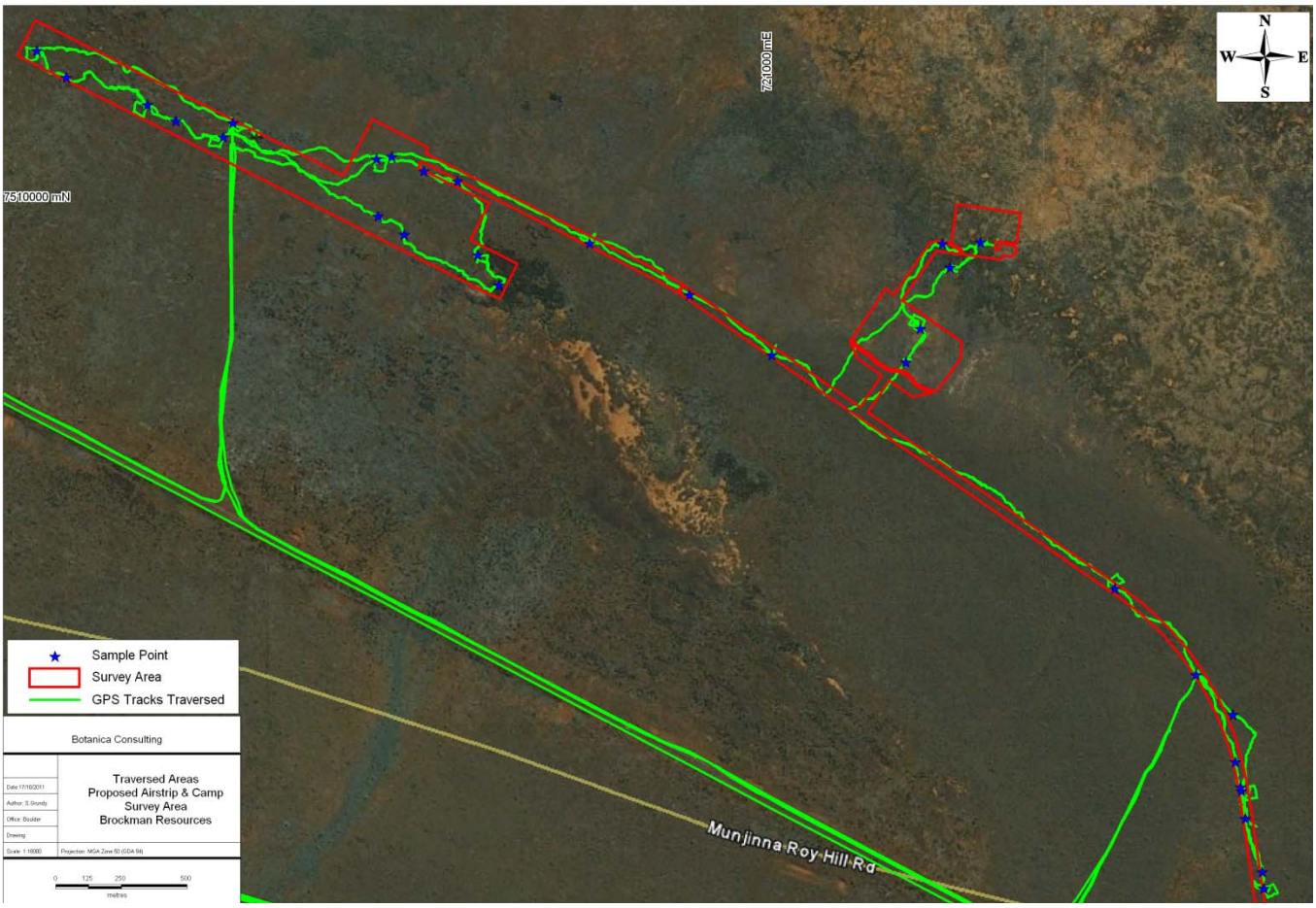

Figure 4: GPS tracks traversed throughout the proposed airstrip and camp survey area

Prior to the commencement of field work, aerial photography was inspected and obvious differences in the vegetation assemblages were identified. The different vegetation communities identified were then inspected during the field survey to assess their validity. A handheld GPS unit was used to record the co-ordinates of the boundaries between existing vegetation communities.

At each sample point, the following information was recorded:

- GPS location;
- Photograph of vegetation;
- Dominant species;
- Collection and documentation of unknown plant specimens; and
- GPS location, photograph and collection of Threatened Flora if encountered.

Unknown specimens collected during the survey were identified with the aid of samples housed at the BC Herbarium and the Western Australian Herbarium. Presence/absence data of species from sample sites of similar vegetation was then compiled forming the five best representative vegetation communities. Similar vegetation communities were recognised visually in the field.

3.2.1 50m X 50m Quadrats

Thirteen 50m x 50m quadrats were established within the survey area, the objective being to have at least three quadrats per vegetation community to capture the floristic variations within the survey area. Where a vegetation community was insufficiently large to accommodate three quadrats, the maximum number of quadrats that would fit within that specific community were established.

The quadrats were established by inserting metal pickets in each corner, and measuring the length of the resultant boundaries to verify the quadrats were 50 metres square.

Following their establishment and boundary verification, the location of each quadrat was recorded by GPS, photographed and all vascular plants within the quadrat were recorded. This included recording of dominant taxa from the upper, middle and lower stratum, and sampling of all unknown taxa. Unknown taxa were identified using BC's own reference herbarium and relevant taxonomical keys. Data on topographical position, percentage litter, percentage bare ground, percentage surface rock (bedrock and surface deposits), and vegetation structure were collected from each quadrat.

3.2.2 Personnel involved

Jim Williams - Environmental Consultant/Botanist (Diploma of Horticulture);
Lauren Padmore - Environmental Consultant (BSc Hons Environmental Sciences).

3.2.3 Scientific licences

Table 3: Scientific Licences of Botanica Staff coordinating the survey

Licensed staff	Permit Number	Valid Until
Jim Williams	SL009438	3-4-2012

3.3 Data Analysis Tools

Once the survey was completed the data obtained was analysed to generate a vegetation map (Appendix 3) using the points in Appendix 5. The statistical program PATN was used to complete a pattern analysis on the data obtained from the quadrats.

3.3.1 PATN Analysis

PATN is a software package that aims to display patterns in complex data. Complex in PATN's terms, means that you have at least 6 objects (i.e. different species) that you want to know something about and a suite of more than 4 variables (i.e. different quadrats) that describe the objects. This is achieved by grouping quadrats based on similarities in the flora species that are present or absent in each quadrat. This produces a quantitative estimate of the relationship between species composition of each quadrat.

Data must be in the form of a Microsoft Excel™ spreadsheet of rows (analysis data/species) and columns (variables/quadrats). The classifications are based upon a Bray-Curtis association matrix using a flexible unweighted pair group method of arithmetic mean (UPGMA) which standardises the data enabling the analysis to be completed. Once the program has completed the analysis it produces a dendrogram (see Figure 5) which represents the groupings of the different quadrats into vegetation communities based on how similar their species composition are. Separate vegetation communities are distinguished by different colours in the dendrogram (i.e. orange and blue). The values along the horizontal axis represent the level of similarity between quadrats ranging from low to high (i.e. low value means high similarity). For example in Figure 5 Quadrats 1 and 5 are most similar as the lines end at value 0.4167.

The dotted line running vertically down the dendrogram represents the point at which quadrats are divided into vegetation communities based on the number of species in common between quadrats.

The analysis also produces a stress value which is a measure of the 'strength' of the analysis (i.e. how well the quadrats are grouped together into the appropriate vegetation communities). The lower the stress value the greater the strength of the analysis with a value of less than 0.3 showing that the analysis grouped quadrats accordingly. A stress value greater than 0.3 suggests that the analysis was unable to group quadrats appropriately due to extraneous variables (i.e. other factors influencing differences in vegetation communities other than species composition eg. fire, clearing disturbance etc.).

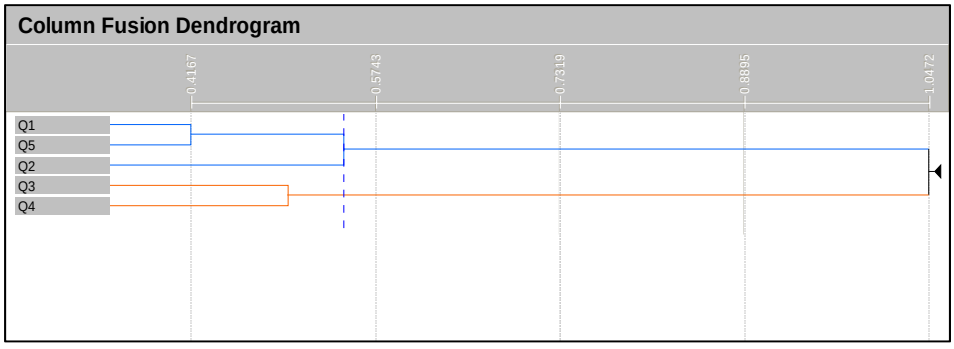

Figure 5: Example of a dendrogram produced from PATN analysis.

The PATN analysis was conducted on all perennial species present in each quadrat using a Flexible UPGMA and a beta value of -0.1. Species reconciliation eliminated those sterile species that could not be fully identified from the analysis.

3.4 Flora survey limitations and constraints

It is important to note that flora surveys will entail limitations notwithstanding careful planning and design. Potential limitations are listed in Table 4.

Table 4: Limitations and constraints associated with the flora and vegetation survey.

Variable	Impact on Survey outcomes
Access problems	The survey area was accessed by a 4WD all terrain vehicle and traversed on foot. Between 70-90% of the ground was covered by dense *Trioda basedowii*, hummock grassland, therefore the tracks shown in Figure 3 were somewhat determined by the density of the vegetation, limiting mobility and access within the area. However, BC staff were able to access the majority of the areas via existing access tracks and could access the less dense areas between the vegetation.
Experience levels	The BC personnel that conducted the survey were regarded as suitably qualified and experienced. **Coordinating Botanist:** Jim Williams **Field Staff:** Jim Williams & Lauren Padmore **Data Interpretation:** Jim Williams, Lauren Pick, Stephen Parkin & Sarah Grundy
Timing of survey, weather & season	Fieldwork was completed during the EPA's recommended time period (i.e., Spring) for detecting most ephemeral flora and when the majority of species are in flower.
Sources of information	BC were able to obtain information about the area from previous research conducted within the Marillana area which enabled adequate background information about the region.
Mapping reliability	BC were unable to obtain high quality ortho aerial images as they were unavailable. A good Google image was created to assist in mapping processes.
Area disturbance	The survey area has been subject to disturbances from cattle grazing and fire. Limited disturbance from human access to the site was noticeable
Survey Intensity	Survey intensity was high with a Level 2 quadrat based survey conducted in Spring. Prior to the quadrats being established a reconnaissance of the survey area was conducted in order to identify vegetation communities and any Priority Flora species. DEC listed threatened flora locations around the survey area, no DEC locations were listed within the survey area.
Resources	The DEC provided threatened flora information and previous reports which were used to complete the survey. Previous reports of the area were also supplied by Ecologica Environmental.
Completeness	In the opinion of BC the survey area was covered sufficiently in order to identify vegetation assemblages. Many of the plants during the spring survey were in flower, however a small percentage of annual species had started to dry out due to the spring season coming to an end. As a result the majority of the flora species could be identified fully, however some annually species may no longer have been present. It is estimated that approximately 90% of the flora within the survey area were able to be fully identified. The vegetation communities for this study were based on visual descriptions of locations in the field. The distribution of these vegetation communities outside the study area is not known, however vegetation communities identified were categorised via comparison to vegetation distributions throughout WA given on Australian Natural Resources Atlas (ANRA, 2011).

4 Results

4.1 Summary

Four broad vegetation communities were identified within the survey area, *Acacia pteraneura* open low woodland over sparse scrub of *Acacia bivenosa*, *Eucalyptus odontocarpa / Hakea lorea* very open shrub mallee over *Triodia basedowi*i dense hummock grassland, *Acacia pteraneura* open low woodland over *Triodia basedowii* mid-dense hummock grassland and *Acacia victoriae* open low shrub over open

dwarf scrub of *Frankenia ambita*. These vegetation communities were represented by a total of 21 Families, 41 Genera and 75 Species (including sub-species and variants).

The data recorded from the quadrat survey was used in a PATN analysis to group quadrats with similar species compositions. Results of the PATN analysis revealed that many of the vegetation communities differed visually from the PATN results. This was in part due to the sparse density of the upper storey species. Within the *Acacia pteraneura* open low woodland over *Triodia basedowii* mid-dense hummock grassland vegetation community, a number of quadrats did not contain the dominant upper storey species even though they shared similar mid and lower storey species. This resulted in the PATN analysis splitting the vegetation community. Several of the vegetation communities also shared enough mid and lower storey species so that a number of the quadrats from each vegetation community were consolidated together.

No DRF species, pursuant to subsection (2) of section 23F of the *Wildlife Conservation Act (1950)* and as listed by the DEC (Atkins, 2010), were identified within the area surveyed. Two weed species were identified within the survey area, *Cenchrus ciliaris* (Buffel Grass) and *Portulaca oleracea* (Purslane).

None of the vegetation communities have National Environmental Significance as defined by the Environment Protection and Biodiversity Conservation (*EPBC) Act 1999*. No Threatened Ecological Communities (TEC) pursuant to Commonwealth legislation or listed by the DEC were recorded within the survey area (DEC, 2011b; DSEWPaC, 2011). The entire survey area is however located within the Fortescue Marsh (Marsh Land System) PEC which is listed by the DEC as a Priority 1 Ecological Community. The south-eastern extremity of the survey area is also located within the Fortescue Sand Dunes PEC which is listed by the DEC as a Priority 3 Ecological Community.

Based on Trudgen's vegetation health rating scale (1991), all four of the vegetation communities were given the health rating of 'good' health (i.e. more obvious signs of damage caused by activities of European man, some obvious impact on vegetation such as low levels of grazing).

4.2 Desktop Assessment

The results of the combined search of the DEC's Declared Rare and Priority Flora databases (DEC, 2011) revealed 34 Priority Flora species within 35km of the survey area. Of these 34 species six have the potential to occur within the survey area as they occur in similar habitats and vegetation communities to those identified within the survey area. Table 5 identifies the DEC listed Threatened Flora species potentially occurring within the survey area. There were no DEC listings of any Priority Flora species within the survey area.

Table 5: **Priority Flora with the potential to occur within the survey area (WAHERB, 2011)**

Species	Conservation Code	Description (WAHERB, 2011)
Atriplex flabelliformis	P3	Monoecious, erect, rounded perennial, herb, to 0.35 m high. Clay loam, loam. Saline flats or marshes.
Eremophila spongiocarpa	P1	Compact, succulent-leaved shrub, to 1 m high. Fl. white, May or Sep. Weakly saline alluvial plain on margins of marsh.
Goodenia nuda	P4	Erect to ascending herb, to 0.5 m high. Fl. yellow, Apr to Aug
Rhynchosia bungarensis	P4	Compact, prostrate shrub, to 0.5 m high. Fl. yellow. Pebbly, shingly coarse sand amongst boulders. Banks of flow line in the mouth of a gully in a valley wall.
Sida sp. Barlee Range (S. van Leeuwen 1642)	P3	Spreading shrub, to 0.5 m high. Fl. yellow, Aug. Skeletal red soils pockets. Steep slope.
Themeda sp. Hamersley Station (M.E. Trudgen 11431)	P3	Tussocky perennial, grass-like or herb, 0.9-1.8 m high. Fl. Aug. Red clay. Clay pan, grass plain.

4.3 Flora of conservation significance

No DRF species, pursuant to subsection (2) of section 23F of the *Wildlife Conservation Act (1950)* and as listed by the DEC (Atkins, 2010), were identified within the survey area. No Priority Flora species were identified in this vegetation community during the survey.

4.4 Vegetation Communities

Four broad vegetation communities were identified within the survey area. These included*:*

1. *Acacia pteraneura* open low woodland over sparse scrub of *Acacia bivenosa;*
2. *Eucalyptus odontocarpa* / *Hakea lorea* very open shrub mallee over *Triodia basedowii* dense hummock grassland;
3. *Acacia pteraneura* open low woodland over *Triodia basedowii* mid-dense hummock grassland; and
4. *Acacia victoriae* open low shrub over open dwarf scrub of *Frankenia ambita.*

The vegetation communities were represented by a total of 21 Families, 41 Genera and 75 Species (including sub-species and variants). The quadrat survey recorded a total of 19 Families, 36 Genera and 55 Species (including sub-species and variants). No DRF or Priority Flora species were identified within the survey area.

Table 6: Summary of vegetation communities and their areas

Vegetation Community	Area (ha)
Acacia pteraneura open low woodland over sparse scrub of *Acacia bivenosa*	4.2
Eucalyptus odontocarpa/Hakea lorea very open shrub mallee over *Triodia basedowii* dense hummock grassland	13
Acacia pteraneura open low woodland over *Triodia basedowii* mid-dense hummock grassland	45
Acacia victoriae open low shrub over open dwarf scrub of *Frankenia ambita*	9.8
Total Area	**72**

4.5 *Acacia pteraneura* open low woodland over sparse scrub of *Acacia bivenosa*

4.5.1 Flora

Flora recorded in this vegetation community was represented by 9 Families, 12 Genera and 20 Species (Appendix 4). Flora recorded in the quadrat survey was represented by 6 Families, 8 Genera and 10 Species (Appendix 8).

No DRF species, pursuant to subsection (2) of section 23F of the *Wildlife Conservation Act (1950)* and as listed by the DEC (Atkins, 2010), were identified within the survey area. No Priority Flora species were identified in this vegetation community during the survey. One weed species was recorded in this vegetation community, *Cenchrus ciliaris* (Buffel Grass). According to the Department of Agriculture and Food WA (DAFWA) *Cenchrus ciliaris* is not listed as a Declared Plant.

4.5.2 Vegetation

The flora recorded in this vegetation community was representative of *Acacia pteraneura* open low woodland over sparse scrub of *Acacia bivenosa* (Plate 1). The species in the upper storey consisted of *Acacia aneura, Eucalyptus odontocarpa,* and *Acacia tetragonophylla*. The mid-storey species included *Acacia bivenosa*, *Melaleuca interioris, Pluchea ferdinandi-muelleri* and *Scaevola spinescens*. The understorey species included *Triodia* b*asedowii*, *Ptilotus exaltatus*, *Senna glutinosa, Cenchrus ciliaris* and *Scaevola spinescens*. Dominant species from the vegetation assemblage according to Muir (1977) is shown in Table 7.

Table 7: **Vegetation assemblage for *Acacia pteraneura open low woodland over sparse scrub of Acacia bivenosa* within the survey area (Muir, 1977).**

Life Form/Height Class	Canopy Cover	Dominant species present
Trees 5-15m	2-10%	*Acacia pteraneura* *Eucalyptus odontocarpa*
Shrub 1-1.5m	10-30%	*Acacia bivenosa*
Shrubs 0-0.5m	10-30%	*Triodia basedowii*

No broad scale clearing has occurred for agricultural purposes in this vegetation community within the survey area.

This vegetation community is best represented by the *Acacia* open woodlands vegetation community which, according to Australian Natural Resources Atlas (ANRA), covers 0.1% of WA (ANRA, 2011).

Plate 1*: Acacia pteraneura* open low woodland over sparse scrub of *Acacia bivenosa*

4.6 *Eucalyptus odontocarpa* / *Hakea lorea* very open shrub mallee over *Triodia basedowii* dense hummock grassland

4.6.1 Flora

Flora recorded in this vegetation community was represented by 8 Families, 16 Genera and 22 Species (Appendix 4). Flora recorded in the quadrat survey was represented by 8 Families, 14 Genera and 18 Species (Appendix 8).

No DRF species, pursuant to subsection (2) of section 23F of the *Wildlife Conservation Act (1950)* and as listed by the DEC (Atkins, 2010), were identified within the survey area. No Priority Flora species were identified in this vegetation community during the survey. No weed species were recorded in this vegetation community.

4.6.2 Vegetation

The flora recorded in this vegetation community was representative of *Eucalyptus odontocarpa/Hakea lorea* very open shrub mallee over *Triodia basedowii* dense hummock grassland (Plate 2). The species in the upper storey included *Eucalyptus odontocarpa*, *Corymbia hamersleyana*, *Hakea lorea* and *Grevillea wickhamii*. The mid-storey species included *Petalostylis labicheoides*, *Acacia aneura subsp. conifera*, *Dodonaea lanceolata*, *Indigofera monophylla* and *Sida sp. Pilbara*. The understorey species consisted of *Triodia basedowii* and *Ptilotus exaltatus*. Dominant species from the vegetation assemblage according to Muir (1977) is shown in Table 8.

Table 8: **Vegetation assemblage for *Eucalyptus odontocarpa/Hakea lorea very open shrub mallee over Triodia basedowii dense hummock grassland* within the survey area (Muir, 1977).**

Life Form/Height Class	Canopy Cover	Dominant species present
Trees <5m	10-30% 2-10%	*Eucalyptus odontocarpa* *Corymbia hamersleyana*
Shrub 1-1.5m	10-30% 10-30%	*Acacia aneura subsp. conifera* *Petalostylis labicheoides*
Shrubs 0-0.5m	70-90%	*Triodia basedowii*

No broad scale clearing has occurred for agricultural purposes in this vegetation community within the survey area.

This vegetation community is best represented by the *Eucalyptus* low open forest vegetation community which, according to Australian Natural Resources Atlas (ANRA), covers 0.1% of WA (ANRA, 2011).

Plate 2: *Eucalyptus odontocarpa/Hakea lorea* very open shrub mallee over *Triodia basedowii* dense hummock grassland

4.7 *Acacia pteraneura* open low woodland over *Triodia basedowii* mid-dense hummock grassland

4.7.1 Flora

Flora recorded in this vegetation community was represented by 16 Families, 27 Genera and 48 Species (Appendix 4). Flora recorded in the quadrat survey was represented by 16 Families, 24 Genera and 34 Species (Appendix 8).

No DRF species, pursuant to subsection (2) of section 23F of the *Wildlife Conservation Act (1950)* and as listed by the DEC (Atkins, 2010), were identified within the survey area. No Priority Flora species were identified in this vegetation community during the survey. Two weed species were recorded in this vegetation community, *Cenchrus ciliaris* (Buffel Grass) and *Portulaca oleracea* (Purslane). According to the Department of Agriculture and Food WA (DAFWA) neither species are listed as Declared Plants.

4.7.2 Vegetation

The flora recorded in this vegetation community was representative of *Acacia pteraneura* open low woodland over *Triodia basedowii* mid-dense hummock grassland (Plate 3).

The species in the upper storey was comprised of *Acacia aneura*, *Hakea lorea* and *Corymbia hamersleyana*. The mid-storey species included *Acacia victoriae*, *Acacia tetragonophylla*, *Indigofera*

monophylla, *Eremophila latrobei subsp. filiformis* and *Eremophila longifolia*. The understorey species included *Triodia basedowii*, *Themeda triandra*, *Sclerolaena densiflora*, *Sclerolaena cuneata* and *Ptilotus obovatus.* Dominant species from the vegetation assemblage according to Muir (1977) is shown in Table 9.

Table 9: **Vegetation assemblage for *Acacia* pteraneura open low woodland over Triodia basedowii mid-dense hummock grassland within the survey area (Muir, 1977).**

Life Form/Height Class	Canopy Cover	Dominant species present
Trees 5-15m	2-10%	*Acacia aneura*
Shrub >2m	2-10%	*Acacia victoriae*
Shrubs 0.5-1m	30-70%	*Triodia basedowii*

No broad scale clearing has occurred for agricultural purposes in this vegetation community within the survey area.

This vegetation community is best represented by the *Acacia* open woodlands vegetation community which, according to Australian Natural Resources Atlas (ANRA), covers 0.1% of WA (ANRA, 2011).

Plate 3: *Acacia pteraneura* open low woodland over *Triodia basedowii* mid-dense hummock grassland

4.8 *Acacia victoriae* open low shrub over open dwarf scrub of *Frankenia ambita*

4.8.1 Flora

Flora recorded in this vegetation community was represented by 7 Families, 13 Genera and 20 Species (Appendix 4). Flora recorded in the quadrat survey was represented by 7 Families, 12 Genera and 15 Species (Appendix 8).

No DRF species, pursuant to subsection (2) of section 23F of the *Wildlife Conservation Act (1950)* and as listed by the DEC (Atkins, 2010), were identified within the survey area. No Priority Flora species were identified in this vegetation community during the survey. One weed species was recorded in this vegetation community, *Cenchrus ciliaris* (Buffel Grass). According to the Department of Agriculture and Food WA (DAFWA) *Cenchrus ciliaris* is not listed as a Declared Plant.

4.8.2 Vegetation

The flora recorded in this vegetation community was representative of *Acacia victoriae* open low shrub over open dwarf scrub of *Frankenia ambita* (Plate 4).

This vegetation community had no visible upper story. The mid-storey species included *Acacia victoriae*, *Maireana georgei* and *Maireana pyramidata*. The understorey species included *Frankenia ambita*, *Triodia basedowii*, *Eragrostis xerophila* and *Atriplex bunburyana*. Dominant species from the vegetation assemblage according to Muir (1977) is shown in Table 10.

Table 10: **Vegetation assemblage for *Acacia victoriae open low shrub over dwarf scrub of Frankenia ambita* within the survey area (Muir, 1977).**

Life Form/Height Class	Canopy Cover	Dominant species present
Shrubs 1-1.5m	2-10%	*Acacia victoriae*
Shrubs 0-0.5m	10-30% 10-30%	*Frankenia ambita* *Triodia basedowii*

No broad scale clearing has occurred for agricultural purposes in this vegetation community within the survey area.

This vegetation community is best represented by the *Acacia* shrublands vegetation community which, according to Australian Natural Resources Atlas (ANRA), covers 9.5% of WA (ANRA, 2011).

Plate 4: *Acacia victoriae* open low shrub over open dwarf scrub of *Frankenia ambita*

4.9 Vegetation of Conservation Significance

No DRF species, pursuant to subsection (2) of section 23F of the Wildlife Conservation Act (1950) and as listed by the DEC (Atkins, 2010), were identified within the survey area. No Priority Flora species were identified within the survey area. No TEC pursuant to the *EPBC Act 1999* or as listed by the DEC were recorded within the survey area (DEC, 2010; DSEWPaC, 2011).

However, the entire survey area is located within the Fortescue Marsh PEC buffer zone which is listed by the DEC as a Priority 1 Ecological Community. This PEC (including the 37.5km buffer zone) encompasses an area of 442,900ha and is centred on the Fortescue Marsh. Priority 1 Ecological Communities are defined by the DEC as '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'. The south-eastern end of the survey area is also located within the Fortescue Sand Dunes PEC buffer zone which is listed by the DEC as a Priority 3 Ecological Community.

From BCs current survey no Flora species of importance have been identified and the proposed Airstrip and Camp project is likely to have no effect on the surrounding vegetation or PEC. None of the vegetation communities have National Environmental Significance as defined by the *EPBC Act 1999*.

4.10 Vegetation condition

Based on Trudgen's vegetation health rating scale (1991) all four of the vegetation communities were given the health rating 'good' health. A good health rating indicates that there are some obvious signs of damage caused by the activities of European man, including some obvious impacts on the vegetation structure; such as that caused by low levels of grazing, vehicular access, or by selective logging and the presence of weed species.

4.11 Introduced Plant Species

Two weed species were identified within the survey area, *Cenchrus ciliaris* (Buffel Grass) and *Portulaca oleracea* (Purslane). According to the Department of Agriculture and Food neither species are listed as Declared plants (DAFWA, 2011).

4.11.1 *Cenchrus ciliaris* (Buffel Grass)

The weed species *Cenchrus ciliaris* was identified within three of the four vegetation communities; *Acacia pteraneura* open low woodland over sparse scrub of *Acacia bivenosa*, *Acacia pteraneura* open low woodland over *Triodia basedowii* mid-dense hummock grassland and *Acacia victoriae* open low shrub over open dwarf scrub of *Frankenia ambita*. *Cenchrus ciliaris* is a tufted or sometimes stoloniferous perennial, grass-like herb that grows between 0.2-1.5m in height. It produces purple flowers from February to October and prefers white, red or brown sand, stony red loam and black cracking clay soils (WAHERB, 2011).

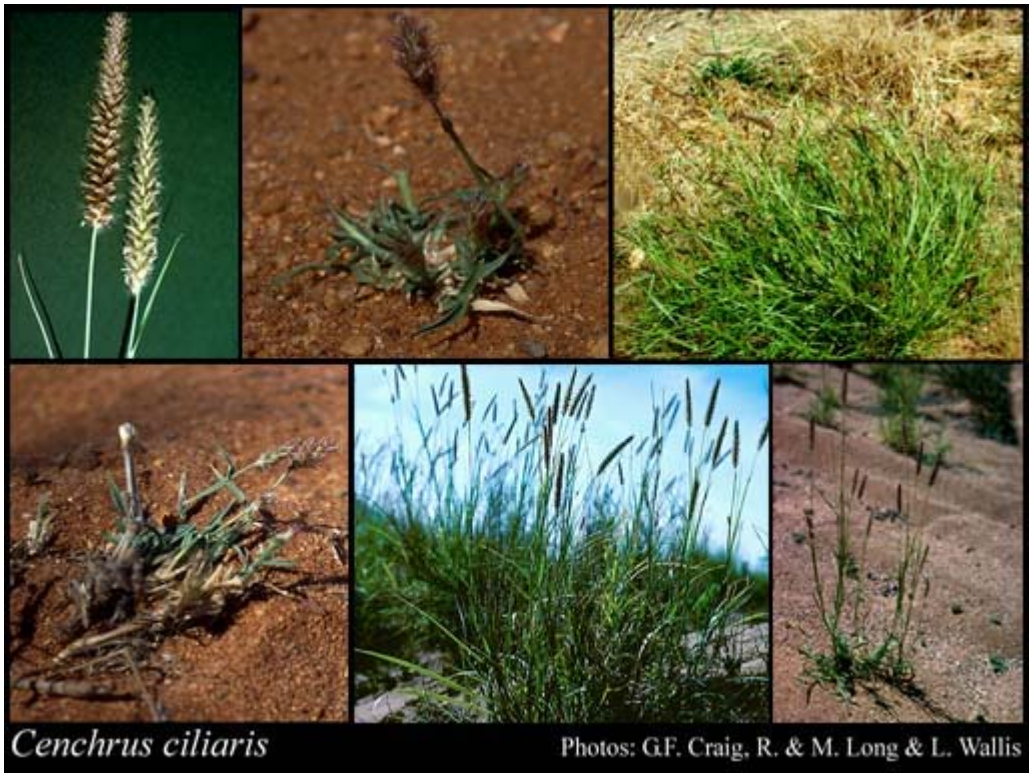

Plate 5: Image of *Cenchrus ciliaris* (WAHERB, 2011)

4.11.2 *Portulaca oleracea* (Purselane)

The weed species *Portulaca oleracea* was identified within the *Acacia pteraneura* open low woodland over *Triodia basedowii* mid-dense hummock grassland vegetation community and *Acacia victoriae* open low shrub over open dwarf scrub of *Frankenia ambita*. *Portulaca oleracea* is a succulent, prostrate to decumbent annual herb that grows to 0.2min height. It produces yellow flowers from April to May and prefers clay loam or sand and is usually found on disturbed sites (WAHERB, 2011).

Plate 6: Image of *Portulaca oleracea* (WAHERB, 2011)

4.12 PATN Analysis on the Marillana Airstrip and Camp Quadrats

PATN analysis was used to determine the similarities or differences between and within delineated vegetation communities. Figure 6 shows the dendrogram for all species recorded. The quadrats are represented as Q1-Q13. Table 11 lists the vegetation community that each quadrat is located within.

Table 11: The thirteen surveyed vegetation communities with corresponding quadrats.

Vegetation community	Quadrat
Acacia pteraneura open low woodland over *Triodia basedowii* mid-dense hummock grassland	Q1, Q2, Q3, Q5, Q4, Q13
Acacia victoriae open low shrub over open dwarf scrub of *Frankenia ambita*	Q9, Q10
Acacia pteraneura open low woodland over sparse scrub of *Acacia bivenosa*	Q11
Eucalyptus odontocarpa / Hakea lorea very open shrub mallee over *Triodia basedowii* dense hummock grassland	Q6, Q7, Q8, Q12,

4.12.1 PATN Analysis for All Recorded Species

The *Acacia pteraneura* open low woodland over *Triodia basedowii* mid-dense hummock grassland vegetation community contained six quadrats (Table 11), however post PATN analysis the majority of the quadrats were split in different vegetation communities. Q13 did not contain the dominant upper story species and the mid and lower strata were significantly different to all other quadrats in its vegetation community. Q13 of the *Acacia pteraneura* open low woodland over *Triodia basedowii* mid-dense hummock grassland vegetation community has therefore been consolidated with Q11 of the *Acacia pteraneura* open low woodland over sparse scrub of *Acacia bivenosa* vegetation community. Although visual observations of the *Acacia pteraneura* open low woodland over sparse scrub of *Acacia bivenosa* vegetation community (Q11) identified this as a separate vegetation community, the PATN analysis highlighted that both Q11 & Q13 shared multiple species in common.

Q1 & Q2 of this vegetation community have been grouped with Q9 and Q10 of the *Acacia victoriae* open low shrub over open dwarf scrub of *Frankenia ambita* vegetation community. These four quadrats share a very similar mid and lower story species composition and this explains why the PATN has recorded and emphasised this relationship. However, in the field situation the introduction of the upper story species for the *Acacia pteraneura* open low woodland over *Triodia basedowii* mid-dense hummock grassland vegetation community composition denotes that they are indeed different vegetation communities.

The species composition of Q1 & Q2 share more species in common with Q9 & Q10 than Q3, Q4 and Q5 of the *Acacia pteraneura* open low woodland over *Triodia basedowii* mid-dense hummock grassland vegetation community. Quadrats 3, 4 & 5 of the *Acacia pteraneura* open low woodland over *Triodia basedowii* mid-dense hummock grassland vegetation community were more closely related to each other than any other quadrats, however not enough to be classed as their own vegetation community. They shared enough species similarity with the *Eucalyptus odontocarpa* / *Hakea lorea* very open shrub mallee over *Triodia basedowii* dense hummock grassland quadrats Q8 & Q12 to create a collective vegetation community.

The *Eucalyptus odontocarpa* / *Hakea lorea* very open shrub mallee over *Triodia basedowii* dense hummock grassland vegetation community contained four quadrats (Q6, Q7, Q8, Q12) of all four quadrats Q8 & Q12 are more similar to each other than to Q6 or Q7. This similarity exists despite the fact that Q8 does not contain the dominant *Eucalyptus odontocarpa* within its quadrat. Both quadrats (Q8 & Q12) contain a lesser number of species, and the species composition of these quadrats mean that they are more similar to, and have therefore been grouped with, Quadrats 3, 4 & 5. The remaining two *Eucalyptus odontocarpa* quadrats (Q6 &Q7) have been consolidated into their own vegetation community, thus supporting the visual identifications made in the field.

In this situation the visual identification of vegetation communities in the field is not as obvious within the PATN analysis. This is likely a result of the vegetation in the survey area being very open. Visually the dominant species were very different thus denoting a difference in vegetation communities, however as the vegetation dominants were so sparse random placement of the quadrats did not always include the upper story dominant species. The PATN application makes its determination based on similar species recorded; it is unable to differentiate which species are within which strata (upper, mid or lower). Many of the vegetation communities identified in the field shared similar understory species.

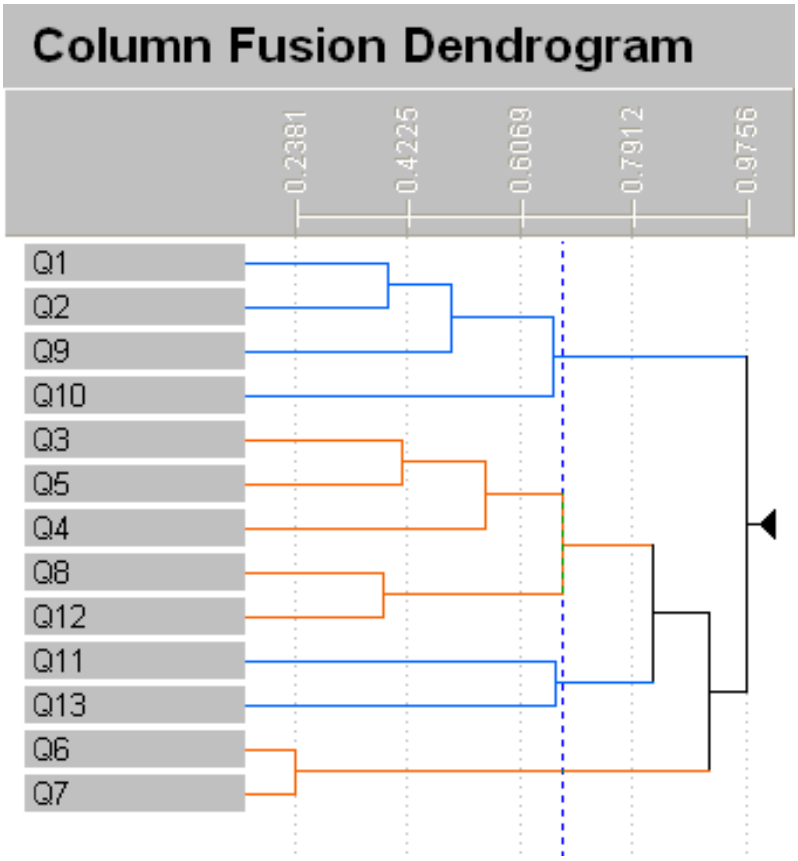

Figure 6: Dendrograms illustrating the grouping of Quadrats into groups based on similarities perennial species recorded during the Spring 2011 Level 2 surveys (Beta value -0.1)

5 Relevant Legislation and Compliance with Recognised Standards

5.1 Commonwealth Legislation

Commonwealth *Environment Protection and Biodiversity Conservation Act 1999 (EPBC 1999)*

The aim of this Act is to protect matters of national environmental significance and is used by the Department of Sustainability, Water, Population and Communities (DSEWPaC) to list threatened species and ecological communities into categories based on the criteria set out in the Act (www.environment.gov.au/epbc/index.html). The Act provides a national environmental assessment and approval system for proposed developments and enforces strict penalties for unauthorised actions that may affect matters of national environmental significance.

The survey area does not have national environmental significance under the *EPBC Act 1999.*

5.2 State Legislation

Clearing of Native Vegetation

The *Environmental Protection (Clearing of Native Vegetation) Regulations WA* 2004 establish that any clearing of native vegetation in Western Australia requires a permit from the DEC. Under Section 51A of the WA *Environmental Protection Act*, *1986* [*EP Act (1999)*] native vegetation includes aquatic and terrestrial vegetation indigenous to Western Australia, and intentionally planted vegetation declared by regulation to be native vegetation, but not vegetation planted in a plantation or planted with commercial intent. Section 51A of the EP Act defines clearing as "*the killing or destruction of; the removal of; the severing or ringbarking of trunks or stems of; or the doing of substantial damage to some or all of the native vegetation in an area, including the flooding of land, the burning of vegetation, the grazing of stock or an act or activity that results in the above*".

Regulation 6 of the 2004 Regulations defines Environmentally Sensitive Areas (ESA) as "*the area covered by vegetation within 50 m of Rare Flora, to the extent to which the vegetation is continuous with the vegetation in which the Rare Flora is located*".

A clearing permit must be granted prior to any clearing within a minimum of 50 m surrounding all populations of Rare Flora. The area covered by a TEC is also considered an ESA wherein clearing cannot occur unless a clearing permit is granted. Exploration activities are exempt from the requirement for clearing permits if undertaken pursuant to a Mining Act approval, for example through a "Programme of Work" provided the area involved does not occur in an ESA.

The survey area is located approximately 8km south of the Fortescue Marsh ESA (as listed by the DEC). However, the survey area does not contain any DRF.

Environmental Protection Act WA 1986

The *Environmental Protection Act (EP Act 1986)* includes requirements relating to the protection of DRF and TEC, and to the assessment of applications for clearing permits. TEC are protected even where exemptions for a clearing permit may apply. The *EP Act (1986)* enforces both financial and/or imprisonment penalties on those who unlawfully damage a TEC.

The survey area does not contain any TEC listed under the *EP Act 1986* and does not contain any DRF.

Wildlife Conservation Act WA 1950

The DEC uses the provisions of this Act to list flora taxa as protected and the level of protection assigned to such flora. Flora species are classified as DRF when their populations are geographically restricted or are threatened by local processes. Under this Act, all native flora (spermatophytes, pteridophytes, bryophytes and thallophytes) are protected throughout the State. Financial penalties pursuant to the Act can be imposed if threatened plant species are collected without an appropriate licence.

DEC Priority lists

The DEC lists 'Priority' flora species which are under consideration for declaration as Rare Flora. Species classed as Priority 1-3 are in urgent need of further survey, whereas Priority 4 species are considered to have been adequately surveyed but may become vulnerable or rare in future years. Priority 4 species are also species that have been removed from the threatened species list in the past 5 years. Priority 5 species are those species which are not currently threatened but are likely to become threatened within 5 years if not subject to a specific conservation program. The DEC also lists PEC as a mechanism for identifying communities that may need monitoring before possible nomination for TEC status. These priority species and communities have no formal legal protection until they are endorsed by the Minister as being Declared Rare Flora and TEC respectively.

Results from the DEC database searches identified 34 Priority Flora species recorded within a 35km radius of the survey area. No Priority Flora species were identified during the survey.

The survey area contains no TEC; however it is located within the Fortescue Marsh PEC which is listed by the DEC as a Priority 1 Ecological Community. The south-eastern extremity of the survey area is also located within the Fortescue Sand Dunes PEC which is listed by the DEC as a Priority 3 Ecological Community (DEC, 2009b).

5.3 EPA Position Statements

The EPA develops Position Statements to inform the public about environmental issues facing Western Australia and the plans for the future to ensure protection and ecological sustainability of environmentally important ecosystems. It provides a set of principles to assist the public and decision-makers on their responsibilities for managing land with care. These principles also provide the basis for the Environmental Protection Authority to evaluate and report upon achieving environmental and ecological sustainability and the protection of natural resources.

Position Statement No. 2 *Environmental Protection of Native Vegetation in Western Australia* (EPA 2000) outlines EPA policy on the protection of native vegetation in Western Australia, particularly in the agricultural area. It identifies basic elements that the EPA should consider when assessing proposals that impact on biological diversity. These include comparison of all proposal options; avoidance of species and community extinctions; an expectation that implementing the proposal will not take a

vegetation type below the "threshold level" of 30%; and that proponents should demonstrate that on and off-site impacts can be managed.

The survey area does not contain any DRF or TEC suggesting that clearing within the survey area will meet the EPA standards outlined in Position statement No. 2. According to DAFWA (2007) the survey area occurs in the pre-European Beard vegetation association Fortescue Valley 111, of which 100% of the original vegetation extent remains.

Position Statement No. 3 *Terrestrial Biological Surveys as an Element of Biodiversity Protection* establishes that the EPA has adopted the definition and principles of biological diversity as defined in the *National Strategy for the Conservation of Australia's Biological Diversity* (Commonwealth of Australia, 1996), and has stipulated the following requirements:

- The quality of information and scope of field surveys should meet standards, requirements and protocols as determined and published by the EPA; and
- The IBRA regionalisations should be used as the largest unit for environmental impact assessment (EIA) decision-making in relation to the conservation of biodiversity.

Pursuant to the IBRA regionalisations, 26 bioregions in WA, which are affected by a range of different threatening processes and have varying levels of sensitivity to impact, have been identified. Terrestrial biological surveys should provide sufficient information to address both biodiversity conservation and ecological functional values within the context of proposals and the results of surveys should be publicly available.

The flora survey of the study area was planned and implemented as far as practicable according to the EPA Guidance Statement No. 51 *Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia* (EPA, 2004). Also, the IBRA regionalisations have been used in preparing the report to identify the conservation status of the area and identify the main threats to the biodiversity of plant species in the region.

6 Conclusions and Recommendations

6.1 Conclusions

The Level 2 Flora survey was conducted of the proposed Marillana Airstrip and Camp survey area (approximately 72ha) and is located in the Pilbara region of Western Australia. The area lies approximately 8 km south of the Fortescue Marsh Environmentally Sensitive Area. Four broad vegetation communities were identified within the survey area, *Acacia pteraneura* open low woodland over sparse scrub of *Acacia bivenosa, Eucalyptus odontocarpa / Hakea lorea* very open shrub mallee over *Triodia basedowi*i dense hummock grassland, *Acacia pteraneura* open low woodland over *Triodia basedowii* mid-dense hummock grassland and *Acacia victoriae* open low shrub over open dwarf scrub

of *Frankenia ambita*. These vegetation communities were represented by a total of 21 Families, 41 Genera and 75 Species (including sub-species and variants).

None of the vegetation communities have National Environmental Significance as defined by the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*. No TEC pursuant to Commonwealth legislation or listed by the Department of Environment and Conservation were recorded within the survey area. The entire survey area is however located within the buffer zone of the Fortescue Marsh (Marsh Land System) Priority 1 Ecological Community. The south-east extremity of the survey area is also located within the buffer zone of the Fortescue Valley Sand Dunes Priority 3 Ecological Community.

Based on Trudgen's vegetation health rating scale (1991), all four of the vegetation communities were given a health rating of 'good' health. Two weed species were identified within the survey area, *Cenchrus ciliaris* (Buffel Grass) and *Portulaca oleracea* (Purslane). According to the Department of Food and Agriculture these species are not recorded as declared plants (DAFWA, 2011).

No DRF species, pursuant to subsection (2) of section 23F of the *Wildlife Conservation Act (1950)* and as listed by the DEC (Atkins, 2010), were identified within the area surveyed. No Priority Flora Species were identified within the survey area.

The data recorded from the quadrat survey was used in a PATN analysis to group quadrats with similar species compositions. Results of the PATN analysis revealed that many of the vegetation communities differed visually from the PATN results. This was in part due to the sparse density of the upper storey species. Within the *Acacia pteraneura* open low woodland over *Triodia basedowii* mid-dense hummock grassland vegetation community a number of quadrats did not contain the dominant upper storey species even though they shared similar mid and lower storey species. This resulted in the PATN analysis splitting this vegetation community. Several of the vegetation communities also shared enough mid and lower storey species so that a number of the quadrats from each vegetation community were consolidated together.

6.2 Recommendations

- Consultation with the DEC is recommended prior to any clearing as the survey area occurs within a Priority 1 Ecological Community.

6.3 Native Vegetation Clearing Principles

Based on the outcomes from the survey undertaken, as presented in this report, BC provides the following comments regarding the native vegetation clearing principles:

a. Native vegetation should not be cleared if it comprises a high level of biological diversity.

The Fortescue Plain subregion is rich and diverse in its flora however most species (excluding Priority Flora species) are wide ranging and usually occur in at least one, and often several, adjoining subregions (Cowan, 2001).

b. Native vegetation should not be cleared if it includes, or is necessary for the continued existence of, rare flora.

No DRF species, pursuant to subsection (2) of section 23F of the *Wildlife Conservation Act (1950)* and as listed by the DEC (Atkins, 2010), were identified within the survey area.

c. 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 (TEC).

No TEC listed under the *EPBC Act 1999* (DSEWPaC, 2011) or by the DEC (2010b) occur in the survey area.

d. Native vegetation should not be cleared if it is significant as a remnant of native vegetation in an area that has been extensively cleared.

According to DAFWA (2007) the survey area occurs in the pre-European Beard vegetation association Fortescue Valley 111, of which 100% of the original vegetation extent remains.

e. Native vegetation should not be cleared if it is growing, in, or in association with, an environment associated with a watercourse or wetland

The survey area lies within the buffer zone of a Priority 1 Ecological Community, the Fortescue Marsh. The Fortescue Marsh is located approximately 8km north of the survey area. No wetlands or associated watercourses were identified during the survey.

f. 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.

The survey area is located within the buffer zone of the Fortescue March PEC1. The ESA will not be impacted by the proposed Airstrip and Camp project.

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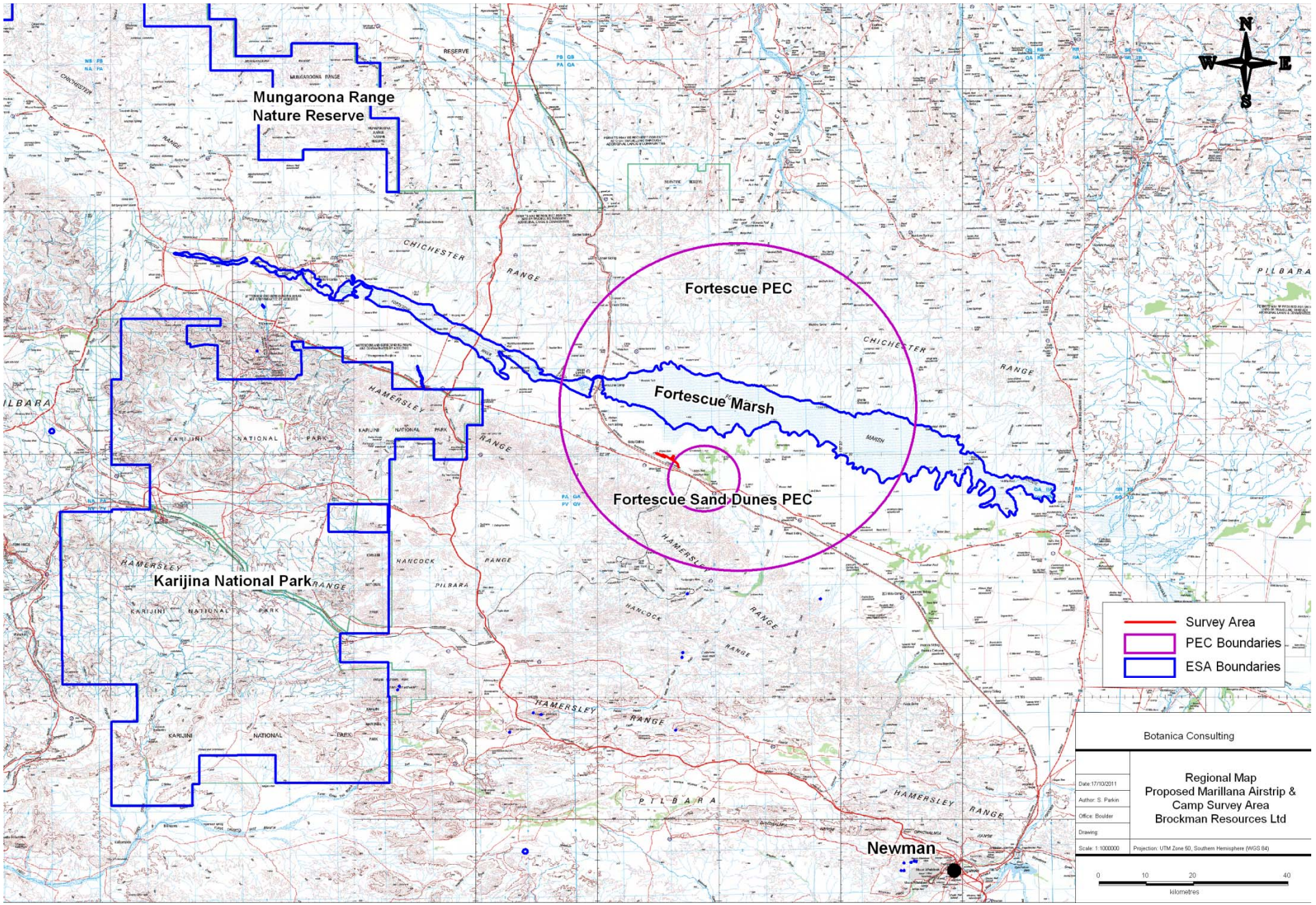
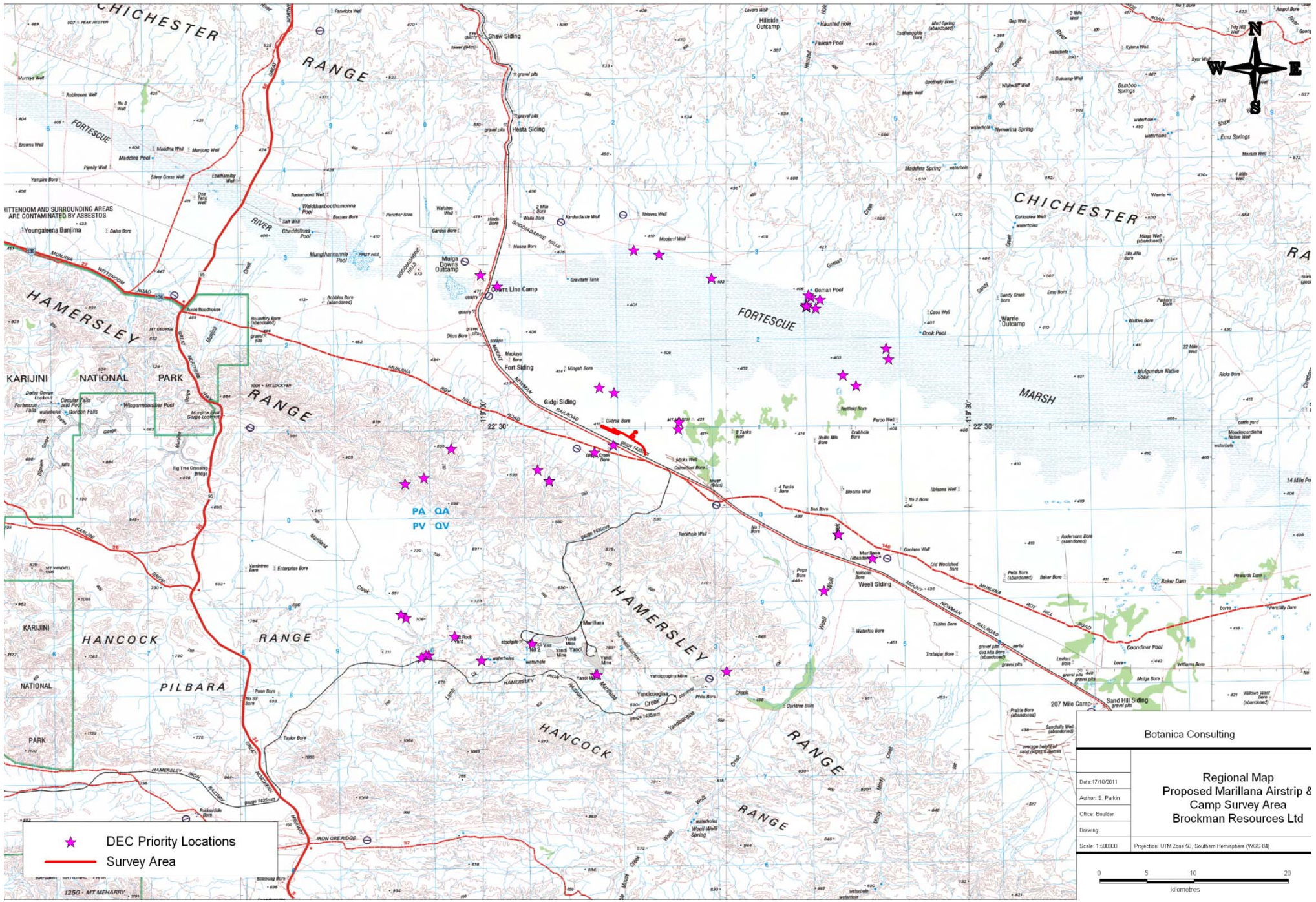
8 Appendices

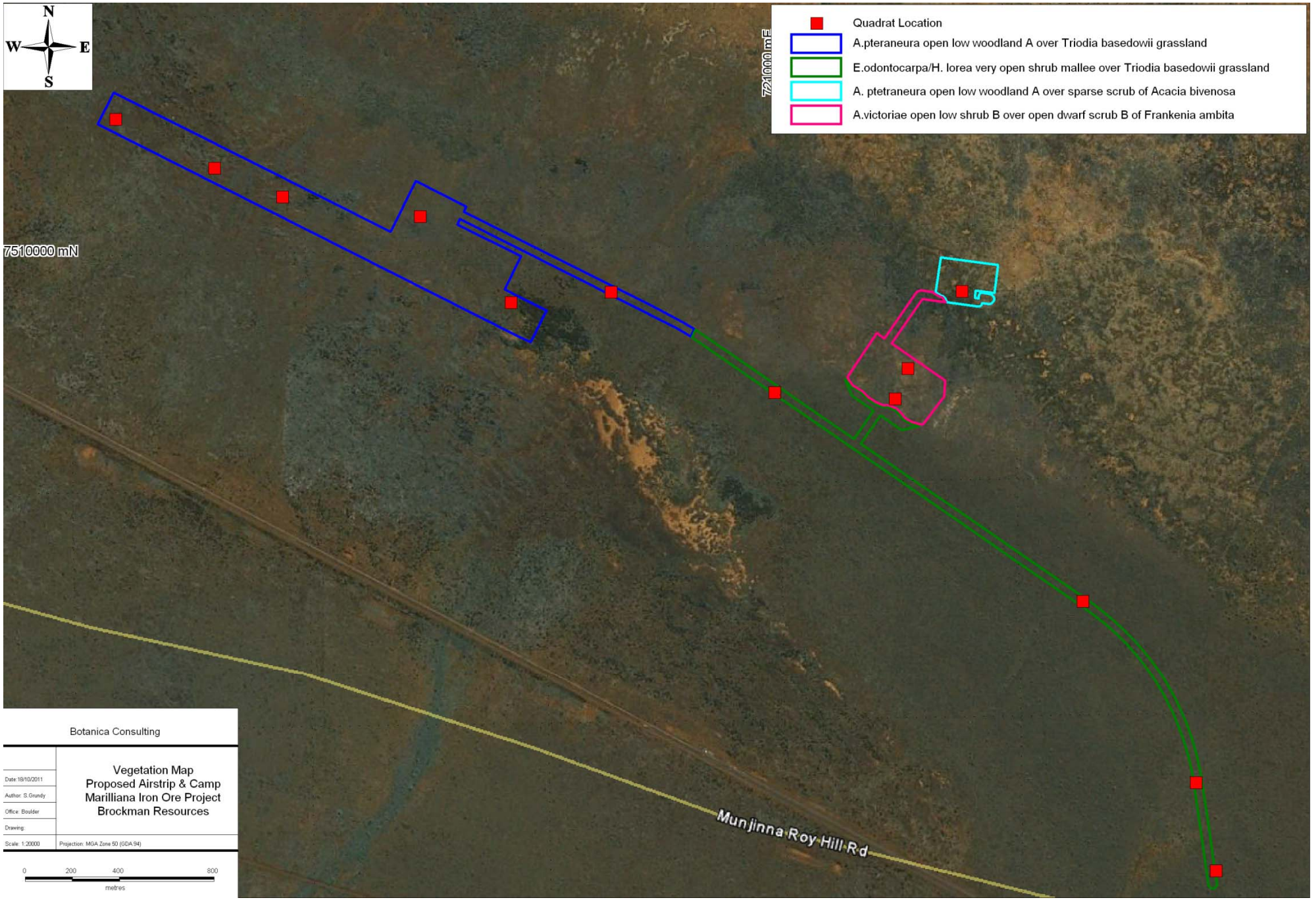
Appendix 1: Regional map of the survey area including PEC and Surrounding ESAs (survey area not to scale).



Appendix 2: Regional map of the survey area including DEC Priority Flora Locations



Appendix 3: Vegetation map of the Proposed Marillana Airstrip and Camp survey area



Appendix 4: List of species identified within each vegetation community

Family	Genus	Species	***Acacia pteraneura* open low woodland over sparse scrub of *Acacia bivenosa***	***Eucalyptus odontocarpa / Hakea lorea* very open shrub mallee over *Triodia basedowii* dense hummock grassland**	***Acacia pteraneura* open low woodland over *Triodia basedowii* mid-dense hummock grassland**	***Acacia victoriae* open low shrub over open dwarf scrub of *Frankenia ambita***
Amaranthaceae	*Gomphrena*	*canescens*			*	
Amaranthaceae	*Ptilotus*	*astrolasius*		*		
Amaranthaceae	*Ptilotus*	*exaltatus (A)*	*	*	*	
Amaranthaceae	*Ptilotus*	*Obovatus*	*	*	*	
Asteraceae	*Pluchea*	*ferdinandi-muelleri*	*			*
Asteraceae	*Streptoglossa*	*Decurrens*			*	
Boraginaceae	*Trichodesma*	*Zeylanicum*			*	
Brassicaceae	*Lepidium*	*platypetalum*			*	
Chenopodiaceae	*Atriplex*	*Bunburyana*				*
Chenopodiaceae	*Atriplex*	*codonocarpa*				*
Chenopodiaceae	*Dissocarpus*	*Paradoxus*				*
Chenopodiaceae	*Dysphania*	*rhadinostachya (A)*	*			
Chenopodiaceae	*Maireana*	*integra*			*	*
Chenopodiaceae	*Maireana*	*trichoptera*			*	
Chenopodiaceae	*Maireana*	*platycarpa*			*	
Chenopodiaceae	*Maireana*	*carnosa*			*	*
Chenopodiaceae	*Maireana*	*georgei*				*
Chenopodiaceae	*Maireana*	*triptera*			*	*
Chenopodiaceae	*Maireana*	*pyramidata*				*
Chenopodiaceae	*Maireana*	*sp. (sterile)*				*
Chenopodiaceae	*Rhagodia*	*eremaea*			*	
Chenopodiaceae	*Salsola*	*tragus (A)*			*	
Chenopodiaceae	*Sclerolaena*	*densiflora*			*	
Chenopodiaceae	*Sclerolaena*	*cuneata*			*	*
Fabaceae	*Acacia*	*ancistrocarpa*			*	
Fabaceae	*Acacia*	*aneura subsp conifera*		*		
Fabaceae	*Acacia*	*bivenosa*	*		*	
Fabaceae	*Acacia*	*citrinoviridis*			*	

Family	Genus	Species	***Acacia pteraneura* open low woodland over sparse scrub of *Acacia bivenosa***	***Eucalyptus odontocarpa / Hakea lorea* very open shrub mallee over *Triodia basedowii* dense hummock grassland**	***Acacia pteraneura* open low woodland over *Triodia basedowii* mid-dense hummock grassland**	***Acacia victoriae* open low shrub over open dwarf scrub of *Frankenia ambita***
Fabaceae	*Acacia*	*prainii*		*		
Fabaceae	*Acacia*	*pruinocarpa*			*	
Fabaceae	*Acacia*	*pteraneura*	*		*	
Fabaceae	*Acacia*	*pyrifolia*			*	
Fabaceae	*Acacia*	*sclerosperma*		*	*	
Fabaceae	*Acacia*	*synchronicia*			*	
Fabaceae	*Acacia*	*tetragonophylla*	*		*	
Fabaceae	*Acacia*	*victoriae*	*	*	*	*
Fabaceae	*Cullen*	*martinii*		*	*	
Fabaceae	*Indigofera*	*monophylla*		*	*	
Fabaceae	*Petalostylis*	*labicheoides*		*		
Fabaceae	*Senna*	*artemisioides*	*			
Fabaceae	*Senna*	*artemisioides subsp. helmsii*	*	*	*	
Fabaceae	*Senna*	*artemisioides subsp. oligophylla*	*		*	
Fabaceae	*Senna*	*glutinosa*	*			
Fabaceae	*Senna*	*glutinosa subsp. chatelainiana*	*			
Fabaceae	*Senna*	*helmsii*			*	
Fabaceae	*Senna*	*pleurocarpa*			*	
Frankeniaceae	*Frankenia*	*ambita*				*
Goodeniaceae	*Scaevola*	*parviflora*		*		
Goodeniaceae	*Scaevola*	*spinescens*	*		*	
Lamiaceae	*Clerodendrum*	*floribundum*	*			
Malvaceae	*Abutilon*	*cunninghamii*		*		
Malvaceae	*Sida*	*sp. Pilbara*		*	*	
Myrtaceae	*Corymbia*	*hamersleyana*		*	*	
Myrtaceae	*Eucalyptus*	*odontocarpa*		*		
Myrtaceae	*Eucalyptus*	*sp. (sterile)*	*			
Myrtaceae	*Melaleuca*	*interioris*	*			
Myrtaceae	*Melaleuca*	*xerophila*				*
Poaceae	*Aristida*	*holathera (A)*			*	

Family	Genus	Species	***Acacia pteraneura* open low woodland over sparse scrub of *Acacia bivenosa***	***Eucalyptus odontocarpa / Hakea lorea* very open shrub mallee over *Triodia basedowii* dense hummock grassland**	***Acacia pteraneura* open low woodland over *Triodia basedowii* mid-dense hummock grassland**	***Acacia victoriae* open low shrub over open dwarf scrub of *Frankenia ambita***
Poaceae	*Cenchrus*	*ciliaris (w)*	*		*	*
Poaceae	*Eragrostis*	*eriopoda*		*		
Poaceae	*Eragrostis*	*pergracilis*				*
Poaceae	*Eragrostis*	*xerophila*		*		*
Poaceae	*Themeda*	*triandra*			*	*
Poaceae	*Triodia*	*basedowii*	*	*	*	*
Portulacaceae	*Portulaca*	*oleracea (w)*			*	*
Proteaceae	*Grevillea*	*wickhamii*		*	*	
Proteaceae	*Hakea*	*lorea*		*	*	
Rubiaceae	*Psydrax*	*latifolia*			*	
Santalaceae	*Santalum*	*lanceolatum*	*			
Sapindaceae	*Dodonaea*	*lanceolata*		*		
Scrophulariaceae	*Eremophila*	*cuneifolia*			*	
Scrophulariaceae	*Eremophila*	*latrobei subsp. filiformis*			*	
Scrophulariaceae	*Eremophila*	*longifolia*			*	
Scrophulariaceae	*Eremophila*	*forrestii*			*	
Solanaceae	*Solanum*	*lasiophyllum*			*	
Zygophyllaceae	*Tribulus*	*suberosus*			*	

w - denotes weed species

A - denotes annual species

Appendix 5: DEC Threatened Flora Database search within 35km of survey area (DEC, 2011)

Species	Cons Code
Acacia bromilowiana	P4
Acacia subtiliformis	P3
Adiantum capillus-veneris	P2
Ampelopteris prolifera	P3
Aristida lazaridis	P2
Atriplex flabelliformis	P3
Barbula ehrenbergii	P1
Brachyscome sp. Wanna Munna Flats (S. van Leeuwen 4662)	P1
Calotis latiuscula	P3
Cladium procerum	P2
Dampieri metallorum	P3
Dicladanthera glabra	P2
Eremophila forrestii subsp. Pingandy (M.E. Trudgen 2662)	P2
Eremophila magnifica subsp. *magnifica*	P4
Eremophila spongiocarpa	P1
Eremophila youngii subsp. *lepidota*	P4
Euphorbia stevenii	P3
Fimbristylis sieberiana	P3
Glycine falcata	P3
Goodenia nuda	P4
Goodenia sp. East Pilbara (A.A. Mitchell PRP 727)	P3
Indigofera gilesii subsp. *gilesii*	P3
Iotasperma sessilifolium	P3
Isotropis parviflora	P2
Nicotiana heterantha	P1
Phragmites karka	P3
Rhynchosia bungarensis	P4
Rostellularia adscendens var. *latifolia*	P3
Sida sp. Barlee Range (S. van Leeuwen 1642)	P3
Spartothamnella puberula	P2
Stylidium weeliwolli	P2
Tecticornia globulifera	P1
Tecticornia medusa	P3
Themeda sp. Hamersley Station (M.E. trudgen 11431)	P3

Appendix 6: GPS Sample points recorded during the survey including Quadrat GPS locations

Sample Point	Zone	Eastings	Northings
299	50 K	718943	7510289
300	50 K	718943	7510289
301	50 K	718906	7510236
302	50 K	718727	7510299
303	50 K	718620	7510361
304	50 K	718313	7510469
305	50 K	718204	7510573
306	50 K	719488	7510143
307	50 K	719667	7510096
308	50 K	719794	7510056
309	50 K	719867	7509775
310	50 K	719945	7509660
311	50 K	719588	7509857
312	50 K	719490	7509928
313	50 K	722573	7508148
314	50 K	722718	7507817
315	50 K	722739	7507708
316	50 K	722735	7507721
317	50 K	722752	7507603
318	50 K	722818	7507338
319	50 K	722813	7507399
320	50 K	722711	7507996
321	50 K	722270	7508479
322	50 K	721488	7509345
323	50 K	721488	7509345
324	50 K	721544	7509471
325	50 K	721633	7509790
326	50 K	721778	7509794
327	50 K	721660	7509701
328	50 K	720978	7509380
329	50 K	720669	7509612
330	50 K	720292	7509812
331	50 K	719546	7510152

GPS coordinates of Quadrats (GDA94)

Quadrat	WP	Zone	Eastings	Northings
1	301	50 K	718906	7510236
2	303	50 K	718620	7510361
3	305	50 K	718204	7510573
4	306	50 K	719488	7510143
5	309	50 K	719867	7509775
6	315	50 K	722739	7507708
7	318	50 K	722818	7507338
8	321	50 K	722270	7508479
9	323	50 K	721488	7509345
10	324	50 K	721544	7509471
11	326	50 K	721778	7509794
12	328	50 K	720978	7509380
13	330	50 K	720292	7509812

Appendix 7: Muir Life Form/Height Class (Muir, 1977).

LIFE FORM/HEIGHT CLASS	CANOPY COVER			
	DENSE 70% -100%	**MID DENSE 30% - 70%**	**SPARSE 10% -30%**	**VERY SPARSE 2% - 10%**
Trees > 30m Trees 15 – 30m Trees 5 – 15m Trees < 5m	Dense Tall Forest Dense Forest Dense Low Forest A Dense Low Forest B	Tall Forest Forest Low Forest A Low Forest B	Tall Woodland Woodland Low woodland A Low Woodland B	Open Tall Woodland Open Woodland Open Low Woodland A Open Low Woodland B
Mallee Tree Form Mallee Shrub Form	Dense Tree Mallee Dense Shrub Mallee	Tree Mallee Shrub Mallee	Open Tree Mallee Open Shrub Mallee	Very Open Tree Mallee Very Open Shrub Mallee
Shrubs > 2m Shrubs 1.5 – 2m Shrubs 1 – 1.5m Shrubs 0.5 – 1m Shrubs 0 – 0.5m	Dense Thicket Dense Heath A Dense Heath B Dense Low Heath C Dense Low Heath D	Thicket Heath A Heath B Low Heath C Low Heath D	Scrub Low Scrub A Low Scrub B Dwarf Scrub C Dwarf Scrub D	Open Scrub Open Low Scrub A Open Low Scrub B Open Dwarf Scrub C Open Dwarf Scrub D
Mat Plants Hummock Grass Bunch grass >0.5m Bunch grass < 0.5m Herbaceous spp.	Dense Mat Plants Dense Hummock Grass Dense Tall Grass Dense Low Grass Dense Herbs	Mat Plants Mid-dense Hummock Grass Tall Grass Low Gras Herbs	Open Mat Plants Hummock Grass Open Tall Grass Open Low Grass Open Herbs	Very Open Mat Plants Open Hummock Grass Very Open Tall Grass Very Open Low Grass Very Open Herbs
Sedges > 0.5m Sedges < 0.5m	Dense Tall Sedges Dense Low Sedges	Tall Sedges Low Sedges	Open Tall Sedges Open Low Sedges	Very Open Tall Sedges Very Open Low Sedges
Ferns Mosses, liverworts	Dense ferns Dense Mosses	Ferns Mosses	Open Ferns Open Mosses	Very Open Ferns Very Open Mosses

Appendix 8: Trudgen (1991) Health Ratings

Health Rating	Health Description	Code	Definition
1	Excellent	E	Pristine or nearly so, no obvious signs of damage caused by the activities of European man.
2	Very Good	VG	Some relatively slight signs of damage caused by the activities of European man. For example some signs of damage to tree trunks caused by repeated fires and the presence of some relatively non-aggressive weeds such as *Ursinia* or *Briza* species or occasional vehicle tracks.
3	Good	G	More obvious signs of damage caused by the activities of European man including some obvious impact on the vegetation structure such as caused by low levels of grazing or by selective logging. Weeds as above, possibly plus some more aggressive ones.
4	Poor	P	Still retains basic vegetation structure or ability to generate to it after very obvious impacts of European man such as grazing or partial clearing (chaining) or very frequent fires. Weeds as above, probably plus some more aggressive ones such as *Ehrharta* species.
5	Very Poor	VP	Severely impacted by grazing, fire, clearing, or a combination of these activities. Scope for some regeneration but not a state approaching good condition without intensive management. Usually with a number of weed species including aggressive species.
6	Completely degraded	D	Areas that are completely or almost completely without native species in the structure of their vegetation., i.e. areas that are cleared or 'parkland cleared' with their flora comprising weed or crop species with isolated native trees or shrubs.

Appendix 9: Datasheets from the Quadrat Flora Survey Spring 2011.

Project Name: Brockman		
Date: 26/09/11	**Botanist:** JW, LP	
Location: Marillana Airstrip & Camp	**Quadrat:** 1	
Quadrat size: 50x50		
WP: 301	**Vegetation group:** *Acacia pteraneura* open low woodland over *Triodia basedowii* mid dense hummock grassland	
Photo number: 156/157/158		
Landform: F / B / VLF		
Land surface/disturbance: 2		
Coarse fragments on the surface (abundance/size/shape): 4 / 2 / A & AT		
Rock outcrop (abundance/runoff): NIL / 3		
Soil (profile/field texture/soil surface): U / ZCL / F		
%Cover leaf litter: 5		
%Cover bare ground: 10		
Tallest stratum	**Mid-stratum**	**Lower stratum**
Growth form: T	**Growth form:** S	**Growth form:** G
Height: 6-12m	**Height:** 1-3m	**Height:** 0.5-1m
Crown cover %: <10	**Crown cover %:** <1	**Crown cover %:** 30-70
Dominant taxa:	**Dominant taxa:**	**Dominant taxa:**
Acacia pteraneura	*Acacia victoriae*	*Triodia basedowii*

ALL SPECIES
Acacia pteraneura
Acacia victoriae
Cenchrus ciliaris (w)
Eremophila latrobei subsp. filiformis
Lepidium platypetalum
Maireana carnosa
Maireana platycarpa
Ptilotus exaltatus (a)
Sclerolaena cuneata
Sclerolaena densiflora
Themeda triandra
Triodia basedowii

Project Name: Brockman	
Date: 26/09/11	**Botanist:** JW, LP
Location: Marillana Airstrip & Camp	**Quadrat:** 2
Quadrat size: 50x50	
WP: 303	**Vegetation group:** *Acacia pteraneura* open low woodland over *Triodia basedowii* mid dense hummock grassland
Photo number: 162 / 163 / 164	
Landform: F / / VLF	
Land surface/disturbance: 2	
Coarse fragments on the surface (abundance/size/shape): 3 / 2 / AT	
Rock outcrop (abundance/runoff): NIL / 0	
Soil (profile/field texture/soil surface): U / MHC / L	
%Cover leaf litter: 5	
%Cover bare ground: 10	

Tallest stratum	**Mid-stratum**	**Lower stratum**
Growth form: T	**Growth form:** S	**Growth form:** G
Height: 3-6m	**Height:** 1-3m	**Height:** 0.5-1m
Crown cover %: <10	**Crown cover %:** <10	**Crown cover %:** >70
Dominant taxa:	**Dominant taxa:**	**Dominant taxa:**
Acacia pteraneura	*Acacia victoriae*	*Triodia basedowii*

ALL SPECIES
Acacia citrinoviridis
Acacia pteraneura
Acacia victoriae
Cullen martinii
Maireana carnosa
Maireana georgei
Maireana platycarpa
Ptilotus exaltatus (a)
Ptilotus obovatus
Sclerolaena cuneata
Sida sp. Pilbara
Themeda triandra
Trichodesma zeylanicum
Triodia basedowii

Project Name: Brockman	
Date: 26/09/11	**Botanist:** JW,LP
Location: Marillana Airstrip & Camp	**Quadrat:** 3
Quadrat size: 50x50	
WP: 305	**Vegetation group:** *Acacia pteraneura* open low woodland over *Triodia basedowii* mid dense hummock grassland
Photo number: 228 / 229 / 230	
Landform: F / / VLF	
Land surface/disturbance: 2	
Coarse fragments on the surface (abundance/size/shape): 3 / 3 / UT	
Rock outcrop (abundance/runoff): 0 / 0	
Soil (profile/field texture/soil surface): U / MHC / C	
%Cover leaf litter: 5	
%Cover bare ground: 10	

Tallest stratum	**Mid-stratum**	**Lower stratum**
Growth form: T	**Growth form:** S	**Growth form:** G
Height: 3-6m	**Height:** 1-3m	**Height:** 0.5-1m
Crown cover %: <10	**Crown cover %:** <10	**Crown cover %:** >70
Dominant taxa:	**Dominant taxa:**	**Dominant taxa:**
Acacia pteraneura	*Acacia victoriae*	*Triodia basedowii*

ALL SPECIES
Acacia citrinoviridis
Acacia pteraneura
Acacia sclerosperma
Acacia victoriae
Aristida holathera (a)
Cenchrus ciliaris (w)
Maireana platycarpa
Ptilotus exaltatus (a)
Ptilotus obovatus
Salsola tragus (a)
Triodia basedowii

Project Name: Brockman		
Date: 26/09/11	**Botanist:** JW, LP	
Location: Marillana Airstrip & Camp	**Quadrat:** 4	
Quadrat size: 50x50		
WP: 306	**Vegetation group:** *Acacia pteraneura open low woodland over Triodia basedowii mid dense hummock grassland*	
Photo number: 231 / 232 / 233		
Landform: F / / VLF		
Land surface/disturbance: 2		
Coarse fragments on the surface (abundance/size/shape): 0 / NIL / NIL		
Rock outcrop (abundance/runoff): NIL / NIL		
Soil (profile/field texture/soil surface): U / MHC / C		
%Cover leaf litter: 5		
%Cover bare ground: 10		
Tallest stratum	**Mid-stratum**	**Lower stratum**
Growth form: T	**Growth form:** S	**Growth form:** G
Height: 3-6m	**Height:** 1-3m	**Height:** 0.5-1m
Crown cover %: <1	**Crown cover %:** <1	**Crown cover %:** >70
Dominant taxa:	**Dominant taxa:**	**Dominant taxa:**
Hakea lorea	*Acacia victoriae*	*Triodia basedowii*

ALL SPECIES
Acacia pyrifolia
Acacia tetragonophylla
Acacia victoriae
Cenchrus ciliaris (w)
Eremophila forrestii
Hakea lorea
Maireana trichoptera
Ptilotus exaltatus (a)
Ptilotus obovatus
Senna pleurocarpa
Solanum lasiophyllum
Triodia basedowii

Project Name: Brockman	
Date: 26/09/11	**Botanist:** JW, LP
Location: Marillana Airstrip & Camp	**Quadrat:** 5
Quadrat size: 50x50	
WP: 309	**Vegetation group:** *Acacia pteraneura* open low woodland over *Triodia basedowii* mid dense hummock grassland
Photo number: 238/ 239 / 240	
Landform: F / B / VLF	
Land surface/disturbance: 3	
Coarse fragments on the surface (abundance/size/shape): 0 / NIL / NIL	
Rock outcrop (abundance/runoff): NIL / 0	
Soil (profile/field texture/soil surface): U / MHC / S	
%Cover leaf litter: 20	
%Cover bare ground: 30	

Tallest stratum	**Mid-stratum**	**Lower stratum**
Growth form: T	**Growth form:** S	**Growth form:** G
Height: 3-6m	**Height:** 1-3m	**Height:** 0.5-1m
Crown cover %: <1	**Crown cover %:** 10-30	**Crown cover %:** >70
Dominant taxa:	**Dominant taxa:**	**Dominant taxa:**
Corymbia hamersleyana	*Senna pleurocarpa*	*Triodia basedowii*

ALL SPECIES
Acacia bivenosa
Acacia pteraneura
Acacia sclerosperma
Acacia victoriae
Cenchrus ciliaris (w)
Corymbia hamersleyana
Psydrax latifolia
Ptilotus obovatus
Scaevola spinescens
Senna pleurocarpa
Triodia basedowii

Project Name: Brockman		
Date: 27/09/11	**Botanist:** JW, LP	
Location: Marillana Airstrip & Camp	**Quadrat:** 6	
Quadrat size: 50x50		
WP: 315	**Vegetation group:** *Eucalyptus odontocarpa / Hakea lorea very open shrub mallee over Triodia basedowii mid-dense hummock grassland*	
Photo number: 269 / 270 / 271		
Landform: F/ B / VLF		
Land surface/disturbance: 2		
Coarse fragments on the surface (abundance/size/shape): 0 / NIL / NIL		
Rock outcrop (abundance/runoff): 0 / 2		
Soil (profile/field texture/soil surface): U/ S/ F		
%Cover leaf litter: 5		
%Cover bare ground: 10		
Tallest stratum	**Mid-stratum**	**Lower stratum**
Growth form: Y	**Growth form:** S	**Growth form:** G
Height: 3-6m	**Height:** 1-3m	**Height:** 0.25-0.5
Crown cover %: <10	**Crown cover %:** <1	**Crown cover %:** >70
Dominant taxa:	**Dominant taxa:**	**Dominant taxa:**
Eucalyptus odontocarpa	*Petalostylis labicheoides*	*Triodia basedowii*
ALL SPECIES		
Acacia aneura subsp. conifera		
Dodonaea lanceolata		
Eucalyptus odontocarpa		
Indigofera monophylla		
Ptilotus astrolasius		
Ptilotus exaltatus (a)		
Scaevola parviflora		
Sida sp. Pilbara		
Triodia basedowii		

Project Name: Brockman		
Date: 27/09/11	**Botanist:** JW, LP	
Location: Marillana Airstrip & Camp	**Quadrat:** 7	
Quadrat size: 50x50		
WP: 318	**Vegetation group:** *Eucalyptus odontocarpa / Hakea lorea very open shrub mallee over Triodia basedowii mid-dense hummock grassland*	
Photo number: 274 / 275 / 276		
Landform: F / B / VLF		
Land surface/disturbance: 2		
Coarse fragments on the surface (abundance/size/shape): 0/ NIL / NIL		
Rock outcrop (abundance/runoff): 0 /		
Soil (profile/field texture/soil surface): U / LS / F		
%Cover leaf litter: 5		
%Cover bare ground: 10		
Tallest stratum	**Mid-stratum**	**Lower stratum**
Growth form: Y	**Growth form:** S	**Growth form:** G
Height: 3-6m	**Height:** 1-3m	**Height:** 0.25-0.5m
Crown cover %: <10	**Crown cover %:** <1	**Crown cover %:** >70
Dominant taxa:	**Dominant taxa:**	**Dominant taxa:**
Eucalyptus odontocarpa	*Petalostylis labicheoides*	*Triodia basedowii*

ALL SPECIES
Abutilon cunninghamii
Dodonaea lanceolata
Eragrostis eriopoda
Eragrostis xerophila
Eucalyptus odontocarpa
Hakea lorea
Indigofera monophylla
Petalostylis labicheoides
Ptilotus astrolasius
Scaevola parvifolia
Sida sp. Pilbara
Triodia basedowii

Project Name: Brockman		
Date: 27/09/11	**Botanist:** JW, LP	
Location: Marillana Airstrip & Camp	**Quadrat:** 8	
Quadrat size: 50x50		
WP: 321	**Vegetation group:** *Eucalyptus odontocarpa / Hakea lorea very open shrub mallee over Triodia basedowii mid-dense hummock grassland*	
Photo number: 278 / 279 / 280		
Landform: F / B / VLF		
Land surface/disturbance: 1		
Coarse fragments on the surface (abundance/size/shape): NIL / /		
Rock outcrop (abundance/runoff): NIL /		
Soil (profile/field texture/soil surface): U / S / S		
%Cover leaf litter: 2		
%Cover bare ground: 10		
Tallest stratum	**Mid-stratum**	**Lower stratum**
Growth form: T	**Growth form:** S	**Growth form:** G
Height: 3-6m	**Height:** 1-3m	**Height:** 0.25-0.5m
Crown cover %: <10	**Crown cover %:** <10	**Crown cover %:** >70
Dominant taxa:	**Dominant taxa:**	**Dominant taxa:**
Hakea lorea	*Acacia sclerosperma*	*Triodia basedowii*
ALL SPECIES		
Hakea lorea		
Acacia sclerosperma		
Triodia basedowii		
Petalostylis labicheoides		
Abutilon cunninghamii		

Project Name: Brockman		
Date: 27/09/11	**Botanist:** JW, LP	
Location: Marillana Airstrip & Camp	**Quadrat:** 9	
Quadrat size: 50x50		
WP: 323	**Vegetation group:** *Acacia victoriae* open low scrub over open dwarf scrub of *Frankenia* ambita	
Photo number: 218 / 219 / 220		
Landform: F / B / VLF		
Land surface/disturbance: 1		
Coarse fragments on the surface (abundance/size/shape): 5 / 2 / A & UT		
Rock outcrop (abundance/runoff): NIL / 3		
Soil (profile/field texture/soil surface): U / MHC / S		
%Cover leaf litter: 0		
%Cover bare ground: 0		
Tallest stratum	**Mid-stratum**	**Lower stratum**
Growth form:	**Growth form:** S	**Growth form:** S
Height:	**Height:** 1-3m	**Height:** <0.25m
Crown cover %:	**Crown cover %:** <10	**Crown cover %:** 10-30
Dominant taxa:	**Dominant taxa:**	**Dominant taxa:**
	Acacia victoriae	*Frankenia ambita*

ALL SPECIES
Acacia victoriae
Atriplex bunburyana
Cenchrus ciliaris (w)
Frankenia ambita
Maireana carnosa
Maireana pyramidata
Maireana triptera
Portulaca oleracea(w)
Triodia basedowii

Project Name: Brockman		
Date: 27/09/11	**Botanist:** JW, LP	
Location: Marillana Airstrip & Camp	**Quadrat:** 10	
Quadrat size: 50x50		
WP: 324	**Vegetation group:** *Acacia victoriae* open low scrub over open dwarf scrub of *Frankenia* ambita	
Photo number: 233 / 234 / 235 / 236		
Landform: F / Nil / VLF		
Land surface/disturbance: 1		
Coarse fragments on the surface (abundance/size/shape): 4 / 2 / A		
Rock outcrop (abundance/runoff): NIL / 3		
Soil (profile/field texture/soil surface): U / MHC / G		
%Cover leaf litter: 0		
%Cover bare ground: 0		
Tallest stratum	**Mid-stratum**	**Lower stratum**
Growth form:	**Growth form:** S	**Growth form:** N/A
Height:	**Height:** 0.25-0.5m	**Height:**
Crown cover %:	**Crown cover %:** <10	**Crown cover %:**
Dominant taxa:	**Dominant taxa:**	**Dominant taxa:**
	Pluchea ferdinandi-muelleri	*Frankenia ambita*
ALL SPECIES		
Atriplex bunburyana		
Cenchrus ciliaris (w)		
Dissocarpus paradoxus		
Frankenia ambita		
Maireana carnosa		
Maireana integra		
Maireana sp. (sterile)		
Pluchea ferdinandi-muelleri		
Portulaca oleracea		
Sclerolaena cuneata		
Themeda triandra		

Project Name: Brockman		
Date: 27/09/11	**Botanist:** JW, LP	
Location: Marillana Airstrip & Camp	**Quadrat:** 11	
Quadrat size: 50x50		
WP: 326	**Vegetation group:** *Acacia pteraneura* open low woodland over sparse scrub of *Acacia bivenosa*	
Photo number: 237 / 238 / 239		
Landform: F / nil / VLF		
Land surface/disturbance: 1		
Coarse fragments on the surface (abundance/size/shape): 3 / 3 / A		
Rock outcrop (abundance/runoff): 0 / 3		
Soil (profile/field texture/soil surface): U / MHC / F		
%Cover leaf litter: 40		
%Cover bare ground: 50		
Tallest stratum	**Mid-stratum**	**Lower stratum**
Growth form: T	**Growth form:** S	**Growth form:** G
Height: 3-6m	**Height:** 1-3m	**Height:** 0.25-0.5m
Crown cover %: <1	**Crown cover %:** >70	**Crown cover %:** 30-70
Dominant taxa:	**Dominant taxa:**	**Dominant taxa:**
Acacia pteraneura	*Acacia bivenosa*	*Triodia basedowii*

ALL SPECIES
Acacia bivenosa
Acacia pteraneura
Acacia tetragonophylla
Cenchrus ciliaris (w)
Melaleuca interioris
Pluchea ferdinandi-muelleri
Ptilotus exaltatus (a)
Scaevola spinescens
Senna artemisioides subsp*. helmsii*
Triodia basedowii

Project Name: Brockman		
Date: 27/09/11	**Botanist:** JW, LP	
Location: Marillana Airstrip & Camp	**Quadrat:** 12	
Quadrat size: 50x50		
WP: 328	**Vegetation group:** *Eucalyptus odontocarpa / Hakea lorea very open shrub mallee over Triodia basedowii mid-dense hummock grassland*	
Photo number: 246 / 247 / 248		
Landform: F / Nil / VLF		
Land surface/disturbance: 1		
Coarse fragments on the surface (abundance/size/shape): Nil		
Rock outcrop (abundance/runoff): 0 / 2		
Soil (profile/field texture/soil surface): U / S / F		
%Cover leaf litter: 30		
%Cover bare ground: 60		
Tallest stratum	**Mid-stratum**	**Lower stratum**
Growth form: T	**Growth form:** S	**Growth form:** G
Height: 3-6m	**Height:** 1-3m	**Height:** 0.25-0.5m
Crown cover %: <1	**Crown cover %:** <1	**Crown cover %:** >70
Dominant taxa:	**Dominant taxa:**	**Dominant taxa:**
Hakea lorea	*Acacia sclerosperma*	*Triodia basedowii*

ALL SPECIES
Acacia sclerosperma
Acacia victoriae
Eucalyptus odontocarpa
Hakea lorea
Petalostylis labicheoides
Ptilotus obovatus
Senna artemisioides subsp. *helmsii*
Triodia basedowii

Project Name: Brockman		
Date: 27/09/11	**Botanist:** JW, LP	
Location: Marillana Airstrip & Camp	**Quadrat:** 13	
Quadrat size: 50x50		
WP: 330	**Vegetation group:** *Acacia pteraneura* open low woodland over *Triodia basedowii* mid dense hummock grassland	
Photo number: 252 / 253 / 254		
Landform: F / nil / VLF		
Land surface/disturbance: 1		
Coarse fragments on the surface (abundance/size/shape): 3 / 3 / A		
Rock outcrop (abundance/runoff): 0 / 3		
Soil (profile/field texture/soil surface): U / MHC / F		
%Cover leaf litter: 5		
%Cover bare ground: 10		
Tallest stratum	**Mid-stratum**	**Lower stratum**
Growth form:	**Growth form:** S	**Growth form:** S
Height:	**Height:** 1-3m	**Height:** 0.25-0.5m
Crown cover %:	**Crown cover %:** <1	**Crown cover %:**
Dominant taxa:	**Dominant taxa:**	**Dominant taxa:**
	Acacia bivenosa	*Triodia basedowii*

ALL SPECIES
Acacia bivenosa
Clerodendrum floribundum
Dysphania rhadinostachya (a)
Ptilotus exaltatus (a)
Senna artemisioides subsp. *helmsii*
Triodia basedowii

Appendix 10: Photographs of each quadrat



Quadrat 1



Quadrat 2



Quadrat 3



Quadrat 4



Quadrat 5



Quadrat 6



Quadrat 7



Quadrat 8



Quadrat 9



Quadrat 10



Quadrat 11



Quadrat 12



Quadrat 13