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RIO TINTO
GREATER WEST ANGELAS
VEGETATION AND FLORA ASSESSMENT

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Document Status						
Rev.	**Author**	**Reviewer/s**	**Date**	**Approved for Issue**		
				Name	**Distributed To**	**Date**
A	C. Parker M. Campos	R. Young	26.11.2012	R. Young	T. Brown C. Nixon	29.11.2012
0	C. Parker M. Campos R. Young	M. Macdonald	01.02.2013			
1	C. Parker M. Campos R. Young	K. Honczar	05.02.2013	K. Honczar	T. Brown C. Nixon	05.02.2013
2	C. Parker M. Campos R. Young	M. Macdonald	18.04.2013			

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TABLE OF CONTENTS

TABLES

FIGURES

APPENDICES

ACRONYMS

AIR	Ashburton Regional Inventory
ARRP Act	*Agriculture and Related Resources Protection Act 1976*
BIF	Banded Ironstone Formation
CALM	Department of Conservation and Land Management (now DEC)
DAFWA	Department of Agriculture and Food Western Australia
DEC	Department of Environment and Conservation
DEFL	Department of Environment and Conservation Endangered Flora Database
EIA	Environmental Impact Assessment
EPA	Environmental Protection Authority
EP Act	*Environmental Protection Act 1986*
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
RT	Rio Tinto
Opp col	Opportunistic collection
PRI	Pilbara Regional Inventory
TEC	Threatened Ecological Community
PEC	Priority Ecological Community
UCL	Unallocated Crown Land
WAHERB	Western Australian Herbarium
WC Act	*Wildlife Conservation Act 1950*
WONS	Weeds of National Significance

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EXECUTIVE SUMMARY

Rio Tinto (RT) commisioned *ecologia* Environment (*ecologia*) to undertake a two phase assessment of the Greater West Angelas Study Area. Greater West Angelas is located approximatley 105 km north-west of Newman and comprises of three disjointed areas covering a total of 17,596 ha. Deposits C, D, D extension, G, F, H and Mt Ella were surveyed.

Methods

The vegetation and flora of the Study Area was surveyed in two phases over two separate trips totalling 60 person days. Survey timing was as follows:

- Phase 1; 9th to 18th of July 2012 (36 person days); and
- Phase 2; 21st-26th August 2021 (24 person days).

Seasonal conditions were favorable, with higher than average rainfall recorded in the months preceding the survey.

One hundred and fifty quadrats (2,500 m^2 each) were surveyed, distributed throughout the Study Area. Locations were selected using aerial photography, topographic features and field observations to represent the diversity of vegetation present. Additional opportunistic collections were made of taxa not already located within the quadrats. Locations of any introduced flora and known or potentially conservation significant taxa encountered were also recorded.

Flora

A total of 441 taxa were recorded from the West Angelas Study Area. Ten taxa could not be fully identified due to lack of reproductive material. The pattern of families and genera represented are considered typical for the Pilbara during favourable seasonal conditions. The high number of taxa within the family Scrophulariaceae and genus *Eremophila* reflects the abundance of mulga woodlands and shrublands. The relatively high representation of Asteraceae, Amaranthaceae and Goodeniaceae is a reflection of the optimal timing of the survey when many ephemeral species were flowering.

Flora sampling adequacy was estimated using species accumulation curve analysis and extrapolation of the curve to the asymptote using Michaelis-Menten modelling. Using this analysis it is estimated that between 86% and 88 % of the taxa present were recorded.

Species richness within quadrats varied from seven to 67 taxa, with a mean species richness of 35.7± 1.0 (n= 150). Vegetation units with the lowest species overall richness include *ApTssp* (*Acacia aptaneura* and *A. pruinocarpa* open woodland over *A. tetragonophylla, Senna glutinosa* subsp. *glutinosa* and *S. artemisioides* subsp. *oligophylla* isolated shrubs over *Triodia wiseana* and *T. pungens* open hummock grassland), and *Tp* (*Eucalyptus leucophloia* subsp. *leucophloia* and *Acacia pruinocarpa* isolated trees over *Senna glutinosa* subsp. *glutinosa, A. bivenosa* and *Ptilotus rotundifolius* isolated shrubs over *Triodia pungens* or *T. basedowii* or *T.* sp. Mt Ella hummock grassland.), both of which are typical of rocky midslopes, with a mean species richness of 15.8 and 16.8, respectively. The most consistently diverse vegetation unit was *AaPoTt* (*Acacia aptaneura* open woodland over *Ptilotus obovatus* sparse shrubland over *Themeda triandra* open tussock grassland), which occurs along sandy floodplains, with mean species richness of 50.1.

Four specimens of *Lepidium catapycnon,* listed under the *Environment Protection and Biodiversity Conservation Act, 1999* (EPBC Act) and the *Wildlife Conservation Act, 1950* (WC Act) (Declared Rare

Flora) were collected opportunistically from four locations within Greater West Angelas. A total of 29 individuals were recorded. Vegetation and landforms consistent with this species' habitat occur within the Study Area and it is possible that more individuals could be present given that access to some areas was limited during the survey.

Thirteen Threatened and Priority Flora taxa were recorded during the survey: one Threatened (*Lepidium catapycnon*); three Priority 1 species (*Aristida jerichoensis* var. *subspinulifera, Brachyscome* sp. Wanna Munna Flats (S. van Leeuwen 4662) and *Brunonia* sp. long hairs (D.E. Symon 2440); two Priority 2 species (*Aristida lazaridis* and *Eremophila forrestii* subsp. Pingandy (M.E. Trudgen 2662)); six Priority 3 species (*Acacia* aff. *subtiliformis, Indigofera* sp. Gilesii (M.E. Trudgen 15869)*, Rhagodia* sp. Hamersley (M. Trudgen 17794), *Sida* sp. Barlee Range (S. van Leeuwen 1642), *Themeda* sp. Hamersley Station (M.E. Trudgen 11431) and *Triodia* sp. Mt Ella (M.E. Trudgen 12739) and one Priority 4 species (*Goodenia nuda*). Seven of these species have previously been recorded within the Study Area. Five of the recorded priority taxa are not represented within conservation estates (*Aristida jerichoensis* var. *subspinulifera*, *Brachyscome* sp. Wanna Munna Flats (S. van Leeuwen 4662), *Brunonia* sp. long hairs (D.E. Symon 2440), *Indigofera* sp. Gilesii (M.E. Trudgen 15869) and *Triodia* sp. Mt Ella (M.E. Trudgen 12739). Current advice form the Western Australian Herbarium is that *Brunonia* sp. long hairs and *Brunonia australis* are likely to be amalgamated in the future (Hislop 2012, *pers. comm.*), but as this change has not yet been adopted by the Western Australian Herbarium, *Brunonia* sp. long hairs is regarded as a priorty taxon in this report.

No Weeds of National Significance (WONS) or Declared Plants were recorded. Nine weeds were recorded within the Study Area, all of which have been assessed within the Department of Environment and Conservation (DEC) classification of Environmental Weeds within the Pilbara. Three species are ranked as a high threat; **Cenchrus ciliaris*, **Cenchrus setiger* and **Vachellia farnesiana*. **Bidens bipinnata* is by far the most abundant weed species recorded in the Study Area.

Vegetation

The West Angelas Study Area is not located within a pastoral lease and, as a result, is not actively grazed by livestock. Overall the vegetation condition was found to be excellent, with 51% and 36% assessed as being in excellent or very good condition, respectively. The disturbance most commonly observed was the presence of weed species, with a small number of areas subject to disturbance from previous exploration activities. The majority of the Study Area has not been recently burnt, with 50% of quadrats assessed as burnt more than five years ago or with no evidence of fire and 44% burnt two to five years ago. The pattern of burning appears sporadic and localised, which is typical of fires arising during the early wet season from lightning strikes that are extinguished relatively rapidly, rather than larger scale fires that burn an extensive area before being extinguished.

Based on multivariate analysis, interpretation of aerial imagery and ground truthing, 22 vegetation communities were described and mapped within the Study Area.

One Priority 1 PEC, West Angelas Cracking-Clays, occurs extensively within the Study Area. This community is further defined as open tussock grasslands of *Astrebla pectinata*, *A. elymoides*, *Aristida latifolia* in combination with *Astrebla squarrosa* and low scattered shrubs of *Sida fibulifera*, on basalt derived cracking-clay loam depressions and flowlines. Threats to this community include; clearing for further mining expansion and future infrastructure development, weed invasion and changes in fire regimes. The vegetation unit *AlAp* was determined to be equivalent to the PEC with the species compositions found to be a good match, despite the lack of *A. elymoides* which was not recorded during the current survey. It is thought that the survey timing for tussock grasses may not have been optimal with reproductive material often being absent and identifications problematic for this group.

Assessment of the significance of the vegetation of the Study Area is constrained by the lack of mapping across the state conducted at a scale comparable to the mapping conducted during the current survey. At a scale of 1: 1,000,000 the vegetation units described by Beard (1975) within the Study Area are well represented elsewhere, and extensively represented for some vegetation types.

The vegetation units mapped in the current survey were compared to those identified in the Biota (2006) survey, in which 12 vegetation types were identified and ME Trudgen & Associates (1998) in which 54 vegetation types were identified.

The mapping boundaries of the ME Trudgen & Associates survey extended beyond that of the current survey resulting in just 29 of the 54 communities defined by ME Trudgen & Associates represented within the current Study Area.

Approximately 50% of the area surveyed by Biota falls outside of the current Study Area, although, of the 12 units described by Biota, 10 identified in the current survey match well and have been interpreted to be equivalent.

Vegetation is also of conservation significance if it has "a role as a key habitat for threatened species" (EPA 2004, page 30). *Lepidium catapycnon* (T) appears to have a high specificity to the vegetation unit *SggIrTw,* rocky hillslopes, which supports 100% of all plants recorded. Although present in 10 vegetation units, *Aristida jerichoensis* var. *subspinulifera* (P1) demonstrates a higher specificity to unit *AaSlTp* (sandy undulating plains) with 40.9% of locations and 57.9% of individuals recorded within this unit. *Indigofera* sp. Gilesii (M.E. Trudgen 15869) demonstrates specificity for the vegetation unit *SggTp,* rocky midslopes, with 47.8% of all locations and 31.9% of individuals recorded within this unit.

Vegetation communities that are groundwater dependent are regionally important and also of conservation significance. Vegetation unit *AaPoTt* supports variable densities of *E. victrix* and therefore may represent a vadophytic ecosystem (i.e. supporting plants that rely on moisture in the upper soil profile) or occasionally phreatophytic (dependent on groundwater), and on this basis has been qualified as a GDE.

In a local context vegetation can be considered significant if it is locally uncommon or provides habitats of local significance. Vegetation of local significance is not legislatively protected but is of conservation value if areas are restricted and have not been identified to occur outside the Study Area, and such conservation significance is typically a consideration for environmental impact assessments. The least extensive vegetation units locally are *AaEffTp* (141.54 ha) and *AmTw* (108.7 ha), which represent 0.80 % and 0.62% of the Study Area, respectively.

Conclusions

Of the 13 threatened and priority taxa recorded, *Lepidium catapycnon*, *Aristida jerichoensis* var. *subspinulifera*, *Brachyscome* sp. Wanna Munna Flats (S. van Leeuwen 4662), *Brunonia* sp. long hairs (D.E. Symon 2440) and *Aristida lazaridis* appear to be the most restricted in distribution, with only 14, six, ten, three and three other West Australian Herbarium records, respectively. Only *Lepidium catapycnon* and *Aristida lazaridis* have one record each within Conservation Reserves, and therefore all of the remaining significant taxa are poorly represented within the Conservation Estate, which adds to their vulnerability.

Vegetation unit *SggIrTw* (rocky hilltops) supports *Lepidium catapycnon* (T) and is therefore of conservation significance and could be the focus of further targeted surveys.

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1 INTRODUCTION

Rio Tinto (RT) requires a series of biological surveys in order to support a strategic assessment of the Greater West Angelas Project, which includes a series of iron ore deposits in the Pilbara region of Western Australia.

RT is currently conducting preliminary feasibility studies for the development of ore deposits C, D, D extension, G, F, H and Mt Ella, collectively termed the Greater West Angelas Study Area (herein referred to as 'the Study Area') located approximately 105 km north-east of Newman (Figure 1.1). The Study Area comprises of three disjointed areas covering a total of 17,565 ha, is situated on RT exploration leases and encompasses the borefield supplying water to West Angelas Mine. The Survey Area does not support any pastoral leases.

As part of the series of biological surveys, *ecologia* was commissioned to conduct a two phase, Level 2 survey of the flora and vegetation of the Survey Area. This survey will provide baseline data which may be supplemented with additional studies, should approval to mine be sought in the future.

1.1 LEGISLATIVE FRAMEWORK

Commonwealth and State legislation applicable to the conservation of native flora and fauna in Western Australia includes, but is not limited to, the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), the Western Australian *Wildlife Conservation Act 1950* (WC Act) and the*Environmental Protection Act 1986* (EP Act).

Section 4a of the EP Act requires that developments take into account the following principles applicable to native flora and fauna:

- The Precautionary Principle

  Where there are threats of serious or irreversible damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation.

- The Principles of Intergenerational Equity

  The present generation should ensure that the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations.

- The Principle of the Conservation of Biological Diversity and Ecological Integrity

  Conservation of biological diversity and ecological integrity should be a fundamental consideration of the project.

Furthermore, floristic surveys undertaken as part of the Environmental Impact Assessment (EIA) process are required to address the following:

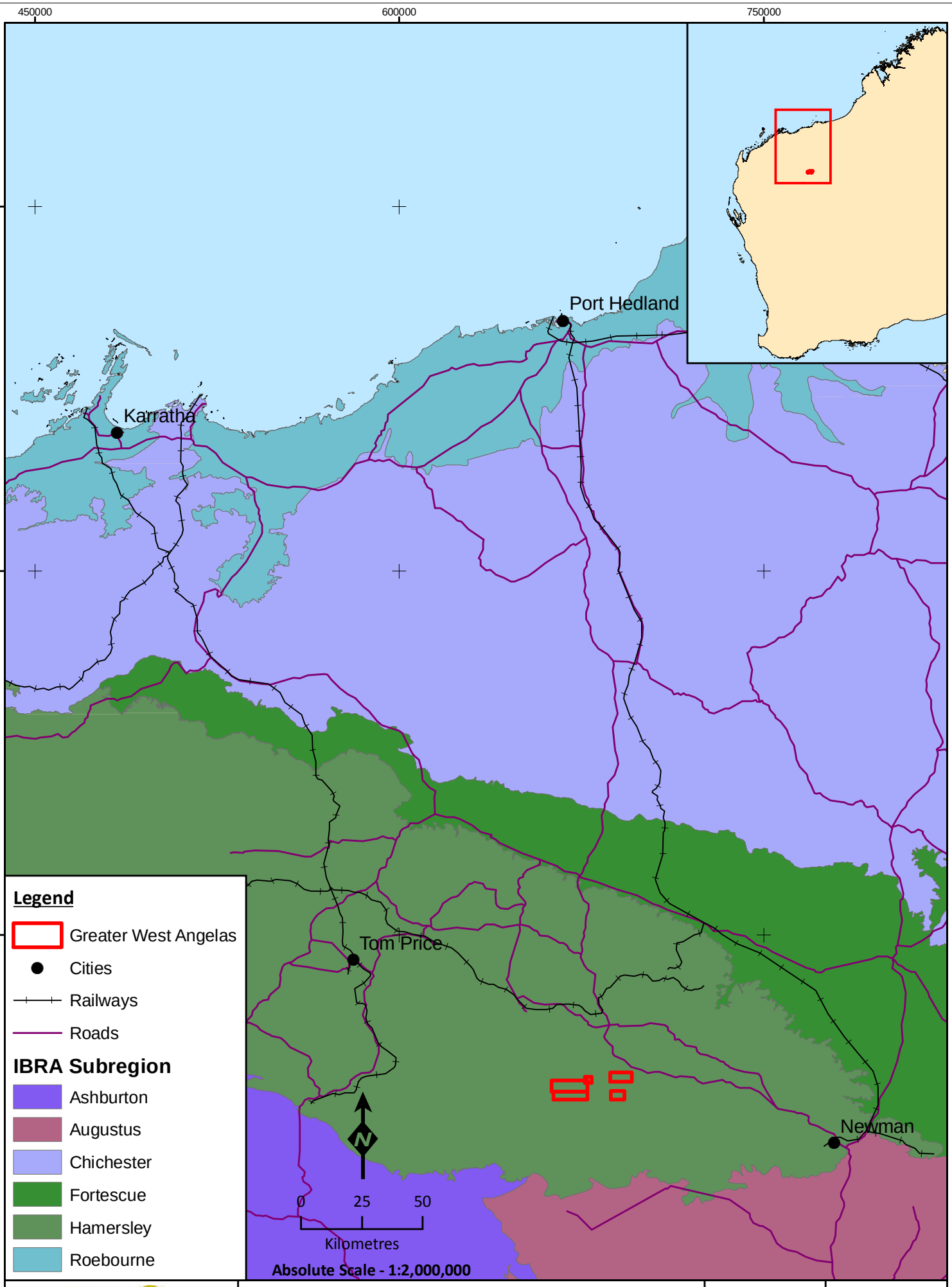
- Environmental Protection Authority's (EPA's) Position Statement No. 3: Terrestrial Biological Surveys as an Element of Biodiversity Protection (Environmental Protection Authority 2002); and

- Guidance Statement No. 51: Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia (Environmental Protection Authority 2004).

The EPBC Act was developed to provide for the protection of the environment, especially those aspects of the environment that are matters of National Environmental Significance, to promote

ecologically sustainable development through the conservation and ecologically sustainable use of natural resources; and to promote the conservation of biodiversity. The EPBC Act includes provisions to protect native species (in particular to prevent the extinction and promote the recovery of threatened species) and to ensure the conservation of migratory species. In addition to the principles outlined in Section 4a of the EP Act, Section 3a of the EPBC Act includes the principle of ecologically sustainable development; that decision-making processes should effectively integrate both long-term and short-term economic, environmental, social and equity considerations.

The WC Act was developed to provide for the conservation and protection of wildlife in Western Australia. Under Section 14 of this Act, all fauna and flora within Western Australia are protected; however, the Minister may, via a notice published in the Government Gazette, declare a list of flora taxa identified as likely to become extinct, or as rare, or otherwise in need of special protection. The current listing was gazetted on 17 February 2012.



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Location of West Angelas and IBRA Subregions

Figure: 1.1	**Drawn: CP**
Project ID: 1457	**Date:04/09/2012**

Coordinate System
Name: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994

Unique Map ID: CP098

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1.2 SURVEY OBJECTIVES

The EPA's objectives with regard to the management of native flora and vegetation are to:

- Avoid adverse impacts on biological diversity comprising the different plants and animals and the ecosystems they form, at the levels of genetic, species and ecosystem diversity.
- Maintain the abundance, species diversity, geographic distribution and productivity of vegetation communities.
- Protect Threatened flora (formerly DRF, Declared Rare Flora) consistent with the provisions of the WC Act.
- Protect other flora species of conservation significance.

The primary objective of the surveys is to provide sufficient information to the EPA to assess the impact of the development on the vegetation, flora and fauna of the Study Area, thereby ensuring that the EPA objectives can be upheld.

Specifically, this survey was to satisfy the requirements documented in the EPA's Guidance Statement 51 and Position Statement No. 3, thus providing:

- A review of background information (including literature and database searches).
- An inventory of vegetation types and flora species occurring in the Study Area, incorporating recent published and unpublished records.
- An inventory of flora species of biological and conservation significance recorded or likely to occur within the Study Area and surrounds.
- A map and detailed description of vegetation types occurring in the Study Area.
- An appraisal of the current knowledge base for the area, including a review of previous surveys conducted in the area relevant to the current.
- A review of regional and biogeographical significance, including the conservation status of species recorded in the Study Area.
- A risk assessment to determine likely impacts of threatening processes on vegetation and flora within the Study Area.

2 EXISTING ENVIRONMENT

2.1 CLIMATE

The Study Area is located in the Pilbara region of Western Australia. The Pilbara experiences an arid-tropical climate with two distinct seasons; a hot summer from October to April and a mild winter from May to September. Temperatures are generally high, with summer temperatures frequently exceeding 40°C. Light frosts occasionally occur inland during July and August.

Rainfall is generally localised and unpredictable (some years have recorded zero rainfall), and temperatures are high, resulting in annual evaporation exceeding rainfall by as much as 500 mm per year. The majority of the Pilbara has a bimodal rainfall distribution; from December to March rains result from tropical storms producing sporadic thunderstorms. Tropical cyclones moving south also bring heavy rains. From May to June, extensive cold fronts move eastwards across the state and occasionally reach the Pilbara. These fronts usually produce only light rains. Surface water can be found in some pools and springs in the Pilbara all year round, although watercourses generally flow intermittently due to the short wet season (Beard 1975).

The nearest Bureau of Meteorology (BOM) station for which both rainfall and temperature data is available is Paraburdoo Aero (Site No. 007185), 85 km west from the western boundary of the Study Area. The location has a typical inland Pilbara climate of hot summers with sporadic summer storms and warm dry winters (Figure 2.1).

Rainfall data is available from Turee Creek Station (Site No 007083) located 45.5 km south of the southern boundary of the Study Area. Rainfall from November 2011 to March 2012 was considerably higher than the long term average at this site and occurred earlier in the season, with February the only month to record slightly below average rainfall. The rainfall received in the months preceding the first and second phases of the survey were below the monthly averages (Table 2.1). Paraburdoo received the majority of its rain later in the season (January to March 2012) with the surrounding months receiving below average rainfall (Table 2.1). Given the proximity to West Angelas, it is probable that rainfall recorded at Turee Creek is a more accurate reflection of the rainfall received by the Study Area than is rainfall at Paraburdoo. The higher than average rainfall earlier in the season and the light but continual rainfall in the months leading up to the survey determined that the survey timing was suitable.

Table 2.1 – Rainfall at Turee Creek and Paraburdoo meteorological stations

Total rainfall (mm)	Turee Creek		Paraburdoo Aero	
	Monthly total	Monthly average (1920-2012)	Monthly total	Monthly average (1974-2012)
August 2011	2	8.3	0	11.6
September 2011	0	2.9	0	3.6
October 2011	2.6	4	0	3.6
November 2011	30.2	8.5	8	8.3
December 2011	27.7	22.6	5	28.5
January 2012	126.3	41	205.2	52
February 2012	42	56.7	73.6	78.3
March 2012	72.5	34.7	77	46.4
April 2012	1.8	18.5	17.4	26.8
May 2012	0	21.6	0	16.4
June 2012	8.6	18.8	10.4	22.2
July 2012	1	10.9	1	14.6

(BOM 2011)

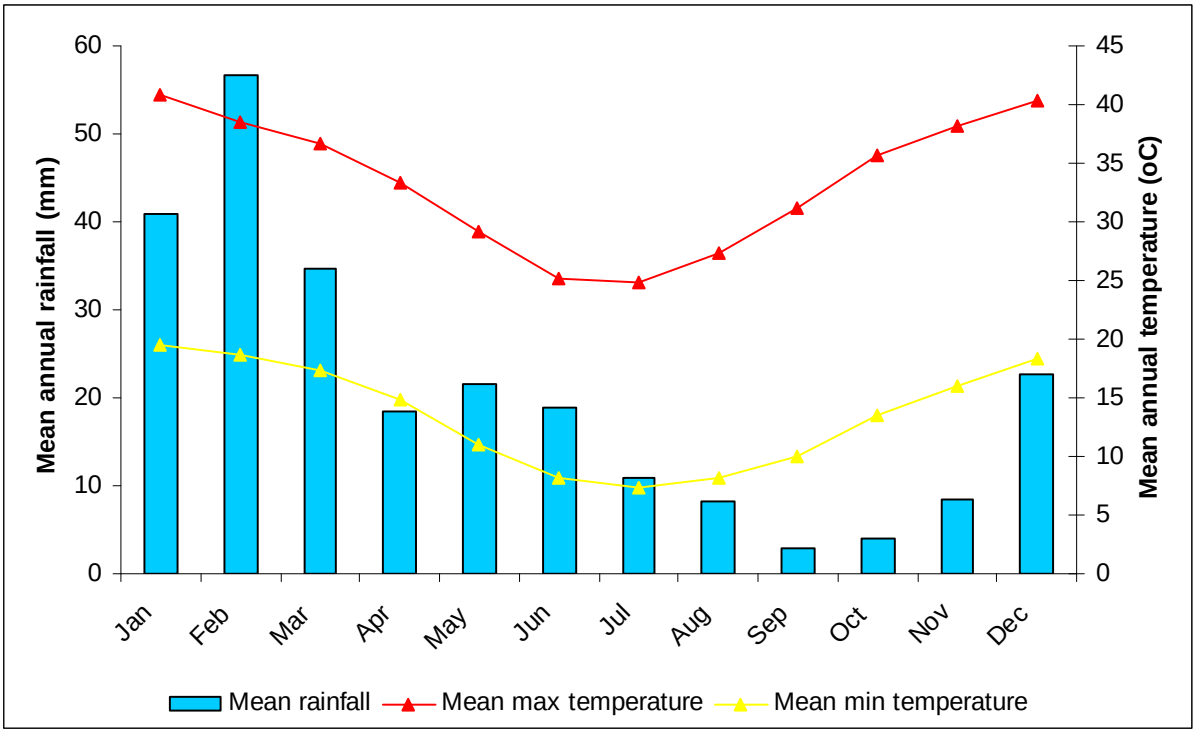


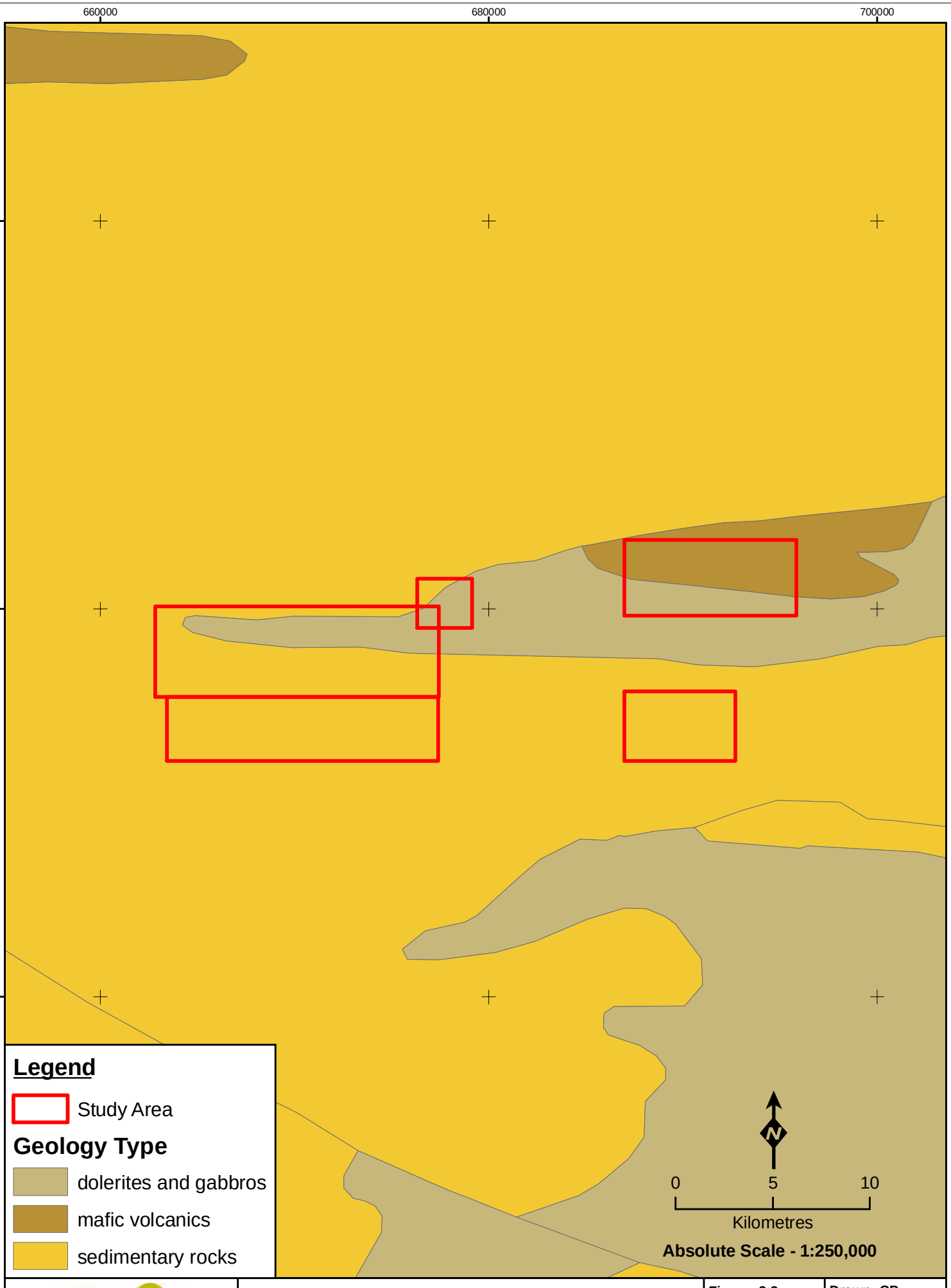
Figure 2.1 – Mean monthly climate data for Turee Creek (temperature from Paraburdoo Aero)

2.2 GEOLOGY, LAND SYSTEMS AND SOILS

2.2.1 Geology

The majority of the Pilbara is comprised of the granite terrain of the Pilbara Block in the north with the rugged sedimentary Hamersley Basin in the south and the sedimentary rocks overlain by Aeolian sands of the Canning Basin to the east. Drainage is mostly via major river catchments of the De Grey, Turner and Yule rivers in the north, and the Fortescue and Robe rivers in the west. All rivers are exoreic (i.e. flow into the ocean) with the exception of Savory Creek, which drains eastwards into Lake Disappointment (Van Vreeswyk *et al*. 2004). The geological stratigraphy in the Pilbara region is relatively continuous, with similar geological processes occurring across the region which have resulted in the enrichment of the iron deposits (Van Vreeswyk *et al.* 2004).

The main source of the magnetic mineralisation in the Pilbara is the Pincunah Formation, which is one of the prominent Banded Ironstone Formations (BIF) within the greenstone belts of the Pilbara Craton. The Study Area supports three different geological formations and these, along with the geology of the surrounding region is presented in Figure 2.2 (Hickman and Kranendonk 2008) with definitions of the geological unit codes provided in Table 2.2. The Study Area is comprised of 12.4% maffic volcanics, 66.4% sedimentary rock and 21.1% dolerites and gabbros geological units (Hickman and Kranendonk 2008).



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Geology of West Angelas Study Area

Figure: 2.2
Project ID: 1457

Drawn: CP
Date: 04/09/2012

Coordinate System
Name: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994

Unique Map ID: CP099

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Table 2.2 – Geology of West Angelas Study Area

Geological Code	Lith Association	Area within Study Area (km^2)	Definition of code
Ap	Mafic volcanics	21.7	Archaean period
Ab	Sedimentary rocks	116.9	Archaean – palaeoproterozoic period
Ad	dolerites and gabbros	37.0	Archaean period

2.2.2 Soils

Twenty-one broad soil groups have been identified by Van Vreeswyk *et al*. (2004) within their study defining land systems within the Pilbara. Soils are predominantly red and shallow with stony mantles.

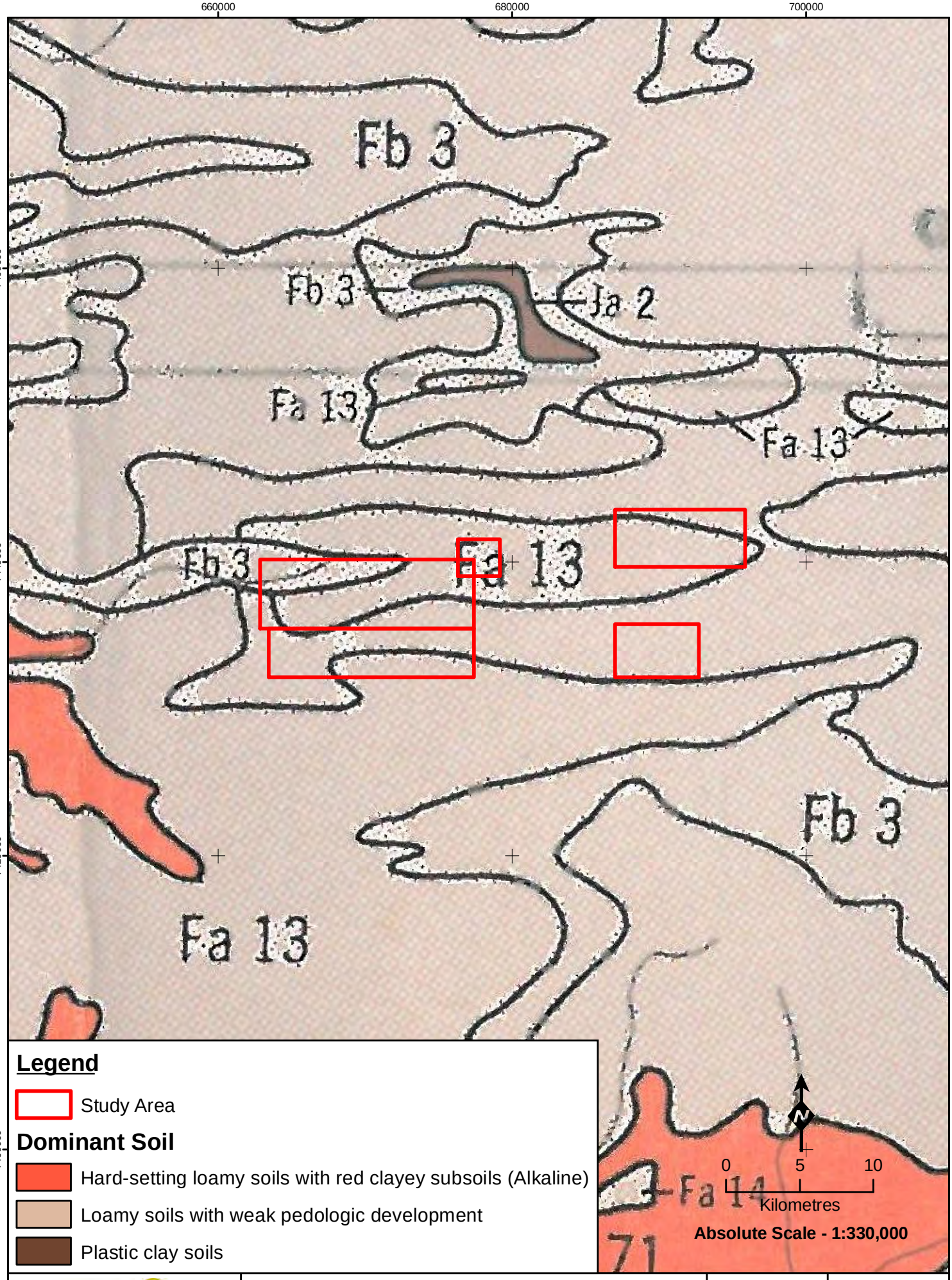
The most extensive soils in the Pilbara are shallow, stony soils on hills and ranges and sands on sandplains. In the south, the soils are predominantly red earths overlying hardpan on level to gently inclined plains. Lower flood plains have cracking and non-cracking clay soils. Duplex (texture-contrast) soils occur in localised areas on saline alluvial plains and elsewhere. These soils support the most preferentially grazed vegetation and are highly susceptible to erosion (Van Vreeswyk *et al*. 2004).

Within the Study Area, the dominant soil type is loamy soils with weak pedology (Figure 2.3) (Bettenay *et al*, 1967), which has been further classified as the following units:

Fa13: Ranges of banded jaspilite and chert along with shales, dolomites, and iron ore formations; some areas of ferruginous duricrust as well as occasional narrow winding valley plains and steeply dissected pediments. This unit is largely associated with the Hamersley and Ophthalmia Ranges. The soils are frequently stony and shallow and there are extensive areas without soil cover: chief soils are shallow stony earthy loams (Um5.51) along with some soils on the steeper slopes (Uc5.11). Associated are soils on the limited areas of dissected pediments, while (Um5.52) and (Uf6.71) soils occur on the valley plains.

Fa14: Steep hills and steeply dissected pediments on areas of banded jaspilite and chert along with shales, dolomite, and iron ore formations; some narrow winding valley plains: chief soils are shallow stony earthy loams (Um5.51) along with some (Uc5.11) soils on the steeper slopes. The (Dr2.33) and (Dr2.32) soils which occur on the pediments are more extensive than unit Fa13, while (Um5.52) and (Uf6.71) soils occur on the valley plains.

Fb3: High-level valley plains set in extensive areas of unit Fa13. There are extensive areas of pisolitic limonite deposits: ptoncipal soils are deep earthy loams (Um5.52) along with small areas of Gn2.12) soils.



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Soils of West Angelas Study Area

Figure: 2.3
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Drawn: CP
Date: 04/09/2012

Coordinate System
Name: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994

Unique Map ID: CP100

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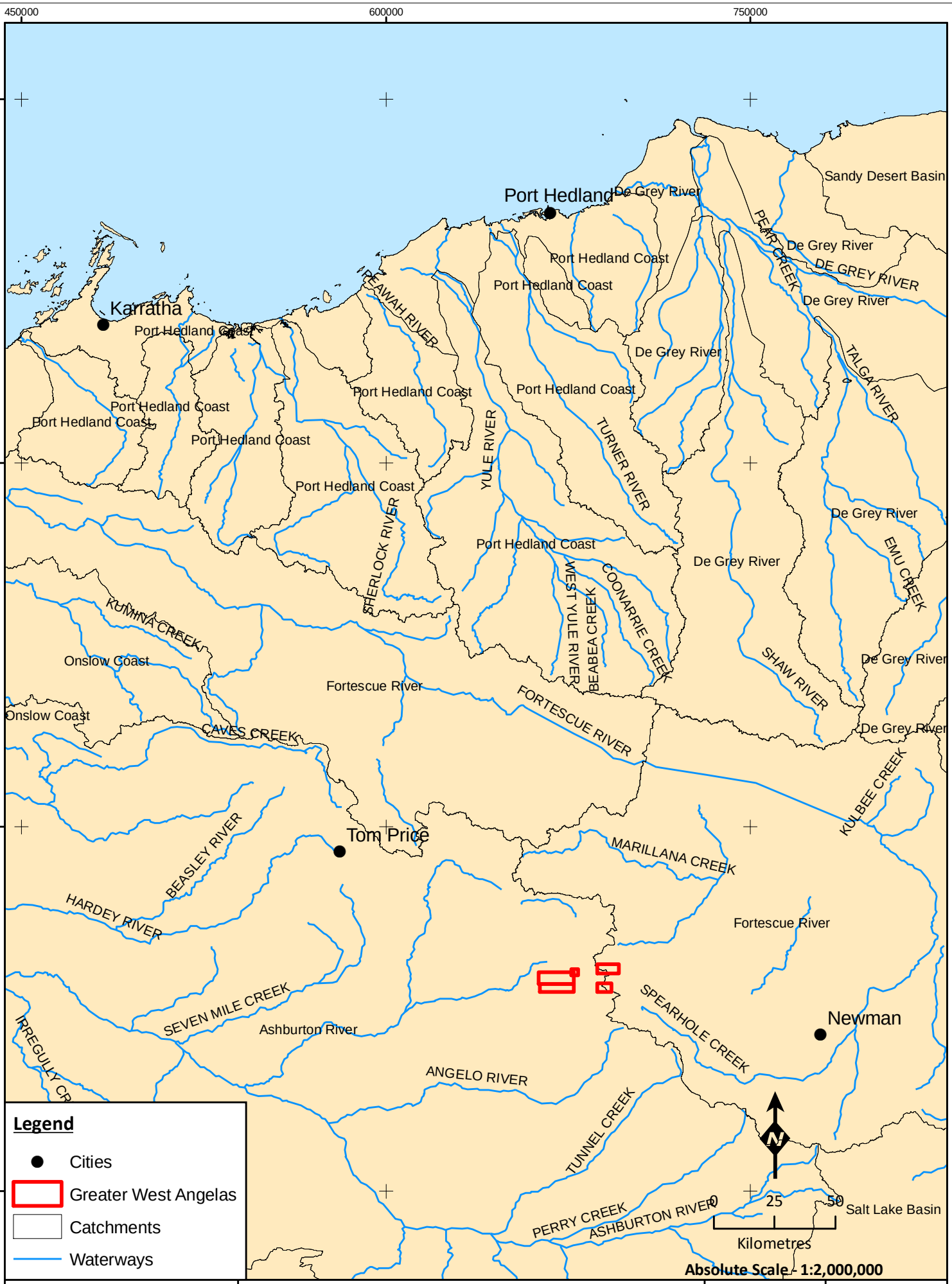
2.3 HYDROGEOLOGY

Central Pilbara groundwater occurs in the Archaean/Proterozoic basement rocks and the Cainozoic deposits. It originates from direct rainfall recharge into basement rock outcrops and indirect recharge through runoff (Johnson and Wright 2001).

The Study Area is located in the Hamersley Range, and is a part of both the Ashburton and the Fortescue Catchments. The closest creek to the Study Area is Turee Creek, a sub-tributary of the Ashburton River. Turee Creek flows west along a 4 km wide valley before turning sharply to exit the Hamersley Range (Johnson and Wright 2001). The West Angelas mine and Study Area are situated in the East Turee Creek catchment (Figure 2.4). The Turee Creek East drainage is fed by a number of smaller creeks originating in the hills to the west (Johnson and Wright 2001). The creek system is ephemeral and does not support any permanent surface-water features (Johnson and Wright 2001). The main aquifer in the area is the vuggy pisolite (Robe Pisolite) which overlies fractured basement rocks of the Woongarra volcanics and Boolgeeda Iron Formations (Johnson and Wright 2001). This aquifer lies within tertiary paleochannels and the aquifer zone varies between 50 and 80 m in thickness and has an estimated permeability of 40-80 m per day (Johnson and Wright 2001).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Tom Price
Newman
Sandy Desert Basin
De Grey River
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PEAR CREEK
DE GREY RIVER
TALGA RIVER
YULE RIVER
TURNER RIVER
SHERLOCK RIVER
WEST YULE RIVER
BEABEA CREEK
COONARRIE CREEK
EMU CREEK
SHAW RIVER
KUMINA CREEK
Onslow Coast
Fortescue River
FORTESCUE RIVER
CAVES CREEK
KULBEE CREEK
BEASLEY RIVER
HARDEY RIVER
MARILLANA CREEK
SEVEN MILE CREEK
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SPEARHOLE CREEK
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ANGELO RIVER
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Legend
Cities
Greater West Angelas
Catchments
Waterways
Absolute Scale - 1:2,000,000
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Location of West Angelas and Regional Hydrology
Figure: 2.4
Project ID: 1457
Drawn: CP
Date:13/06/2012
Coordinate System
Name: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994
Unique Map ID: CP085
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2.4 LAND USE HISTORY

2.4.1 Overview

Pastoralism is the most extensive land use in the Pilbara bioregion with 812 different pastoral leases encompassing 109,285 km^2 (61.4%) of the region. Areas set aside for conservation account for 14,763 km^2 (8.3%), consisting of the Cane River Conservation Park, Karijini and Millstream Chichester National Parks, Mungaroona Range and an unnamed Nature Reserve (LandGate, 2012). In addition, the pastoral leases of Mt Minnie and Nanutarra (adjoining the Cane River Conservation Park), Mt Florence (adjoining Karijini NP) and Meentheena have been purchased by the DEC and destocked. Although currently of informal status, these areas will ultimately be incorporated into the conservation estate, contributing a further 1.9%.

The Aboriginal reserves of Abydos, Jigalong, Woodstock and Yandeyarra, and the special lease for Aboriginal use, Callawa, occupy 10,655 km^2 (6%) of the bioregion.

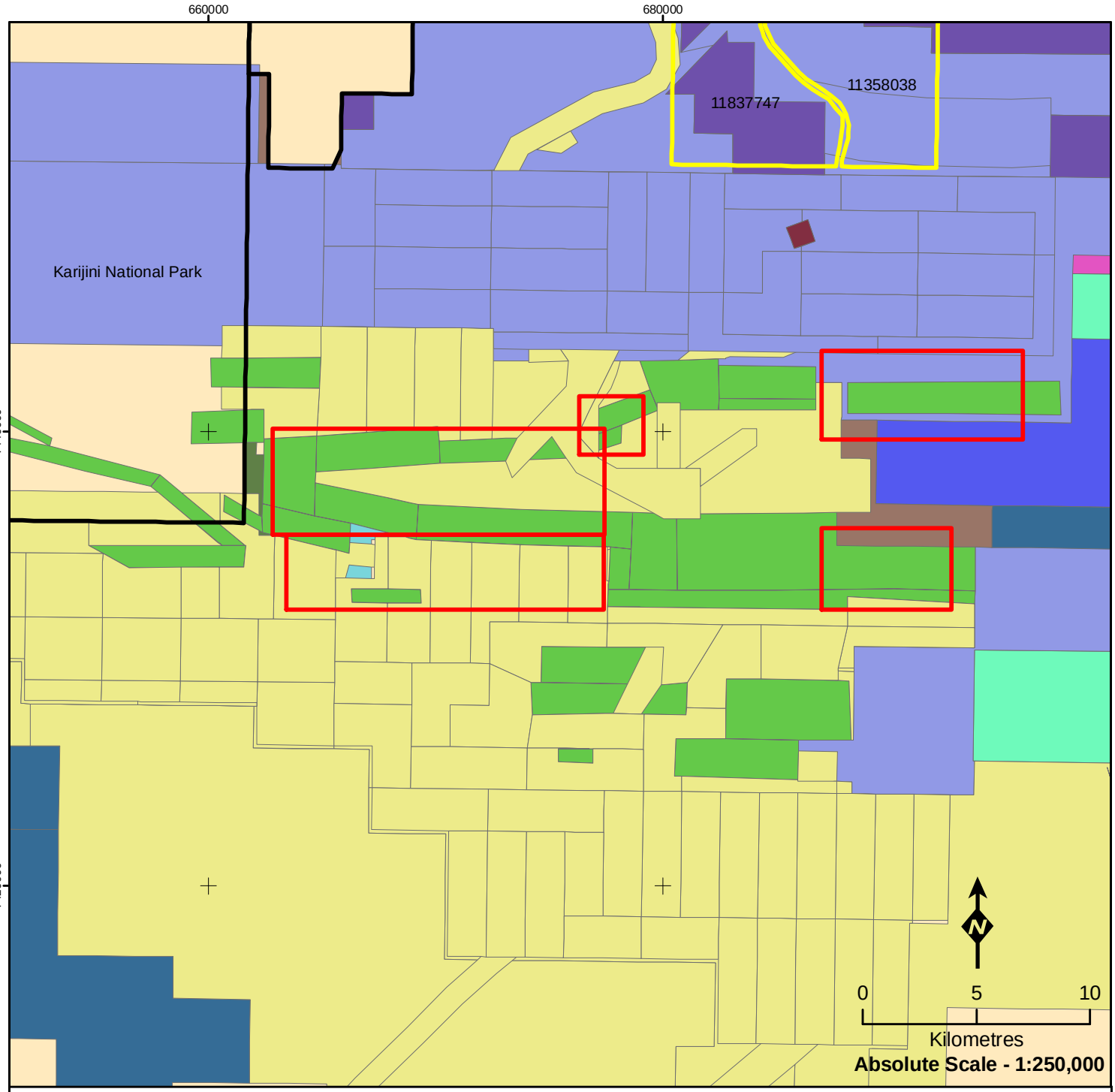
The total area of unallocated Crown land within the Pilbara bioregion is 496 km^2 (0.28%).

Mining is an important land use of ironstone ranges and greenstone belts throughout the bioregion, with development of the iron ore rich deposits accelerated in the 1960s after the Commonwealth lifted the 1938 export embargo on iron ore. Mining and exploration leases encompass 4.1% and 86% of the region, respectively. The development of the iron ore industry has resulted in activity within the Pilbara increasing from cattle and sheep stations and small coastal ports to a large mining economic base with a commensurate increase in population. In 2009, the Pilbara Development Commission reported that the Pilbara was at that time producing approximately 95% of Australia's iron ore exports, estimated at 157 Mtpa and with a value of over $5.1 billion per year (Pilbara Development Commision 2009).

Approximately 1% of the bioregion consists of town, commons and various reserves.

2.4.2 Local Land Use

The Study Area is not bound by, nor does it form part of any pastoral lease in the area. Exploration and mining leases owned by RT encompass 100% of the Study Area. As a result, the site is not subject to grazing pressure from cattle or other livestock. The Study Area (Particularly Deposit G) intersects the active West Angelas mine and infrastructure and these areas are subject to clearing and heavy vehicle traffic. All deposits in the Study Area have been subject to varying levels of clearing due to extensive resource exploration in the past during the feasibility and extent evaluation processes.



Legend

- Study Area
- Conservation Reserves
- Pastoral Lease Boundaries

Mining Tenements

- BHP BILLITON MINERALS PTY LTD
- FMG PILBARA PTY LTD
- HAMERSLEY RESOURCES LTD
- HAMERSLEY WA PTY LTD
- HOPE DOWNS IRON ORE PTY LTD
- ILMENITE RESOURCES PTY LTD
- MAMBA RESOURCE MANAGEMENT PTY LTD
- MULGA MINERALS PTY LTD
- ROBE RIVER LTD
- ROBE RIVER MINING CO. PTY LTD
- TALISMAN MINING LTD
- UNITED IRON PTY LTD
- WEST AUSTRALIAN MINISTER FOR STATE DEVELOPMENT
- WESTMAG LTD

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Local Land Use of West Angelas Study Area

Figure: 2.5
Project ID: 1457
Drawn: CP
Date: 05/09/2012

Coordinate System
Name: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994

Unique Map ID: CP101

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2.5 PILBARA BIOGEOGRAPHIC REGION

The Study Area is situated within the Pilbara Region of the Interim Biogeographic Regionalisation of Australia, IBRA 7 (Australian Government Department of Sustainability 2012). The Pilbara biogeographic region comprises four subregions: Hamersley, RT Plains, Chichester and Roebourne, and the Study Area lies within the Hamersley subregion (Figure 1.1). The Hamersley subregion encompasses 6,215,092 ha of the southern section of the Pilbara Craton. It is comprised of mountainous areas of Proterozoic sedimentary ranges and plateauxs, dissected by gorges (basalt, shale and dolerite). Mulga low woodland over bunch grasses on fine textured soils in valley floors, and *Eucalyptus leucophloia* over *Triodia brizoides* occur on the skeletal soils of the ranges. The climate is Semi-desert tropical, with an average 300 mm annual rainfall, usually in summer cyclonic or thunderstorm events, while winter rain is not uncommon. Drainage flows into either the Fortescue (to the north), the Ashburton to the south, or the Robe to the west (Kendrick and McKenzie 2001).

2.6 LAND SYSTEMS

The Study Area crosses the northern boundary of the area surveyed by Payne *et al* (1982) in the Regional Inventory of the Ashburton Rangelands and into the area surveyed by Van Vreeswyk *et al*. (2004) in the Regional Inventory of the Pilbara Rangelands. Both surveys documented the land systems present and their condition. Because the Survey Area intersects both Regional Inventory surveys, they will be discussed collectively for the purpose of the report. The Ashburton Regional Inventory (AIR) and Pilbara Regional Inventory (PIR) collectively cover an area of approximately 275,323 km^2, encompassing the Ashburton River and Rous Creek, part of the Yannarie River catchment, as well as the costal strip from and including Marrilla Station in the south, extending to Broome in the north-east.

Seven land systems mapped by Payne *et al* (1982) within the AIR and by Van Vreeswyk *et al*. (2004) in the PRI are present within the Study Area, each of which has been further classified by landform, soil, vegetation and drainage patterns (Table 2.3, Figure 2.6). The seven land systems within the Study Area include the Boolgeeda, Egerton, Elimunna, Newman, Platform, Rocklea and Wannamunna, with the Newman (71.4 km^2) and Boolgeeda (56.2 km^2) land systems being the most extensive.

The condition of vegetation of each land system within the AIR and PIR were also assessed. Regionally the majority of the area within each of these land systems was assessed to be in very good condition due to their inaccessibility and lack of palatable vegetation. The Elimunna and Wannamunna Land Systems are the exception, with only 39% and 44% assessed regionally as being in good or very good condition, respectively. The remaining percentage was assessed as either; fair, poor or very poor. The condition assessment for both Land Systems is due to the presence of vegetation that is attractive to grazing animals and prone to degradation if grazing pressure is excessive. The Wannamunna Land System is regionally restricted, comprising only 0.22% of the combined ARI and PRI areas surveyed by Payne *et al* (1982) and Van Vreeswyk *et al*. (2004). Within the Study Area it is also restricted, comprising only 0.3% of the total area. The area of each land system within the Study Area represents less than one percent of their individual regional distribution.

Given the aim of assessing the pastoral value of rangelands, the presence of the introduced grass **Cenchrus ciliaris* (Buffel grass) was not considered a negative indicator of condition, due to its perceived foraging value to pastoralists. However, this species is a serious environmental weed and the proportion of land systems in poor condition within an environmental context is therefore likely to be significantly higher, particularly for those land systems which support extensive stands of this species. Conversely the value of areas in which this species is not widespread is likely to be higher.

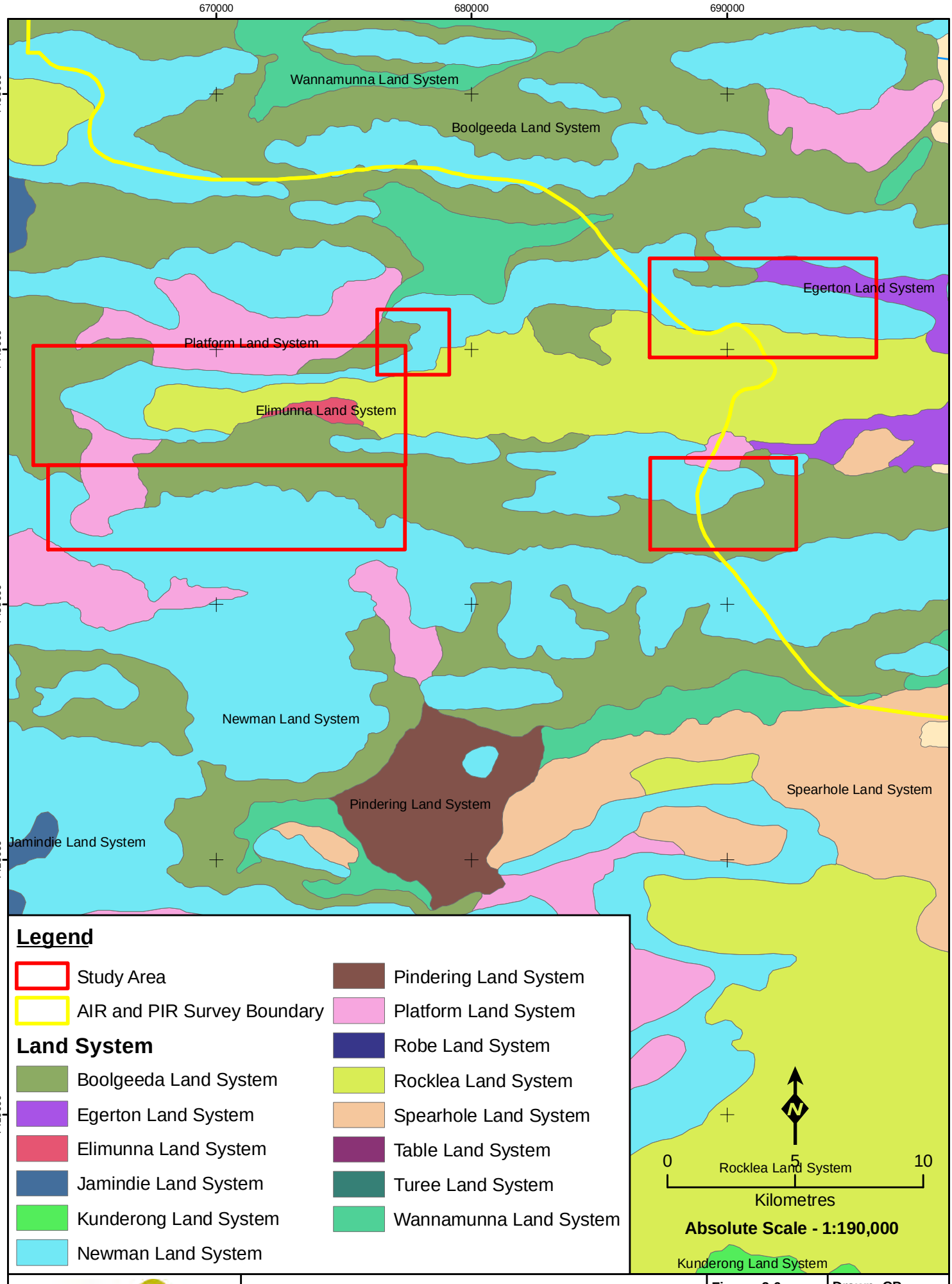
Table 2.3 – Extent of land systems present within the Study Area

Land System (% of Study Area)	Area (% of PIR and AIR combined)	Area within West Angelas Study Area (% of Land System)	Description	Vegetation Condition Assessment	Landform (and % of Land system)	Vegetation Community
Boolgeeda (32.01%)	10337 km^2 (3.8%)	56.2 km^2 (0.54%)	Stony lower slopes and plains below hill systems supporting hard and soft spinifex grasslands and mulga shrublands.	Very good 82%, good 13%, fair 4%, poor 1%. Hard spinifex grasslands not preferred by livestock.	Low hill and rises (4%)	Hummock grasslands of *T. wiseana* and other *Triodia* spp. with very scattered *Acacia* spp. Shrubs.
					Stony slope and upper plain (20%)	Hummock grasslands of *T. lanigera*, *T. wiseana* or scattered tall shrublands of *A. aneura*, *A. ancistrocarpa*, *A. atkinsiana* and other *Acacia* spp., with occasional *Eucalyptus* trees.
					Stony lower plain (65%)	Hummock grasslands of *T. wiseana*, *T. lanigera* or *T. pungens*. Also scattered to moderately close tall shrublands of *A. aneura* and other *Acacia* spp. with hard and soft *Triodia* spp. ground layer.
					Grove (small drainage foci) (1%)	Moderately closed woodlands or tall shrublands of *A. aneura* with sparse low shrubs and tussock or hummock grasses.
					Narrow drainage floor and channel (10%)	Scattered to closed tall shrublands or woodlands of *A. aneura*, *A. atkinsiana* and *C. hamersleyana* with sparse low shrubs and hummock and tussock grasses. Occasionally hummock grasslands of *T. pungens*.
Egerton (2.52%)	3868 km^2 (1.40%)	4.4 km^2 (0.11%)	Dissected hardpan plains supporting mulga shrublands and hard spinifex hummock grasslands.	Very good 89%, good 11%. Vegetation not preferred by livestock.	Hardpan plains (10%)	Very scattered to scattered tall shrublands of *Acacia aneura* and other *Acacia* spp. with prominent ground layer of *Triodia* spp.
					Dissected slopes (75%)	Hummock grasslands of *Triodia brizoides*, *T. wiseana* with isolated *Acacia* shrubs and *Eucalypt*s.
					Calcrete drainage margins (6%)	Hummock grasslands of *T. wiseana* with sparse *Eucalyptus socialis* trees or mallees and isolated low shrubs.
					Drainage floors and channels (9%)	Moderately close woodlands/tall shrublands of *A. aneura* with other shrubs including *Senna* spp., *Ptilotus obovatus* and *Eremophila forrestii* with *Triodia* spp. ground layer.
Elimunna (1.15%)	656.6 km^2 (0.24%)	2.0 km^2 (0.30%)	Stony plains on basalt supporting	Very good 14%, good 25%, fair 35%, poor	Hills and low rises (10%)	Hummock grasslands of *Triodia wiseana* (hard spinifex) or very scattered shrublands of *Acacia* and *Senna* spp.

Land System (% of Study Area)	Area (% of PIR and AIR combined)	Area within West Angelas Study Area (% of Land System)	Description	Vegetation Condition Assessment	Landform (and % of Land system)	Vegetation Community
			Sparse *Acacia* and cassia shrublands and patchy tussock grasslands.	21%., very poor, 5% Vegetation attractive to grazing animals and prone to degradation if grazing pressure is excessive.	Stony plains (45%)	Very scattered to scattered mixed height shrublands with *Acacia aneura* (mulga) other *Acacia*s, *Senna* spp. (cassias) and *Eremophila* spp Occasionally with patchy *Triodia* spp. (hard spinifex) understorey.
					Gilgai plains (26%)	Patchy tussock grasslands with *Eragrostis xerophila* (Roebourne Plains grass), *E. setifolia* (neverfail), *Astrebla pectinata* (barley Mitchell grass) with isolated shrubs mainly *Eremophila* and *Senna* spp.
					Hardpan plains (6%)	Very scattered tall shrublands of *A. aneura* and other *Acacia*s.
					Groves (1%)	Moderately close to close tall shrublands of *A. aneura* with numerous other shrubs and patchy perennial grasses.
					Drainage floors (12%)	Tussock grasslands with *Astrebla* and *Eragrostis* spp. or very scattered to moderately close tall shrublands of *Acacia* spp. with various low shrubs and patchy tussock and/or hummock grasses.
Newman (40.66%)	21109 km^2 (7.7%)	71.4 km^2 (0.34%)	Rugged jaspilite plateaux, ridges and mountains supporting hard.	Very good 91%, good 7%, fair 1%, poor 1%. Inaccessible or poorly accessible and is unsuitable for pastoral purposes.	Plateaux, ridges, mountains and hills (70%)	Hummock grasslands of *Triodia wiseana*, *T. brizoides*, *T. plurinervata* with very scattered to scattered shrubs and trees including *Acacia* and *Senna* spp., *Grevillea wickhamii*, *Eucalyptus leucophloia* and other eucalypts. Occasionally hummock grass is *Triodia biflora*.
					Lower slopes (20%)	Similar to the vegetation community above.
					Stony plains (5%)	Hummock grasslands of *Triodia wiseana*, *T.* spp. (hard spinifex) with isolated to very scattered shrubs of *Acacia* and *Senna* spp. and occasional eucalypt trees. Occasionally hummock grasslands of *Triodia pungens* (soft spinifex).
					Narrow drainage floors with channels (5%)	Smaller floors support hummock grassland of *Triodia pungens* with very scattered shrubs. Larger floors and channel support tall shrublands/woodlands of *Acacia* spp. and *Eucalyptus victrix* with tussock grass or hummock grass understoreys.

Land System (% of Study Area)	Area (% of PIR and AIR combined)	Area within West Angelas Study Area (% of Land System)	Description	Vegetation Condition Assessment	Landform (and % of Land system)	Vegetation Community
Platform (9.75%)	2552 km^2 (0.9%)	17.1 km^2 (0.67%)	Dissected slopes and raised plains supporting hard spinifex grasslands.	Very good 97%, good 3%. Vegetation on this system is not preferred by livestock and is of Very little use for pastoralism. The system is not susceptible to erosion.	Stony upper plains (25%)	Hummock grasslands of *Triodia wiseana* and other *Triodia* spp. (hard spinifex) with isolated to very scattered *Acacia* spp. shrubs
					Dissected slopes (60%)	Hummock grasslands of *Triodia wiseana*, *T. plurinervata* (hard spinifex) with isolated to very scattered *Acacia* spp. shrubs or *Eucalyptus leucophloia* (snappy gum)
					Drainage floors (15%)	Scattered to close tall shrublands/woodlands with *Acacia citrinoviridis* (black mulga), *A. tumida* (pindan wattle) and other *Acacia*s, occasional eucalypt trees, numerous low shrubs including *Senna* spp. (cassias), *Ptilotus obovatus* (cotton bush), *Corchorus walcottii* (grey Corchorus) and *Triodia pungens* (soft spinifex)
Rocklea (13.89%)	31089 km^2 (11.3%)	24.4 km^2 (0.08%)	Basalt hills, plateaux, lowers slopes and minor stony plains supporting hard spinifex (and occasionally soft spinifex) grasslands.	Very good 89%, good 7%, fair 2%, poor 2% Spinifex grasslands inaccessible and not preferred by livestock.	Hills, ridges, plateaux and upper slopes (65%)	Hummock grasslands of *T. wiseana*, *Triodia* spp. or less frequently, of *T. pungens* with isolated to very scattered shrubs such as *A. inaequilatera* and *Senna* spp.
					Lower slopes (15%)	Hummock grasslands of *T. wiseana*, *Triodia* spp. Or less frequently, of *T. pungens* with isolated to very scattered shrubs such as *A. inaequilatera* and *Senna* spp.
					Stony plains and interfluves (10%)	Hummock grasslands of *T. wiseana* or less frequently *T. pungens* with isolated to very scattered shrubs such as *A. inaequilatera*. Occasionally grassy shrublands with *Acacia*, *Senna* and *Eremophila* spp.
					Gilgai plains (1%)	Tussock grasslands with *Astrebla pectinata*, *E. xerophila* and other perennial grasses.
					Upper drainage lines (4%)	Hummock grasslands of *T. wiseana* or *T. pungens* with very scattered to scattered *Acacia* shrubs and occasional *C. hamersleyana* trees.
					Drainage floors and channels (5%)	Scattered to moderately close tall shrublands or woodlands of *Acacia* and *Eucalyptus* spp. with numerous undershrubs and hummock grass understoreys or tussock grass understoreys.

Land System (% of Study Area)	Area (% of PIR and AIR combined)	Area within West Angelas Study Area (% of Land System)	Description	Vegetation Condition Assessment	Landform (and % of Land system)	Vegetation Community
Wannamunna (0.03%)	630.1 km^2 (0.22%)	0.04 km^2 (0.006%)	Hardpan plains and internal drainage tracts supporting mulga shrublands and woodlands (and occasionally eucalypt woodlands).	Very good 19%, good 25%, fair 19%, poor 21%., very poor, 16% The system supports low shrubs and tussock grasses which are highly preferred by grazing animals and are prone to degradation if grazing pressure is excessive.	Stony plains (8%	Very scattered to scattered tall shrublands of *Acacia aneura* (mulga) with sparse low shrubs and *Triodia* sp. (hard spinifex) understorey
					Hardpan plains (56%)	Very scattered tall or low shrublands of *Acacia aneura*, *Eremophila* spp., *Ptilotus obovatus* (cotton bush), *Maireana villosa*.
					Calcrete platforms (1%)	Scattered shrublands with *Acacia aneura* and other *Acacia*s, *Senna* spp. and *Triodia wiseana* (hard spinifex)
					Groves (15%)	Moderately close to closed woodlands of *Acacia aneura* with numerous undershrubs and tussock grasses such as *Chrysopogon fallax* (ribbon grass) and *Themeda triandra* (kangaroo grass).
					Internal drainage plains (20%)	Moderately close to closed woodlands of *Acacia aneura* and *Eucalyptus victrix* (coolibah) with sparse undershrubs such as *Muehlenbeckia florulenta* (lignum) and *Chenopodium auricomum* (swamp bluebush) and patchy tussock grasses. Also grasslands of *Eriachne* sp. with isolated *Eucalyptus victrix* trees and shrubs such as *M. florulenta* or grassy scattered woodlands of *E. victrix*



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Land Systems of West Angelas Study Area

Figure: 2.6	**Drawn: CP**
Project ID: 1457	**Date: 05/09/2012**

Coordinate System
Name: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994

Unique Map ID: CP103

A4

2.7 THREATENED ECOLOGICAL COMMUNITIES

2.7.1 Commonwealth Threatened Ecological Communities

Ecological communities are naturally occurring biological assemblages associated with a particular type of habitat. At a commonwealth (national) level, flora and Threatened Ecological Communities (TECs) are protected under the EPBC Act. An ecological community may be categorised into one of three sub-categories:

- Critically endangered if it is facing an extremely high risk of extinction in the wild in the immediate future.
- Endangered if it is not critically endangered and is facing a very high risk of extinction in the wild in the near future.
- Vulnerable if it is not critically endangered or endangered, and is facing a high risk of extinction in the wild in the medium-term future.

No Commonwealth listed TECs occur in the vicinity of the Study Area.

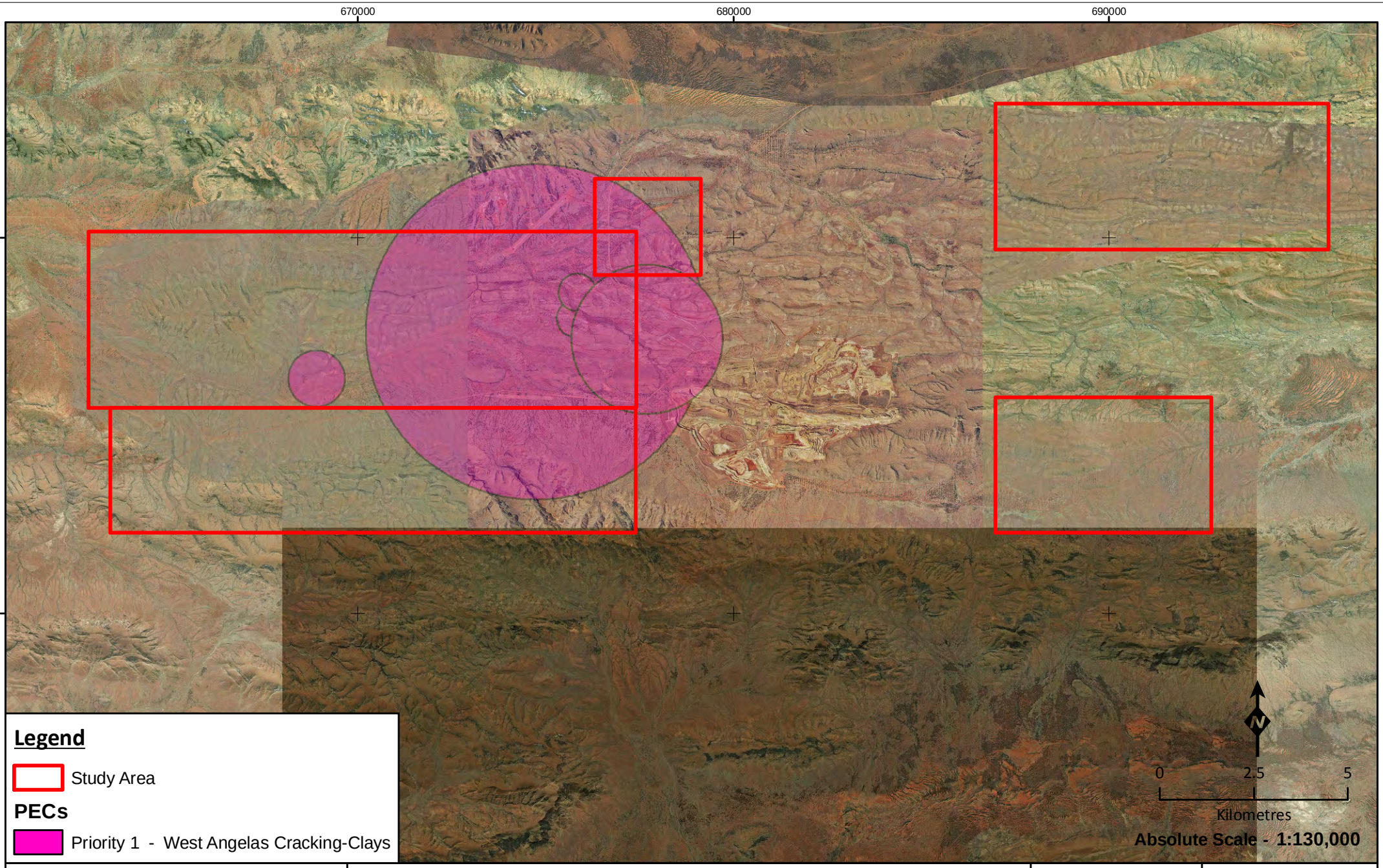
2.7.2 State Threatened Ecological Communities

The Western Australian DEC maintains a list of TECs which are further caterorised into three subcategories which replicate those of the EPBC Act, but with further definition of the threatening processes as detailed in Appendix D.

No state threatened ecological communities are located within a 40 km radius of the Study Area

2.7.3 State Priority Ecological Communities

The DEC also maintains a list of Priority Ecological Communities (PECs) which includes potential TECs that do not meet survey criteria, or that are not adequately defined. As at 13 April 2012 (Department of Environment and Conservation 2012), one Priority 1 PEC; West Angelas Cracking-Clays, has been identified to occur extensively within the Study Area (Figure 2.7). This community is further defined as open tussock grasslands of *Astrebla pectinata*, *A. elymoides*, *Aristida latifolia* in combination with *Astrebla squarrosa* and low scattered shrubs of *Sida fibulifera*, on basalt derived cracking-clay loam depressions and flowlines. Threats to this community include clearing for further mining expansion and future infrastructure development, weed invasion and changes in fire regimes.



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PECs of the West Angelas Study Area

Figure: 2.7
Project ID: 1457

Drawn: CP
Date: 20/09/2012

Coordinate System
Name: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994

Unique Map ID: CP138

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2.8 PREVIOUS VEGETATION SURVEYS

2.8.1 Beard Vegetation Descriptions

The Study Area lies within the area mapped by Beard (1975) within the Pilbara region of the Eremaean Botanical Province. The vegetation mapping was subsequently reinterpreted to reflect the National Vegetation Information System (NVIS) (Department of Environment and Water Resources 2012) standards, taxonomy revised where required and digitised (Shepherd *et al*. 2001). Two vegetation units have been mapped within the Study Area, the distributions and features of which are detailed in Figure 2.8 and Table 2.4, respectively.

Table 2.4 – Vegetation association codes.

Code	Structure	Vegetation Association	Species
18	Low woodland; mulga (*Acacia aneura*)	*Acacia* open shrubland / *Ptilotus* mixed open forbland	*Acacia aneura*, *Acacia pru*inocarpa, *Acacia aneura* var. *aneura Eremophila fraseri*, *Eremophila foliosissima*, *Eremophila exilifolia Senna* sp., *Solanum lasiophyllum*, *Ptilotus obovatus*.
82	Open hummock grassland	Hummock grasslands, low tree steppe; snappy gum over *Triodia wiseana*	*Eucalyptus leucophloia*, *Eucalyptus gamophylla*, *Senna artemisioides subs*p. x *sturtii*, *Dodonaea viscosa*, *Grevillea wickhamii*, *Triodia wiseana*, *Ptilotus rotundifolius*, *Acacia lycopodiifolia* and *Triodia wiseana*.

2.8.2 Finer Scale Vegetation Surveys

In recent history, strong iron ore prices have resulted in a boom in resource development projects in the Pilbara which has resulted in a significant increase in biological survey effort for the Bioregion. *ecologia* has reviewed previous survey data ranging from 1979 to the present day. During this period, the Greater West Angelas area has been subject to a series of previous vegetation, targeted flora and monitoring surveys. Infrastructure triggering previous vegetation surveys included: railway lines, gas pipelines, power stations, borefields and viable ore deposits. The most relevant spatial and temporal surveys to the current study are summarised in table Table 2.5.

Table 2.5 – Previous Vegetation Surveys at Greater West Angelas

Author	Survey	Year
ENV. Australia	Flora, Vegetation and Fauna Assessment of the Re-Aligned Gas Pipeline Corridor at West Angelas	2011
Rio Tinto	Flora and Vegetation Assessment of the West Angelas water pipeline Study Area	2011
Rio Tinto	Statement Addressing the 10 CP for West Angelas Power Station and Borrow Pits	2011
Biota Environmental Sciences	A Flora and Vegetation Survey of the Proposed West Angelas Gas-Fired Power Station and Pipeline Corridor	2010
Rio Tinto	Flora and Vegetation Assessment of the Proposed West Angelas Discharge Creekline Corridor (WADCC)	2009
ecologia Environment	West Angelas Multiple Areas Flora and Vegetation Survey & Desktop Fauna Assessment	2008
Biota Environmental Sciences	Vegetation and Flora Survey of West Angelas Deposits E and F	2006
Biota Environmental Sciences	Vegetation and Flora Survey of West Angelas Deposits E & F	2005
ME Trudgen & Associates	Flora & Vegetation Surveys of Orebody A & B in the West Angelas Hill Area	1998 (1995)

Of the surveys summarised in Table 2.5, the vegetation mapping conducted by Biota Environmental Sciences in 2006 and 2010 (Biota 2006, Biota 2010) and ME Trudgen & Associates (1998) are of particular relevance. These three are also quadrat based flora and vegetation assessments that encompass areas within and adjacent to the current Study Area.

The Biota survey, "Flora and Vegetation Survey of the Proposed West Angelas Gas-Fired Power Station" (Biota 2010), was a single phase Level Two flora and vegetation survey. A total of 262 taxa from 93 genera and 35 families were recorded from a combination of 37, 50 x 50 m bound quadrats and targeted searches.

Earlier, in 2006 Biota completed; "Flora Survey of West Angelas Deposits E and F" (Biota 2006), where 24 detailed flora quadrats and 17 releves, as well as observations in the field were used to record a total of 429 taxa of native vascular flora from 143 genera belonging to 53 families.

ME Trudgen & Associates (1998) mapped a large proportion of the current Study Area in "Flora & Vegetation Surveys of Orebody A & B in the West Angelas Hill Area" where 635 taxa were recorded.

Table 2.6 summarises the vegetation units of the three surveys mapped within the current Study Area. The most abundant unit from the ME Trudgen & Associates (1998) survey was vegetation unti *5edb,* covering 2,536.25 ha of the Study Area. In the 2006 survey conducted by Biota the most abundant vegetation unit was *H1*, *Eucalyptus leucophloia* low open woodland over *Acacia maitlandii*, *A*. *hamersleyensis* shrubland over *Triodia pungens* (*T*. *wiseana*) mid-dense hummock grassland, covering an area of 206.08 ha.

The most restricted vegetation units within the Study Area were units *6adb212* (0.06 ha) and *6adb213* (0.35 ha) from the ME Trudgen & Associates (1998) survey and unit *CdAanAprTsTp* (0.91 ha), *Corymbia deserticola*, *Acacia aneura*, *A. pruinocarpa* low open woodland over *Triodia sch*inz*ii*, *T. pungens* hummock grassland, from the Biota (2010) survey.

Table 2.6 – Summary of Vegetation Units of Previous Studies Within the Study Area

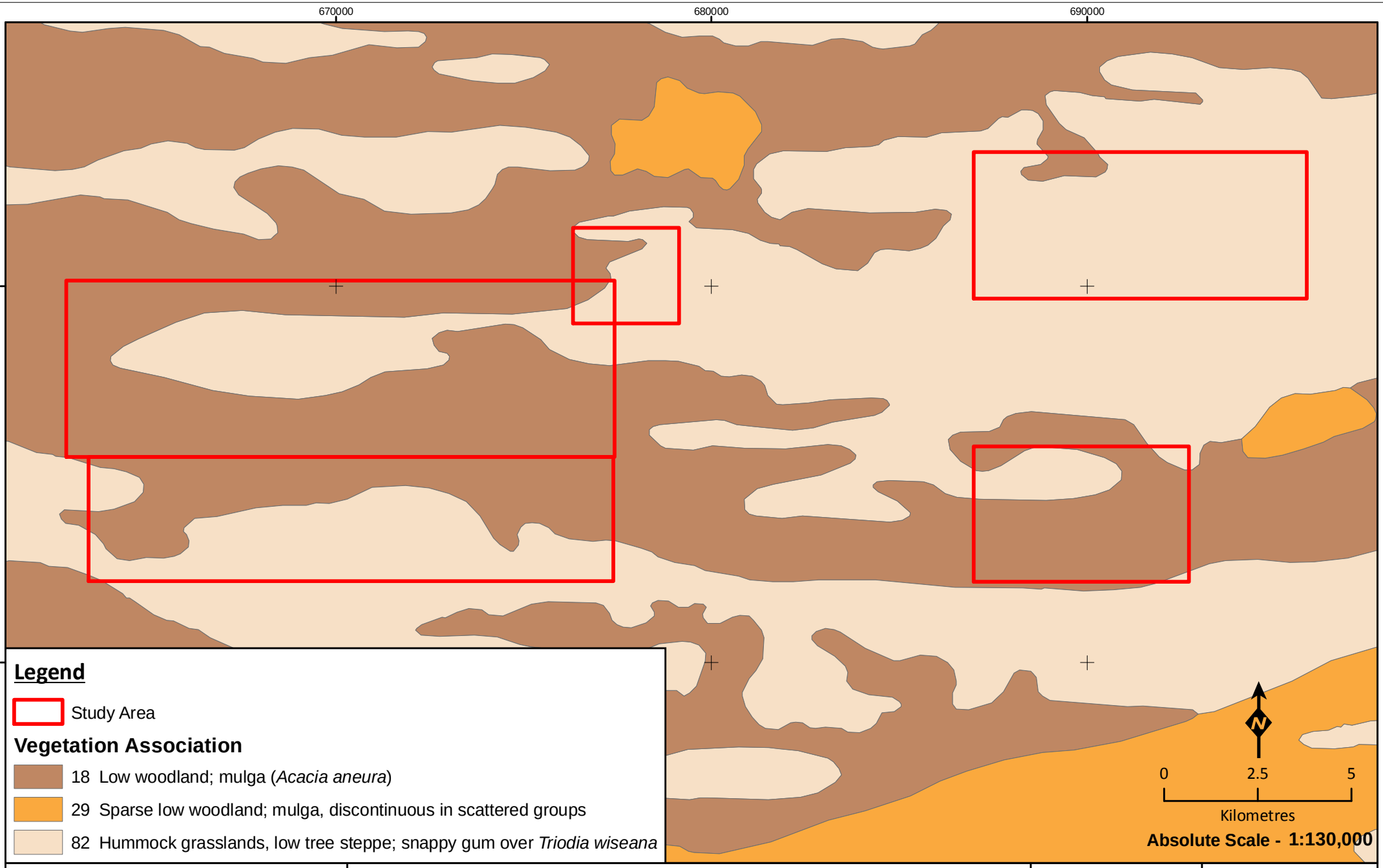
Biota (2010)			Biota (2006)			ME Trudgen & Associates(1998)		
Unit	**Description**	**Area (ha)**	**Unit**	**Description**	**Area (ha)**	**Unit**	**Description**	**Area (ha)**
AanAprRHeE RfoTHtTlo	*Acacia aneura*, *A. pruinocarpa* low woodland over *Rhagodia eremaea*, *Eremophila forrestii* open shrubland over *Themeda triandra* open *tussock* grassland, *Triodia longiceps* scattered hummock grasses	34.28	*C1*	*Eucalyptus* spp. scattered low trees over *Acacia maitlandii*, *Gossypium robinsonii*, *Petalostylis labicheoides* shrubland over *Triodia pungens* open hummock grassland *and Eriachne mucronata*, *Themeda triandra* open *tussock* grassland	40.38	*2cab*	*Eucalyptus xerothermica* low open woodland over *Acacia pruinocarpa* scattered tall shrubs over *Maireana* spp. Scattered low shrubs over *Triodia pungens* open hummock grassland with *Themeda triandra* scattered tussock grass	576.73
AanAprTbrTp	*Acacia aneura*, *A. pruinocarpa* tall open shrubland over *Triodia brizoides*, *T. pungens* hummock grassland	32.48	*C2*	*Eucalyptus xerothermica* low open woodland over *Acacia maitlandii*, *Petalostylis labicheoides*, *Rulingia luteiflora* shrubland to tall shrubland over *Triodia pungens* open hummock grassland	10.09	*2cac*	*Eucalyptus xerothermica* scattered low trees over *Acacia aneura* var. *longicarpa* and *Acacia* aff. *aneura* high shrubland over *Themeda triandra* and *Chrysopogon fallax* very open tussock grassland with *Triodia pungens* and *Triodia wiseana* scattered hummock grass	272.04
AanAprTp/A anTp	*Acacia aneura*, *A. pruinocarpa* tall open *scrub* over *Triodia pungens very* open hummock grassland; occurring in mosaic with groves of *Acacia aneura* low open *forest* over *Triodia pungens* hummock grassland	10.79	*H1*	*Eucalyptus leucophloia* low open woodland over *Acacia maitlandii*, *A. hamersleyensis* shrubland over *Triodia pungens (T. wiseana)* mid-dense hummock grassland	206.08	*5eda*	*Corymbia deserticola* scattered low trees over *Acacia bivenosa*, *Acacia pruinocarpa* and *Hakea chordophylla* scattered tall shrubs over *Cassia prunosa* scattered shrubs over *Triodia* aff. *basedowii* and *Triodia pungens* open hummock grassland	1,798.74
AanApyTHt	*Acacia aneura* low open woodland over *A. pyrifolia* scattered tall *shrubs* over *Themeda triandra tussock* grassland	21.88	*H2*	*Acacia catenulata* low woodland over *Triodia pungens* mid-dense hummock grassland	4.54	*5edac*	*Eucalyptus gamophylla* scattered low trees over *Acacia bivenosa*, A. pyrifolia scattered tall shrubs over *Triodia pungens* open hummock grassland	132.06
AanArERfoTp	*Acacia aneura* low woodland over *A. rhodophloia*, *Eremophila forrestii*, open shrubland over *Triodia pungens* open hummock grassland	8.23	*H3*	*Corymbia ferriticola*, *Eucalyptus leucophloia* low open woodland over *Triodia* sp. *Mt Ella*, *T. pungens* hummock grassland *and Eriachne mucronata* open *tussock* grassland	45.18	*5edacl*	*Eucalyptus gamophylla* scattered low trees over *Acacia bivenosa* scattered tall shrubs over *Triodia pungens* and *Triodia longiceps* open hummock grassland.	47.95

Biota (2010)			Biota (2006)			ME Trudgen & Associates(1998)		
Unit	**Description**	**Area (ha)**	**Unit**	**Description**	**Area (ha)**	**Unit**	**Description**	**Area (ha)**
AanArGbERf oERpCAsTp	*Acacia aneura* low woodland over *A. rhodophloia*, *Grevillea berryana* scattered tall *shrubs* over *Eremophila phyllopoda*, *E.* sp., *Cassia stricta* low open shrubland over *Triodia pungens very* open hummock grassland	21.31	*H4*	*Eucalyptus leucophloia* low open woodland over *Triodia wiseana* mid-dense hummock grassland *and Themeda triandra tussock* grassland	1.09	*5edad*	*Eucalyptus gamophylla* scattered low trees over *Acacia bivenosa* and *Acacia pyrifolia* scattered tall shrubs over *Triodia pungens* and *Triodia longiceps* open hummock grassland	665.01
AbApyTp	*Acacia bivenosa*, *A. pyrifolia* shrubland over *Triodia pungens* hummock grassland	1.50	*H5*	*Eucalyptus gamophylla* low woodland over *Triodia* aff. *basedowii (T. pungens)* mid-dense hummock grassland	111.44	*5edae*	*Scaervola acacioides* open shrubland over *Triodia pungens* open hummock grassland	296.24
AciTHtTp	*Acacia citrinoviridis* tall shrubland over *Themeda triandra* open *tussock* grassland over *Triodia pungens* scattered hummock grasses	38.86	*M1*	*Acacia aneura* low open woodland over *Acacia bivenosa*, *Gossypium robinsonii*, *Sida* aff. *cardiophylla*, *Scaevola parvifolia* shrubland to low open shrubland over *Triodia pungens*, *T. schinzii* mid-dense hummock grassland	184.02	*5edaf*	*Acacia aneura* var. *longicarpa* and *Acacia rhondophloia* high shrubland over *Eremophila fraseri* ssp. *fraseri*, *Eremophila lachnocalyx* and *Eremophila exilifolia* shrubland over *Triodia pungens* open hummock grassland	194.01
AiTbrTw	*Acacia* in*aequilatera* tall shrubland over *Triodia brizoides*, *T. wiseana* hummock grassland	60.56	*M2*	*Acacia aneura* low open woodland over *Triodia pungens*, *T.* aff. *basedowii* mid-dense hummock grassland	22.81	*5edag*	*Corymbia ferriticola* ssp. *ferriticola* low open woodland over *Acacia pruinocarpa* and *Acacia aneura* var. *aneura/ intermedia* high open shrubland over *Harneria kempeana* ssp. *muelleri* and *Ptilotus obovatus* shrubland over *Triodia pungens* and *Plectrachne melvillei* very open hummock grassland with *Themeda triandra* scattered tussock grassland.	24.22
AprAanAwTp	*Acacia pru*inocarpa, *A. aneura* tall open *scrub* over *A. wanyu* scattered *shrubs* over *Triodia pungens* hummock grassland	47.20	*M3*	*Acacia aneura* woodland over *Maireana villosa*, *Ptilotus obovatus*, *Rhagodia* sp. *Hamersley* open to low open shrubland over *Triodia* sp. *Mt Ella* open hummock grassland	129.84	*5edb*	*Acacia ayersiana*, *Acacia* aff. *aneura* (narrow green), *Acacia* Aff. *catenulata*, *Acacia* aff. *aneura* (grey, bushy form) and *Acacia* aff. *aneura* (scythe-shaped) high open shrubland over *Maireana* spp. low scattered shrubs over *Triodia pungens* very open hummock grassland	2,536.25
AprAciApyTp	*Acacia pru*inocarpa, *A. citrinoviridis*, *A.*	17.64	*M4*	*Acacia aneura*, *A. pruinocarpa* low *closed forest*	66.28	*5edbw*	*Eucalyptus leucophloia, Corymbia*	913.81

Biota (2010)			Biota (2006)			ME Trudgen & Associates(1998)		
Unit	**Description**	**Area (ha)**	**Unit**	**Description**	**Area (ha)**	**Unit**	**Description**	**Area (ha)**
	pyrifolia open shrubland over *Triodia pungens* hummock grassland			to low woodland over *Eremophila forrestii*, *E. longifolia*, *Ptilotus obovatus*, *Rhagodia* sp. *Hamersley* low open shrubland to open shrubland over *Triodia pungens* open hummock grassland			*hamersleyana* and *Eucalyptus pilbarensis* scattered low trees over *Acacia pruinocarpa* and *Acacia rhodophloia* scattered tall shrubs over *Ptilotus obovatus* scattered shrubs over *Triodia wiseana* and *Triodia pungens* hummock grassland	
AprAiTw	*Acacia pruinocarpa*, *A.* in*aequilatera* open shrubland over *Triodia wiseana* hummock grassland	50.13	*M5*	*Acacia aneura* low *closed forest* over *Triodia pungens* mid-dense hummock grassland	32.32	*5kd3r*	*Eucalyptus leucophloia* low open woodland over *Acacia pruinocarpa* scattered tall shrubs over *Triodia pungens* open hummock grassland.	885.70
ApyAciTp	*Acacia pyrifolia*, *A. citrinoviridis* tall shrubland over *Triodia pungens* open hummock grassland	2.46				*5kd3w*	*Eucalyptus leucophloia* low open woodland over *Triodia wiseana* open hummock grassland with *Eriachne mucronata* scattered tussock grass	15.50
AteTbr	*Acacia tenuissima* scattered *shrubs* over *Triodia brizoides* hummock grassland	17.78				*5kdm1*	*Eucalyptus leucophloia* scattered low trees over *Triodia* aff. *basedowii* and *Triodia pungens* open hummock grassland	687.41
CdAanAprTsTp	*Corymbia deserticola*, *Acacia aneura*, *A. pruinocarpa* low open woodland over *Triodia schinzii*, *T. pungens* hummock grassland	0.91				*5kdm2*	*Eucalyptus leucophloia* and *Corymbia hamersleyana* low open woodland over *Acacia maitlandii* scattered shrubs over *Triodia wiseana* open hummock grassland	1.16
ChAciGwRUlTp	*Corymbia hamersleyana*, *Acacia citrinoviridis* low woodland over *Grevillea wickhamii*, *Rulingia luteifolia* shrubland over *Triodia pungens* hummock grassland	23.19				*5kdm3*	*Eucalyptus leucophloia* scattered low trees over *Acacia pruinocarpa* scattered tall shrubs over *Triodia pungens* open hummock grassland	36.71
Disturbed	Cleared of native vegetation	4.53				*5kdmaf*	*Eucalyptus leucophloia* and *Corymbia ferriticola* low woodland over *Acacia pruinocarpa* and *Acacia anuran* var. *longicarpa* high open shrubland over *Ptilotus obovatus* and *Olearia stuartii* low open shrubland over *Triodia pungens* open hummock grassland	30.84

Biota (2010)			Biota (2006)			ME Trudgen & Associates(1998)		
Unit	**Description**	**Area (ha)**	**Unit**	**Description**	**Area (ha)**	**Unit**	**Description**	**Area (ha)**
EgAiAprAbTp	*Eucalyptus gamophylla*, *Acacia* in*aequilatera*, *A. pruinocarpa*, *A. bivenosa* open shrubland over *Triodia pungens* hummock grassland	19.26				*6/2ef*	*Eucalyptus victrix* open woodland over *Acacia aneura* var. *longicarpa* scattered tall shrubs over *Enneapogon* sp. and *Eriachne benthamii* tussock grassland over *Eragrostis pergracilis* and *Aristida contorta*	508.84
ElCdAiTbrTp	*Eucalyptus leucophloia*, *Corymbia deserticola* scattered trees over *Acacia* in*aequilatera* open shrubland over *Triodia brizoides*, *T. pungens* hummock grassland	8.00				*6adb212*	*Acacia* aff. *aneura* (narrow, green; M.E.T. 15,850), *Acacia* aff. *catenulata, Acacia* aff. *ayersiana* (narrow form; M.E.T. 15,786) and *Acacia ayersiana* high shrubland over *Plectrachne melvillei* and *Triodia pungens* scattered hummock grassland	0.06
EvAciTHtEUaCYaTp	*Eucalyptus victrix*, *Acacia citr*inoviridis low woodland over *Themeda triandra*, *Eulalia aurea*, *Cymbopogon ambiguus* open *tussock* grassland, *Triodia pungens* hummock grassland	3.76				*6adb213*	*Acacia* aff. *aneura* (scythe-shaped; MET 15,743), *A. pruinocarpa*, A. aff. *aneura* (grey, bushy form; MET 15,732 high shrubland over *Eremophila forrestii* subsp. *forrestii* scattered shrubs over *Triodia pungens* very open hummock grassland	0.35
						6adb215	*Aristida contorta* open annual tussock grassland	13.17
						6adb231	*Acacia* aff. *aneura* (grey, bushy form; M.E.T. 15,732) and *Acacia aneura* var. *longicarpa* high open shrub land over *Triodia pungens* very open hummock grassland	627.79
						6adb232	*Acacia aneura* var. *longicarpa* high shrubland over *Rhagodia* sp. Hamersley, *Ptilotus obovatus* open shrubland over *Digitaria brownii* scattered tussock grassland	1.09
						6adb26	*Acacia* aff. *aneura* and *Acacia pruinocarpa* scattered tall trees over *Maireana* spp. scattered low shrubs	167.00

Biota (2010)			Biota (2006)			ME Trudgen & Associates(1998)		
Unit	**Description**	**Area (ha)**	**Unit**	**Description**	**Area (ha)**	**Unit**	**Description**	**Area (ha)**
							over *Triodia pungens* open hummock grassland with *Themeda triandra* scattered tussock grass	
						8bj	*Acacia aneura* var. *longicarpa* and *Acacia pruinocarpa* high open shrubland over *Acacia pyrifolia* and cassia *oligophylla* scattered shrubs over *Triodia wiseana* and *Triodia pungens* open hummock grassland	947.73
						8bja	*Eremophila fraseri spp. fraseri* and *Acacia pyrifolia* scattered shrubs over *Triodia wiseana* open hummock grassland	3.12
						8db/8dc	*Astrebla pectinata*, *Astrebla elymoides* and *Aristida latifolia* open tussock grassland	239.13
						8dd	*Sida fibulifera* low scattered shrubs over *Astrebla squarrosa* tussock grassland	11.12
						11kb	*Acacia* sp., *Acacia pyrifolia* and *Acacia bivenosa* scattered shrubs over *Triodia wiseana* open hummock grassland	139.81



ecologia ENVIRONMENT

Shepherd *et al.* (2001) Vegetation Units of West Angelas Study Area

Figure: 2.8
Project ID: 1457

Drawn: CP
Date: 16/10/2012

Coordinate System
Name: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994

Unique Map ID: CP104

A4

2.8.3 Previous Records of Priority Flora at West Angelas

Searches of the DEC database, the Department's Threatened Flora Database (DEFL) and the Western Australian Herbarium's specimen database were conducted for all records within a polygon encompassing the West Angelas Study Area and a 40 km buffer zone. In addition, the published Threatened and Priority Taxa listing was searched for records for which the named location is within the search area. The latter search is less precise as no coordinates are provided for records retrieved.

Two EPBC listed, Threatened Flora (Declared Rare Flora) have previously been recorded within the search area: *Thrypt*o*mene wittweri* from the location-based search of the Threatened and Priority listing and *Lepidium catapycnon* from the spatial DEFL and Western Australian Herbarium searches. Twenty nine other Priority flora were also recoded in the location based search and 37 additional records resulted within the 40 km spatial database search area. Thirteen locations of *Lepidium catapycnon* are present within the 40 km search area, with the closest falling within 4 km of the Study Area boundary (Figure 2.9).

A review of RT spatial data and the DEC database revealed that 11 species of Priority flora were observed to occur within the Study Area; *Aristida lazaridis*, *Dampiera me*tall*orum Eremophila forrestii sub*sp. Pingandy (M.E. Trudgen 2662), *Goodenia* sp. East Pilbara (A.A. Mitchell PRP 727), *Indigofera* sp. Gilesii (M.E. Trudgen 15869), *Oldenlandia* sp. Hamersley Station (A.A. Mitchell PRP 1479), *Rhagodia* sp. *Hamersley* (M. Trudgen 17794), *Sida* sp. *Barlee Range* (S. van Leeuwen 1642), *Tetratheca fordiana*, *Themeda* sp. Hamersley Station (M.E. Trudgen 11431) and *Triodia* sp. Mt Ella (M.E. Trudgen 12739).

The likelihood of occurrence of each taxon within the Study Area was assessed based on distribution and known habitat preference (Table 2.8), using the following rankings:

Table 2.7 – Criteria used to Assess Likelihood of Occurrence of Significant Flora at West Angelas.

Likelihood of Occurrence	Criteria
Certain	The taxon has already been recorded within the Study Area.
Probable	Due to the proximity of previous records (<2 km) and the presence of suitable habitat, the taxon is considered highly likely to occur.
Likely	Given the presence of suitable habitat and moderate proximity (2-10 km) of previous records, the taxon is considered likely to occur.
Possible	The habitat specificity of the taxon is only broadly defined, or is not defined and/or there are no current records within 10 km. However there is insufficient information available to exclude the possibility of occurrence.
Unlikely	The habitat specificity of the taxon is well defined from previous records and the habitat is considered unlikely to be present within the Study Area.

Table 2.8 – Priority Flora Previously Recorded in the Vicinity of the West Angelas.

Conservation Status	Taxon	Family	Source	Bio-region	Habitat (WA Herbarium 2012)	Nearest Localities or Towns	Flowering Period	Likelihood of Occurrence
4	*Acacia bromilowiana*	Fabaceae	WAHERB, DRF, DEC	PILB	High in landscape, summit of hill and on steep slope, skeletal red gritty soil over massive basalt type rock	Tom Price, Balfour Downs Stn, West Angelas, Hope Downs, Hamersley Ranges, Marillana Stn, Ophthalmia Range	Jul-Aug	Probable
3	*Acacia daweana*	Fabaceae	DEC	PILB	Very stony red loam, gentle slope	Hamersley Range, Karijini N.P.	Jul	Possible
3	*Acacia effusa*	Fabaceae	WAHERB, DRF, DEC	PILB	Stony red loam. Scree slopes of low ranges	Mt Bruce, Hamersley Ra., Karijini N.P., Juna Downs	May to Aug	Likely
3	*Acacia* aff. *subtiliformis*	Fabaceae	WAHERB, DRF, DEC	PILB	On rocky calcrete plateaus	Hamersley Ranges, Hancock Range, Ophthalmia Range, Hope Down North, Marillana Stn	Jul, Aug	Likely
2	*Adiantum capillus-veneris*	Pteridaceae	DEC	PILB, SWAN	Moist, sheltered sites in gorges and on cliff walls	Hamersley Range, Karijini N.P., Peppermint Grove	-	Unlikely
1	*Aluta quadrata*	Myrtaceae	RT	PILB	Edge of creek beds, base of cliffs, rocky crevices, near crest of ridge	Mt Channar, Paraburdoo	May-Jun	Unlikely
3	*Ampelopteris prolifera*	Thelypteridaceae	DEC	KIMB, PILB	Near water or in wet ground	Barlee Range N.R., Doongan Stn, Karijini N.P., Prince Regent River	-	Unlikely
2	*Aristida calycina* var. *calycina*	Poaceae	DEC	PILB	Red earths, sands, alluvial soils	Karijini N.P., Eastern States	-	Unlikely
2	*Aristida lazaridis*	Poaceae	DEC, RT	PILB	Sand or loam	Karijini N.P., Queensland	Apr	Certain
1	*Barbula ehrenbergii*	Pottiaceae	DEC	PILB	Gorge wall, restricted to a small area where water trickles down the wall. On rock iron rich, weathered conglomerate	Dale's Gorge, Hamersley Range	-	Unlikely
1	*Bothriochloa decipiens* var. *cloncurrensis*	Poaceae	DEC	PILB	On a stony clay plain. Red-brown clay loam with a sparse surface mantle of ironstone	Hamersley Range, Queensland	-	Unlikely

Conservation Status	Taxon	Family	Source	Bio-region	Habitat (WA Herbarium 2012)	Nearest Localities or Towns	Flowering Period	Likelihood of Occurrence
1	*Brachyscome* sp. Wanna Munna Flats (S. van Leeuwen 4662)	Asteraceae	WAHERB	PILB	Plain; deep clay loam with very fine buckshot gravel along with a clay crust on the surface	Tom Price, Newman	July, Sep	Possible
1	*Brunonia* sp. Long hairs (D.E. Symon 2440)	Goodeniaceae	WAHERB	CR, PILB	Along creeklines and floodplains in clay or sandy clay	West Angelas, Newman	Ma	Likely
3	*Calotis latiuscula*	Asteraceae	DEC	GOLD, PILB	Sand, loam. Rocky hillsides, floodplains, rocky creeks or river beds	Giles, Warburton, Blackstone Range, Rawlinson Range, Hamersley Range	Jun to Oct	Possible
1	*Calotis squamigera*	Asteraceae	DEC	PILB	Plain with pebbly red-brown loam with loam surface.	Wittenoom, Hamersley Range	-	Possible
2	*Cladium procerum*	Cyperaceae	DEC	PILB	Perennial pools	Karijini N.P., Millstream-Chichester N.P.	Nov	Unlikely
3	*Dampiera anonyma*	Goodeniaceae	DEC	PILB	High in landscape, summit of hill and on steep slope, skeletal red gritty soil over massive basalt type rock (Jerrinah formation)	Mt Bruce, Mt Nameless, Hamersley Ranges, Mt Sheila, Karijini NP	Jun-Aug	Unlikely
3	*Dampiera metallorum*	Goodeniaceae	WAHERB, DRF, DEC	PILB	Rocky ledges and breakaways with loose scree material in lower section of plot.	Hamersley Range, Mt Meharry, West Angelas, Karijini NP	Sep	Certain
1	*Dicrastylis mitchellii*	Laminaceae	WAHERB, DEC	MWST, PILB	Sand or clay soils around dunes	Killara Stn, Turee Creek	Oct	Possible
1	*Eragrostis* sp. Mt Robinson (S. van Leeuwen 4109)	Poaceae	WAHERB, DRF, DEC	PILB	Red-brown skeletal soils, ironstone. Steep slopes, summits	Hamersley Range	Sep	Likely
2	*Eremophila forrestii* subsp. Pingandy (M.E. Trudgen 2662)	Scrophulariaceae	WAHERB, DRF, DEC, RT	PILB	Flat terrain, low in landscape, base of broad valley, stony gibber plain above shallow drainage line, red clay-loam	Karijini NP, Hamersley Range NP, Turee Creek Stn	May-Jul	Certain
3	*Eremophila forrestii* subsp. *viridis*	Scrophulariaceae	DEC	PILB	Dune. Red [sand]	Hamersley Range, Onslow, Canning Stock Route	Aug	Unlikely
4	*Eremophila magnifica* subsp. *magnifica*	Scrophulariaceae	WAHERB, DEC	PILB	High in landscape, summit of hill, skeletal red brown soil over massive ironstone, Brockam Iron Formation.	Hamersley Ranges, Tom Price, Marandoo, Wittenoom	Jul-Sep	Possible

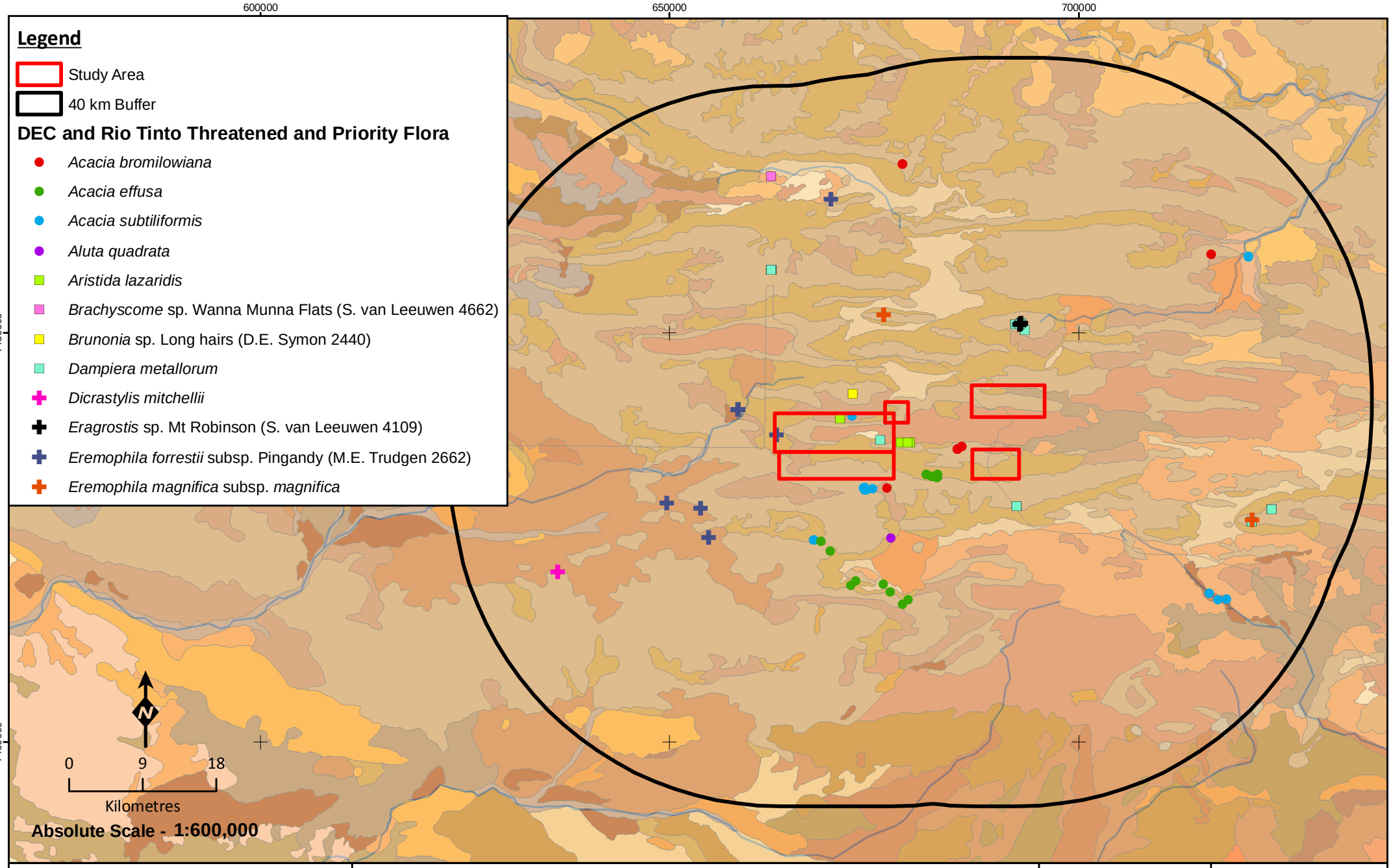
Conservation Status	Taxon	Family	Source	Bio-region	Habitat (WA Herbarium 2012)	Nearest Localities or Towns	Flowering Period	Likelihood of Occurrence
3	*Eremophila magnifica* subsp. *velutina*	Scrophulariaceae	WAHERB, DRF, DEC	PILB	Skeletal soils over ironstone. Summits	Hamersley Ranges, Newman, Marandoo	Jul-Sep	Possible
1	*Eremophila* sp. Hamersley Range (K. Walker KW 136) PN	Scrophulariaceae	DEC	PILB	Summit of hill, high in landscape, steep rock slopes and scree, skeletal brown-red soil over massive banded ironstone of the Brockman Iron Formation	Newman, Hamersley Range	Aug	Likely
1	*Eremophila* sp. Snowy Mountain (S. van Leeuwen 3737)	Scrophulariaceae	DEC	PILB	Summit of hill, high in landscape, skeletal red gritty soil over massive ironstone of the Brockman Iron Formation	Hamersley Range	-	Unlikely
1	*Eremophila* sp. West Angelas (S. van Leeuwen 4068)	Scrophulariaceae	WAHERB, DEC	PILB	High in landscape, summit of hill, gently undulating to steep terrain, skeletal red gritty soil over massive banded iron of the Brockman Iron Formation	West Angela Hill, Opthalmia, Hamersley Range	Sep-Oct	Likely
3	*Eriachne* sp. Dampier Peninsula (K.F. Kenneally 5946)	Poaceae	DEC	KIMB	Plain. Red-brown sandy loam	Karijini N.P., Dampier Peninsula, King Hall Is.	Mar-Apr	Possible
1	*Eucalyptus lucens*	Myrtaceae	DEC	PILB	Rocky mountain top; ironstone.	Hamersley Range	-	Unlikely
2	*Euphorbia clementii*	Euphorbiaceae	DRF	PILB	Sandplains, gravelly hillsides, stony grounds	Ashburton and Yule River	-	Likely
2	*Euphorbia* sp. *Mt Bruce flats (S. van Leeuwen 3861)*	Euphorbiaceae	DEC	PILB	Sump, low in landscape, alluvial cracking clay loamy soil, gritty with ironstone fragments, some sinkholes	Karijini NP	-	Possible
3	*Euphorbia stevenii*	Euphorbiaceae	DEC	KIMB, PILB	Bedrock rise with thin proximal colluvium. Gently inclined slope, cracking black clay plain	Karijini N.P., Kununurra	-	Possible
3	*Fimbristylis sieberiana*	Cyperaceae	DEC	KIMB, PILB	Mud, skeletal soil pockets. Pool edges, sandstone cliffs	Hamersley Range, Millstream, Fitzroy Crossing, King Leopold Range, Halls Creek, Little Sandy Desert	May to Jun	Unlikely

Conservation Status	Taxon	Family	Source	Bio-region	Habitat (WA Herbarium 2012)	Nearest Localities or Towns	Flowering Period	Likelihood of Occurrence
3	*Geijera salicifolia*	Rutaceae	DEC	PILB	Red skeletal sand in massive rock scree, high in landscape.	Mt Samson, Mt Howieson, Tom Price, Hamersley Ranges, Qld, NT	-	Unlikely
1	*Genus* sp. Hamersley Range hilltops (S. van Leeuwen 4345)	Asteraceae	DEC	PILB	Skeletal, brown gritty soil over ironstone. Hill summit	Hamersley Range	-	Unlikely
3	*Goodenia lyrata*	Goodeniaceae	WAHERB, DRF	PILB, GIB, MUR	Red sandy loam. Near claypan	Newman, Gibson Desert Nature Reserve, Coodewonna Flats	Aug	Possible
4	*Goodenia nuda*	Goodeniaceae	RT	PILB	Wide alluvial plain or creek beds. Red-brown clay loam, ironstone.	Dry brown-red sand – loam occasionally in areas of recent burns	Apr to Aug	Likely
3	*Goodenia* sp. East Pilbara (A.A. Mitchell PRP 727)	Goodeniaceae	DRF, RT	PILB, GAS	Red-brown clay soil, calcrete pebbles. Low undulating plain, swampy plains	Tom Price, Newman	Mar, Apr	Certain
1	*Grevillea* sp. Turee (J. Bull & G. Hopkinson ONS JJ 01.01) PN	Proteaceae	DEC	PILB	Breakaways and scree slopes, orange-brown loam soils	Paraburdoo, Tom Price, Karijini, Newman	Feb-Mar	Likely
2	*Hibiscus* sp. Gurinbiddy Range (M.E. Trudgen MET 15708) PN	Malvaceae	DEC	PILB	Near summit of hill, high in landscape, skeletal red-brown stony soil over massive ironstone of the Brockman Iron Formation	Hamersley Range, Karijini N.P.	May, Jul	Probable
1	*Hibiscus* sp. Mt Brockman (E. Thoma ET 1354) PN	Malvaceae	DEC	PILB	Rocky Places and Gorges	Hamersley Range, Tom Price	Aug	Unlikely
3	*Indigofera* sp. Gilesii (M.E. Trudgen 15869)	Fabaceae	WAHERB, DRF, DEC, RT	GOLD, KIMB, PILB	Pebbly loam amongst boulders & outcrops. Hills	Hamersley Range, Meekatharra, West Angelas, Rawlinson Range, Tanami Desert	May, Aug	Certain
2	*Indigofera ixocarpa*	Fabaceae	DEC	PILB	High in landscape, summit of hill, skeletal red brown soil over massive ironstone, Brockam Iron Formation.	Marandoo, Tom Price, Nullagine, Karijini NP	Mar, May	Possible
3	*Indigofera* sp. Bungaroo Creek (S. van Leeuwen 4301)	Fabaceae	DEC	PILB	Cracking loam flat with some flow channels. Soil: red-brown loam, pebbly.	Hamersley Range, Tom Price	Jul	Unlikely
3	*Iotasperma sessilifolium*	Asteraceae	DEC	PILB	Cracking clay, black loam. Edges of waterholes, plains	Ethel Creek Stn, Coolawanya Stn, Juna Downs Stn, Hamersley Range	Jul-Sep	Possible

Conservation Status	Taxon	Family	Source	Bio-region	Habitat (WA Herbarium 2012)	Nearest Localities or Towns	Flowering Period	Likelihood of Occurrence
2	*Isotropis parviflora*	Fabaceae	DEC	KIMB, PILB	Valley slope of ironstone plateau.	East Angelas, Karijini N.P., Tanami Desert	Feb-Mar, May	Possible
1	*Josephinia* sp. Marandoo (M.E. Trudgen 1554)	Pedaliaceae	WAHERB, DRF, DEC	PILB	Outer edge of creek vegetation. Soil: Orange-brown (terracotta) coloured clay-loam	Marandoo, West Angelas	-	Likely
T	*Lepidium catapycnon*	Brassicaceae	WAHERB, DRF, DEC	PILB	Skeletal soils. Hillsides	Wittenoom Gorge, Hamersley Range, Weeli Wolli, Newman	Oct-Jan?	Likely
3	*Nicotiana umbratica*	Solanaceae	DEC	PILB	Shallow soils. Rocky outcrops	Newman, Karijini N.P., Marble Bar, Woodstock, Abydos	Apr, Jun, Sept	Possible
3	*Oldenlandia* sp. Hamersley Station (A.A. Mitchell PRP 1479)	Rubiaceae	WAHERB, DEC	PILB	Cracking clay, basalt. Gently undulating plain with large surface rocks, flat crabholed plain	Millstream-Chichester N.P., Hamersley Range, Caoolawanyah Stn	Mar-May, Jul	Certain
3	*Olearia mucronata*	Asteraceae	WAHERB, DRF, DEC	GOLD, PILB	Schistose hills, along drainage channels	Hamersley and Chichester Range area, West Angelas, Paraburdoo, Mt Margaret, Mt Keith, Wiluna	Aug-Jan	Likely
2	*Oxalis* sp. Pilbara (M.E. Trudgen 12725)	Oxalidaceae	WAHERB, DEC	PILB	Gully. Brown-red loam, cobbles and pebbles	Karijini N.P., Hamersley Range	May	Likely
3	*Phyllanthus aridus*	Phyllanthaceae	DEC	KIMB, PILB	Sandstone, gravel, red sand.	West Kimberley, Chichester Range, West Angelas, Pardoo, Shay Gap, Doongan Homestead, Durack River	May-Jun	Possible
2	*Pilbara trudgenii*	Asteraceae	WAHERB, DRF, DEC	PILB	Skeletal, red stony soil over ironstone. Hill summits, steep slopes, screes, cliff faces	Hamersley Range	Sep-Oct	Likely
4	*Ptilotus mollis*	Amaranthaceae	RT	LSD, PILB	Stony hills and screes	Tom Price, Paraburdoo, Marble Bar, Hamersley Range National Park	May or Sep	Unlikely
3	*Rhagodia* sp. Hamersley (M. Trudgen 17794)	Chenopodiaceae	WAHERB, DRF, DEC, RT	PILB	Broad plain at the base of hills (enclosed on all sides). Red brown clay/ loam. Ironstone pebbles	Hamersley Ranges	May	Certain
1	*Rhodanthe ascendens*	Asteraceae	WAHERB, DRF, DEC	MWST, PILB	Clay	Gascoyne Junction, Middalya Station, Karijini N.P.	Aug	Likely

Conservation Status	Taxon	Family	Source	Bio-region	Habitat (WA Herbarium 2012)	Nearest Localities or Towns	Flowering Period	Likelihood of Occurrence
4	*Rhynchosia bungarensis*	Fabaceae	DEC	MWST, PILB	Pebbly, shingly coarse sand amongst boulders. Banks of flow line in the mouth of a gully in a valley wall.	Hamersley Ranges, Chichester Ranges, Yardie Creek, Robe River, Tom Price, Ashburton, East Lewis Island, Burrup Peninsula, Dampier Archipelago	May-Dec	Unlikely
3	*Rostellularia adscendens* var. *latifolia*	Acanthaceae	WAHERB, DEC	PILB	Ironstone soils. Near creeks, rocky hills	Hamersley Ranges	Apr to May	Likely
2	*Scaevola* sp. Hamersley Range basalts (S. van Leeuwen 3675)	Goodeniaceae	DEC	PILB	Skeletal, brown gritty soil over basalt. Summits of hills, steep hills	Hamersley Range	Jul to Aug	Unlikely
3	*Sida* sp. Barlee Range (S. van Leeuwen 1642)	Malvaceae	WAHERB, DEC, RT	PILB	Skeletal red soils pockets. Steep slope.	Barlee Range, Turee Creek, Paraburdoo, Hamersley Range	Aug	Certain
1	*Sida* sp. Hamersley Range (K. Newbey 10692)	Malvaceae	DEC	PILB	High in landscape, summit of hill, skeletal red stony soil over massive Brockman Iron Formation bedrock	Hamersley Range, Lawloit Range	-	Unlikely
2	*Spartothamnella puberula*	Lamiaceae	WAHERB, DRF, DEC	PILB	Rocky loam, sandy or skeletal soils, clay. Sandplains, hills	Mt Bruce, Hamersley Range, West Angelas, NT	Sep to Nov	Likely
1	*Tetratheca fordiana*	Elaeocarpaceae	WAHERB, DRF, DEC, RT	PILB	Shale pocket amongst ironstone	West Angelas, Hamersley Range	Sep	Certain
1	*Teucrium pilbaranum*	Lamiaceae	WAHERB	PILB	Crab hole plain in a river floodplain, margin of calcrete table	Millstream National Park, Wittenoom	May or Sep	Likely
3	*Themeda* sp. Hamersley Station (M.E. Trudgen 11431)	Poaceae	WAHERB, DEC, RT	PILB	Red clay. Clay pan, grass plain	Karratha, Millstream, Hamersley Stn, West Angelas, Coondewanna Flats	Aug	Certain
T	*Thryptomene wittweri*	Myrtaceae	WAHERB, DRF, DEC	GOLD, MWST, PILB	Skeletal red stony soils. Breakaways, stony creek beds	Hamersley Range, Mt Augustus, Carnarvon Range, White Cliffs Stn, NT	Aug-Oct	Possible
3	*Triodia* sp. Mt Ella (M.E. Trudgen 12739)	Poaceae	WAHERB, DEC, RT	PILB	Light orange-brown, pebbly loam. Amongst rocks & outcrops, gully slopes	Hamersley Range, Mt Ella	-	Certain
3	*Triodia* sp. *Robe River* (M.E. Trudgen et al. MET 12367)	Poaceae	DEC	PILB	Rangeland. Hillside and hill top. Brown/red ironstone gravel	Yarraloola Stn, Yalleen Stn., Red Hill Stn., Mt Stuart Stn., Hamersley Range	-	Unlikely

Conservation Status	Taxon	Family	Source	Bio-region	Habitat (WA Herbarium 2012)	Nearest Localities or Towns	Flowering Period	Likelihood of Occurrence
2	*Vigna* sp. *central* (M.E. Trudgen 1626)	Fabaceae	DEC	PILB	Plain with thin sheet of sand (light orange / brown) over compacted hardpan and limestone rock	Karijini N.P., Nyang Stn, Warrawagine Stn	May-Jun, Oct	Possible
1	*Vittadinia* sp. Coondewanna Flats (S. van Leeuwen 4684)	Asteraceae	WAHERB, DEC	PILB	Flat plain. Red sandy clay-loam.	Hamersley Range	Jul	Probable



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Regional Threatened and Priority Flora of Greater West Angelas - Map A

Figure: 2.9
Project ID: 1457

Drawn: CP
Date: 19/09/2012

Coordinate System
Name: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994

Unique Map ID: CPXXX

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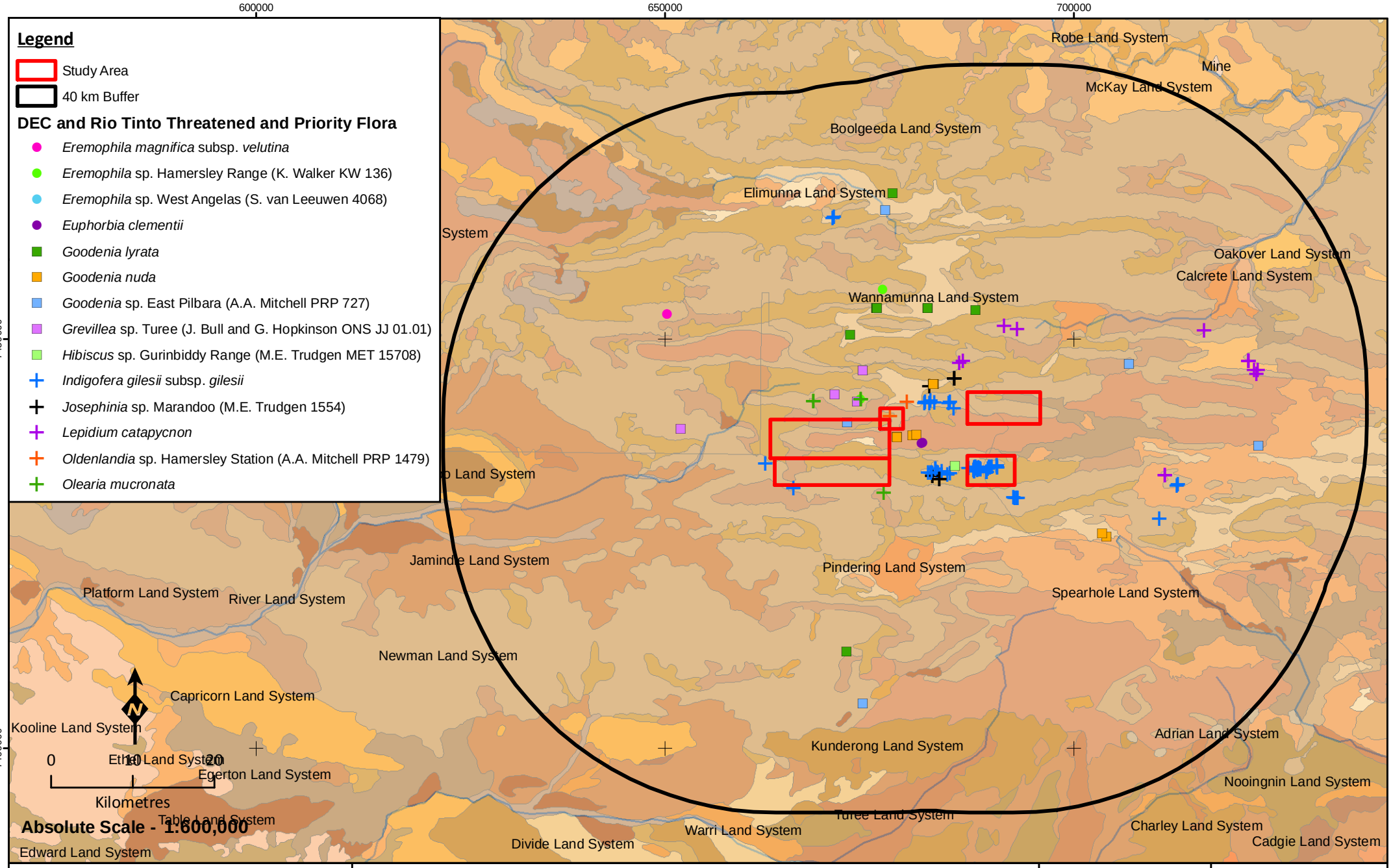

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Regional Threatened and Priority Flora of Greater West Angelas - Map B

Figure: 2.10
Project ID: 1457

Drawn: CP
Date: 19/09/2012

Coordinate System
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Projection: Transverse Mercator
Datum: GDA 1994

Unique Map ID: CP170

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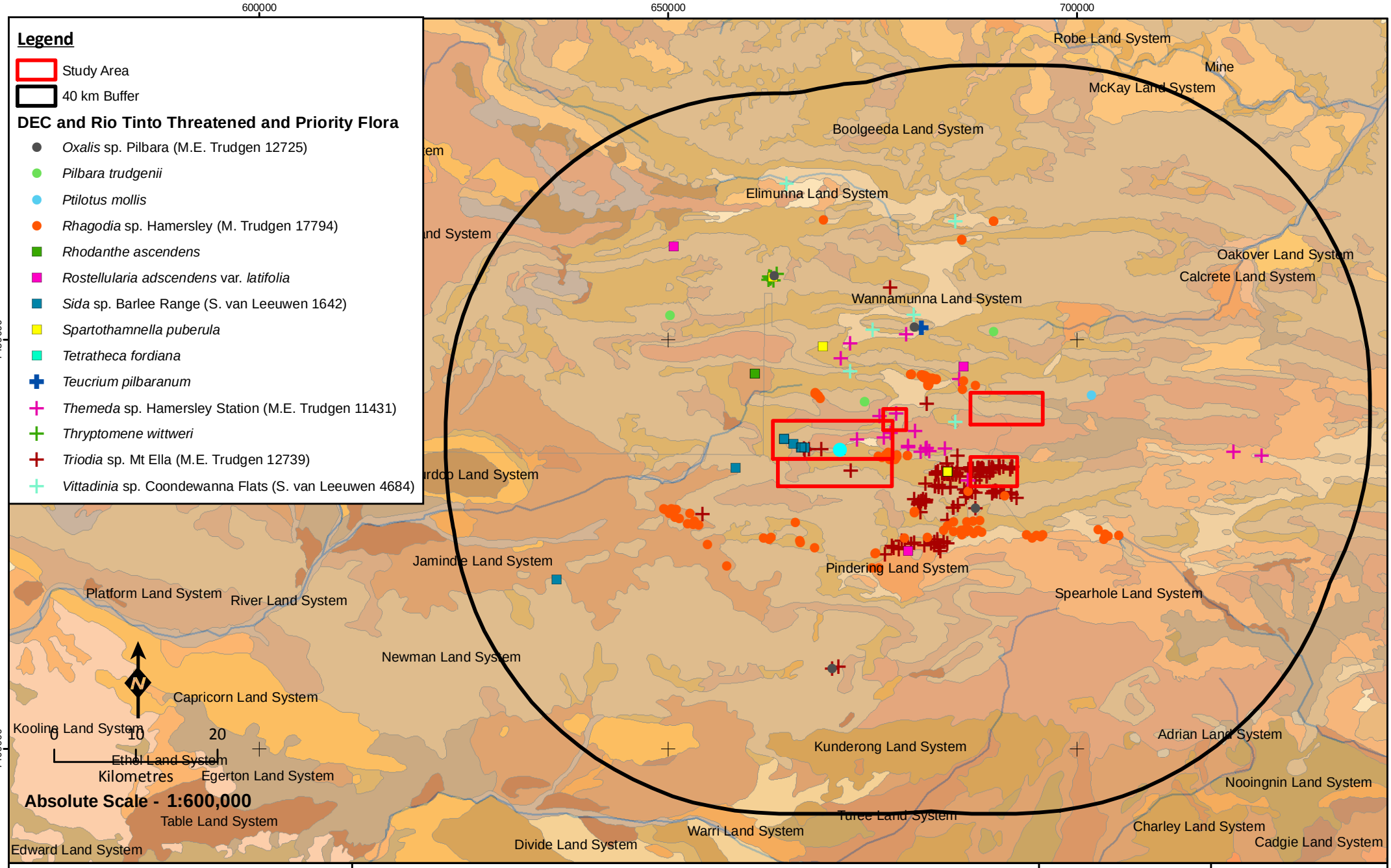

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Regional Threatened and Priority Flora of Greater West Angelas - Map C

Figure: 2.11
Project ID: 1457

Drawn: CP
Date: 19/09/2012

Coordinate System
Name: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994

Unique Map ID: CP172

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3 SURVEY METHODOLOGY

3.1 GUIDING PRINCIPLES

The survey methods adopted by *ecologia* were formulated using:

- Position Statement 3 (Environmental Protection Authority 2002), Terrestrial Biological Surveys as an Element of Biodiversity Protection;
- Guidance Statement 51 (Environmental Protection Authority 2004) Terrestrial Flora and Vegetation Surveys for nvEironmental Impact Assessment;
- Consultation with DEC personnel;
- Background research to gather background information on the footprint or target area (i.e. search of literature, data and map-based information); and
- A reconnaissance survey, conducted in February 2011, to verify the accuracy of the background information, broadly characterise the flora and range of vegetation units present in the footprint and to identify logistical constraints to survey.

Guidance Statement 51 recommends the following characteristics for a Level 2 surveys which were incorporated into the survey and reporting design:

- One or more visits to the target area in the main flowering season and visits in other seasons;
- Replication of plots in each vegetation unit to thoroughly sample the flora and characterise the vegetation units over their full extent in the target area;
- Multivariate analysis of the vegetation using, at a minimum, presence/absence data and perennial species;
- Mapping of vegetation at an appropriate scale; and
- Tabulation of the area of each vegetation unit mapped and an assessment of the environmental values including such factors as extent, condition and presence or significant flora.

3.2 DATABASE SEARCHES

A search of the following databases were undertaken in May 2012 prior to the field survey, to determine flora species and ecological communities of conservation significance previously recorded in the vicinity of the Study Area:

- DEC Threatened (Declared Rare) Flora Database (DEFL);
- DEC Declared Rare and Priority Flora List;
- DEC Western Australian Herbarium Specimen Database (WAHERB);

- DEC Threatened Ecological Community Database; and
- Department of the Sustainability, Environment, Water, Populations and Communities (DSEPaC) Protected Matters search.

3.3 VEGETATION AND FLORA ASSESSMENT

The two-phase survey involved a combination of sampling within bounded quadrats of 2,500 m^2 in area, in accordance with Guidance Statement 51, supplemented by a series of linked field traverses. Linked traverses assisted in maximising the floristic inventory and thus increasing the probability of locating flora of potential significance. Standardised quadrats allow the vegetation to be consistently characterised and facilitate multivariate analysis. Both methods contributed to the delineation of vegetation units and a comprehensive floristic inventory of the Study Area.

3.3.1 Survey Timing

The vegetation and flora of the Study Area was surveyed in two phases over two separate trips totalling 60 person days. Survey timing was as follows:

- Phase 1; 9 to 18 July 2012 (36 person days); and
- Phase 2; 21 to 26 August 2011 (24 person days).

The objectives of these surveys were to provide:

- Inventory of vascular plant species;
- Description and mapping of plant communities, including an update (Deposits C, D extension and G) and extension (Deposits C, D, F and H) of historical vegetation mapping;
- Review of plant species considered to be rare and endangered, or geographically restricted, which are known to, or may occur, within the Study Area;
- Inventory of exotic plants, including Declared Plantss; and
- Review of the significance of the plant communities within a local, regional, and state context.

3.3.2 Quadrat-Based and Transect Sampling

One hundred and fifty quadrats, distributed throughout the Study Area as detailed in Figure 3.1 were surveyed. Locations were selected using aerial photography, topographic features and field observations to represent the diversity of vegetation present. The majority of quadrats were 50 x 50 m, however the dimensions were modified where necessary to ensure that sampling occurred in homogeneous vegetation. For example, 25 x 100 m quadrats were frequently used for vegetation along drainage lines and other linear features.

Coordinates for all quadrats are detailed in Appendix A.

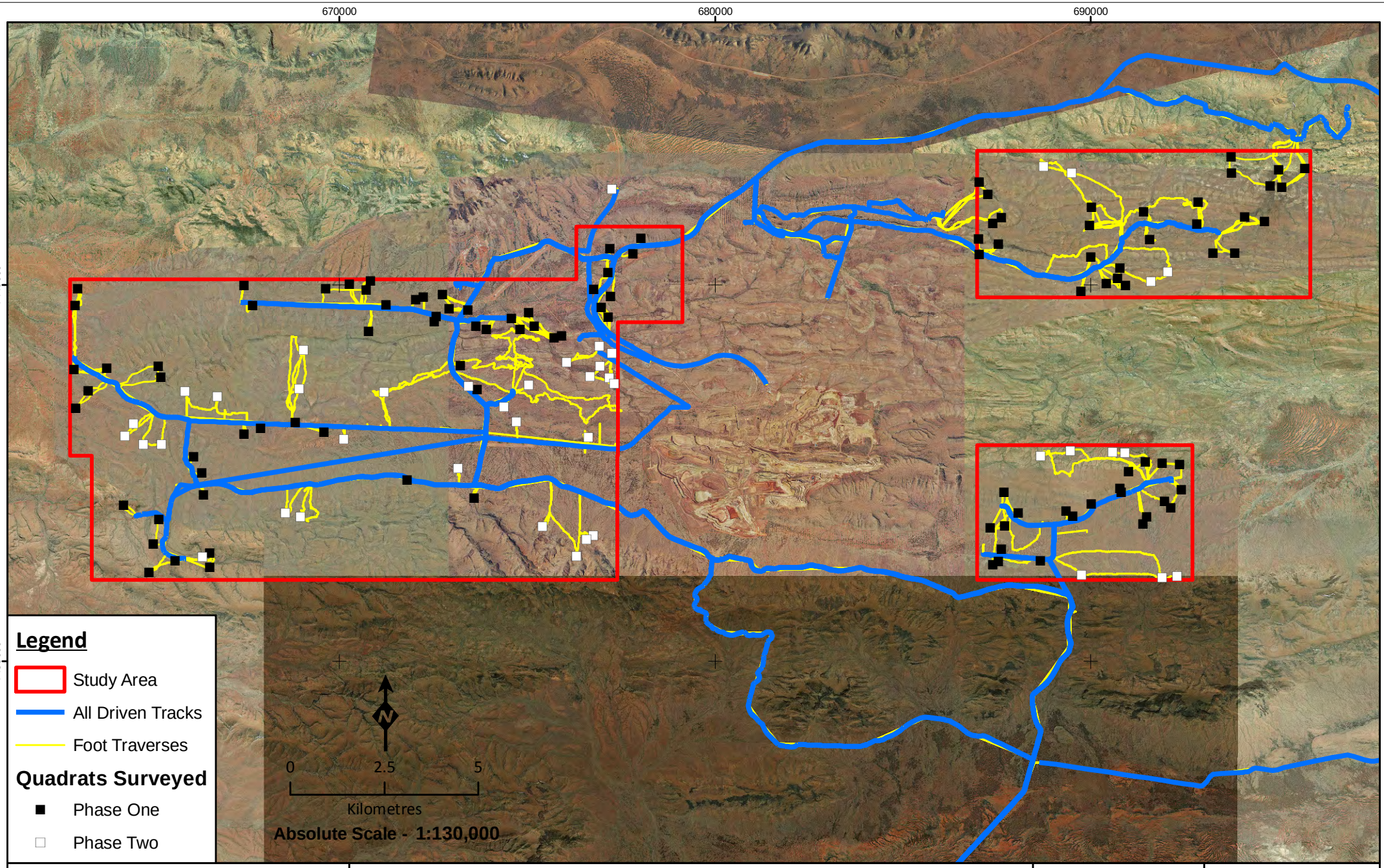
For each quadrat, the following was recorded:

- Coordinates of each corner of the quadrat;
- Site features such as topography, soil and lithology;

- Structure of the vegetation, including the height, cover, habit and dominant species within each stratum;
- Height range and percentage foliage cover for each species within the site (including introduced species);
- Vegetation condition (degree of disturbance); and
- Estimated time since fire.

At least one specimen of all taxa recorded was collected for subsequent verification. Nomenclature and taxonomy follow the conventions currently adopted by the Western Australian Herbarium (Western Australian Herbarium 1998-2013).

While walking between quadrats (Figure 3.1), opportunistic collections were made of taxa not recorded within the quadrats. Locations of any introduced flora, known or potentially conservation significant taxa encountered were also recorded, and notes were made on the boundaries of the vegetation communities to facilitate with the mapping of the vegetation communities.



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Quadrat Locations and Foot Traverses of the Greater West Angelas Study Area

Figure: 3.1
Project ID: 1457

Drawn: CP
Date: 27/09/2012

Coordinate System
Name: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994

Unique Map ID: CP147

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3.3.3 Vegetation Condition

Vegetation condition was assessed at each quadrat using the condition scale based on Trudgen (1991) based on the criteria described in Table 3.1.

Table 3.1 – Vegetation Condition Scale

Vegetation Condition	Criteria
Excellent	Pristine or nearly so, no obvious sign of damage caused by European man
Very good	Some relatively slight signs of damage caused by the activities of European man. E.g. damage to tree trunks by repeated fires, the presence of some relatively non-aggressive weeds or occasional vehicle tracks.
Good	More obvious signs of damage caused by the activities of European man, including some obvious impact to vegetation structure such as caused by low levels of grazing or by selective logging. Weeds as above, possibly plus some more aggressive ones
Poor	Still retains basic vegetation structure or ability to regenerate it after very obvious impacts of European man such as grazing or partial clearing or very frequent fires. Presence of some more aggressive weeds.
Very poor	Severely impacted by grazing, fire, clearing or a combination of these activities. Scope for some regeneration but not to a state approaching good condition without intensive management. Usually with a number of weeds species including aggressive species.
Completely Degraded	Areas that are completely or almost completely without native vegetation e.g. areas that are cleared or parkland cleared with their flora comprising weed or crop species with isolated native trees or shrubs.

3.3.4 Vegetation Mapping

Vegetation mapping is the delineation of plant communities based on distinctive characteristics of these communities such as the vegetation structure, dominant species, species composition, soil types and position in the landscape.

A combination of multivariate analysis of species composition of quadrats and ground truthing was employed to define communities. Multivariate analysis was conducted using the species matrix data from quadrats completed during both field trips. Cluster analysis was performed on the cover weighted site by species matrix using an association matrix of the Bray-Curtis coefficient with the multivariate program SYSTAT™. The resultant dendrogram was used in the definition of hierarchy of vegetation assemblages. This method provides an objective means of defining vegetation communities and provides insight into the hierarchical relationship between communities based on the degree of similarity in species composition and abundance.

The communities were described to Association level (NVIS level V). The boundaries of communities were then extrapolated to the entire Study Area based on their appearance in aerial imagery.

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4 FLORA RESULTS

A total of 441 taxa were recorded from the West Angelas Study Area in this study. Ten taxa could not be fully identified due to lack of reproductive material, nine of which are likely to be recollections of fully identified taxa. Only the 431 fully identified records were included in the diversity and multivariate analyses, but all 441 taxa are presented in the species list (Appendix C).

The summary of the composition of the fully identified species inventory is summarised in Table 4.1 .

Table 4.1 – Diversity of the Flora of Survey Area

Number of Quadrats Surveyed	Number of Taxa Recorded	Number of Families	Number of Genera	Number of Families Represented by a Single Taxon	Number of Genera Represented by a Single Taxon
149	431	48	163	13	94

The families and genera represented by the greatest number of taxa and the most frequently recorded species in the Study Area are listed in Table 4.2. This pattern of representation is typical of surveys within the Pilbara. The large number of taxa within the family Scrophulariaceae and genus *Eremophila* reflects the abundance of mulga woodlands and shrublands, within which most of these taxa occur. The relatively high representation of Asteraceae, Amaranthaceae and Goodeniaceae is a reflection of the optimal timing of the survey when many ephemeral species were flowering.

Table 4.2 – Most Frequently Recorded Families, Genera and Taxa in the Current Survey

Most Common Families	Most Common Genera	Most Frequently Recorded Taxa
Poaceae (76 taxa)	*Acacia* (33 taxa)	*Triodia pungens* (99 quadrats, 66 %)
Fabaceae (72 taxa)	*Eremophila* (17 taxa)	*Acacia pruinocarpa* (94 quadrats, 63 %)
Malvaceae (46 taxa)	*Ptilotus* (15 taxa)	*Ptilotus nobilis* subsp. *nobilis* (92 quadrats, 61 %)
Asteraceae (27 taxa)	*Senna* (15 taxa)	*Aristida contorta* (85 quadrats, 57 %)
Amaranthaceae (23 taxa)	*Sida* (15 taxa)	*Enneapogon polyphyllus* (85 quadrats, 57 %)
Chenopodiaceae (20 taxa)	*Abutilon* (11 taxa)	*Acacia bivenosa* (74 quadrats, 49 %)
Scrophulariaceae (17 taxa)	*Eragrostis* (9 taxa)	*Pterocaulon sphacelatum* (73 quadrats, 49 %)
Goodeniaceae (14 taxa)	*Aristida* (8 taxa)	*Ptilotus obovatus* (73 quadrats, 49 %)
Myrtaceae (14 taxa)	*Eucalyptus* (8 taxa)	*Themeda triandra* (72 quadrats, 48 %)
	Goodenia (8 taxa)	*Solanum lasiophyllum* (68 quadrats, 45%)

Species richness within quadrats varied from seven to 67 taxa, with a mean species richness of 35.7± 1.0 (n= 150). Vegetation units with the lowest overall species richness include *ApTssp* (*Acacia aptaneura* and *A. pruinocarpa* open woodland over *A. tetragonophylla, Senna glutinosa* subsp. *glutinosa* and *S. artemisioides* subsp. *oligophylla* isolated shrubs over *Triodia wiseana* and *T. pungens* open hummock grassland.), and *Tp* (*Eucalyptus leucophloia* subsp. *leucophloia* and *Acacia pruinocarpa* isolated trees over *Senna glutinosa* subsp. *glutinosa, A. bivenosa* and *Ptilotus rotundifolius* isolated shrubs over *Triodia pungens* or *T. basedowii* or *T.* sp. Mt Ella hummock grassland.), both of which are typical of rocky midslopes, with a mean species richness of 15.8 and 16.8 respectively. The most consistently diverse vegetation unit was *AaPoTt* (*Acacia aptaneura* open woodland over *Ptilotus obovatus* sparse shrubland over *Themeda triandra* open tussock grassland), which occurs along sandy floodplains, with mean species richness of 50.1.

4.1.1 Sampling Adequacy for the Study Area

Species accumulation curves (SAC) provide a theoretical basis for understanding the relationship between sampling effort and the accumulation of species, and therefore provide a means of estimating the survey adequacy. As sampling effort increases, the rate at which new species are recorded is reduced until ultimately the curve representing the number of species recorded becomes asymptotic. At the point where there is a negligible increase in species inventory with continued sampling effort, the survey effort is deemed sufficient.

Flora sampling adequacy was estimated using SAC analysis (Colwell 2009) and extrapolation of the curve to the asymptote using Michaelis-Menten modelling (Figure 4.1). The incidence-based coverage estimators of species richness; ICE Mean, Chao 2 Mean were determined as 462 and 470, respectively. The total number of taxa collected in the study was 441 if all potential duplicates not fully identified to subspecies level (and therefore possibly repeats of other taxa) are excluded. Thus, it is estimated that between 86% and 88 % of the taxa present were recorded.

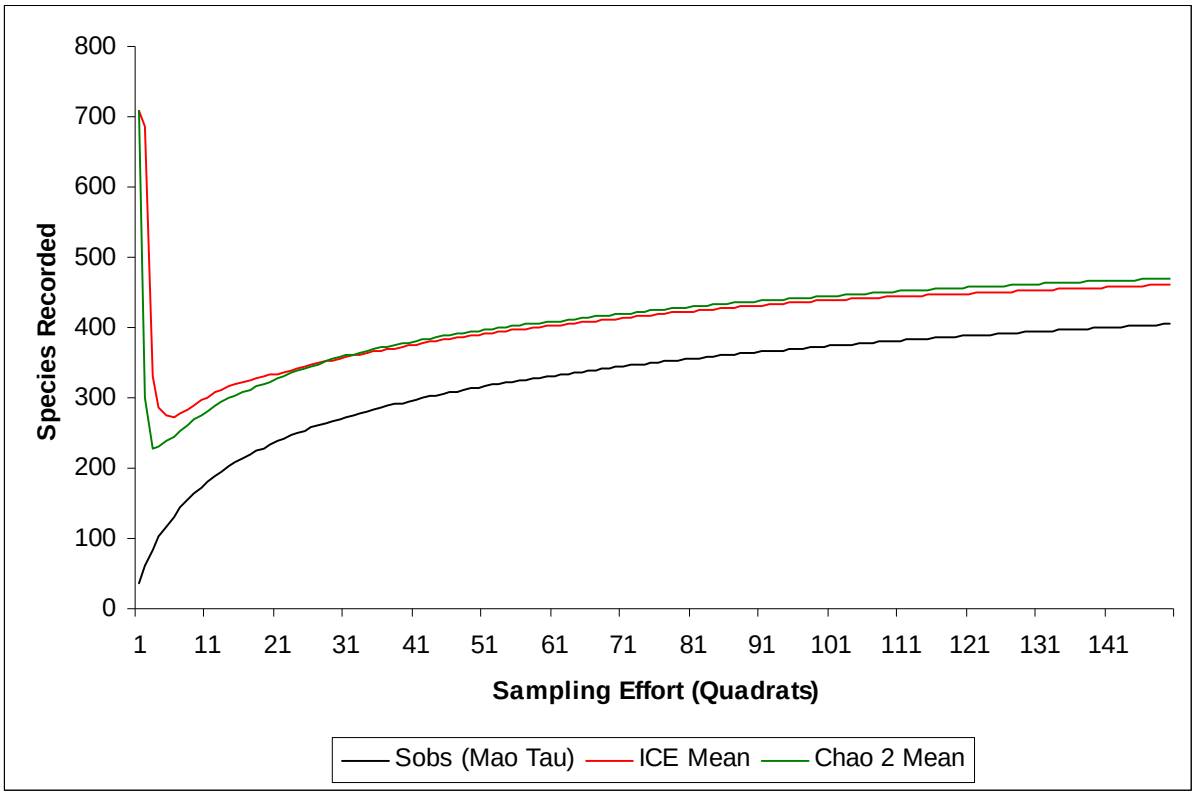


Figure 4.1 – Average Randomised Species Accumulation Curve for Greater West Angelas

4.2 FLORA OF CONSERVATION SIGNIFICANCE

4.2.1 EPCB Act

At a Commonwealth level, flora are protected under the EPBC Act, which lists species that are considered Critically Endangered, Endangered, Conservation Dependant, Extinct, or Extinct in the Wild (Appendix D). Two taxa occurring within the Pilbara bioregion are listed: *Lepidium catapycnon* and *Thryptomene wittweri* (both Vulnerable).

Four specimens of *Lepidium catapycnon* were collected opportunistically from four locations within Greater West Angelas, all within the northern portion of Deposit H. A total of 29 individuals were recorded. Vegetation and landforms consistent with this species habitat occur within the Study Area (Table 4.3) and it is possible that more individuals could be present given that access to some areas was limited during the survey.

The GPS coordinates of each location at which *Lepidium catapycnon* was observed are provided in Appendix E, and the Priority Flora Report Forms for these are presented in Appendix F. The general characteristics of the species and maps showing the locations of all recorded priority taxa are presented in Section 4.2.3.

The nearest record of *Thryptomene wittweri* lies 17 km to the north of the Study Area boundary and this species was not recorded during the survey. However, due to the presence of suitable habitat and its proximity to the Study Area, it is considered possible that this species may occur.

4.2.2 WC Act

Taxa which have been adequately searched for and are deemed to be either rare, in danger of extinction, or otherwise in need of special protection, are gazetted as such (Schedule 1, *WC Act* 1950). Threatened Flora (Schedule 1, December 2010) taxa are further categorised by the Department according to their level of threat using IUCN Red List criteria:

- CR: Critically Endangered – considered to be facing an extremely high risk of extinction in the wild;
- EN: Endangered – considered to be facing a very high risk of extinction in the wild; and
- VU: Vulnerable – considered to be facing a high risk of extinction in the wild.

These taxa are legally protected and their removal or impact to their surroundings cannot be conducted without Ministerial approval, obtained specifically on each occasion for each population (refer to Appendix D for category definitions).

There are two State Listed Threatened taxa known to occur within the Pilbara, *Lepidium catapycnon* and *Thryptomene wittweri* (both Vulnerable). As discussed above, 29 individuals of *Lepidium catapycnon* was collected from four locations within the Study Area, and further results are presented in Section 4.2.3 (species characteristics and distribution maps) and in Appendices E (GPS coordinates of collections) and F (Priority Flora Report Forms).

4.2.3 Priority Flora

The DEC maintains a list of Priority Flora taxa, which are considered poorly known, uncommon or under threat but for which there is insufficient justification, based on known distribution and

population sizes, for inclusion in Schedule 1 of the *WC Act*. A Priority Flora taxon is assigned to one of four priority categories (Appendix D).

Currently, 163 Priority Flora taxa are listed as occurring in the Pilbara region, including 60 Priority 1, 24 Priority 2, 68 Priority 3, and nine Priority 4 taxa (Western Australian Herbarium 1998-2013).

Thirteen Priority taxa were recorded in the Study Area during the current survey (Table 4.3). The distribution of records within the Study Area are illustrated in Figure 4.2 and coordinates of records and Rare Flora Report Forms are provided in Appendices E and F, respectively.

Table 4.3 – Priority Flora Recorded Within the West Angelas Study Area

Conservation Status	Taxon	Family	No. of records in Study Area	Habitat (WA Herbarium 2012)	Distribution	Flower Period	Picture
T	*Lepidium catapycnon* A papilose perennial herb or shrub. Leaves small, linear, ascending, terete succulent - on characteristically zigzag branch tips.	Brassicaceae	4 locations (29 plants)	Outer edge of creek vegetation and on rocky screes. Soil: Orange-brown (terracotta) coloured clay-loam	Marandoo, West Angelas, Tom Price	Oct-Jan	 (*ecologia* 2012)
P1	*Aristida jerichoensis* var. *subspinulifera* A tufted annual grass. Leaf-blade wire-like, round in cross section, surface scabrous.	Poaceae	44 locations (1,948 plants)	Plains with brown-red loam, clay	East Angelas, Sylvania Station, Newman		 (*ecologia* 2012)

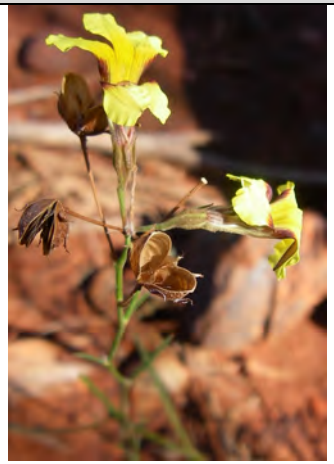
Conservation Status	Taxon	Family	No. of records in Study Area	Habitat (WA Herbarium 2012)	Distribution	Flower Period	Picture
P1	*Brachyscome* sp. Wanna Munna Flats (S. van Leeuwen 4662) PN Erect annual herbaceous daisy with pinnatisect leaves and light purple flower heads.	Asteraceae	2 locations (2 plants)	Plain; deep clay loam with very fine buckshot gravel along with a clay crust on the surface	Tom Price, Newman	July, Sep	 (*ecologia* 2012)
P1	*Brunonia* sp. long hairs (D.E. Symon 2440) PN Rosulate herb with long silvery hairs, especially at the base of the leaves and bright blue flowers in an aggregated head.	Goodeniaceae	10 locations (>20 plants)	Along creeklines and floodplains in clay or sandy clay	West Angelas, Newman	May	 (*ecologia* 2012)

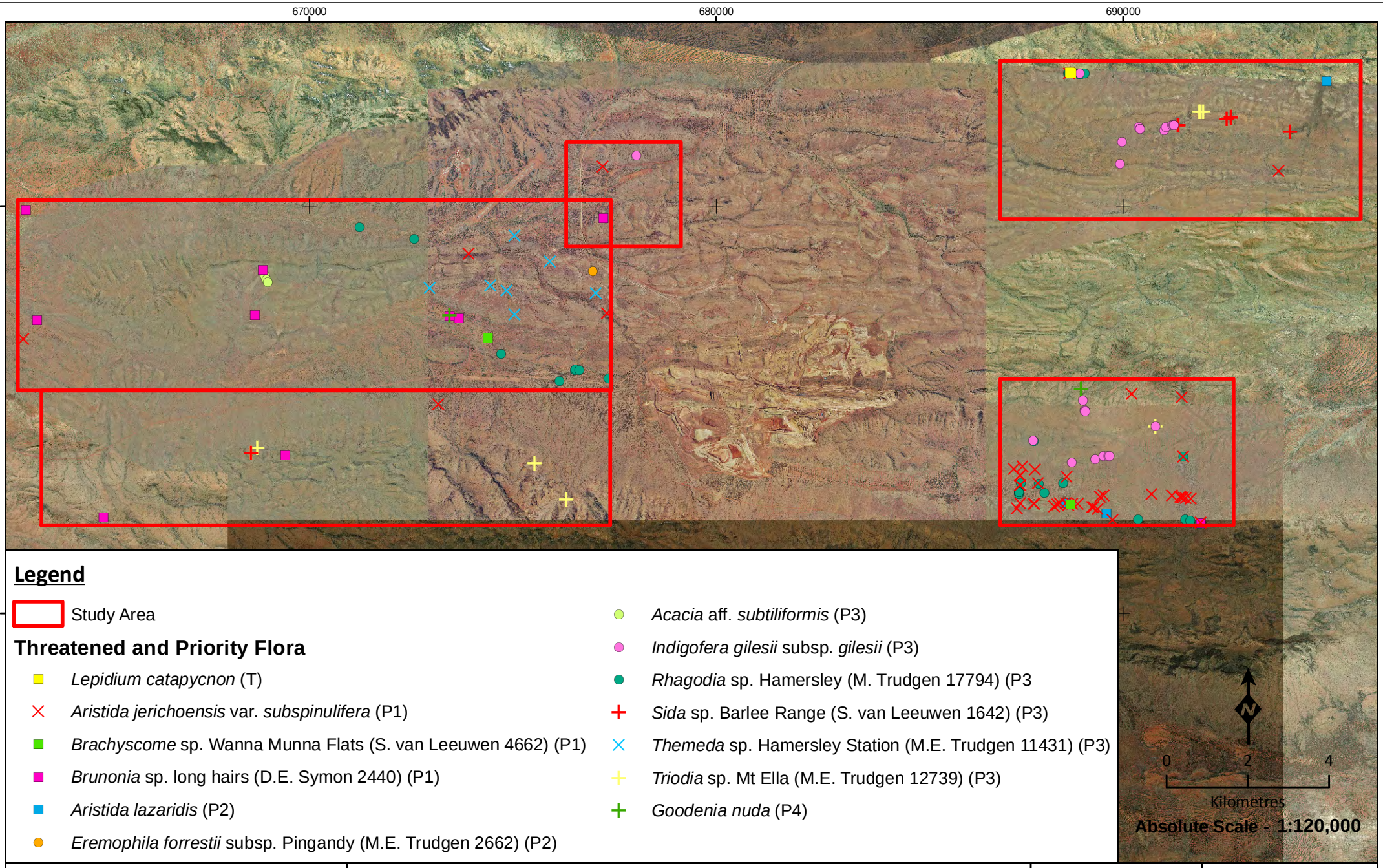
Conservation Status	Taxon	Family	No. of records in Study Area	Habitat (WA Herbarium 2012)	Distribution	Flower Period	Picture
P2	*Aristida lazaridis* A tufted perennial grass. Leaf-blade surface scaberulous; rough on both sides.	Poaceae	3 locations (>23 plants)	Sand or loam	Karijini N.P., Queensland	Apr	 (Western Australia Herbarium 2012)
P2	*Eremophila forrestii* subsp. Pingandy (M.E. Trudgen 2662) Shrub to 50 cm tall, compact tight bush. Flowers pale yellow-cream to pinky-yellow.	Scrophulariaceae	1 location (1 plant)	Flat terrain, low in landscape, base of broad valley, stony gibber plain above shallow drainage line, red clay-loam.	West Angela Hill, Karijini National Park, Turee Creek Homestead	Jun	 (*ecologia* 2012)

Conservation Status	Taxon	Family	No. of records in Study Area	Habitat (WA Herbarium 2012)	Distribution	Flower Period	Picture
P3	*Acacia* aff. *subtiliformis* Erect, spindly, wispy, single-stemmed, glabrous shrubs, the upper branches scarred where phyllodes have fallen.	Fabaceae	3 locations (~250 plants)	On rocky calcrete plateaus	Hamersley Ranges, Hancock Range, Ophthalmia Range, Hope Down North, Marillana Stn	Jul, Aug	 (*ecologia* 2012)
P3	*Indigofera* sp. Gilesii (M.E. Trudgen 15869) An open shrub, to 1.5 m high with purple-pink flowers.	Fabaceae	24 locations (>232 plants)	Pebbly loam amongst boulders & outcrops. Hills	Mt Ella, Newman, Rhodes Ridge, Coondewanna and West Angelas Hill	May or Aug	 (*ecologia* 2012)

Conservation Status	Taxon	Family	No. of records in Study Area	Habitat (WA Herbarium 2012)	Distribution	Flower Period	Picture
P3	*Rhagodia* sp. Hamersley (M. Trudgen 17794) Small erect, open shrub or scrambler to 4 m high with green - cream flowers.	Chenopodiaceae	31 locations (>81 plants)	Gravely silt and sand in sheet-flood fans. Red brown silty clay loam / silty loam on undulating plains.	Tom Price, Paraburdoo, Brockman and Newman	May	 (*ecologia* 2012)
P3	*Sida* sp. Barlee Range (S. van Leeuwen 1642) PN Rounded, densely woolly to velvety somewhat woody shrub, with small ovate ruminate leaves and yellow flowers.	Malvaceae	8 locations (>42 plants)	Skeletal red soils pockets. Steep slope.	Barlee Range, Turee Creek, Paraburdoo, Hamersley Range	Aug	 (*ecologia* 2012)

Conservation Status	Taxon	Family	No. of records in Study Area	Habitat (WA Herbarium 2012)	Distribution	Flower Period	Picture
P3	*Themeda* sp. Hamersley Station (M.E. Trudgen 11431) PN A robust Kangaroo Grass, tall, with a bluish tinge to tussock.	Poaceae	7 locations (>3505 plants)	Red clay. Clay pan, grass plain	Karratha, Millstream, Hamersley Stn, West Angelas, Coondewanna Flats	Aug	 (*ecologia* 2012)
P3	*Triodia* sp. *Mt Ella (M.E. Trudgen 12739)* A diffuse, loose, sprawling rather than rounded, hummock hard spinifex grass, leaves bright mid-green, shiny, very resinous with a distinctive resinous smell.	Poaceae	8 locations (>300 plants)	Rangeland. Hillside and hill top. Brown/red ironstone gravel	Yarraloola Stn, Yalleen Stn., Red Hill Stn., Mt Stuart Stn., Hamersley Range	-	 (*ecologia* 2012)

Conservation Status	Taxon	Family	No. of records in Study Area	Habitat (WA Herbarium 2012)	Distribution	Flower Period	Picture
P4	*Goodenia nuda* An erect herb with yellow flowers with a maroon centre.	Goodeniaceae	2 location (2 plants)	Dry brown-red sand – loam occasionally in areas of recent burns.	Port Headland, Newman, Onslow, Paraburdoo and Tom Price	Apr to Aug	 (*ecologia* 2011)



Legend

- Study Area

Threatened and Priority Flora

- *Lepidium catapycnon* (T)
- *Aristida jerichoensis* var. *subspinulifera* (P1)
- *Brachyscome* sp. Wanna Munna Flats (S. van Leeuwen 4662) (P1)
- *Brunonia* sp. long hairs (D.E. Symon 2440) (P1)
- *Aristida lazaridis* (P2)
- *Eremophila forrestii* subsp. Pingandy (M.E. Trudgen 2662) (P2)
- *Acacia* aff. *subtiliformis* (P3)
- *Indigofera gilesii* subsp. *gilesii* (P3)
- *Rhagodia* sp. Hamersley (M. Trudgen 17794) (P3
- *Sida* sp. Barlee Range (S. van Leeuwen 1642) (P3)
- *Themeda* sp. Hamersley Station (M.E. Trudgen 11431) (P3)
- *Triodia* sp. Mt Ella (M.E. Trudgen 12739) (P3)
- *Goodenia nuda* (P4)

N

0 2 4

Kilometres

Absolute Scale - 1:120,000

ecologia ENVIRONMENT

Threatened and Priority Flora of the Greater West Angelas Study Area

Figure: 4.2
Project ID: 1457

Drawn: CP
Date: 16/10/2012

Coordinate System
Name: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994

Unique Map ID: CP148

A4

4.2.4 Range Extensions Recorded in the Study Area

The extensions of the known range of distribution for flora recorded in the Study Area have been subdivided into three categories:

- Bioregional Extensions: the taxon has not been previously recorded in the IBRA Bioregion in which the Study Area is located;
- Range Extension: the records in this study are at least 100 km from the boundary of distribution based on lodged records; and
- Bridging Record: a record lying between widely separated populations.

Based on collection records lodged at the WA Herbarium (Western Australian Herbarium 1998-2013), records from the current survey include one bioregional extension, *Maireana lanosa*, although only 44 km north of the known population. Records of two taxa represent range extensions; *Corymbia zygophylla* and *Euphorbia schultzii* (Table 4.4). Threatened and Priority Flora Report Forms have been completed for these taxa ready for lodgement and can be found in Appendix F

One additional species, *Yakirra australiensis* var. *australiensis* has been determined to be a bridging record, as itscollection point was at least 250 km from any other known location.

Table 4.4 – Collections in the Survey Area that Increase the Known Distribution of its Taxa

Taxon	Type of record	Notes	*ecologia* locations	WAHERB locations
Maireana lanosa	Bioregional Extension	44 km N of known population First record of the species in the Pilbara Bioregion	1	28
Corymbia zygophylla	Range Extension	210 km S of northern population and 300 km E of western population in the Pilbara	1	97
Euphorbia schultzii	Range Extension	102 km SE of known population	2	50
Yakirra australiensis var. *australiensis*	Bridging Record	264 km SE of Pilbara population and 700 km W of eastern record	1	9

4.3 INTRODUCED FLORA

4.3.1 Weeds of National Significance (WONS)

At a national level there are twenty introduced flora species listed as Weeds of National Significance (WONS). *The Commonwealth National Weeds Strategy: A Strategic Approach* to *Weed Problems* of *National Significance* (2012) describes broad goals and objectives to manage these species. Of these species, eight are currently recorded within the Pilbara (Mesquite, *Prosopis* spp.; Athel Pine, *Tamarix aphylla;* Common prickly pear, *Opuntia stricta; Parthenium hysterophorus; Prosopis glandulosa x velutina;* Mesquite, *Prosopis pallida;* Salvinia, *Salvinia molesta;* Athel tree, *Tamarix aphylla;* and Parkinsonia, *Parkinsonia aculeata*) but are not known from the Study Area.

No Weeds of National Significance were recorded in the Study Area.

4.3.2 Declared Plants

Weeds that are, or have the potential to become, pests to agriculture can be declared formally under the *Agriculture and Related Resources Protection Act 1976* (ARRP Act Department of Agriculture and Food 1976) as Declared Plants. Weeds listed under this Act are listed with Standard Control Codes that outline the requirements for their control. Five priority groupings exist (P1, P2, P3, P4 or P5) and more than one priority may be assigned to a weed species. Different priority levels apply to different municipal districts . Details of these codes are included in Appendix G. Landholders having Declared Plants on their property are obliged to control them at their own expense, and are encouraged to follow the standard control codes.

No Declared Plants were recorded by *ecologia* in the West Angelas Study Area.

4.3.3 Environmental Weeds

A third and much more extensive categorisation of weeds has been developed by the DEC, formerly the Department of Conservation and Land Management (CALM) in the Environmental Weed Strategy for Western Australia (Department of Conservation and Land Management 1999). Weed species considered to adversely affect the communities they invade are evaluated based on the degree of invasiveness, distribution and environmental impacts. Weeds listed as Environmental Weeds are ranked into four categories using the above criteria and the scoring system:

- High; a species which scores as yes to all three of the above criteria. A rating of high indicates a species that should be prioritised for control and/or research;
- Moderate; a species which scores yes for two of the above criteria. A rating of moderate indicates a species which should be monitored. Control or research should be directed to it if funds are available;
- Mild; a species which scores yes to one of the criteria. A mild rating indicates monitoring or control if appropriate; and
- Low; a species which does not score yes for any of the criteria. A low rating indicates a low requirement for monitoring.

The assessment has recently been expanded to include a number of other criteria, although no revision of the Environmental Rating has been published.

The following nine weed species were recorded within the Study Area:

- *Acetosa vesicaria;*
- *Bidens bipinnata*;
- *Cenchrus ciliaris*;
- *Cenchrus setiger;*
- *Flaveria trinervia*;
- *Malvastrum americanum*;
- *Portulaca oleracea*;
- *Sigesbeckia orientalis*; and
- *Vachellia farnesiana*.

The locations at which these species were recorded are listed in Appendix H and mapped in Figure 4.3. The characteristics and broad distributions of these species are summarised in Table 4.5 and Table 4.6.

Table 4.5 – Environmental Status of Introduced Species Recorded in the Study Area

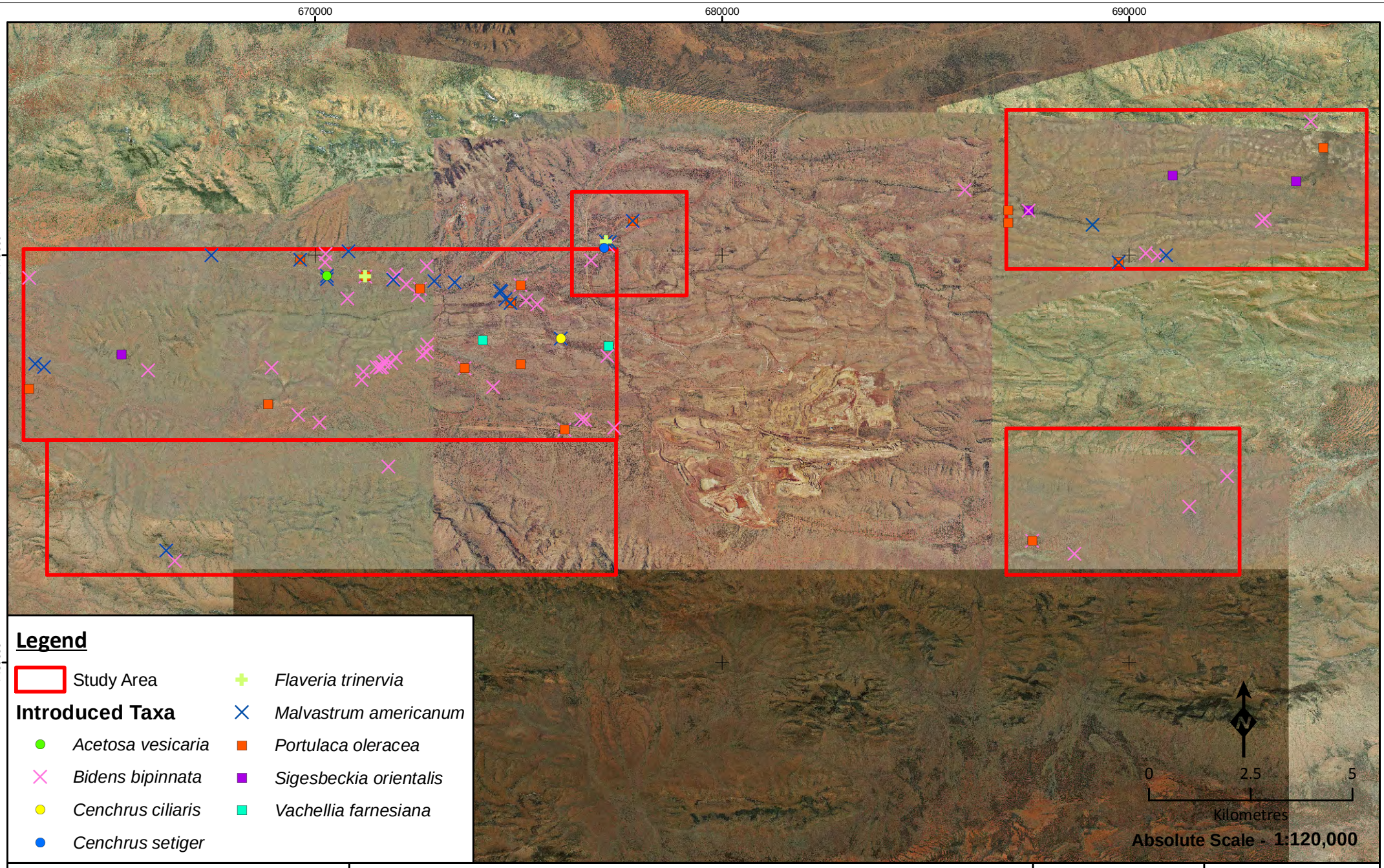
Taxa	DEC Environmental Threat Assessment for the Pilbara Bioregion (DEC 2011)								No. locations within Study Area
	Env. Rating	Current Distrib.	Abundance	Ecological Impact	Invasiveness	Feasibility of Control	General Trend	Status	
Acetosa vesicaria	Unrated	High	Common	High	Rapid	High	Increasing	Established	1
Bidens bipinnata	Unrated	High	-	Unknown	Rapid	Low	-	-	72
Cenchrus ciliaris	High	High	Abundant	High	Rapid	Low	Increasing	Established	1
Cenchrus setiger	High	High	Abundant	High	Rapid	Low	Increasing	Established	1
Flaveria trinervia	not listed								2
Malvastrum americanum	Moderate	High	Abundant	High	Rapid	Low	Increasing	Established	22
Portulaca oleracea	Low	-	-	Low	-	-	-	-	17
Sigesbeckia orientalis	Moderate	Moderate	-	Unknown	Rapid-Moderate	Low	-	-	4
Vachellia farnesiana	High	High	Common	High	Rapid	Low	Stable	Established	2

Table 4.6 – Introduced Flora Recorded in the Study Area

Taxon	Description	Picture
Acetosa vesicaria Polygonaceae (ruby dock; rosy dock)	*Acetosa vesicaria* is an erect, stout, fleshy herb from 0.2 to 1 m high (Western Australian Herbarium 1998-2012) with broadly triangular leaves ad inconspicuous flowers (Hussey *et al*. 2007). Red or pink flowers can be seen from July to September (Western Australian Herbarium 1998-2012). This weed is widely distributed in the Eremaean and South-west regions of Western Australia along roadsides and disturbed areas (Western Australian Herbarium 1998-2012). Native to North Africa, Middle East and India (Hussey *et al*. 2007).	 (*ecologia* 2012)
Bidens bipinnata Asteraceae (beggar's ticks)	*Bidens bipinnata* is an erect annual herb, 0.1 to 1.5 m high with yellow flowers from March to September (Western Australian Herbarium 1998-2012). It grows on alluvium, clay, loam over sandstone, limestone, along rivers and creeks, coastal areas and rocky hillsides (Western Australian Herbarium 1998-2012). *B*idens *bipinnata* is found worldwide and in Western Australia it is distributed in the Northern, Eremaean and South-West (Western Australian Herbarium 1998-2012).	 (*ecologia* 2012)
Cenchrus ciliaris Poaceae (Buffel grass)	*Cenchrus ciliaris* is a tufted, often tussocking perennial grass up to 1 m high (Hussey *et al*. 2007). The inflorescence is cylindrical, with purple flowers produced from February to October (Western Australian Herbarium 1998-2012). This species is found on white, red or brown sand, stony red loam or black cracking clay in the Northern, Eremaean and South-west regions of Western Australia (Western Australian Herbarium 1998-2012). Apart from being widely distributed in Western Australia (Western Australian Herbarium 1998-2012), it is present in all States and territories of continental Australia (PlantNET 2013). Native to Africa and India (Hussey *et al*. 2007).	 (*ecologia* 2012)

Taxon	Description	Picture
Cenchrus setiger Poaceae (birdwood grass)	*Cenchrus setiger* is a tufted perennial up to 0.8 m high with a compact, green spike-like inflorescence up to 20 cm long (Hussey *et al*. 2007). Flowers are cream and purple, produced from April to May (Western Australian Herbarium 1998-2012). The distribution of this species ranges from the Kimberley to Geraldton (Hussey *et al*. 2007). It is native to Africa and India, and was introduced as a fodder plant in pastoral areas but is now a serious weed (Hussey *et al*. 2007).	 (*ecologia* 2012)
Flaveria trinervia Asteraceae (Speedy weed)	*Flaveria trinervia* is a herb with yellow flowered clustered at the top and with finely serrated leaves. It occurs in disturbed areas and waterways, and can often be found under the shade of other trees or shrubs.	 (*Ecologia* 2012)
Malvastrum americanum Malvaceae	*Malvastrum americanum* is an erect perennial herb or shrub from 0.5 to 1.3 m high (Western Australian Herbarium 1998-2012). The flowers are yellow to orange in a dense terminal spike (Hussey *et al*. 2007), open from April to July (Western Australian Herbarium 1998-2012). It occurs in various soil types, including sands, clays, limestone and calcrete and can be found along drainage lines, floodplains, stony ridges and hillsides (Western Australian Herbarium 1998-2012). Distributed in the Northern and Eremaean regions of Western Australia (Western Australian Herbarium 1998-2012).	 (*Ecologia* 2012)
Portulaca oleracea Portulacaceae (pig weed, purslane)	*Portulaca oleracea* is a succulent, prostrate to decumbent annual, herb up to 20 cm high (Western Australian Herbarium 1998-2012). Under water stress the whole plant becomes reddish (Hussey *et al*. 2007). It flowers between April and May and the petals are yellow (Western Australian Herbarium 1998-2012). This species occurs in clay loam and sands and is often observed in disturbed sites (Western Australian Herbarium 1998-2012). It is a common and widespread weed of horticulture, paddocks and gardens (Hussey *et al*. 2007).	 (*Ecologia* 2012)

Taxon	Description	Picture
	It is distributed widely in Western Australia, in the Northern, Eremaean and South-west (Western Australian Herbarium 1998-2012).	
Sigesbeckia orientalis Asteraceae (Indian weed)	*Sigesbeckia orientalis* is an erect slender annual herb up to 1 m high (Western Australian Herbarium 1998-2012). It occurs on loamy soils over limestone or granite and can be found in rock gullies, limestone ranges or creek beds (Western Australian Herbarium 1998-2012). *Sigesbeckia orientalis* is a cosmopolitan weed found in the Pilbara, and in forested areas between Perth and Albany (Hussey *et al.* 2007).	 (Western Australian Herbarium 1998-2012)
Vachellia farnesiana Fabaceae (mimosa bush)	*Vachellia farnesiana* is an erect, spreading, thicket-forming, thorny tree or shrub up to 4 m high (Western Australian Herbarium 1998-2012). It has dark grey bark and pinnate green leaves (Western Australian Herbarium 1998-2012). Its flowers are yellow and open from June to August (Western Australian Herbarium 1998-2012). This species occurs in various types of soil in disturbed sites in low-lying areas, river or creek banks in the Kimberley and Eremaean regions of Western Australia and also North of Perth (Western Australian Herbarium 1998-2012).	 (*ecologia* 2012)



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Introduced Flora of the Greater West Angelas Study Area

Figure: 4.3
Project ID: 1457

Drawn: CP
Date: 16/10/2012

Coordinate System
Name: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994

Unique Map ID: CP149

A4

5 VEGETATION

5.1 VEGETATION CONDITION

The Study Area is not bound by, nor does it form part of any pastoral lease in the area. Exploration and mining leases owned by RT encompass 100% of the Study Area, which is subject to little grazing pressure from cattle or other livestock. Recorded evidence of grazing, scats and animal tracks from introduced species was minimal and this is reflected in the assessment of vegetation condition in surveyed quadrats, with 51% and 36% assessed as being in excellent or very good condition, respectively. The remaining quadrats were recorded as good (11%) or poor (2%). None were recorded to be in very poor condition. The disturbance most commonly observed was the presence of weed species, usually *Bidens bipinnata*, with a small number of areas subject to disturbance from previous exploration activities. Figure 5.1 details the condition rankings of all quadrats assessed within the Study Area. The majority of quadrats ranked as in good or poor condition are located within the drainage systems where seeds can be dispersed by water flow and upstream impacts from cattle grazing can be carried downstream.

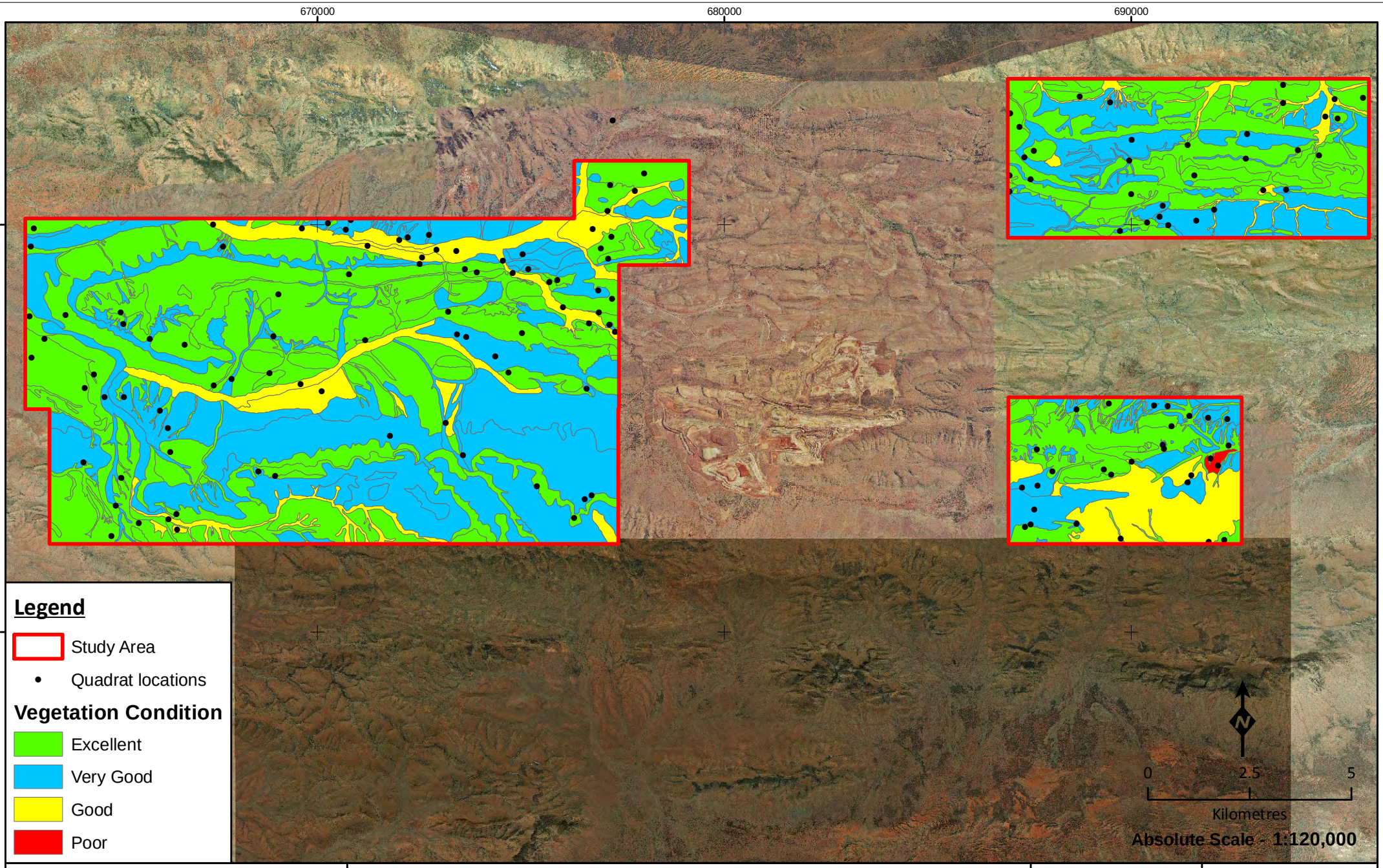
5.2 FIRE HISTORY OF THE STUDY AREA

The majority of the Study Area has not been recently burnt, with 50% of quadrats assessed as burnt more than 5 years ago or with no evidence of fire and 44% burnt 2-5 years ago. The pattern of burning appears sporadic and localised (Figure 5.2), which is typical of fires arising during the early wet season from lightning strikes that are extinguished relatively rapidly, rather than larger scale fires that burn an extensive area before being extinguished.

5.3 VEGETATION COMMUNITIES

Twenty two vegetation communities were described to association level (NVIS level V) and delineated within the Study Area, the characteristics of which are summarised in Table 5.1. The distribution of each vegetation unit is mapped in Figure 5.3 to 5.18 and the relative similarity of quadrats as determined by multivariate analysis is detailed in Figure 5.21. The structure and floristic composition of each quadrat is detailed in Appendix B.

The cluster analysis used in this study is based on both species composition and abundance. The resulting groups are in many cases based on the *Acacia, Senna* and *Triodia* species, which are commonly dominant taxa. In some cases, however, the vegetation units were also characterised by indicator species; i.e. taxa which are not dominant, but are totally or partially restricted to that particular vegetation unit.



ecologia ENVIRONMENT

Vegetation Condition of the Greater West Angelas Study Area

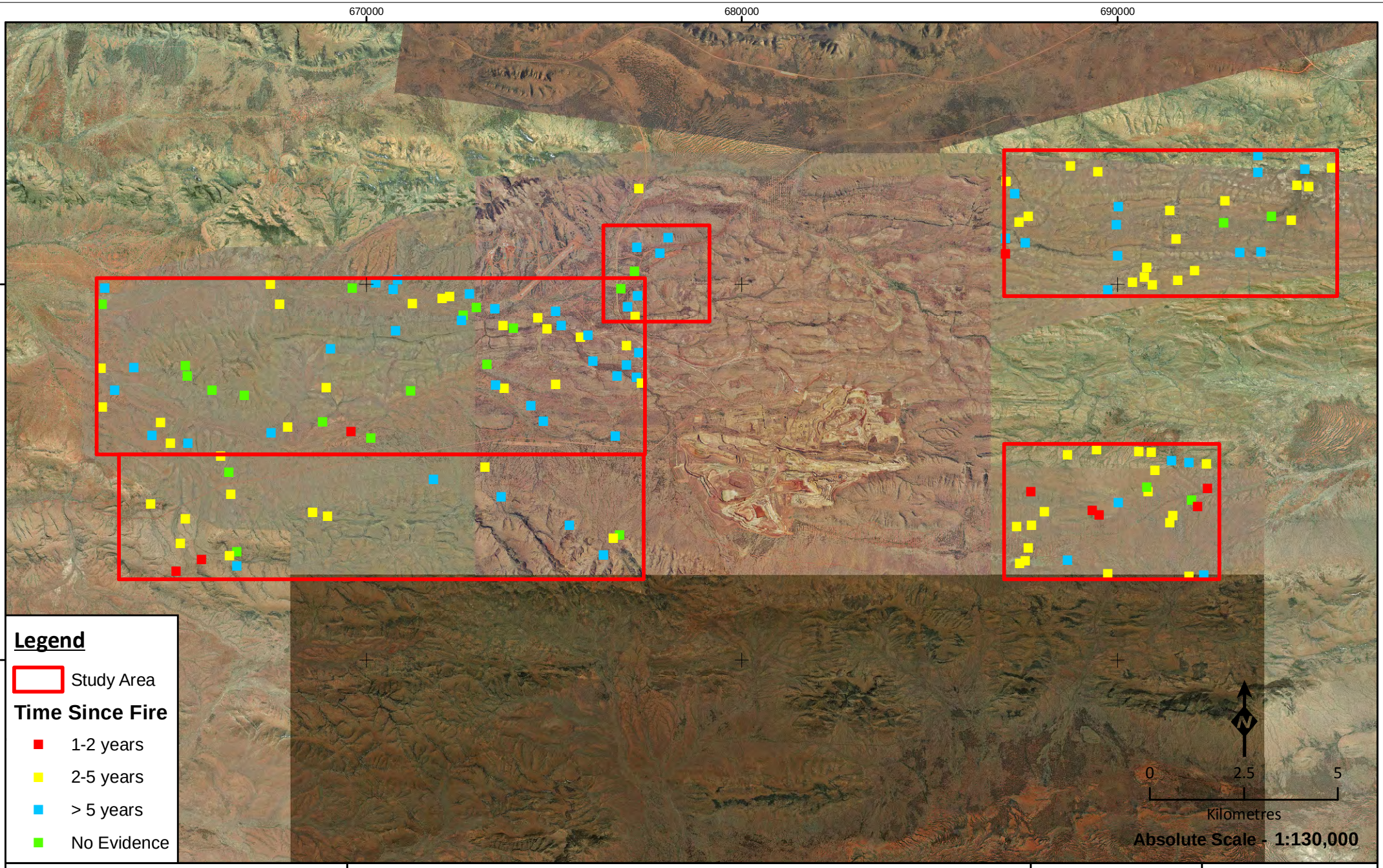
Figure: 5.1
Project ID: 1457

Drawn: CP
Date: 27/09/2012

Coordinate System
Name: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994

Unique Map ID: CP146

A4



ecologia ENVIRONMENT

Fire History of the Greater West Angelas Study Area

Figure: 5.2
Project ID: 1457

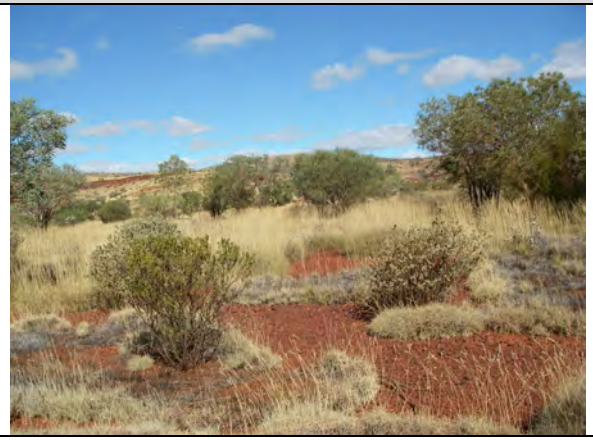
Drawn: CP
Date: 27/09/2012

Coordinate System
Name: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994

Unique Map ID: CP145

A4

Table 5.1 – Vegetation Units of West Angelas.

Vegetation unit mapping code	Quadrats	Vegetation description (NVIS Level V)	Associated species	Area km^2 (% of Study Area)	Photograph
Gravely Plains					
AaTb *Acacia* open woodland over *Triodia* open hummock grassland	14 16 28 75 107 109 114 121	*Acacia aptaneura* and *A. pruinocarpa* open woodland over *A. bivenosa* isolated shrubs *Triodia basedowii* and *T. pungens* open hummock grassland. Average species richness = 26.5 ± 1.9 Sample size = 8	*Acacia prionocarpa* *Triodia basedowii* *Triodia pungens* *Acacia aptaneura* *Acacia bivenosa* *Aristida contorta* *Dysphania kalpari* *Ptilotus calostachyus* *Enneapogon polyphyllus* *Eragrostis eriopoda* *Eremophila forrestii* subsp. *forrestii* *Senna glutinosa* subsp. *glutinosa*	1512.6 ha (8.6%)	
SggAbTp *Senna* and *Acacia* open shrubland over *Triodia* hummock grassland	6 8 23 26 34 92 98 100 102	*Acacia pruinocarpa* and *Eucalyptus leucophloia* subsp. *leucophloia* or *Corymbia hamersleyana* isolated trees over *Senna glutinosa* subsp. *glutinosa, Acacia bivenosa* and *Gossypium robinsonii* open shrubland over *Triodia pungens* hummock grassland. Average species richness = 38.0 ± 5.0 Sample size = 9	*Senna glutinosa* subsp. *glutinosa* *Acacia pruinocarpa* *Triodia pungens* *Acacia bivenosa* *Gossypium robinsonii* *Ptilotus obovatus* *Indigofera monophylla* *Themeda triandra* *Ptilotus rotundifolius* *Evolvulus alsinoides* var. *villisocalyx* *Tribulus suberosus* *Eucalyptus leucophloia* subsp. *leucophloia* *Acacia aptaneura* *Corymbia hamersleyana*	1539.18 ha (8.75%)	

Vegetation unit mapping code	Quadrats	Vegetation description (NVIS Level V)	Associated species	Area km^2 (% of Study Area)	Photograph
Gullies					
AaPoTp *Acacia* open woodland over *Ptilotus* isolated shrubs over *Triodia* open tussock grassland	25 33 72 74 129 148	*Acacia aptaneura* open woodland over *Ptilotus obovatus* isolated shrubs over *Themeda triandra* and *Eriachne mucronata* open tussock grassland. Average species richness = 39.2 ± 3.0 Sample size = 6	*Eriachne mucronata* *Ptilotus obovatus* *Acacia aptaneura* *Trichodesma zeylanicum* *Triodia pungens* *Themeda triandra* *Gomphrena cunninghamii* *Cymbopogon ambiguus* *Dysphania rhadinostachya* subsp. *rhadinostachya* *Pterocaulon sphaecelatum* *Dodonaea pachyneura^* *Ficus brachypoda^* *Cyperus cunninghamii* subsp. *cunninghamii^*	319.01 ha (1.81%)	
Rocky Footslopes/Rises					
AaTssp *Acacia* open woodland over *Triodia* open hummock grassland	42 59 60 79 82 90 131 155	*Acacia aptaneura* and *A. pruinocarpa* open woodland over *A. tetragonophylla, Senna glutinosa* subsp. *glutinosa* and *S. artemisioides* subsp. *oligophylla* isolated shrubs over *Triodia wiseana* and *T. pungens* open hummock grassland. Average species richness = 39.0 ± 3.2 Sample size = 8	*Acacia aptaneura* *Acacia pruinocarpa* *Enneapogon polyphyllus* *Senna glutinosa* subsp. *Glutinosa* *Acacia tetragonophylla* *Duperreya commixta* *Ptilotus helipteroides* *Rhagodia eremaea* *Triodia wiseana* *Triodia pungens* *Senna artemisioides* subsp. *oligophylla* *Aristida contorta* *Acacia bivenosa* *Bidens bipinnata*	927.28 ha (5.27%)	

Vegetation unit mapping code	Quadrats	Vegetation description (NVIS Level V)	Associated species	Area km^2 (% of Study Area)	Photograph
Rocky Hilltops					
EllSggTw *Eucalyptus* open woodland over *Senna* open shrubland over *Triodia* open hummock grassland	2 5 35 57 133 156	*Eucalyptus leucophloia* subsp. *leucophloia* and *Acacia aptaneura* open woodland over *Senna glutinosa* subsp. *glutinosa* and *S. artemisioides* subsp. *oligophylla* open shrubland over *Triodia wiseana* or *T. pungens* open hummock grassland. Average species richness = 23.7 ± 2.7 Sample size = 6	*Senna glutinosa* subsp. *glutinosa* *Senna artemisioides* subsp. *oligophylla* *Acacia bivenosa* *Acacia inaequilatera* *Ptilotus rotundifolius* *Acacia tetragonophylla* *Triodia wiseana* *Triodia pungens* *Eucalyptus leucophloia* subsp. *leucophloia* *Acacia aptaneura* *Acacia pruinocarpa* *Hakea chordophylla*	1227.4 ha (6.98%)	
EllAmTssp *Eucalyptus* open woodland over *Senna* open shrubland over *Triodia* open hummock grassland	20 40 56 105 106 110 113 127 140 142 147 149	*Eucalyptus leucophloia* subsp. *leucophloia* and *E. gamophylla* open woodland over *Acacia maitlandii, A. hamersleyensis, Keraudrenia velutina* and *Senna glutinosa* subsp. *glutinosa* open shrubland over *Triodia wiseana* and/or *T. pungens* and/or *T. basedowii* open hummock grassland. Average species richness = 27.4 ± 1.1 Sample size = 12	*Acacia maitlandii* *Senna glutinosa* subsp. *glutinosa* *Eucalyptus leucophloia* subsp. *leucophloia* *Hakea chordophylla* *Goodenia triodiophyla* *Triodia wiseana* *Triodia basedowii* *Triodia pungens* *Acacia hamersleyensis* *Gompholobium oreophilum* *Keraudrenia velutinea* *Corchorus lasiocarpus* *Acacia pyrifolia* var. *pyrifolia* *Eucalyptus gamophylla*	1215.97 ha (6.91%)	

Vegetation unit mapping code	Quadrats	Vegetation description (NVIS Level V)	Associated species	Area km^2 (% of Study Area)	Photograph
AmTw *Acacia* sparse shrubland over *Triodia* hummock grassland	37 38 136 153	*Eucalyptus leucophloia* subsp. *leucophloia* isolated trees over *Acacia maitlandii* sparse shrubland over *Triodia wiseana* and *T. longiceps* hummock grassland. Average species richness = 17.3 ± 3.8 Sample size = 4	*Triodia wiseana* *Acacia maitlandii* *Acacia bivenosa* *Eucalyptus leucophloia* subsp. *leucophloia* *Petalostylis labicheoides* *Ptilotus calostachyus* *Themeda triandra* *Triodia longiceps* *Acacia pyrifolia* subsp. *pyrifolia* *Ptilotus nobilis* subsp. *nobilis* *Senna artemisioides* subsp. *oligophylla* *Melaleuca eleuterostachya*^	108.7 ha (0.62%)	
EllSggTp *Eucalyptus* open woodland over *Senna* open shrubland over *Triodia* open hummock grassland	3 11 24 27 103 139 151 152	*Eucalyptus leucophloia* subsp. *leucophloia* and *Acacia marramambra* open woodland over *Senna glutinosa* subsp. *glutinosa* open shrubland over *Triodia pungens* open hummock grassland. Average species richness = 36.4 ± 3.0 Sample size = 8	*Senna glutinosa* subsp. *glutinosa* *Eucalyptus leucophloia* subsp. *leucophloia* *Aristida contorta* *Triodia pungens* *Acacia pruinocarpa* *Eriachne mucronata* *Eremophila latrobei* subsp. *latrobei* *Ptilotus nobilis* subsp. *nobilis* *Enneapogon polyphyllus* *Ptilotus calostachyus* *Solanum lasiophyllum* *Acacia marramamba* *Acacia aptaneura*	2491.87 ha (14.16%)	

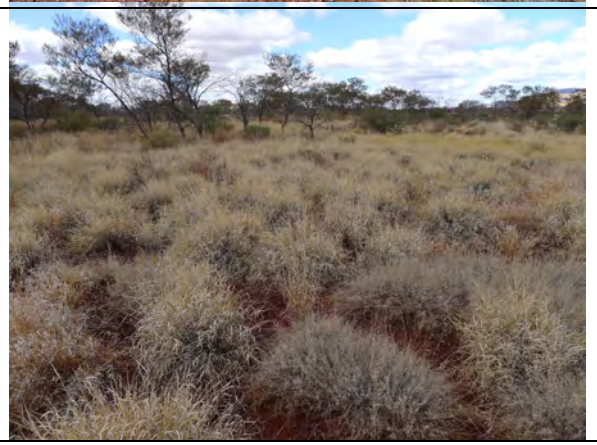
Vegetation unit mapping code	Quadrats	Vegetation description (NVIS Level V)	Associated species	Area km^2 (% of Study Area)	Photograph
SggIrTw *Senna* shrubland over *Triodia* hummock grassland	132 134 143 144 160	*Acacia inaequilatera* isolated trees over *Senna glutinosa* subsp *glutinosa* and *Indigofera rugosa* open shrubland over *Triodia wiseana* hummock grassland. Average species richness = 27.0 ± 3.6 Sample size = 5	*Triodia wiseana* *Senna glutinosa* subsp. *glutinosa* *Acacia inaequilatera* *Indigofera rugosa^* *Themeda triandra* *Senna artemisioides* subsp. *oligophylla* *Acacia dictyophleba* *Coryotheca micrantha^* *Enneapogon caerulescens* *Goodenia muelleriana* *Trichodesma zeylanicum*	1045.87 ha (5.94%)	
Rocky Midslope					
AaEffTp *Acacia* open woodland over *Eremophila* sparse shrubland and *Triodia* sparse hummock grassland	85 65	*Acacia aptaneura* and *A. pruinocarpa* open woodland over sparse *Eremophila fraseri* subsp. *fraseri* and *Acacia marramamba* sparse shrubland over *Triodia pungens* sparse hummock grassland. Average species richness = 38.0 ± 5.0 Sample size = 2	*Acacia aptaneura* *Acacia pruinocarpa* *Triodia pungens* *Acacia marramamba* *Eremophila fraseri* subsp. *fraseri* *Acacia bivenosa* *Aristida contorta* *Codonocarpus cotinifolius* *Duperreya commixta* *Evolvulus alsinoides* var. *villosicalyx* *Exocarpos sparteus* *Grevillea berryana* *Hibiscus burtonii*	141.54 ha (0.8%)	

Vegetation unit mapping code	Quadrats	Vegetation description (NVIS Level V)	Associated species	Area km^2 (% of Study Area)	Photograph
Tp *Triodia* hummock grassland	4 15 22 36	*Eucalyptus leucophloia* subsp. *leucophloia* and *Acacia pruinocarpa* isolated trees over *Senna glutinosa* subsp. *glutinosa, A. bivenosa* and *Ptilotus rotundifolius* isolated shrubs over *Triodia pungens* or *T. basedowii* or *T.* sp. Mt Ella hummock grassland. Average species richness = 16.8 ± 1.5 Sample size = 4	*Senna glutinosa* subsp. *glutinosa* *Acacia bivenosa* *Acacia pruinocarpa* *Ptilotus rotundifolius* *Eriachne mucronata* *Eucalyptus leucophloia* subsp. *leucophloia* *Ischaemum albovillosum* *Triodia pungens* *Cymbopogon ambiguus* *Eremophila fraseri* subsp. *fraseri* *Paspalidium clementii* *Triodia* sp. Mt Ella *Templetonia egena*^ *Senna sericea*^	975.86 ha (5.55%)	
ApTssp *Acacia* open woodland over *Triodia* open hummock grassland	30 58 125 128	*Acacia pruinocarpa* and *Eucalyptus leucophloia* subsp. *leucophloia* open woodland over *Senna glutinosa* subsp. *glutinosa* and *A. maitlandii* isolated shrubs over *Triodia basedowii* or *T. pungens* or *T. wiseana* open hummock grassland. Average species richness = 15.8 ± 5.7 Sample size = 4	*Senna glutinosa* subsp. *glutinosa* *Acacia pruinocarpa* *Eucalyptus leucophloia* subsp. *leucophloia* *Acacia maitlandii* *Senna ferraria* *Triodia pungens* *Triodia basedowii* *Indigofera monophylla* *Acacia pyrifolia* var. *pyrifolia* *Acacia sibirica* *Corymbia deserticola* subsp. *deserticola*	292.18 ha (1.66%)	

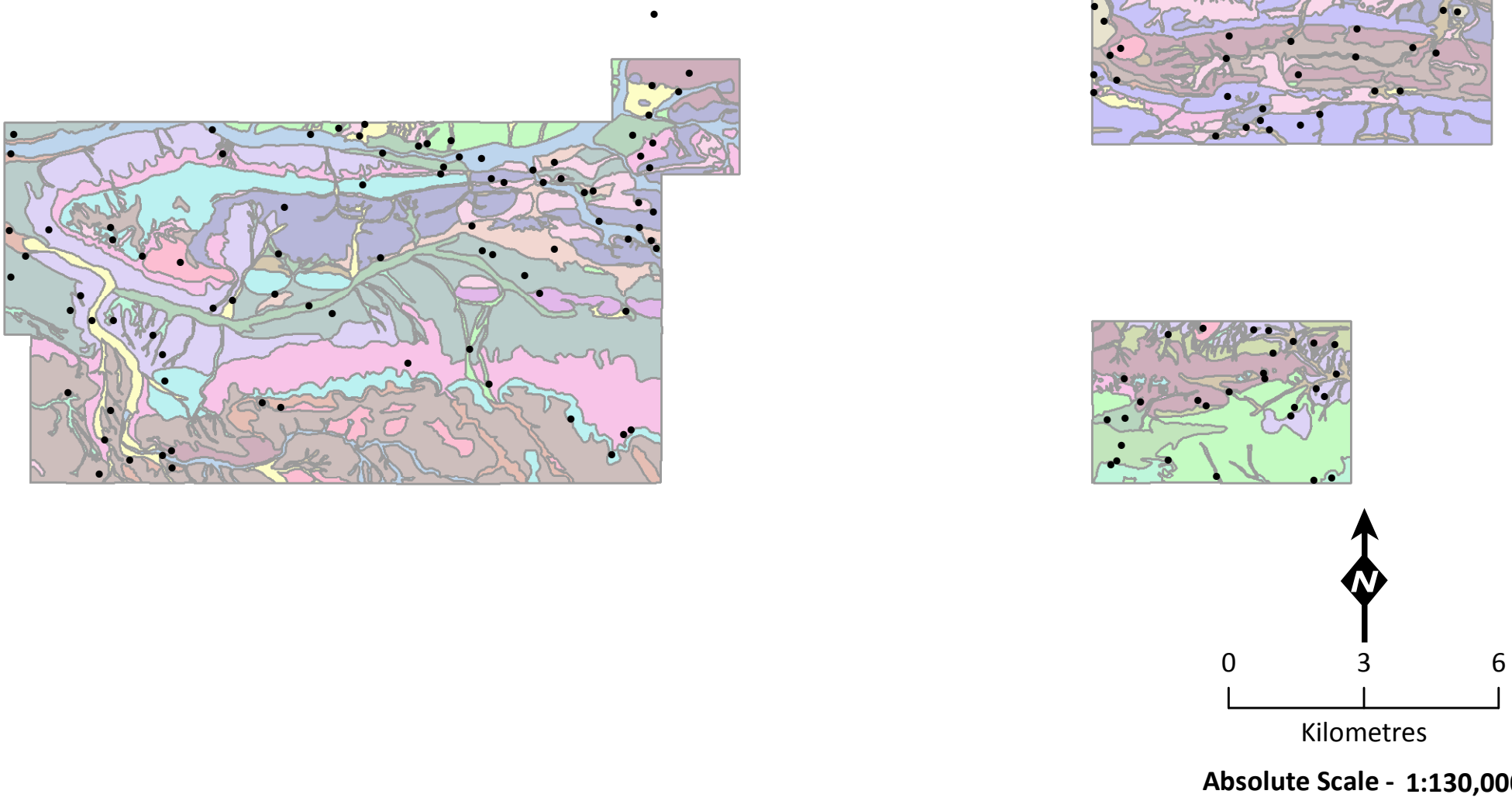
Vegetation unit mapping code	Quadrats	Vegetation description (NVIS Level V)	Associated species	Area km^2 (% of Study Area)	Photograph
SggTp *Senna* sparse shrubland over *Triodia* open hummock grassland	111 112 120 124 126 146	*Eucalyptus leucophloia* subsp. *leucophloia* and *Corymbia hamersleyana* isolated trees over *Senna glutinosa* subsp. *glutinosa* and *Acacia maitlandii* sparse shrubland over *Triodia pungens* open hummock grassland. Average species richness = 34.2 ± 3.8 Sample size = 6	*Senna glutinosa* subsp. *glutinosa* *Corymbia hamersleyana* *Themeda triandra* *Acacia maitlandii* *Dodonaea lanceolata* var. *lanceolata*^ *Jasminum didymum* subsp. *lineare* *Triodia pungens* *Eucalyptus leucophloia* subsp. *leucophloia* *Androcalva luteiflora* *Gossypium robinsonii* *Indigofera monophylla* *Senna ferraria*	210.6 ha (1.2%)	
Sandy Floodplains/Dry Rivers					
AaPoTt *Acacia* open woodland over *Ptilotus* sparse shrubland over *Themeda* open tussock grassland	7 31 43 76 84 87 96 97 104 130 141 201	*Acacia aptaneura* open woodland over *Ptilotus obovatus* sparse shrubland over *Themeda triandra* open tussock grassland. Average species richness = 50.1 ± 2.9 Sample size = 12	*Ptilotus obovatus* *Salsola australis* *Pterocaulon sphacelatum* *Cleome viscose* *Bidens bipinnata* *Enneapogon polyphyllus* *Evolvulus alsinoides* var. *villisocalyx* *Malvastrum americanum* *Ptilotus nobilis* subsp. *nobilis* *Acacia aptaneura* *Themeda triandra* *Rhagodia eremaea* *Eucalyptus victrix*^ *Triraphis mollis*^ *Corchorus tridens*^ *Amaranthus mitchellii*^	706.06 ha (4.01%)	

Vegetation unit mapping code	Quadrats	Vegetation description (NVIS Level V)	Associated species	Area km^2 (% of Study Area)	Photograph
AaTt *Acacia* woodland over *Themeda* open tussock grassland	55 99 123 135 137 138 145	*Acacia aptaneura* and *Eucalyptus xerothermica* woodland over *Ptilotus obovatus* isolated shrubs over *Themeda triandra* open tussock grassland Average species richness = 44.6 ± 2.3 Sample size = 7	*Themeda triandra* *Aristida contorta* *Pterocaulon sphacelatum* *Enneapogon polyphyllus* *Ptilotus nobilis* subsp. *nobilis* *Cleome viscose* *Duperreya commixta* *Evolvulus alsinoides* var. *villisocalyx* *Acacia aptaneura* *Eucalyptus xerothermica* *Ptilotus obovatus* *Capparis lasiantha* *Eucalyptus trivalva*^	391.54 ha (2.23%)	
Floodplains/Drainage lines					
AaAc *Acacia* open woodland over *Aristida* sparse tussock grassland	9 12 45 46 47 64 67 69 78 89	*Acacia aptaneura* and *A. pruinocarpa* open woodland over *Aristida contorta* sparse tussock grassland over *Pterocaulon sphacelatum* and *Ptilotus nobilis* subsp. *nobilis* isolated forbs. Average species richness = 37.7 ± 2.8 Sample size = 10	*Acacia aptaneura* *Pterocaulon sphacelatum* *Ptilotus nobilis* subsp. *nobilis* *Abutilon otocarpum* *Enneapogon polyphyllus* *Aristida contorta* *Acacia pruinocarpa* *Ptilotus helipteroides* *Salsola australis* *Evolvulus alsinoides* var. *villisocalyx* *Triodia pungens* *Senna artemisioides* subsp. *oligophylla* *Senna notabilis*	505.39 ha (2.87%)	

Vegetation unit mapping code	Quadrats	Vegetation description (NVIS Level V)	Associated species	Area km^2 (% of Study Area)	Photograph
AaSaoTp *Acacia* open woodland over *Senna* sparse shrubland over *Triodia* open hummock grassland	10 19 41 44 54 80 86 154	*Acacia aptaneura* and *A. ayersiana* open woodland over *Senna artemisioides* subsp. *oligophylla, S. glutinosa* subsp. *glutinosa* and *Eremophila forrestii* subsp. *forrestii* sparse shrubland over *Triodia pungens* open hummock grassland. Average species richness = 44.8 ± 2.8 Sample size = 9	*Acacia aptaneura* *Senna artemisioides* subsp. *oligophylla* *Senna glutinosa* subsp. *glutinosa* *Aristida contorta* *Evolvulus alsinoides* var. *villisocalyx* *Hibiscus burtonii* *Triodia pungens* *Eremophila forrestii* subsp. *forrestii* *Acacia pruinocarpa* *Eriachne pulchella* subsp. *dominii* *Euphorbia australis* *Sida* sp. spiciform panicles *Acacia ayersiana*	447.27 ha (2.54%)	
EgSggTb *Eucalyptus* open woodland over *Senna* sparse shrubland over *Triodia* open hummock grassland	17 93 116 117 119 122	*Eucalyptus gamophylla* and *Corymbia deserticola* subsp. *deserticola* open woodland over *Senna artemisioides* subsp. *oligophylla* and *Indigofera monophylla* sparse shrubland over *Triodia basedowii* and *T. pungens* open hummock grassland. Average species richness = 32.7 ± 3.5 Sample size = 6	*Keraudrenia velutina* *Senna glutinosa* subsp. *glutinosa* *Paraneurachne muelleri* *Ptilotus calostachyus* *Triodia basedowii* *Triodia pungens* *Eucalyptus gamophylla* *Acacia bivenosa* *Acacia adsurgens* *Corymbia deserticola* subsp. *deserticola* *Ptilotus nobilis* subsp. *nobilis* *Solanum lasiophyllum* *Acacia ancistrocarpa^*	309.52 ha (1.76%)	
Sandy Plain					

Vegetation unit mapping code	Quadrats	Vegetation description (NVIS Level V)	Associated species	Area km^2 (% of Study Area)	Photograph
AaEcTp *Acacia* open woodland over *Eremophila* isolated shrubs over *Triodia* open hummock grassland	29 49 50 53 63 70 71 81 200	*Acacia aptaneura* and *A. pruinocarpa* open woodland over *Eremophila caespitosa* and *Tribulus suberosus* isolated shrubs over *Triodia pungens* open hummock grassland. Average species richness = 37.2 ± 2.6 Sample size = 9	*Acacia aptaneura* *Triodia pungens* *Aristida contorta* *Ptilotus nobilis* subsp. *nobilis* *Senna notabilis* *Acacia pruinocarpa* *Enneapogon polyphyllus* *Ptilotus schwartzii* var. *schwartzii* *Eremophila caespitosa* *Eriachne pulchella* subsp. *dominii* *Tribulus suberosus* *Eragrostis pergracilis*^ *Ptilotus roei*^	1769.85 ha (10.06%)	
AlAp *Aristida* and *Astrebla* tussock grassland	21 61 62 66 68 94 95	*Aristida latifolia, Astrebla pectinata* and *Brachyachne convergens* tussock grassland with isolated *Salsola australis, Boerhavia paludosa* and *Ptilotus nobilis* subsp. *nobilis* forbs. Average species richness = 35.0 ± 2.3 Sample size = 7	*Astrebla pectinata* *Aristida latifolia* *Salsola australis* *Brachyachne convergens*^ *Ptilotus nobilis* subsp. *nobilis* *Boerhavia paludosa* *Iseilema vaginiflorum* *Panicum decompositum* *Pterocaulon sphacelatum* *Sida spinosa*^ *Hibiscus trionum*^ *Themeda* sp. Hamersley Station^	302.23 ha (1.72%)	

Vegetation unit mapping code	Quadrats	Vegetation description (NVIS Level V)	Associated species	Area km^2 (% of Study Area)	Photograph
PsTp *Pterocaulon* sparse forbland with *Triodia* open hummock grassland	51 52 108	*Acacia aptaneura* or *A. ayersiana* open woodland over *Pterocaulon sphacelatum* and *Dysphania kalparri* sparse forbland with *Triodia pungens* open hummock grassland. Average species richness = 36.7 ± 2.6 Sample size = 3	*Pterocaulon sphacelatum* *Dysphania kalpari* *Aristida contorta* *Enneapogon polyphyllus* *Aristida jerichoensis* var. *subspinulifera*^ *Cucumis variabilis* *Euphorbia drummondii* *Panicum effusum* *Sida* sp. verrucose glands *Triodia pungens* *Themeda triandra*	174.39 ha (0.99%)	
Sandy Undulating Plain					
AaTp *Acacia* woodland over *Triodia* open hummock grassland	18 48 77 91 115 118	*Acacia pruinocarpa, A. aptaneura* and *A. ayersiana* woodland over *Triodia pungens* open hummock grassland. Average species richness = 29.3 ± 3.9 Sample size = 6	*Acacia aptaneura* *Triodia pungens* *Acacia pruinocarpa* *Aristida contorta* *Hibiscus burtonii* *Solanum lasiophyllum* *Acacia ayersiana* *Enneapogon polyphyllus* *Ptilotus nobilis* subsp. *nobilis* *Ptilotus obovatus* *Senna glutinosa* subsp. *glutinosa*	982.26 ha (5.58%)	



Absolute Scale - 1:130,000

Legend

- Quadrat locations

Vegetation Units

AaAc — *Acacia aptaneura* and *A. pruinocarpa* open woodland over *Aristida contorta* sparse tussock grassland over *Pterocaulon sphacelatum* and *Ptilotus nobilis* subsp. *nobilis* isolated forbs

AaEffTp — *Acacia aptaneura* and *A. pruinocarpa* open woodland over sparse *Eremophila fraseri* subsp. *fraseri* and *Acacia marramamba* sparse shrubland over *Triodia pungens* sparse hummock grassland

AaPoTp — *Acacia aptaneura* open woodland over *Ptilotus obovatus* isolated shrubs over *Themeda triandra* and *Eriachne mucronata* open tussock grassland

AaPoTt — *Acacia aptaneura* open woodland over *Ptilotus obovatus* sparse shrubland over *Themeda triandra* open tussock grassland

AaSaoTp — *Acacia aptaneura* and *A. ayersiana* open woodland over *Senna artemisioides* subsp. *oligophylla*, *S. glutinosa* subsp. *glutinosa* and *Eremophila forrestii* subsp. *forrestii* sparse shrubland over *Triodia pungens* open hummock grassland

AaTssp — *Acacia aptaneura* and *A. pruinocarpa* open woodland over *A. tetragonophylla*, *Senna glutinosa* subsp. *glutinosa* and *S. artemisioides* subsp. *oligophylla* isolated shrubs over *Triodia wiseana* and *T. pungens* open hummock grassland

AaTp — *Acacia pruinocarpa*, *A. aptaneura* and *A. ayersiana* woodland over *Triodia pungens* open hummock grassland

Tp — *Eucalyptus leucophloia* subsp. *leucophloia* and *Acacia pruinocarpa* isolated trees over *Senna glutinosa* subsp. *glutinosa*, *A. bivenosa* and *Ptilotus rotundifolius* isolated shrubs over *Triodia pungens* or *T. basedowii* or *T.* sp. Mt Ella hummock grassland

EliSggTw — *Eucalyptus leucophloia* subsp. *leucophloia* and *Acacia aptaneura* open woodland over *Senna glutinosa* subsp. *glutinosa* and *S. artemisioides* subsp. *oligophylla* open shrubland over *Triodia wiseana* or *T. pungens* open hummock grassland

EllAmTssp — *Eucalyptus leucophloia* subsp. *leucophloia* and *E. gamophylla* open woodland over *Acacia maitlandii*, *A. hamersleyensis*, *Keraudrenia velutina* and *Senna glutinosa* subsp. *glutinosa* open shrubland over *Triodia wiseana* and/or *T. pungens* and/or *T. basedowii* open hummock grassland

AmTw — *Eucalyptus leucophloia* subsp. *leucophloia* isolated trees over *Acacia maitlandii* sparse shrubland over *Triodia wiseana* and *T. longiceps* hummock grassland

ApEcTp — *Acacia aptaneura* and *A. pruinocarpa* open woodland over *Eremophila caespitosa* and *Tribulus suberosus* isolated shrubs over *Triodia pungens* open hummock grassland

ApTssp — *Acacia pruinocarpa* and *Eucalyptus leucophloia* subsp. *leucophloia* open woodland over *Senna glutinosa* subsp. *glutinosa* and *A. maitlandii* isolated shrubs over *Triodia basedowii* or *T. pungens* or *T. wiseana* open hummock grassland

AaTb — *Acacia aptaneura* and *A. pruinocarpa* open woodland over *A. bivenosa* isolated shrubs *Triodia basedowii* and *T. pungens* open hummock grassland

SggTp — *Eucalyptus leucophloia* subsp. *leucophloia* and *Corymbia hamersleyana* isolated trees over *Senna glutinosa* subsp. *glutinosa* and *Acacia maitlandii* sparse shrubland over *Triodia pungens* open hummock grassland

EgSggTb — *Eucalyptus gamophylla* and *Corymbia deserticola* subsp. *deserticola* open woodland over *Senna artemisioides* subsp. *oligophylla* and *Indigofera monophylla* sparse shrubland over *Triodia basedowii* and *T. pungens* open hummock grassland

EllSggTp — *Eucalyptus leucophloia* subsp. *leucophloia* and *Acacia marramambra* open woodland over *Senna glutinosa* subsp. *glutinosa* open shrubland over *Triodia pungens* open hummock grassland

AaTt — *Acacia aptaneura* and *Eucalyptus xerothermica* woodland over *Ptilotus obovatus* isolated shrubs over *Themeda triandra* open tussock grassland

AlAp — *Aristida latifolia*, *Astrebla pectinata* and *Brachyachne convergens* tussock grassland with isolated *Salsola australis*, *Boerhavia paludosa* and *Ptilotus nobilis* subsp. *nobilis* forbs

PsTp — *Acacia aptaneura* or *A. ayersiana* open woodland over *Pterocaulon sphacelatum* and *Dysphania kalparri* sparse forbland with *Triodia pungens* open hummock grassland

SggAbTp — *Acacia pruinocarpa* and *Eucalyptus leucophloia* subsp. *leucophloia* or *Corymbia hamersleyana* isolated trees over *Senna glutinosa* subsp. *glutinosa*, *Acacia bivenosa* and *Gossypium robinsonii* open shrubland over *Triodia pungens* hummock grassland

SggIrTw — *Acacia inaequilatera* isolated trees over *Senna glutinosa* subsp *glutinosa* and *Indigofera rugosa* open shrubland over *Triodia wiseana* hummock grassland

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Overview of Vegetation Units at Greater West Angelas

Figure: 5.3
Project ID: 1457

Drawn: CP
Date: 04/02/2013

Coordinate System
Name: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994

Unique Map ID: MXXX

A3

686000 688000 690000

7444000

7442000

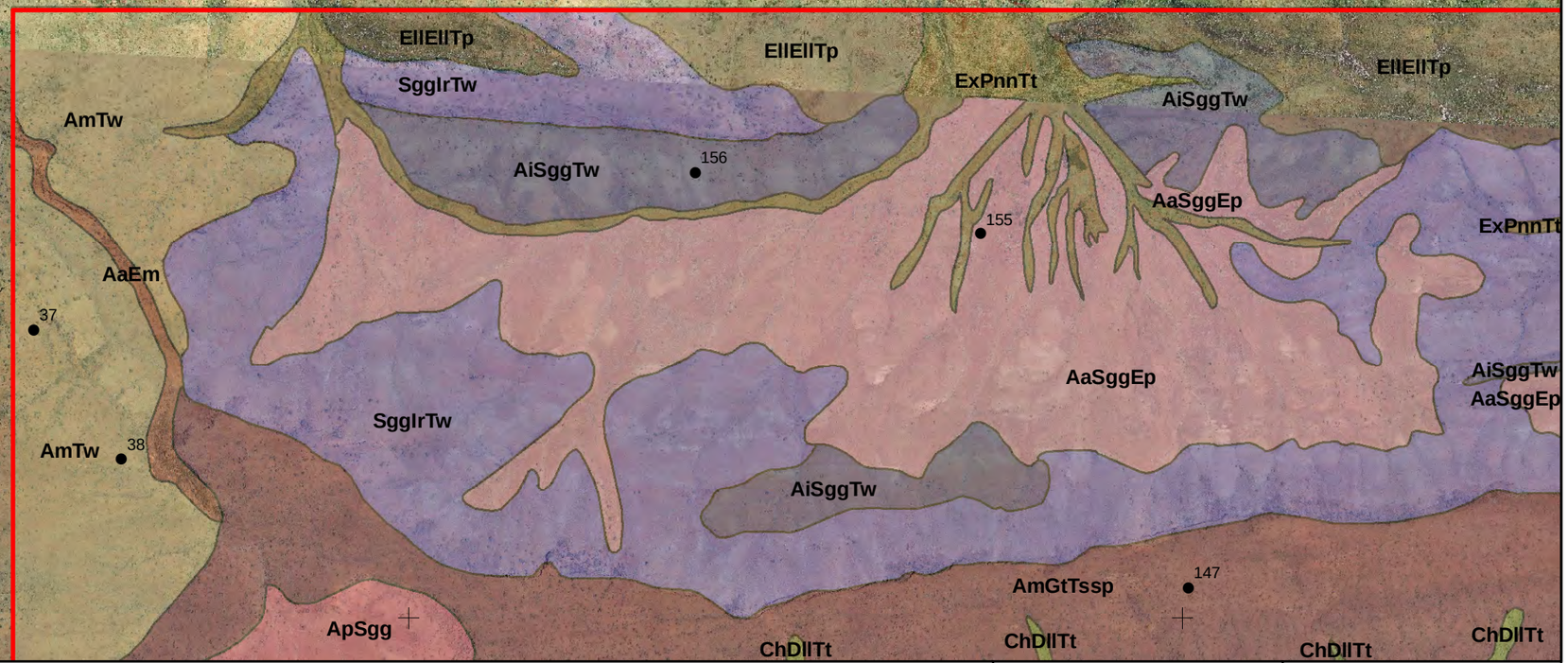
Legend

Study Area

Quadrat locations

Vegetation Units

- *AaAc*
- *AaEffTp*
- *AaPoTp*
- *AaPoTt*
- *AaSaoTp*
- *AaTssp*
- *AaTp*
- *Tp*
- *EllSggTw*
- *ElAmTssp*
- *AmTw*
- *ApEcTp*
- *ApTssp*
- *AaTb*
- *SggTp*
- *EgSggTb*
- *EllSggTp*
- *AaTt*
- *AlAp*
- *PsTp*
- *SggAbTp*
- *SggIrTw*



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Vegetation Units within the West Angelas Study Area
Map A5

Figure: 5.4
Project ID: 1457

Drawn: CP
Date: 23/11/2012

Coordinate System
Name: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994

Unique Map ID: CP153

A3

691200 693000 694800

7444800

7443000

N

0 0.25 0.5

Kilometres

Absolute Scale - 1:15,000

Legend

Study Area

Quadrat locations

Vegetation Units

AaAc
AaEffTp
AaPoTp
AaPoTt
AaSaoTp
AaTssp
AaTp
Tp
EllSggTw
ElAmTssp
AmTw
ApEcTp
ApTssp
AaTb
SggTp
EgSggTb
EllSggTp
AaTt
AlAp
PsTp
SggAbTp
SggIrTw

AiSggTw
EllEllTp
ExPnnTt
AaSggEp
SggIrTw
AmGtTssp
AaEm
ChDllTt
AmTw
151
152
137
138
135
136
140
139

ecologia ENVIRONMENT

Vegetation Units within the West Angelas Study Area
Map A6

Figure: 5.5
Project ID: 1457

Drawn: CP
Date: 23/11/2012

Coordinate System
Name: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994

Unique Map ID: CP153

A3

662400 664200 666000 667800

7441200

7439400

N

0 0.25 0.5

Kilometres

Absolute Scale - 1:15,000

Legend

- Study Area
- Quadrat locations

Vegetation Units

- *AaAc*
- *AaEffTp*
- *AaPoTp*
- *AaPoTt*
- *AaSaoTp*
- *AaTssp*
- *AaTp*
- *Tp*
- *EllSggTw*
- *ElAmTssp*
- *AmTw*
- *ApEcTp*
- *ApTssp*
- *AaTb*
- *SggTp*
- *EgSggTb*
- *EllSggTp*
- *AaTt*
- *AlAp*
- *PsTp*
- *SggAbTp*
- *SggIrTw*

71 72 84 65

AaEm ApEcTp AaPoEp AaEffTp ApTb AaSlTp AaEffTpApTb SggGrTp AbPrIa AaSggEp EllElTp AiSggTw

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Vegetation Units within the West Angelas Study Area
Map B1

Figure: 5.6
Project ID: 1457

Drawn: CP
Date: 23/11/2012

Coordinate System
Name: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994

Unique Map ID: CP153

A3

667800 669600 671400 673200

7441200

7439400

0 0.25 0.5

Kilometres

Absolute Scale - 1:15,000

Legend

- Study Area
- Quadrat locations

Vegetation Units

- *AaAc*
- *AaEffTp*
- *AaPoTp*
- *AaPoTt*
- *AaSaoTp*
- *AaTssp*
- *AaTp*
- *Tp*
- *EllSggTw*
- *ElAmTssp*
- *AmTw*
- *ApEcTp*
- *ApTssp*
- *AaTb*
- *SggTp*
- *EgSggTb*
- *EllSggTp*
- *AaTt*
- *AlAp*
- *PsTp*
- *SggAbTp*
- *SggIrTw*

AaSlTp AaSaoTp AaSggEp AaPoEp ApTb SggGrTp AbPrIa AaAoAc ExPnnTt AiSggTw ApEcTp

18 19 43 86 69 97 89 90 36 57 44 77 78

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Vegetation Units within the West Angelas Study Area
Map B2

Figure: 5.7
Project ID: 1457

Drawn: CP
Date: 23/11/2012

Coordinate System
Name: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994

Unique Map ID: CP153

A3

675000 676800 678600

7441200

7439400

Legend

Study Area

Quadrat locations

Vegetation Units

AaAc
AaEffTp
AaPoTp
AaPoTt
AaSaoTp
AaTssp
AaTp
Tp
EllSggTw
ElAmTssp
AmTw
ApEcTp
ApTssp
AaTb
SggTp
EgSggTb
EllSggTp
AaTt
AlAp
PsTp
SggAbTp
SggIrTw

AaSlTp AmGtTssp AiSggTw AaSaoTp AaPoEp AaAoAc SggGrTp ExPnnTt PnnAp ApEcTp AaSggEp

56 10 141 7 9 8 6 2 87 94 96 35 82 79 76 68 67 42 5

0 0.25 0.5

Kilometres

Absolute Scale - 1:15,000

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Vegetation Units within the West Angelas Study Area
Map B3

Figure: 5.8
Project ID: 1457

Drawn: CP
Date: 23/11/2012

Coordinate System
Name: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994

Unique Map ID: CP153

A3

687600 689400 691200

7441200 7439400

38 AaEm AaSggEp AaSggEp AiSggTw SgglrTw AaSggEp AaSggEp AaSggEp SgglrTw ExPnnTt

AmTw 147 AaEm AmGtTssp 139

ApSgg 128 40 EllEllTp

ExPnnTt AmGtTssp ChDllTt 146 AmTw AaSggEp

AaSggEp AaSggEp AaSggEp

160 EllEllTp AmGtTssp 142

AaSaoTp 129 AaSggEp AaSlTp EllEllTp

AaEm SggGrTp AaSggEp

41 SggGrTp 134 SgglrTw

AaSaoTp SgglrTw 133

SggGrTp 143

SgglrTw SggGrTp AiSggTw

ExPnnTt132 144

AaSggEp AiSggTw 131 145

ExPnnTt AaSggEp SgglrTw

ExPnnTt ExPnnTt

130 ExPnnTt

SgglrTw

N

0 0.25 0.5

Kilometres

Absolute Scale - 1:15,000

Legend

Study Area

Quadrat locations

Vegetation Units

- *AaAc*
- *AaEffTp*
- *AaPoTp*
- *AaPoTt*
- *AaSaoTp*
- *AaTssp*
- *AaTp*
- *Tp*
- *EllSggTw*
- *ElAmTssp*
- *AmTw*
- *ApEcTp*
- *ApTssp*
- *AaTb*
- *SggTp*
- *EgSggTb*
- *EllSggTp*
- *AaTt*
- *AlAp*
- *PsTp*
- *SggAbTp*
- *SggIrTw*

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Vegetation Units within the West Angelas Study Area
Map B5

Figure: 5.9
Project ID: 1457

Drawn: CP
Date: 23/11/2012

Coordinate System
Name: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994

Unique Map ID: CP153

A3

691200 693000 694800

7441200

7439400

SgglrTw AaSggEp ExPnnTt AaEm AmGtTssp AmGtTssp ChDllTt ChDllTt AmGtTssp AaSggEp EllEllTp AmGtTssp AaSllTp SgglrTw SggGrTp AaSggEp ExPnnTt AaSaoTp SgglrTw ExPnnTt AaEm ExPnnTt AiSggTw AiSggTw AaSggEp AmTw AiSggTw SgglrTw AmGtTssp AmGtTssp AaEm AmTw AmGtTssp AaSggEp AmGtTssp AaSggEp AmGtTssp SgglrTw SgglrTw SgglrTw SgglrTw

140 139 153 148 149 142 55 154 133 143 132 144 145

Legend

- Study Area
- Quadrat locations

Vegetation Units

- *AaAc*
- *AaEffTp*
- *AaPoTp*
- *AaPoTt*
- *AaSaoTp*
- *AaTssp*
- *AaTp*
- *Tp*
- *EllSggTw*
- *ElAmTssp*
- *AmTw*
- *ApEcTp*
- *ApTssp*
- *AaTb*
- *SggTp*
- *EgSggTb*
- *EllSggTp*
- *AaTt*
- *AlAp*
- *PsTp*
- *SggAbTp*
- *SggIrTw*

N

0 0.25 0.5

Kilometres

Absolute Scale - 1:15,000

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Vegetation Units within the West Angelas Study Area
Map B6

Figure: 5.10
Project ID: 1457

Drawn: CP
Date: 23/11/2012

Coordinate System
Name: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994

Unique Map ID: CP153

A3

662400 664200 666000 667800

7437600

7435800

N

0 0.25 0.5

Kilometres

Absolute Scale - 1:15,000

Legend

Study Area

Quadrat locations

Vegetation Units

- *AaAc*
- *AaEffTp*
- *AaPoTp*
- *AaPoTt*
- *AaSaoTp*
- *AaTssp*
- *AaTp*
- *Tp*
- *EllSggTw*
- *ElAmTssp*
- *AmTw*
- *ApEcTp*
- *ApTssp*
- *AaTb*
- *SggTp*
- *EgSggTb*
- *EllSggTp*
- *AaTt*
- *AlAp*
- *PsTp*
- *SggAbTp*
- *SggIrTw*

AaEffTp
ApEcTp
AaSggEp
AaSggEp
AaSggEp
EllEllTp
AbPrIa
AaSggEp
EllEllTp
24
28
74
AaSggEp
AbPrIa
AaSggEp
AaSggEp
AiSggTw
EllEllTp
AaEm
27
AaSggEp
ApTb
ApTb
29
26
EllEllTp
AaSaoTp
SggGrTp
ApSgg
58
70
ApEcTp
ApTb
75
ApEcTp
53
EgKvPm
81
EgKvPm
54
AaAoAc
ApEcTp
AaSaoTp
80
ApTb
16
EgKvPm
EgKvPm
ApTb
ApTb
EgKvPm
17
ApTb
EgKvPm
ApTb
EgKvPm
ApTb
ApEcTp
EgKvPm
SggGrTp
EllEllTp

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Vegetation Units within the West Angelas Study Area
Map C1

Figure: 5.11
Project ID: 1457

Drawn: CP
Date: 23/11/2012

Coordinate System
Name: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994

Unique Map ID: CP153

A3

667800 669600 671400 673200

7437600

7435800

N

0 0.25 0.5

Kilometres

Absolute Scale - 1:15,000

Legend

Study Area

Quadrat locations

Vegetation Units

AaAc
AaEffTp
AaPoTp
AaPoTt
AaSaoTp
AaTssp
AaTp
Tp
EllSggTw
ElAmTssp
AmTw
ApEcTp
ApTssp
AaTb
SggTp
EgSggTb
EllSggTp
AaTt
AlAp
PsTp
SggAbTp
SggIrTw

AbPrIa AaSggEp AaSggEp AbPrIa AaSggEp ExPnnTt AaSggEp AiSggTw AaSaoTp AaAoAc ApEcTp ApTb AiSggTw ApTb AiSggTw PnnAp ApTb ApEcTp ExPnnTt AaAoAc ExPnnTt PnnAp ApEcTp AbPrIa AbPrIa AaSggEp EgKvPm ApEcTp AaEffTp AaAoAc ApEcTp PnnAp AaSlTp ApEcTp EgKvPm EgKvPm ApEcTp ApTb ApEcTp SggGrTp ApTb SggGrTp ApEcTp

36 57 64 66 21 12 49

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Vegetation Units within the West Angelas Study Area
Map C2

Figure: 5.12
Project ID: 1457

Drawn: CP
Date: 23/11/2012

Coordinate System
Name: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994

Unique Map ID: CP153

A3

673200 675000 676800

7437600

7435800

AbPrla AaSggEp ExPnnTt AaSggEp AiSggTw AaSggEp AiSggTw AaSggEp AiSggTw AiSggTw AaSggEp AaSggEp PnnAp ApEcTp ApEcTp SggGrTp SggGrTp

AaSggEp ApEcTp AaAoAc PnnAp AaSggEp AaPoEp AiSggTw AaPoEp AaSggEp PnnAp AaSggEp AaSlTp AaSggEp AiSggTw ApEcTp ApEcTp AaSlTp AaEffTp AaAoAc AaEffTp AaSaoTp AaAoAc ApEcTp

61 200 50 63 62 85 104 95 60 59 91 5 42 47

AaSggEp AaAoAc AaEffTp AaSlTp ApEcTp ApEcTp ApEcTp SggGrTp ApEcTp SggGrTp

N

0 0.25 0.5

Kilometres

Absolute Scale - 1:15,000

Legend

- Study Area
- Quadrat locations

Vegetation Units

- *AaAc*
- *AaEffTp*
- *AaPoTp*
- *AaPoTt*
- *AaSaoTp*
- *AaTssp*
- *AaTp*
- *Tp*
- *EllSggTw*
- *ElAmTssp*
- *AmTw*
- *ApEcTp*
- *ApTssp*
- *AaTb*
- *SggTp*
- *EgSggTb*
- *EllSggTp*
- *AaTt*
- *AlAp*
- *PsTp*
- *SggAbTp*
- *SggIrTw*

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Vegetation Units within the West Angelas Study Area
Map C3

Figure: 5.13
Project ID: 1457

Drawn: CP
Date: 23/11/2012

Coordinate System
Name: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994

Unique Map ID: CP153

A3

685800 687600 689400

7437600

7435800

Legend

Study Area

Quadrat locations

Vegetation Units

AaAc
AaEffTp
AaPoTp
AaPoTt
AaSaoTp
AaTssp
AaTp
Tp
EllSggTw
ElAmTssp
AmTw
ApEcTp
ApTssp
AaTb
SggTp
EgSggTb
EllSggTp
AaTt
AlAp
PsTp
SggAbTp
SggIrTw

N

0 0.25 0.5

Kilometres

Absolute Scale - 1:15,000

AmGtTssp EgKvPm ChDllTt ApTb EgKvPm EgKvPm ApTb EgKvPm ApTb 125 ApSgg ApTb ApTb EgKvPm 122 ApTb 121 ExPnnTt

AmGtTssp 120 ChDllTt EgKvPm EgKvPm ChDllTt EgKvPm ApTb ApTb ApTb EgKvPm ExPnnTt ApTb

EgKvPm ChDllTt ChDllTt ChDllTt AmGtTssp ChDllTt

AmGtTssp AmGtTssp ChDllTt ChDllTt ChDllTt AmGtTssp ChDllTt 124 AmGtTssp

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Vegetation Units within the West Angelas Study Area
Map C5

Figure: 5.14
Project ID: 1457

Drawn: CP
Date: 23/11/2012

Coordinate System
Name: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994

Unique Map ID: CP153

A3

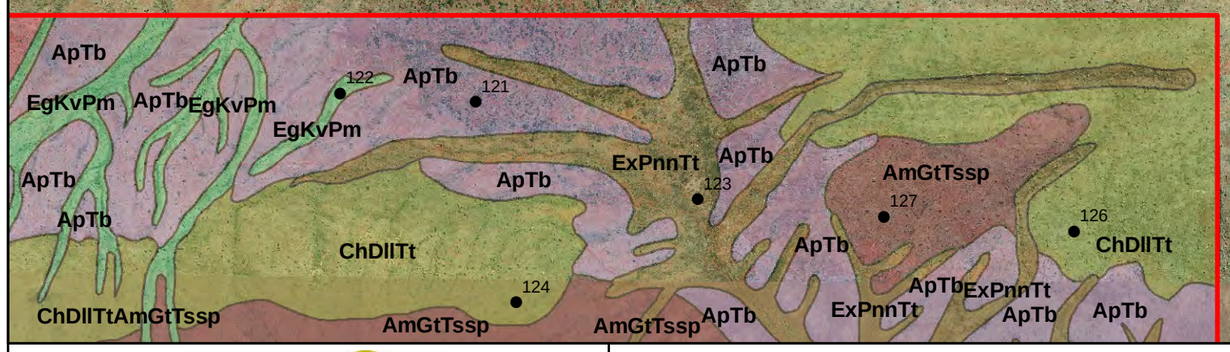
691200

693000

694800

7437600

7435800



Legend

- Study Area
- Quadrat locations

Vegetation Units

- *AaAc*
- *AaEffTp*
- *AaPoTp*
- *AaPoTt*
- *AaSaoTp*
- *AaTssp*
- *AaTp*
- *Tp*
- *EllSggTw*
- *ElAmTssp*
- *AmTw*
- *ApEcTp*
- *ApTssp*
- *AaTb*
- *SggTp*
- *EgSggTb*
- *EllSggTp*
- *AaTt*
- *AlAp*
- *PsTp*
- *SggAbTp*
- *SggIrTw*

N

0 0.25 0.5

Kilometres

Absolute Scale - 1:15,000

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Vegetation Units within the West Angelas Study Area
Map C6

Figure: 5.15
Project ID: 1457

Drawn: CP
Date: 23/11/2012

Coordinate System
Name: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994

Unique Map ID: CP153

A3

664200 666000 667800

7434000

7432200

N

0 0.25 0.5

Kilometres

,000

Legend

Study Area

Quadrat locations

Vegetation Units

- *AaAc*
- *AaEffTp*
- *AaPoTp*
- *AaPoTt*
- *AaSaoTp*
- *AaTssp*
- *AaTp*
- *Tp*
- *EllSggTw*
- *ElAmTssp*
- *AmTw*
- *ApEcTp*
- *ApTssp*
- *AaTb*
- *SggTp*
- *EgSggTb*
- *EllSggTp*
- *AaTt*
- *AlAp*
- *PsTp*
- *SggAbTp*
- *SggIrTw*

ApTb EgKvPm EgKvPm EgKvPm ApTb ApTb

SggGrTp ApEcTp EgKvPm 14 EgKvPm

EllElTp 15 AbPrla EgKvPm SggGrTp

3 AaSaoTp

SggGrTp EgKvPm AbPrla

93 EgKvPm SggGrTp EllElTp

AbPrla AaEm

EgKvPm AaSaoTp AaSlTp EllElTp

100 AaSggEp

20 AmGtTssp

EllElTp 31 AaSaoTp AaPoEp

103 EllElTp AaEm

AaSggEp 25 AaEm AaSaoTp

11 EllElTp EllElTp EllElTp EllElTp

AaEm EllElTp

EllElTp

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Vegetation Units within the West Angelas Study Area
Map D1

Figure: 5.16
Project ID: 1457

Drawn: CP
Date: 23/11/2012

Coordinate System
Name: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994

Unique Map ID: CP153

A3

667800 669600 671400 673200

7434000

7432200

ApEcTp ApTb EgKvPm SggGrTp AbPrIa AaSlTp EllEllTp AaEm ApSgg AaSaoTp ExPnnTt AmGtTssp

92 48 33 30

N

0 0.25 0.5

Kilometres

Legend

Study Area

Quadrat locations

Vegetation Units

- *AaAc*
- *AaEffTp*
- *AaPoTp*
- *AaPoTt*
- *AaSaoTp*
- *AaTssp*
- *AaTp*
- *Tp*
- *EllSggTw*
- *ElAmTssp*
- *AmTw*
- *ApEcTp*
- *ApTssp*
- *AaTb*
- *SggTp*
- *EgSggTb*
- *EllSggTp*
- *AaTt*
- *AlAp*
- *PsTp*
- *SggAbTp*
- *SggIrTw*

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Vegetation Units within the West Angelas Study Area Map D2

Figure: 5.17
Project ID: 1457

Drawn: CP
Date: 23/11/2012

Coordinate System
Name: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994

Unique Map ID: CP153

A3

673200 675000 676800 678600

7434000

7432200

ApEcTp
ApEcTp
ApEcTp
48
SggGrTp
AaSlTp
SggGrTp
102
AbPrIa
SggGrTp
22
AbPrIa
23
34
4
EllEllTp
ApSgg
EllEllTp
AaEm
AaEm
ApSgg
AbPrIa
EllEllTp
AaEm
EllEllTp
AaPoEp

Legend

- Study Area
- Quadrat locations

Vegetation Units

- *AaAc*
- *AaEffTp*
- *AaPoTp*
- *AaPoTt*
- *AaSaoTp*
- *AaTssp*
- *AaTp*
- *Tp*
- *EllSggTw*
- *ElAmTssp*
- *AmTw*
- *ApEcTp*
- *ApTssp*
- *AaTb*
- *SggTp*
- *EgSggTb*
- *EllSggTp*
- *AaTt*
- *AlAp*
- *PsTp*
- *SggAbTp*
- *SggIrTw*

N

0 0.25 0.5

Kilometres

Absolute Scale - 1:15,000

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Vegetation Units within the West Angelas Study Area
Map D3

Figure: 5.18
Project ID: 1457

Drawn: CP
Date: 23/11/2012

Coordinate System
Name: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994

Unique Map ID: CP153

A3

685800 687600 689400 691200

7434000

7432200

Legend

- Study Area
- Quadrat locations

Vegetation Units

- *AaAc*
- *AaEffTp*
- *AaPoTp*
- *AaPoTt*
- *AaSaoTp*
- *AaTssp*
- *AaTp*
- *Tp*
- *EllSggTw*
- *ElAmTssp*
- *AmTw*
- *ApEcTp*
- *ApTssp*
- *AaTb*
- *SggTp*
- *EgSggTb*
- *EllSggTp*
- *AaTt*
- *AlAp*
- *PsTp*
- *SggAbTp*
- *SggIrTw*

N

0 0.25 0.5

Kilometres

Absolute Scale - 1:15,000

ecologia ENVIRONMENT

Vegetation Units within the West Angelas Study Area
Map D5

Figure: 5.19
Project ID: 1457

Drawn: CP
Date: 23/11/2012

Coordinate System
Name: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994

Unique Map ID: CP153

A3

689400 691200 693000 694800

7434000

7432200

ApSgg ApTb EgKvPm ApTb ApTb EgKvPm ApTb EgKvPm ApTb ApTb EgKvPm ChDllTt EgKvPm ChDllTt ChDllTt ApTb ApTb ApTb 123 ApTb 127 AmGtTssp 126 ChDllTt 124 ApTb ApTb ApTb AbPrIa AbPrIa AmGtTssp ChDllTt 111 AbPrIa ChDllTt 106 AbPrIa 99 ExPnnTt ApTb ApTb AaSlTp 98 SggGrTp AmGtTssp 105 112 ChDllTt 107 ApTb ApTb 109 115 114 ApTb PsAjs AaSlTp EgKvPm 116 EgKvPm 118 117 EgKvPm

Legend

- Study Area
- Quadrat locations

Vegetation Units

- *AaAc*
- *AaEffTp*
- *AaPoTp*
- *AaPoTt*
- *AaSaoTp*
- *AaTssp*
- *AaTp*
- *Tp*
- *EllSggTw*
- *ElAmTssp*
- *AmTw*
- *ApEcTp*
- *ApTssp*
- *AaTb*
- *SggTp*
- *EgSggTb*
- *EllSggTp*
- *AaTt*
- *AlAp*
- *PsTp*
- *SggAbTp*
- *SggIrTw*

N

0 0.25 0.5

Kilometres

Absolute Scale - 1:15,000

ecologia ENVIRONMENT

Vegetation Units within the West Angelas Study Area
Map D6

Figure: 5.20
Project ID: 1457

Drawn: CP
Date: 23/11/2012

Coordinate System
Name: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994

Unique Map ID: CP153

A3

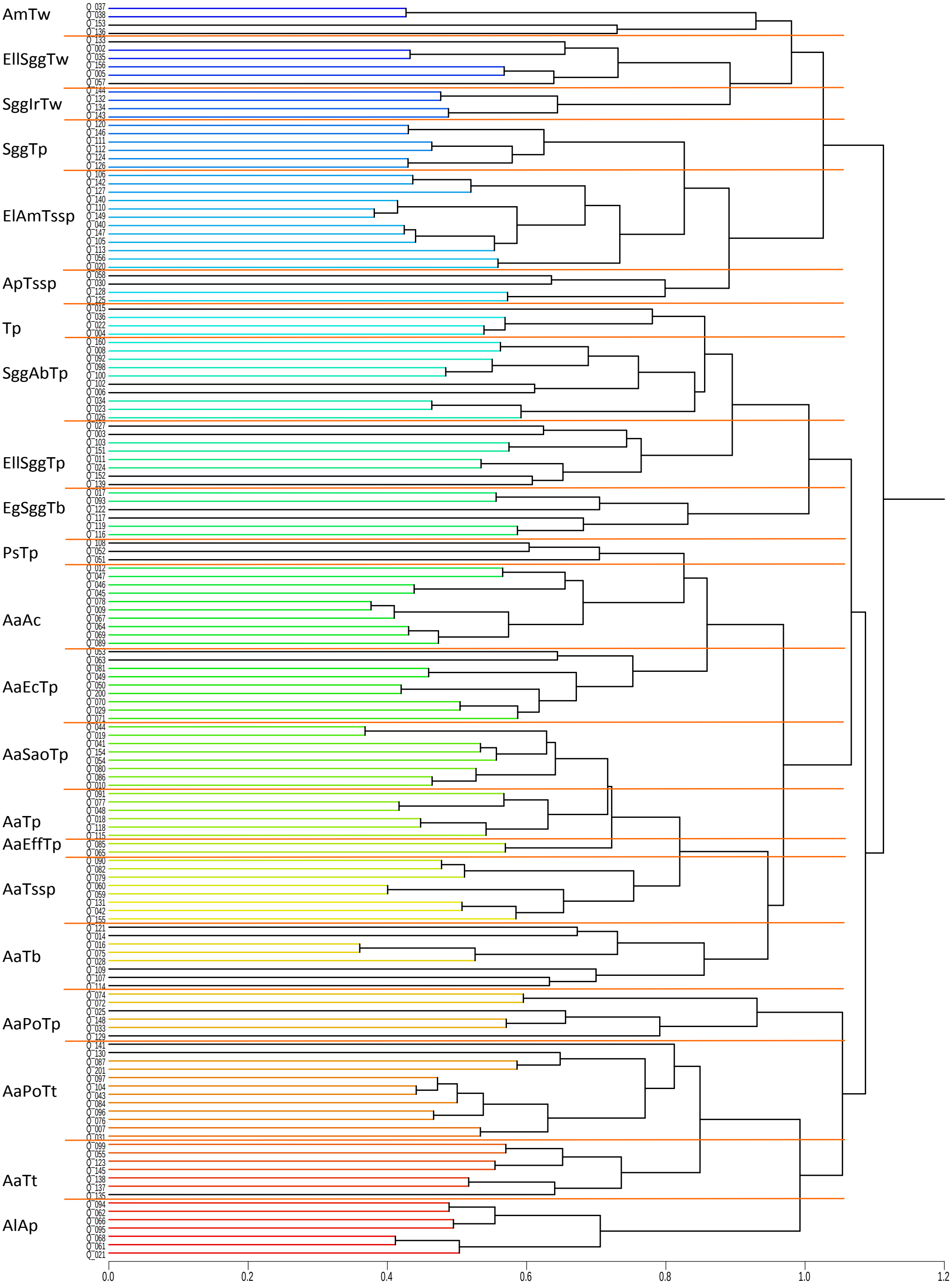

Figure 5.21 - Dendrogram of similarities between quadrats (SYSTAT)

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6 DISCUSSION

The significance of the vegetation and flora of the Study Area has been assessed at four scales: national, state, regional and local.

National significance refers to those features of the environment which are recognised under legislation as being of importance to the Australian community. Flora species and Threatened Ecological Communities (TECs) listed under the EPBC Act are regarded as nationally significant.

State significance refers to those features of the environment that are recognised under state legislation as being of importance to the Western Australian community. It includes species that are listed as Threatened under the WC Act and TECs and PECs listed by the DEC, or vegetation which supports fauna of scheduled status.

Regional significance addresses the representation of species and habitats at a biogeographical level. That is, species or habitat types that are endemic to the Hamersley sub-region or whose distributions are limited or unknown are considered regionally significant.

Vegetation and flora species are of local significance when their presence is confined to a very locallised area or a specialised habitat type that is not common in the local or regional contaxt and whose disturbance or removal may lead to local extinction.

6.1 FLORISTIC RICHNESS

Species richness is a fundamental measurement of community and regional diversity (Gotelli and Colwell 2001). It is the simplest representation of species diversity (Magurran 1988, Fowler and Cohen 1990) and is the basic indicator of diversity used for this survey.

Table 6.1 compares the floristic inventory recorded during the current survey to that recorded in other quadrat-based surveys conducted in the Pilbara. The most directly comparable survey was in 1998 of the Turee Study Area by ME Trudgen & Associates (1998) which was also a large scale survey. In ME Trudgen & Associates a larger area was survyed, encapusulating a greater range of habitats/landsystems which also resulted in a greater number of taxa recorded.

A comparison of survey intensity with that of the remaining previous projects is difficult due to the differing scales of survey sizes.

The survey intensity of the current study (0.85 quadrats/km^2) is considered adequate to the area surveyed; which is reflected in the high number of taxa recorded for its scale.

Table 6.1 – A Comparison of Floristic Richness of Study Area with Nearby Studies

Study Site	Date Surveyed	Number Quadrats Surveyed	Area (km^2)	Quadrats /km^2	Number Taxa Recorded	Number of Taxa/ km^2
Current study	June-August 2012	149	175	0.85	431	2.46
ME Trudgen & Associates 1998	May-Aug 2011	-	353	-	635	1.80
Biota 2010	May-12	37	10	3.70	262	26.20
Rio Tinto 2010	April-10	17	5	3.40	184	36.80
Biota 2006	May-04	41	19	2.16	429	22.58

6.1.1 Flora of National Significance

Lepidium catapycnon is the most significant taxon with regards to conservation status recorded within the current survey and is listed as vulnerable under the EPBC Act. Descriptions of the EPBC Act vulnerability codes can be found in Appendix D. Fourteen other collection points are lodged at the West Australian Herbarium, located within Western Australia and in close proximity each other. Based on collections from the current survey, this taxon is not abundant within the West Angelas Study Area, with 29 individuals from four locations recorded, however further targeted surveys have the potential to expand the known population. There is one known location from within the conservation estate.

Lepidium catapycnon appears to favour the outer edge of creek vegetation and rocky scree slopes that consist of orange-brown (terracotta) coloured clay-loam soil; and it is also favourable to areas where disturbance has exposed sub-soils, particularly of the calcareous type. Thirteen other locations of *Lepidium catapycnon* occur regionally within 40 km of the Study Area, suggesting that the taxon is likely to occur elsewhere within the Study Area (Figure 5.9 and Table 2.8).

The main threat to *L. catapycnon* is mining and exploration activities as its preferred habitat and the majority of recorded populations occur within mining and exploration tenements (Threatened Species Scientific Committee 2008). Processes which have been identified as potential threats to this species include roadworks, as it tends to prefer recently disturbed areas and colonises graded mining and exploration tracks (Threatened Species Scientific Committee 2008). The spread of the introduced species Ruby Dock (*Acetosa vesicaria*, which was also recorded within the Study Area) has been suggested to prevent establishment of this species in some areas (Threatened Species Scientific Committee 2008).

6.1.2 Flora of State Significance

Lepidium catapycnon, as above, is listed as Threatened (formerly Declared Rare Flora) under the WC Act.

6.1.3 Flora of Regional Significance

Thirteen Threatened and Priority Flora taxa were recorded by *ecologia* during the current survey: one Threatened (*Lepidium catapycnon*), three Priority 1 species (*Aristida jerichoensis* var. *subspinulifera, Brachyscome* sp. Wanna Munna Flats (S. van Leeuwen 4662) and *Brunonia* sp. long hairs (D.E. Symon 2440), two Priority 2 species (*Aristida lazaridis* and *Eremophila forrestii* subsp. Pingandy (M.E.

Trudgen 2662), six Priority 3 species (*Acacia* aff. *subtiliformis, Indigofera* sp. Gilesii (M.E. Trudgen 15869)*, Rhagodia* sp. Hamersley (M. Trudgen 17794), *Sida* sp. Barlee Range (S. van Leeuwen 1642), *Themeda* sp. Hamersley Station (M.E. Trudgen 11431) and *Triodia* sp. Mt Ella (M.E. Trudgen 12739) and one Priority 4 species (*Goodenia nuda*). Seven of these have been previously recorded by RT (but not by the DEC) within the Study Area. Table 6.2 summarises the known distribution and abundance of these taxa from all sources, including DEC records. Based on current records of the Western Australian Herbarium (Florabase), of the 13 species recorded within Greater West Angelas, five are not represented within the conservation estate (*Aristida jerichoensis* var. *subspinulifera*, *Brachyscome* sp. Wanna Munna Flats (S. van Leeuwen 4662), *Brunonia* sp. long hairs (D.E. Symon 2440), *Indigofera* sp. Gilesii (M.E. Trudgen 15869) and *Triodia* sp. Mt Ella (M.E. Trudgen 12739). It is possible that future studies in conservation reserves may result in the discovery of these taxa within their boundaries, but as this is not a certainty, these taxa are considered more vulnerable to mining activities, as there is no locality in which a representative population of the species can be preserved.

Aristida jerichoensis var. *subspinulifera* is a Priority One taxon with six known locations within the Pilbara bioregion. It was collected within the West Angelas Study Area, with an estimated 1948 individuals from 44 locations. Previous records for this taxon indicate that it can become locally common in preferred habitat, which is present within hardpan sandplains within the Study Area.

Brunonia sp. long hairs (D.E. Symon 2440), Priority One, was collected from 10 locations in the current survey, with 20 individuals recorded. It tends to occur as scattered individuals growing on floodplains and rangelands in red sandy-clay soils. *Brunonia* sp. long hairs is taxonomically similar to *Brunonia australis sensu lato*, which is a phenotypically plastic species occurring in a wide variety of environments across Australia, and is highly variable with respect to the degree of hairiness (Carolin 1992). Current advice form the Western Australian Herbarium is that the two are likely to be amalgamated in the future (Hislop 2012, *pers. comm.*), but as this change has not yet been adopted by the Western Australian Herbarium, *Brunonia* sp. long hairs is considered distinct and regarded as Priorty Flora species for in this study.

Records of two taxa represent significant range extensions; *Corymbia zygophylla* and *Euphorbia schultzii*. These range extensions may reflect the boundary of the species habitat, but are also likely to result from a lack of collection and/or lodgement. One other taxon has been recorded for the first time in the Pilbara Bioregion: *Maireana lanosa*. It is not considered a significant range extension as it does not exceed 100 km in distance from a known record; but it expands the population occurrence in terms of regional distribution.

Table 6.2 – Regional Distribution of Priority Flora Recorded during the Current Survey

Species	Status	RT Locations in Study Area	*ecologia* Locations in Study Area	Number of Individuals Recorded	Florabase (regional) records	Bioregions of occurrence	Records within Conservation Estates	Recorded abundance elsewhere
Lepidium catapycnon	T	0	4	29	14	Pilbara	1	Isolated populations
Aristida jerichoensis var. *subspinulifera*	P1	0	44	1948	6	Pilbara	0	Locally common
Brachyscome sp. Wanna Munna Flats (S. van Leeuwen 4662)	P1	0	2	2	10	Gascoyne, Pilbara	0	Uncommon
Brunonia sp. long hairs (D.E. Symon 2440)	P1	0	10	20	3	Central Ranges, Pilbara	0	Uncommon
Aristida lazaridis	P2	1	3	23	3	Pilbara	1	Rare
Eremophila forrestii subsp. Pingandy (M.E. Trudgen 2662)	P2	1	1	1	4	Pilbara	3	Common
Acacia aff. *subtiliformis*	P3	0	3	250	11	Pilbara	1	Locally abundant
Indigofera sp. Gilesii (M.E. Trudgen 15869)	P3	37	23	232	16	Central Ranges, Pilbara, Tanami	0	Common
Rhagodia sp. Hamersley (M. Trudgen 17794)	P3	7	31	81	23	Gascoyne, Pilbara	2	Common
Sida sp. Barlee Range (S. van Leeuwen 1642)	P3	6	7	42	30	Gascoyne, Pilbara	5	Locally Common
Themeda sp. Hamersley Station (M.E. Trudgen 11431)	P3	3	7	3505	20	Pilbara	1	Locally Uncommon
Triodia sp. Mt Ella (M.E. Trudgen 12739)	P3	39	9	300	14	Pilbara	0	Locally Common
Goodenia nuda	P4	0	2	2	37	Gascoyne, Pilbara	1	Locally Common

6.2 VEGETATION OF CONSERVATION SIGNIFICANCE

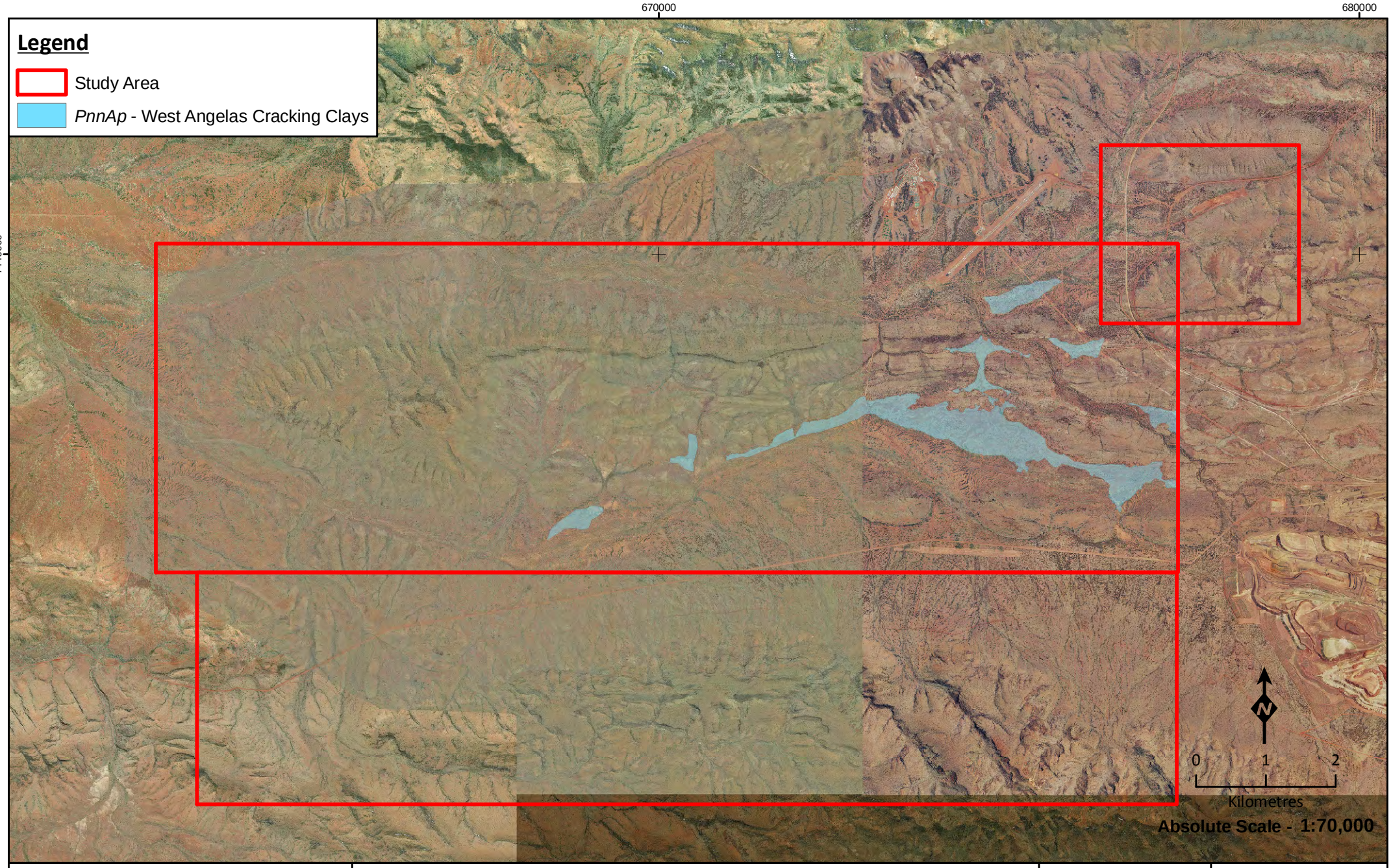
6.2.1 Vegetation of National Significance

National significance refers to those features of the environment which are recognised under legislation as being of importance to the Australian community. TECs listed under the EPBC Act are regarded as nationally significant. Currently, there are no nationally-listed TECs that occur within 40 km of the Study Area.

6.2.2 Vegetation of State Significance

State significance refers to those features of the environment that are recognised under State legislation as being of importance to the Western Australian community, in particular, communities listed as TECs or PECs. Ecological communities with insufficient information available to be considered a TEC, or which are rare but not currently threatened, are placed on the Priority list and referred to as PECs.

One Priority 1 PEC; West Angelas Cracking-Clays, occurs extensively within the Study Area (Figure 2.7). This portion of the Study Area was relatively accessible and no new areas of this community were observed outside of previously defined locations. The biggest threat to this PEC is from mining activities and associated infrastructure (Kendrick 2001). In this survey it was identified as vegetation unit *AlAp* (*Aristida latifolia, Astrebla pectinata* and *Brachyachne convergens* tussock grassland with isolated *Salsola australis, Boerhavia paludosa* and *Ptilotus nobilis* subsp. *nobilis* forbs) and covers an area of 302.23 ha (Figure 6.1). The PEC is officially described by the DEC as "open tussock grasslands of *Astrebla pectinata*, *A. elymoides*, *Aristida latifolia*, in combination with *Astrebla squarrosa* and low scattered shrubs of *Sida fibulifera*, on basalt derived cracking-clay loam depressions and flowlines". The vegetation unit *AlAp* shares the dominant grasses of *Aristida latifolia* and *Astrebla pectinata*, but the remaining species typical of the PEC were not present as dominants. However, *Sida fibulifera* was recorded in five of the seven quadrats of this vegetation type, although not in high abundances. *Astrebla elymoides* was not recorded at all within the study area. This species is known to occur in the West Angelas PEC but is difficult to identify later in the season when tussock grass heads have dicintergrated. Specifically for tussock grassland communties the survey timing may not have been optimal.



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Distribution of PEC Unit *PnnAp* within the Greater West Angelas Study Area

Figure: 6.1
Project ID: 1457

Drawn: CP
Date: 23/11/2012

Coordinate System
Name: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994

Unique Map ID: CP173

A4

Assessment of the significance at a state level of the vegetation of the Study Area is constrained by the lack of mapping across the state at a scale comparable to the mapping conducted during the current survey. The only source of vegetation mapping available across the state is that conducted by Beard (and in some instances co-authors) at a scale of 1:1,000,000. Beard attempted to map the vegetation as it would have been prior to European settlement (Beard 1976). Subsequently this dataset has been digitised and reinterpreted by the Department of Agriculture and Food to provide an estimate of current representations of these vegetation units (Shepherd *et al*. 2001). The spatial data provides an insight into the loss of vegetation as a result of settlement, its preservation within the conservation estate and its natural abundance. It has been used in the evaluation of conservation priorities for vegetation by the Northern Agricultural Region Native Vegetation Management Plan (Department of Environment and Conservation 2008), the Australian National Resources Atlas Biodiversity Assessment (Department of Sustainability Environment Water Population and Communities 2009) and the Biodiversity Audit of Western Australia (Department of Conservation and Land Management 2003).

Table 6.3 details the extent of these units within the Study Area, State and within land managed by the DEC. Table 6.3 shows that units 18 and 82 occur extensively and are relatively well represented within the conservation estate. The combined area of units 18 and 82 within the Study Area is <0.5% of their total representation and therefore the vegetation is well represented outside of the Study Area.

Table 6.3 – Representation of Shepherd Vegetation Units Within the State and Study Area

Shepherd/Beard Units		Area* in Western Australia (km^2)	Conservation Reserves		Representation Within the Study Area	
No.	Beard Description		Total Area Within DEC Managed Lands** (km^2)	Total Extent within Cons. Reserves (%)	Extent* (km^2)	Total Extent Within Study Area (%)
18	*Acacia* open shrubland / Ptilotus mixed open forbland	199,807.3	12,440.8	6.2	89.7	0.04
82	Hummock grasslands, low tree steppe; snappy gum over *Triodia wiseana*	25,655.7	2,692.1	10.5	85.9	0.33

*The current Native Vegetation Extent dataset may contain some polygon errors such as overlaps (Department of Agriculture and Food).

** DEC Managed Lands as at June 2009

Vegetation is of conservation significance if it has "a role as a key habitat for threatened species" (EPA 2004, page 30). In this context the degree to which Priority taxa were localised to particular vegetation units was also assessed (Table 6.4).

Lepidium catapycnon (T) appears to have a high specificity to the vegetation unit *SggIrTw,* rocky hillslopes, accounting for 100% of all plants recorded. The vegetation unit *SggIrTw* is widespread in the study area (1,045 ha), and it is likely that the threatened species occurs in a particular habitat within the community. Nonetheless, this unit is significant due to the rarity of the species it supports. Similarly, *Aristida jerichoensis* var. *subspinulifera* (P1), although being present within 10 vegetation units, demonstrates a higher specificity to unit *AaTp* (sandy undulating plains) with 40.9% of locations and 57.9% of individuals recorded within this unit. *Indigofera* sp. Gilesii (M.E. Trudgen 15869) demonstrates specificity for the vegetation unit *SggTp,* rocky midslopes, with 47.8% of all locations and 31.9% of individuals recorded in this unit. *Sida* sp. Barlee Range (S. van Leeuwen 1642) favoured vegetation unit *AaPoTp,* which is only found in gullies and gorges, with 42.9% of the locations recorded in this unit.

Vegetation units *SggIrTw* (rocky hilltops) and *AaEcTp* (sandy plains) support five individual threatened and/or priority taxa. Collectively, these units account for eight out of the 13 Threatened and Priority Flora recorded in the survey: *Aristida jerichoensis* var. *subspinulifera*, *Brachyscome* sp. Wanna Munna Flats, *Brunonia* sp. long hairs, *Goodenia nuda, Indigofera* sp. Gilesii (M.E. Trudgen 15869), *Lepidium catapycnon*, *Rhagodia* sp. Hamersley and *Sida* sp. Barlee Range.

Table 6.4 – Assessment of Specificity of Priority Taxa to West Angelas Vegetation

Taxon	Status	Vegetation Unit	Records		Individuals	
			Count	%	Count	%
Lepidium catapycnon	T	*SggIrTw*	4	1.0	29	1.0
Aristida jerichoensis var. *subspinulifera*	P1	*AaAc*	5	11.4	201	10.1
		AaSaoTp	2	4.5	15	0.8
		AaTssp	1	2.3	5	0.3
		AaTp	18	40.9	1155	57.9
		AaEcTp	1	2.3	5	0.3
		AaTb	1	2.3	50	2.5
		EgSggTb	4	9.1	66	3.3
		AaTt	1	2.3	10	0.5
		PsTp	10	22.7	486	24.4
		SggIrTw	1	2.3	1	0.1
Brachyscome sp. Wanna Munna Flats (S. van Leeuwen 4662) PN	P1	*AaEcTp*	1	0.5	1	0.3
		PsTp	1	0.5	2	0.7
Brunonia sp. long hairs (D.E. Symon 2440)	P1	*AaAc*	1	10.0	5	13.9
		AaTp	1	10.0	2	5.6
		EllSggTw	1	10.0	2	5.6
		AaEcTp	4	40.0	9	25.0
		ApTssp	1	10.0	15	41.7
		EllSggTp	1	10.0	2	5.6
		SggAbTp	1	10.0	1	2.8
Aristida lazaridis	P2	*AaTp*	1	33.3	20	74.1
		AaTt	1	33.3	5	18.5
		PsTp	1	33.3	2	7.4
Eremophila forrestii subsp. Pingandy (M.E. Trudgen 2662)	P2	*AaTssp*	1	100.0	1	100.0
Acacia aff. *subtiliformis*	P3	*EllSggTw*	3	100.0	250	100.0
Indigofera sp. Gilesii (M.E. Trudgen 15869)	P3	*AaPoTp*	3	13.0	15	5.4
		ElAmTssp	2	8.7	27	9.7
		SggTp	11	47.8	89	31.9
		EgSggTp	4	17.4	45	16.1
		SggAbTp	1	4.3	2	0.7
		SggIrTw	2	8.7	101	36.2
Rhagodia sp. Hamersley (M. Trudgen 17794)	P3	*AaAc*	3	9.7	9	9.4
		AaEffTp	1	3.2	5	5.2
		AaSaoTp	2	6.5	6	6.3
		AaTp	6	19.4	13	13.5
		EllSggTw	2	6.5	4	4.2
		AaEcTp	2	6.5	8	8.3
		PsTp	8	25.8	29	30.2
		SggAbTp	1	3.2	2	2.1
		SggIrTw	6	19.4	20	20.8
Sida sp. Barlee Range (S. van Leeuwen 1642)	P3	*AaPoTp*	3	42.9	18	33.3
		EllSggTp	2	28.6	2	3.7
		SggIrTw	2	28.6	34	63.0
Themeda sp. Hamersley Station (M.E. Trudgen 11431) PN	P3	*AaTssp*	1	14.3	1000	28.3
		EllSggTw	1	14.3	500	14.1
		AlAp	5	71.4	2035	57.6
Triodia sp. Mt Ella (M.E. Trudgen	P3	*AaPoTp*	2	25.0	105	31.2

Taxon	Status	Vegetation Unit	Records		Individuals	
			Count	%	Count	%
12739)		*Tp*	2	25.0	82	24.3
		ElAmTssp	3	37.5	120	35.6
		SggTp	1	12.5	30	8.9
Goodenia nuda	P4	*AaEcTp*	1	50.0	5	71.4
		AaTb	1	50.0	2	28.6

6.2.3 Vegetation of Regional Significance

The regional inventory of the Pilbara Rangelands undertaken by Van Vreeswyk *et al.* (2004) and the Ashburton Rangelands surveyed by Payne *et al* (1982) provides some insight into the distribution of broad scale vegetation in a regional context. Of the seven land systems recorded within the Study Area, no single system represents more than one percent of the total land system mapped in the PIR and AIR. This indicates that each land system is represented well in a regional context.

6.2.3.1 Groundwater Dependent Ecosystems

Groundwater Dependent Ecosystems (GDEs) are defined by their dependence on groundwater for their continued survival. Dependence at any stage(s) during a lifecycle is considered sufficient to be defined as a GDE (Eamus 2009). Whilst some ecosystems may use groundwater reserves they may not be entirely dependent on them and hence are not defined as a GDE.

Of the four known types of GDEs described by Hatton *et al* (1998) (Terrestrial vegetation, River base flow systems, Wetlands and Aquifer/Cave ecosystems), only River base flow systems are present within the West Angelas Study Area. These ecosystems are characterised by the presence of species that have been found to rely on groundwater sources for water intake, known as phreatophytic species (Maunsell Australia 2006). Three species known to be phreatophytic are known to occur within the vicinity of the Study Area: *Eucalyptus camaldulensis* subsp. *refulgens*, *Melaleuca argentea* and *Eucalyptus victrix* (facultative phreatophyte). The degree to which *E. victrix* is an obligate phreatophyte is not well defined and may vary from location to location.

While *E. victrix* is the only phreatophytic species that was confirmed with reporoductive material within the West Angelas Study Area, *E. camaldulensis* is also known to be present along major drainage lines and is likely to occur within vegetation unit *AaPoTt*. This unit supports variable densities of *E. victrix* and therefore may be a vadophytic ecosystem (i.e. supporting plants that rely on moisture in the soil surface profile) or occasionally phreatophytic, and on this basis has been qualified as a potential GDE. Using the precautionary principles outlined in Position Statement 3, this vegetation unit is regarded as a potential GDE for this study. These vegetation units are localised to the Turee Creek area, which runs across the north of the Study Area (Figure 6.2).

6.2.3.2 Sheet-Flow Dependent Vegetation

Sheet-flow Dependent Vegetation

Groved and banded mulga communities growing on relatively flat plains are widely recognised as being dependent on patterns of surface water flow. The term "mulga" describes a group of *Acacia* species that were previously referred to as varieties of *Acacia aneura*. The species currently in this group include: *Acacia aneura*, *A. aptaneura*, *A. caesaneura*, *A. fuscaneura*, *A. incurvaneura*, *A. macraneura*, *A. mulganeura* and *A. pteraneura*. The species within the mulga group are bushy shrubs

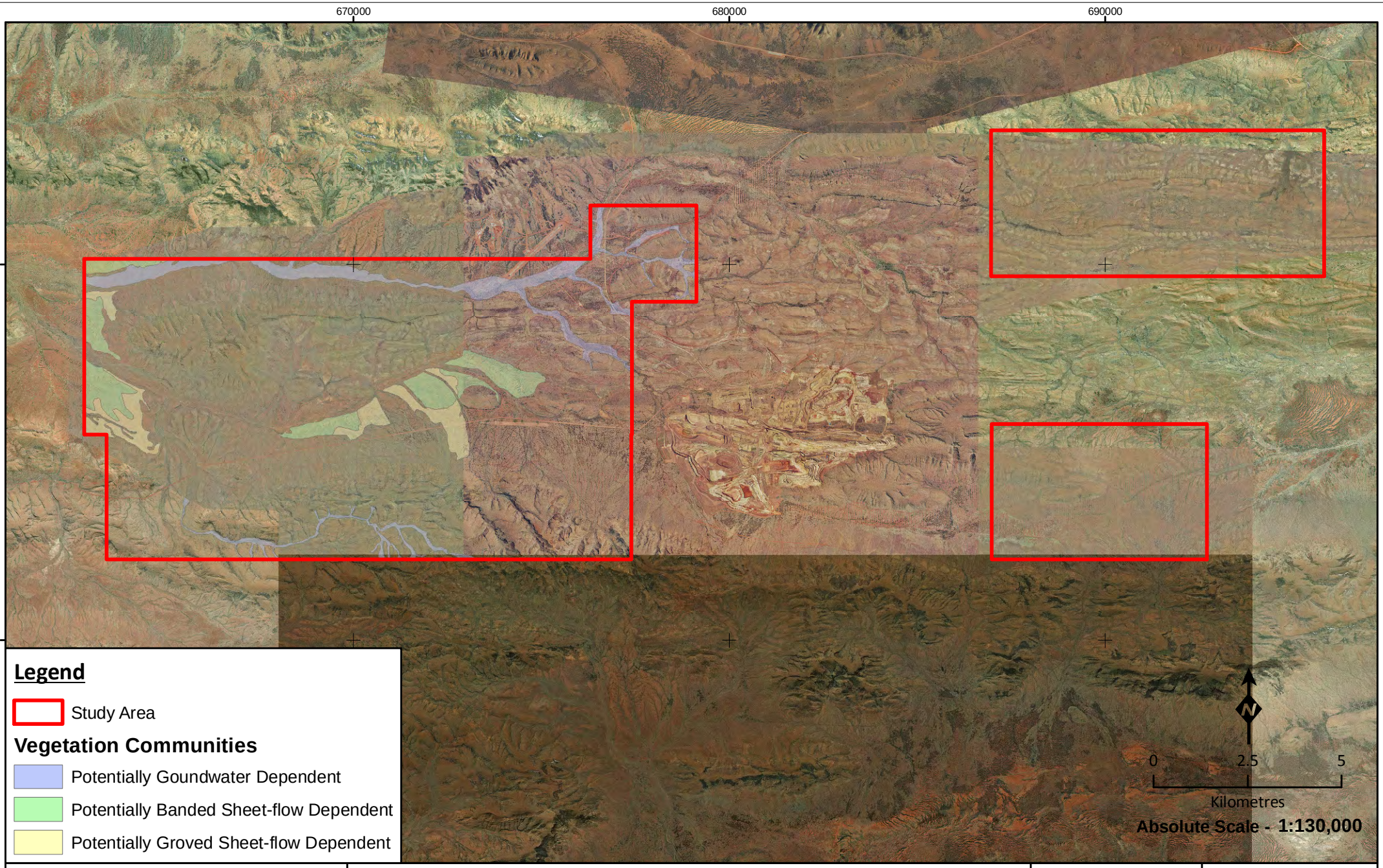
or trees ranging in height from 2-10 m, with considerable variation in growth form and phyllode morphology.

Sheet flows carry material (including seeds and other organic and inorganic debris) which is trapped by existing vegetation. his leads to the formation of a mosaic pattern of groves and banded vegetation with relatively bare areas in between. Thus the development and retention of mulga groves is directly dependent upon sheet flow. The different forms of Mulga (banded or groved) result from the position within the landscape and the availability of sheet flows of surface water. It is therefore thought that the susceptibility to alterations in sheet flow may also differ between banded and groved Mulga. However, both forms are potentially affected when sheet flow is disrupted within a landscape (University of Western Australia 2010).

Mulga has a root system that is adapted for taking up water from thin surface soils and has adaptations that concentrate soil water near the plant and conserve water within the plant. Consequently, the distribution and abundance of mulga is particularly influenced by soil moisture and the pattern of surface drainage (Paczkowska and Chapman, 2000). Construction can have an impact on sheet flow by creating a barrier on flow that increases the quantity of water on one side and decreases it on the other, or diverts the flow to a different area. Alterations to sheet-flow are likely to be greater in close proximity to the construction, but estimating impact is speculative and requires hydrogeological modelling. Until the shadow effect of a proposed development can be determined and the impact adequately assessed, a precautionary approach should be taken.

The diversion of sheet flow or concentration of sheet flow to particular areas is likely to deprive or waterlog soils, with deleterious impacts on mulga. Hence areas with very shallow topography, which commonly support mulga, are likely to be more susceptible. The current analysis has identified banded or groved mulga communities on shallow topography as potentially Sheet Flow Dependent Vegetation (SDV).

The vegetation unit *AaEcTp* (*Acacia* open woodland over *Eremophila* isolated shrubs over *Triodia* open grassland) supports groved and banded mulga communities and is considered likely to be sheet-flow dependent. The distribution of this unit is detailed in Figure 6.2. Other vegetation communities described in this survey are characterised by mulga species, but due to the fact that the trees do not occur in groved or banded patterns, they have not been included in the mapping.



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Sheet-flow and Groundwater Dependent Ecosystems of the West Angelas Study Area

Figure: 6.2
Project ID: 1457

Drawn: CP
Date: 23/11/2012

Coordinate System
Name: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994

Unique Map ID: CP150

A4

6.2.4 Vegetation of Local Significance

In a local context, vegetation can be considered significant if it is locally uncommon or is associated with habitats of local significance. Vegetation of local significance is not legislatively protected but is of conservation value if areas are restricted and have not been identified to occur outside the Study Area. The least extensive vegetation units locally are *AaEffTp* (141.54 ha) and *AmTw* (108.7 ha), which represent 0.80 % and 0.62% of the Study Area, respectively (Table 6.5).

Vegetation which supports rare flora is also considered locally significant. Vegetation units *AaPoTp, AaTp, SggTp* and *SggIrTw* all support Priority or Threatened flora. In particular, vegetation units *SggIrTw* (rocky hilltops) and *AaEcTp* (sandy plains) support five individual threatened and/or priority taxa. Collectively these units account for eight out of the 13 threatened and priority flora recorded in the survey: *Aristida jerichoensis* var. *subspinulifera*, *Brachyscome* sp. Wanna Munna Flats, *Brunonia* sp. long hairs, *Goodenia nuda, Indigofera* sp. Gilesii (M.E. Trudgen 15869), *Lepidium catapycnon*, *Rhagodia* sp. Hamersley and *Sida* sp. Barlee Range.

Table 6.5 – Local Extent of Vegetation Units within the West Angelas Study Area.

Unit	Landform	Vegetation Description	Area (ha)	% Total
AaAc	Floodplain/Drainage Line	*Acacia aptaneura* and *A. pruinocarpa* open woodland over *Aristida contorta* sparse tussock grassland over *Pterocaulon sphacelatum* and *Ptilotus nobilis* subsp. *nobilis* isolated forbs.	505.39	2.87
AaEffTp	Rocky Midslope	*Acacia aptaneura* and *A. pruinocarpa* open woodland over sparse *Eremophila fraseri* subsp. *fraseri* and *Acacia marramamba* sparse shrubland over *Triodia pungens* sparse hummock grassland.	141.54	0.80
AaPoTp	Gully	*Acacia aptaneura* open woodland over *Ptilotus obovatus* isolated shrubs over *Themeda triandra* and *Eriachne mucronata* open tussock grassland.	319.01	1.81
AaPoTt	Sandy Floodplain	*Acacia aptaneura* open woodland over *Ptilotus obovatus* sparse shrubland over *Themeda triandra* open tussock grassland.	706.06	4.01
AaSaoTp	Floodplain/Drainage Line	*Acacia aptaneura* and *A. ayersiana* open woodland over *Senna artemisioides* subsp. *oligophylla, S. glutinosa* subsp. *glutinosa* and *Eremophila forrestii* subsp. *forrestii* sparse shrubland over *Triodia pungens* open hummock grassland.	447.27	2.54
AaTssp	Rocky Footslope	*Acacia aptaneura* and *A. pruinocarpa* open woodland over *A. tetragonophylla, Senna glutinosa* subsp. *glutinosa* and *S. artemisioides* subsp. *oligophylla* isolated shrubs over *Triodia wiseana* and *T. pungens* open hummock grassland.	927.28	5.27
AaTp	Sandy Undulating Plain	*Acacia pruinocarpa, A. aptaneura* and *A. ayersiana* woodland over *Triodia pungens* open hummock grassland.	982.26	5.58
Tp	Rocky Midslope	*Eucalyptus leucophloia* subsp. *leucophloia* and *Acacia pruinocarpa* isolated trees over *Senna glutinosa* subsp. *glutinosa, A. bivenosa* and *Ptilotus rotundifolius* isolated shrubs over *Triodia pungens* or *T. basedowii* or *T.* sp. Mt Ella hummock grassland.	975.86	5.55
AaTb	Rocky Hilltop	*Acacia aptaneura* and *A. pruinocarpa* open woodland over *A. bivenosa* isolated shrubs *Triodia basedowii* and *T. pungens* open hummock grassland.	1,227.4	6.98
EllSggTw	Rocky Hilltop	*Eucalyptus leucophloia* subsp. *leucophloia* and *Acacia aptaneura* open woodland over *Senna glutinosa* subsp. *glutinosa* and *S. artemisioides* subsp. *oligophylla* open shrubland over *Triodia wiseana* or *T. pungens* open hummock grassland	1,215.97	6.91
EllAmTssp	Rocky Hilltop	*Eucalyptus leucophloia* subsp. *leucophloia* and *E. gamophylla* open woodland over *Acacia maitlandii, A. hamersleyensis, Keraudrenia velutina* and *Senna glutinosa* subsp. *glutinosa* open shrubland over *Triodia wiseana* and/or *T. pungens* and/or *T. basedowii* open hummock grassland.	108.7	0.62
AmTw	Sandy Plain/Riverbed	*Eucalyptus leucophloia* subsp. *leucophloia* isolated trees over *Acacia maitlandii* sparse shrubland over *Triodia wiseana* and *T. longiceps* hummock grassland.	1,769.85	10.06
AaEcTp	Rocky Midslope	*Acacia aptaneura* and *A. pruinocarpa* open woodland over *Eremophila caespitosa* and *Tribulus suberosus* isolated shrubs over *Triodia pungens* open hummock grassland	292.18	1.66
ApTssp	Gravely Plain	*Acacia pruinocarpa* and *Eucalyptus leucophloia* subsp. *leucophloia* open woodland over *Senna glutinosa* subsp. *glutinosa* and *A. maitlandii* isolated shrubs over *Triodia basedowii* or *T. pungens* or *T. wiseana* open hummock grassland.	,	8.60
SggTp	Rocky Midslope	*Eucalyptus leucophloia* subsp. *leucophloia* and *Corymbia hamersleyana* isolated trees over *Senna glutinosa* subsp. *glutinosa* and *Acacia maitlandii* sparse shrubland over *Triodia pungens* open hummock grassland.	210.6	1.20
EgSggTb	Floodplain/Drainage Line	*Eucalyptus gamophylla* and *Corymbia deserticola* subsp. *deserticola* open woodland over *Senna artemisioides* subsp. *oligophylla* and *Indigofera monophylla* sparse shrubland over *Triodia basedowii* and *T. pungens* open hummock grassland	309.52	1.76
EllSggTp	Rocky Hilltop	*Eucalyptus leucophloia* subsp. *leucophloia* and *Acacia marramambra* open woodland over *Senna glutinosa* subsp.	2,491.87	14.16

Unit	Landform	Vegetation Description	Area (ha)	% Total
		glutinosa open shrubland over *Triodia pungens* open hummock grassland		
AaTt	Sandy Floodplain	*Acacia aptaneura* and *Eucalyptus xerothermica* woodland over *Ptilotus obovatus* isolated shrubs over *Themeda triandra* open tussock grassland	391.54	2.23
AlAp	Sandy Plain	*Aristida latifolia, Astrebla pectinata* and *Brachyachne convergens* tussock grassland with isolated *Salsola australis, Boerhavia paludosa* and *Ptilotus nobilis* subsp. *nobilis* forbs	302.23	1.72
PsTp	Sandy Plain	*Acacia aptaneura* or *A. ayersiana* open woodland over *Pterocaulon sphacelatum* and *Dysphania kalparri* sparse forbland with *Triodia pungens* open hummock grassland	174.39	0.99
SggAbTp	Gravely Plain	*Acacia pruinocarpa* and *Eucalyptus leucophloia* subsp. *leucophloia* or *Corymbia hamersleyana* isolated trees over *Senna glutinosa* subsp. *glutinosa, Acacia bivenosa* and *Gossypium robinsonii* open shrubland over *Triodia pungens* hummock grassland	1,539.18	8.75
SggIrTw	Rocky Hilltop	*Acacia inaequilatera* isolated trees over *Senna glutinosa* subsp *glutinosa* and *Indigofera rugosa* open shrubland over *Triodia wiseana* hummock grassland	1,045.87	5.94
TOTAL			17,596.58	100

Shading highlights vegetation units considered to be of local conservation significance due to their rarity.

Shading highlights vegetation units considered to be of local conservation significance due to specificity of rare flora.

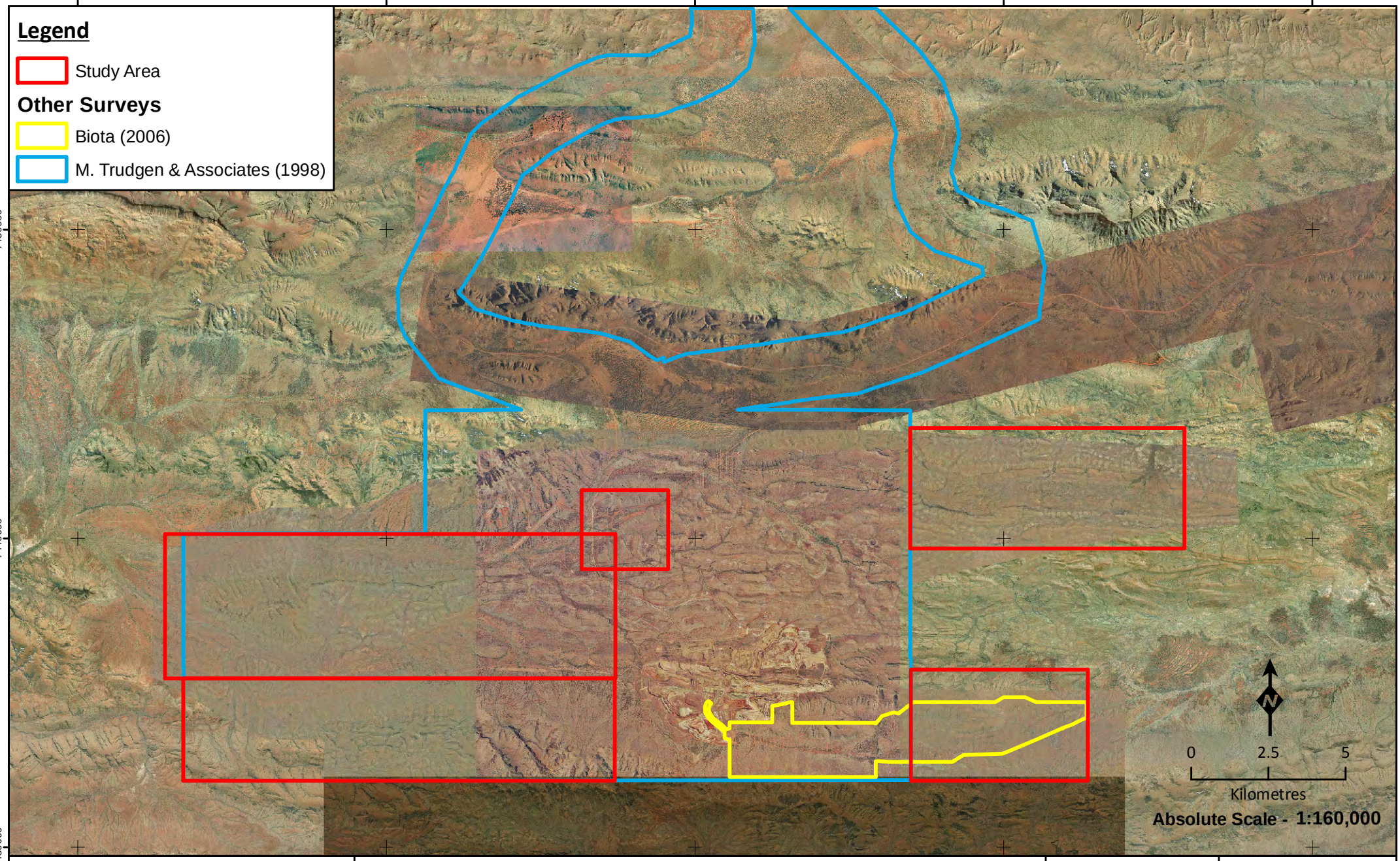
6.3 COMPARISON OF LOCAL VEGETATION COMMUNITIES

One hundred and fifty quadrats were used to define 22 vegetation units within the Study Area. All vegetation units from the ME Trudgen & Associates (1998), Biota (2006) and Biota (2010) surveys were compared with the current survey's data. The use of multivariate software SYSTAT™ was not possible in this instance as the species by site matrices were not available.

Vegetation communities were instead analysed by comparing the spatial data, vegetation descriptions and associated species to align the most similar units between each project. The species used to describe the vegetation units are paramount to the comparison, and it is possible, therefore, that the results drawn from this comparison would be different to results derived from species by site matrices data.

When vegetation units from the current survey (22 units from 150 quadrats) were compared to the ME Trudgen & Associates (1998) survey it was apparent that the quadrat density of the current survey allowed the majority of the vegetation to be mapped at a finer scale. Multiple vegetation units from the current survey were classified as the same under the broader units defined by ME Trudgen & Associates. The exception to this is the riverine/floodplain communities which were mapped at a finer scale by M. Trudgen & Associates when compared to the current survey. This is depicted in Table 6.6 where it can be seen that vegetation unit *AaPoTt* from the current survey is comparable to units 2cab, 2cac and 6/2ef from the ME Trudgen & Associates survey in the same area. The mapping boundaries of the ME Trudgen & Associates survey extended beyond that of the current survey resulting in just 29 of the 54 communities defined by ME Trudgen & Associates represented within the current Study Area. Table 6.6 depicts a comparison of units from each survey that are the most directly comparable, whilst also indicating regional distribution outside of the current Study Area.

Vegetation communities of the current survey were also co-analysed with units described in the 2006 Biota survey of Deposits E and F. The mapping of these two surveys was completed at a comparable scale and vegetation units corresponded well based on location, description and associated species as depicted in Table 6.7. Approximately 50% of the area surveyed by Biota falls outside of the current Study Area, although, of the 12 units described by Biota, 10 of the vegetation units identified in the current survey match well and are interpreted to be equivalent.



ecologia ENVIRONMENT

Location of West Angelas, M. Trudgen & Associates (1998) and Biota (2006) Study Areas

Figure: 6.3
Project ID: 1457

Drawn: CP
Date: 23/11/2012

Coordinate System
Name: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994

Unique Map ID: CP151

A4

Table 6.6 – Comparison of Trudgen & Associates Vegetation Units within the Study Area

ecologia 2012 Vegetation Units		ME Trudgen & Associates (1998) Vegetation Units		Area outside of Study Area (ha)
Vegetation Unit	**NVIS level VI Description**	**Vegetation Unit**	**NVIS level V Description**	
AaAc	*Acacia aptaneura* and *A. pruinocarpa* open woodland over *Aristida contorta* sparse tussock grassland over *Pterocaulon sphacelatum* and *Ptilotus nobilis* subsp. *nobilis* isolated forbs.	*6/2ef*	*Eucalyptus victrix* open woodland over *Acacia aneura* var. *longicarpa* scattered tall shrubs over *Enneapogon* sp. and *Eriachne benthamii* tussock grassland over *Eragrostis pergracilis* and *Aristida contorta*	978.55
		6adb215	*Aristida contorta* open annual tussock grassland	17.39
AaPoTp	*Acacia aptaneura* and *A. pruinocarpa* open woodland over sparse *Eremophila fraseri* subsp. *fraseri* and *Acacia marramamba* sparse shrubland over *Triodia pungens* sparse hummock grassland.	*5edaf*	*Acacia aneura* var. *longicarpa* and *Acacia rhondophloia* high shrubland over *Eremophila fraseri* ssp. *fraseri*, *Eremophila lachnocalyx* and *Eremophila exilifolia* shrubland over *Triodia pungens* open hummock grassland	0.00
AaPoTt	*Acacia aptaneura* open woodland over *Ptilotus obovatus* isolated shrubs over *Themeda triandra* and *Eriachne mucronata* open tussock grassland.	*2cab*	*Eucalyptus xerothermica* low open woodland over *Acacia pruinocarpa* scattered tall shrubs over *Maireana* spp. Scattered low shrubs over *Triodia pungens* open hummock grassland with *Themeda triandra* scattered tussock grass	81.79
		2cac	*Eucalyptus xerothermica* scattered low trees over *Acacia aneura* var. *longicarpa* and *Acacia* aff. *aneura* high shrubland over *Themeda triandra* and *Chrysopogon fallax* very open tussock grassland with *Triodia pungens* and *Triodia wiseana* scattered hummock grass	879.89
		6/2ef	*Eucalyptus victrix* open woodland over *Acacia aneura* var. *longicarpa* scattered tall shrubs over *Enneapogon* sp. and *Eriachne benthamii* tussock grassland over *Eragrostis pergracilis* and *Aristida contorta*	978.55
AaSaoTp	*Acacia aptaneura* and *A. ayersiana* open woodland over *Senna artemisioides* subsp. *oligophylla, S. glutinosa* subsp. *glutinosa* and *Eremophila forrestii* subsp. *forrestii* sparse shrubland over *Triodia pungens* open hummock grassland.	*5edacl*	*Eucalyptus gamophylla* scattered low trees over *Acacia bivenosa* and *Acacia pyrifolia* scattered tall shrubs over *Triodia pungens* and *Triodia longiceps* open hummock grassland	288.48
AaTssp	*Acacia aptaneura* and *A. pruinocarpa* open woodland over *A. tetragonophylla, Senna glutinosa* subsp. *glutinosa* and *S. artemisioides* subsp. *oligophylla* isolated shrubs over *Triodia wiseana* and *T. pungens* open hummock grassland.	*5edb*	*Acacia ayersiana*, *Acacia* aff. *aneura* (narrow green), *Acacia* Aff. *catenulata*, *Acacia* aff. *aneura* (grey, bushy form) and *Acacia* aff. *aneura* (scythe-shaped) high open shrubland over *Maireana* spp. low scattered shrubs over *Triodia pungens* very open hummock grassland	2,762.56
AaTp	*Acacia pruinocarpa, A. aptaneura* and *A. ayersiana* woodland over *Triodia pungens* open hummock grassland.	*6adb26*	*Acacia* aff. *aneura* (scythe-shaped; MET 15,743), *A. pruinocarpa* scattered tall shrubs over *Triodia pungens* open hummock grassland with *Themeda triandra* scattered tussock grasses	231.33

ecologia 2012 Vegetation Units		ME Trudgen & Associates (1998) Vegetation Units		Area outside of Study Area (ha)
Vegetation Unit	**NVIS level VI Description**	**Vegetation Unit**	**NVIS level V Description**	
		6adb213	*Acacia* aff. *aneura* (scythe-shaped; MET 15,743), *A. pruinocarpa*, A. aff. *aneura* (grey, bushy form; MET 15,732 high shrubland over *Eremophila forrestii* subsp. *forrestii* scattered shrubs over *Triodia pungens* very open hummock grassland	246.47
Tp	*Eucalyptus leucophloia* subsp. *leucophloia* and *Acacia pruinocarpa* isolated trees over *Senna glutinosa* subsp. *glutinosa, A. bivenosa* and *Ptilotus rotundifolius* isolated shrubs over *Triodia pungens* or *T. basedowii* or *T.* sp. Mt Ella hummock grassland.	*5edae*	*Scaervola acacioides* open shrubland over *Triodia pungens* open hummock grassland	108.22
EllSggTw	*Eucalyptus leucophloia* subsp. *leucophloia* and *Acacia aptaneura* open woodland over *Senna glutinosa* subsp. *glutinosa* and *S. artemisioides* subsp. *oligophylla* open shrubland over *Triodia wiseana* or *T. pungens* open hummock grassland	*8bj*	*Acacia aneura* var. *longicarpa* and *Acacia pruinocarpa* high open shrubland over *Acacia pyrifolia* and cassia *oligophylla* scattered shrubs over *Triodia wiseana* and *Triodia pungens* open hummock grassland	2,875.92
EllAmTssp	*Eucalyptus leucophloia* subsp. *leucophloia* and *E. gamophylla* open woodland over *Acacia maitlandii, A. hamersleyensis, Keraudrenia velutina* and *Senna glutinosa* subsp. *glutinosa* open shrubland over *Triodia wiseana* and/or *T. pungens* and/or *T. basedowii* open hummock grassland.	*5kdm1*	*Eucalyptus leucophloia* scattered low trees over *Triodia* aff. *basedowii* and *Triodia pungens* open hummock grassland	2,582.85
		5kdm2	*Eucalyptus leucophloia* and *Corymbia hamersleyana* low open woodland over *Acacia maitlandii* scattered shrubs over *Triodia wiseana* open hummock grassland	1,147.37
		5edac	*Eucalyptus gamophylla* scattered low trees over *Acacia bivenosa*, A. pyrifolia scattered tall shrubs over *Triodia pungens* open hummock grassland	3.35
AaEcTp	*Acacia aptaneura* and *A. pruinocarpa* open woodland over *Eremophila caespitosa* and *Tribulus suberosus* isolated shrubs over *Triodia pungens* open hummock grassland	*6adb26*	*Acacia* aff. *aneura* and *Acacia pruinocarpa* scattered tall trees over *Maireana* spp. scattered low shrubs over *Triodia pungens* open hummock grassland with *Themeda triandra* scattered tussock grass	231.33
AaTb	*Acacia aptaneura* and *A. pruinocarpa* open woodland over *A. bivenosa* isolated shrubs *Triodia basedowii* and *T. pungens* open hummock grassland.	*6adb232*	*Acacia aneura* var. *longicarpa* high shrubland over *Rhagodia* sp. Hamersley, *Ptilotus obovatus* open shrubland over *Digitaria brownii* scattered tussock grassland	201.59
SggTp	*Eucalyptus leucophloia* subsp. *leucophloia* and *Corymbia hamersleyana* isolated trees over *Senna glutinosa* subsp. *glutinosa* and *Acacia maitlandii* sparse shrubland over *Triodia pungens* open hummock grassland.	*5kdm3*	*Eucalyptus leucophloia* scattered low trees over *Acacia pruinocarpa* scattered tall shrubs over *Triodia pungens* open hummock grassland	209.82

ecologia 2012 Vegetation Units		ME Trudgen & Associates (1998) Vegetation Units		Area outside of Study Area (ha)
Vegetation Unit	**NVIS level VI Description**	**Vegetation Unit**	**NVIS level V Description**	
EgSggTb	*Eucalyptus gamophylla* and *Corymbia deserticola* subsp. *deserticola* open woodland over *Senna artemisioides* subsp. *oligophylla* and *Indigofera monophylla* sparse shrubland over *Triodia basedowii* and *T. pungens* open hummock grassland	*5eda*	*Corymbia deserticola* scattered low trees over *Acacia bivenosa*, *Acacia pruinocarpa* and *Hakea chordophylla* scattered tall shrubs over *Cassia prunosa* scattered shrubs over *Triodia* aff. *basedowii* and *Triodia pungens* open hummock grassland	1,898.14
SggAbTp	*Acacia pruinocarpa* and *Eucalyptus leucophloia* subsp. *leucophloia* or *Corymbia hamersleyana* isolated trees over *Senna glutinosa* subsp. *glutinosa, Acacia bivenosa* and *Gossypium robinsonii* open shrubland over *Triodia pungens* hummock grassland			
EllSggTp	*Eucalyptus leucophloia* subsp. *leucophloia* and *Acacia marramambra* open woodland over *Senna glutinosa* subsp. *glutinosa* open shrubland over *Triodia pungens* open hummock grassland	*5edad*	*Eucalyptus leucophloia* low open woodland over *Acacia* aff. *aneura*, *Acacia pruinocarpa* and *Acacia aneura* var. ?*aneura* open scrub over *Eremophila lachnocalyx* scattered shrubs over *Triodia pungens* open hummock grassland	199.33
		5kd3r	*Eucalyptus leucophloia* low open woodland over *Acacia pruinocarpa* scattered tall shrubs over *Triodia pungens* open hummock grassland.	0.00
AlAp	*Aristida latifolia, Astrebla pectinata* and *Brachyachne convergens* tussock grassland with isolated *Salsola australis, Boerhavia paludosa* and *Ptilotus nobilis* subsp. *nobilis* forbs	*8db/8dc*	*Astrebla pectinata*, *Astrebla elymoides* and *Aristida latifolia* open tussock grassland	166.06
		8dd	*Sida fibulifera* low scattered shrubs over *Astrebla squarrosa* tussock grassland	0.00

Note: Comparisons are based on aerial imagery and vegetation descriptions. Species by site matrices were not available for data comparison.

Table 6.7 – Comparison of Biota (2006) Vegetation Units within the Study Area

Ecologia 2012 Vegetation Units		Biota (2006) Vegetation Units		Area out side of Study Area (ha)
Vegetation Unit	**NVIS level VI Description**	**Vegetation Unit**	**NVIS level V Description**	
SggAbTp	*Acacia pruinocarpa* and *Eucalyptus leucophloia* subsp. *leucophloia* or *Corymbia hamersleyana* isolated trees over *Senna glutinosa* subsp. *glutinosa, Acacia bivenosa* and *Gossypium robinsonii* open shrubland over *Triodia pungens* hummock grassland	*C1*	*Eucalyptus* spp. scattered low trees over *Acacia maitlandii*, *Gossypium robinsonii*, *Petalostylis labicheoides* shrubland over *Triodia pungens* open hummock grassland and *Eriachne mucronata*, *Themeda triandra* open tussock grassland	15.97
AaTt	*Acacia aptaneura* and *Eucalyptus xerothermica* woodland over *Ptilotus obovatus* isolated shrubs over *Themeda triandra* open tussock grassland	*C2*	*Eucalyptus xerothermica* low open woodland over *Acacia maitlandii*, *Petalostylis labicheoides*, *Rulingia luteiflora* shrubland to tall shrubland over *Triodia pungens* open hummock grassland	14.86
EllAmTssp	*Eucalyptus leucophloia* subsp. *leucophloia* and *E. gamophylla* open woodland over *Acacia maitlandii, A. hamersleyensis, Keraudrenia velutina* and *Senna glutinosa* subsp. *glutinosa* open shrubland over *Triodia wiseana* and/or *T. pungens* and/or *T. basedowii* open hummock grassland.	*H1*	*Eucalyptus leucophloia* low open woodland over *Acacia maitlandii*, A. *hamersleyensis* shrubland over *Triodia pungens* (T. wiseana) mid-dense hummock grassland	210.12
SggTp	*Eucalyptus leucophloia* subsp. *leucophloia* and *Corymbia hamersleyana* isolated trees over *Senna glutinosa* subsp. *glutinosa* and *Acacia maitlandii* sparse shrubland over *Triodia pungens* open hummock grassland.	*H2*	*Acacia catenulata* low woodland over *Triodia pungens* mid-dense hummock grassland	0.00
Tp	*Eucalyptus leucophloia* subsp. *leucophloia* and *Acacia pruinocarpa* isolated trees over *Senna glutinosa* subsp. *glutinosa, A. bivenosa* and *Ptilotus rotundifolius* isolated shrubs over *Triodia pungens* or *T. basedowii* or *T.* sp. Mt Ella hummock grassland.	*H3*	*Corymbia ferriticola*, *Eucalyptus leucophloia* low open woodland over *Triodia* sp. Mt Ella, *T. pungens* hummock grassland and *Eriachne mucronata* open tussock grassland	33.43
EllAmTssp	*Eucalyptus leucophloia* subsp. *leucophloia* and *E. gamophylla* open woodland over *Acacia maitlandii, A. hamersleyensis, Keraudrenia velutina* and *Senna glutinosa* subsp. *glutinosa* open shrubland over *Triodia wiseana* and/or *T. pungens* and/or *T. basedowii* open hummock grassland.	*H4*	*Eucalyptus leucophloia* low open woodland over *Triodia wiseana* midd-dense hummock grassland and *Themeda triandra* tussock grassland	0.00
		H5	*Eucalyptus gamophylla* low woodland over *Triodia* aff. *basedowii* (*T. pungens*) mid-dense hummock grassland	415.33
AaTp	*Acacia pruinocarpa, A. aptaneura* and *A. ayersiana* woodland over *Triodia pungens* open hummock grassland.	*M1*	*Acacia aneura* low open woodland over *Acacia bivenosa*, *Gossypium robinsonii*, *Sida* aff. *cardiophylla*, Scaevola parvifolia shrubland to low open shrubland over *Triodia* pungens, *T. schinzii* mid-dense hummock grassland	98.62

Ecologia 2012 Vegetation Units		Biota (2006) Vegetation Units		Area out side of Study Area (ha)
Vegetation Unit	**NVIS level VI Description**	**Vegetation Unit**	**NVIS level V Description**	
AaTb	*Acacia aptaneura* and *A. pruinocarpa* open woodland over *A. bivenosa* isolated shrubs *Triodia basedowii* and *T. pungens* open hummock grassland.	*M2*	*Acacia aneura* low open woodland over *Triodia* pungens, *T.* aff. *basedowii* mid-dense hummock grassland	23.63
		M5	*Acacia aneura* low closed forest over *Triodia pungens* mid-dense hummock grassland	0.00
PsTp	*Acacia aptaneura* or *A. ayersiana* open woodland over *Pterocaulon sphacelatum* and *Dysphania kalparri* sparse forbland with *Triodia pungens* open hummock grassland	*M3*	*Acacia aneura* woodland over *Maireana* villosa, *Ptilotus obovatus*, *Rhagodia* sp. Hamersley open to low open shrubland over *Triodia* sp. Mt Ella open hummock grassland	32.00
AaAc	*Acacia aptaneura* and *A. pruinocarpa* open woodland over *Aristida contorta* sparse tussock grassland over *Pterocaulon sphacelatum* and *Ptilotus nobilis* subsp. *nobilis* isolated forbs.	*M4*	*Acacia aneura*, *A. pruinocarpa* low closed forest to low woodland over *Eremophila forrestii*, *E. longifolia*, *Ptilotus obovatus*, *Rhagodia* sp. Hamersley low open shrubland to open shrubland over *Triodia pungens* open hummock grassland	223.85

Note: Comparisons are based on aerial imagery and vegetation descriptions. Species by site matrices were not available for data comparison

6.4 LAND DEGREDATION ANANYSIS

6.4.1 Erosion

The seven land systems present within the Study Area as mapped by Payne *et al* (1982) in the Regional Inventory of the Ashburton Rangelands and by Van Vreeswyk *et al*. (2004) in the Regional Inventory of the Pilbara Rangelands are categorised as being quite resistant to the processes of erosion (Van Vreeswyk *et al.* 2004). Van Vreeswyk *et al*. (2004) and Payne *et al* (1982) assessed the percentage of each land system that has been affected by erosion (Table 6.8). Each of the seven land systems have been subject to little or no erosion, the worst affected being the Wannamunna Land System with both minor (3%) and moderate (2%) erosion present in low levels. This data is further supported by observations made in the field where no serious erosion was observed in the Study Area.

Table 6.8 – Erosion as Assessed by Van Vreeswyk *et al*. (2004) and Payne *et al* (1982)

Land System	Description	No Erosion	Minor Erosion	Moderate Erosion
Boolgeeda	Stony lower slopes and plains below hill systems supporting hard and soft spinifex grasslands and mulga shrublands.	100%	0%	0%
Egerton	Dissected hardpan plains supporting mulga shrublands and hard spinifex hummock grasslands.	100%	0%	0%
Elimunna	Stony plains on basalt supporting Sparse *Acacia* and cassia shrublands and patchy tussock grasslands.	99%	1%	0%
Newman	Rugged jaspilite plateaux, ridges and mountains supporting hard.	99%	0.5%	0.5%
Platform	Dissected slopes and raised plains supporting hard spinifex grasslands.	100%	0%	0%
Rocklea	Basalt hills, plateaux, lowers slopes and minor stony plains supporting hard spinifex (and occasionally soft spinifex) grasslands.	100%	0%	0%
Wannamunna	Hardpan plains and internal drainage tracts supporting mulga shrublands and woodlands (and occasionally eucalypt woodlands).	95%	3%	2%

6.4.2 Spread of Weeds

Vegetation condition ratings within the Study Area were high, with 87% of assessed quadrats being in either excellent or very good condition (Figure 5.1) with the presence of weeds within the Study Area being minimal. This is reflected by the absence of livestock as the Study Area is not located on pastoral land. Figure 4.3 demonstrates that higher densities of weeds were recorded along the rivers and creeks. Drainage lines are a major source of transportation for the most prevalent weed species in the region: *Acetosa vesicaria, Bidens bipinnata, Cenchrus ciliaris* and *Acetosa vesicaria.* These species are likely to continue to spread naturally along the river system, but alterations to flow in both volume and direction will likely facilitate the spread further.

There was also evidence to suggest that *Bidens bipinnata* is also being spread to a small degree by native fauna. *Acetosa vesicaria* was sighted growing within the 3 m buffer of the rail corridor in Deposit G. Track work and other maintenance in these areas could facilitate the spread of this species via vehicles or personnel, as well as soil disturbance. Control methods such as brush-down procedures should be used when working in these areas of the rail.

6.4.3 Previous Disturbance

Previous disturbance within the Study Area was observed to be predominantly from clearing pertaining to previous exploration lines, drill pads, access tracks and associated infrastructure. Deposit G is the most disturbed as part of the rail and the main access road into the West Angelas Mine are within this site. Apart from the primary disturbance from the initial clearing footprint of this infrastructure, dust is also another source of disturbance in the area. West Angeles Mine currently has management plans in place to help control the impact and spread of dust.

6.5 SURVEY LIMITATIONS AND CONSTRAINTS

According to the EPA Guidance Statement 51; *Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessments in Western Australia* (Environmental Protection Authority 2004), vegetation and flora surveys may be limited by several aspects. An assessment of these aspects with regard to this study is detailed in Table 6.9.

Table 6.9– Flora and Vegetation Survey Limitations

Aspect	Constraint	Comment
Sources of information and availability of contextual information (i.e. pre-existing background versus new material)	Minor	Broad scale (1:1,000,000) mapping by Shepherd *et al* (2006) based on the mapping by Beard (1975) is available. More recently the land systems (Van Vreeswyk *et al*. 2004) have been mapped which show also broad scale regional information on vegetation communities based on land systems. Information at a local context was available with the Biota Environmental Sciences surveys in 2006 and 2010 (Biota 2006, Biota 2010), and ME Trudgen & Associates (1998), providing regional data at comparable scale of survey intensity and vegetation mapping. The lack of Species x Site matrices resulted in the need for these surveys to be compared based on their descriptions and spatial position and not on cluster analysis.
The scope (i.e. what life forms were sampled)	Nil	The vascular flora of the Study Area was sampled in accordance with Guidance Statement 51.
Proportion of flora collected and identified (based on sampling, timing and intensity)	Minor	Species accumulation curve analysis suggests that 86-88% of the taxa expected to be present were recorded. Survey timing was considered optimal, with a high proportion of plants flowering and >99% of all collections fully identified. Twenty-four of a total 6,003 specimens were not identified to species level. However, access limitations in some areas may have reduced the total inventory to a minor degree.
Completeness and further work which might be needed *(*e.g. was the relevant area fully surveyed)	Minor	The quadrat density of 1 quadrat per 1.17 km^2 is considered adequate. Quadrats were broadly distributed throughout the Study Area, however the several areas where no vehicular access was possible and distances were too great to be achieved on foot, or where the steepness of escarpments precluded access. All vegetation units were represented with at least two quadrats and in many cases more than 10. Targeted surveys performed during the second were extremely beneficial to the survey with multiple locations of Priority Flora recorded.
Mapping reliability	Minor	For some areas, the aerial imagery as of lo resolution and was therefore blurry in its appearance, making defining vegetation community boundaries difficult at times. The number and distribution of quadrats is considered adequate for definition of vegetation within most areas, however since access to some areas was restricted, it remains possible that additional community types could be defined.
Timing/weather/season/cycle	Minor	The timing of the survey was optimal for most of the flora species with most recorded to be flowering or fruiting. However some of the tussock grasses collected were dry and lacked reproductive material, which resulted in challenges in completing identifications of these taxa. A survey carried out shortly following summer rains did not take place, which may have precluded the collection of some annuals and grasses.
Disturbances (e.g. fire, flood, accidental human intervention)	Nil	There were no natural or man-made interventions that constrained the survey.

Aspect	Constraint	Comment
Intensity (in retrospect, was the intensity adequate?)	Minor	The species accumulation curve suggests that 86-88 % of species present were collected. All vegetation units were mapped were represented by at least two quadrats. Quadrats were distributed across the Study Area at a density of 1 quadrat per 1.17 km^2; however the distribution was limited in some areas due to access constraints.
Resources	Nil	A total of 60 person-days were expended across the survey period. There was sufficient time to access all areas that could be accessed using a vehicle and foot traverses.
Access problems	Moderate	The majority of the survey area was easily accessed. However, the absence and poor condition of some tracks, as well as some vital tracks being recently rehabilitated required an investment of time and effort for accessing some areas on foot. The southeast and northwest areas of the larger study polygon and the centre-southeast area of the smaller study polygon were the least sampled areas due to access difficulties. Aerial imagery and landform mapping for this area indicate that the vegetation communities in the areas where access was restricted have been sampled elsewhere.
Experience levels (e.g. degree of expertise in plant identification to taxon level)	Nil	The Project was overseen by the Biological Sciences Manager who has over 14 years experience in biological assessments within Western Australia, the project manager and field leader have six and two years experience, respectively. Other botanists engaged in survey work have between 1 and 5 years experience in biological surveys. The two taxonomists responsible for identifications both have Doctorates in botanical taxonomy and have completed identifications for multiple, large scale projects within the Pilbara.

7 CONCLUSION

7.1 FLORA

Flora sampling adequacy was estimated using species accumulation curve analysis and extrapolation. Using this analysis it is estimated that between 86% and 88 % of the taxa present were recorded.

Four specimens of the EPBC Act and the WC Act (Declared Rare Flora) listed *Lepidium catapycnon* were collected opportunistically from four locations within Greater West Angelas. A total of 29 individuals were recorded. The presence of preferred habitats beyond the location where the four specimens were collected suggest that it is possible that more individuals could be present given that access to some areas was limited during the survey. Further targeted surveys would be advantageous in defining the population.

Of the thirteen Threatened and Priority Flora taxa, five are not represented within conservation estates (*Aristida jerichoensis* var. *subspinulifera*, *Brachyscome* sp. Wanna Munna Flats (S. van Leeuwen 4662), *Brunonia* sp. long hairs (D.E. Symon 2440), *Indigofera* sp. Gilesii (M.E. Trudgen 15869) and *Triodia* sp. Mt Ella (M.E. Trudgen 12739). These taxa are considered to be of higher conservation significance, irrespective of the fact that *Aristida jerichoensis* var. *subspinulifera* (P1), *Indigofera* sp. Gilesii (M.E. Trudgen 15869) (P3) and *Triodia* sp. Mt Ella (M.E. Trudgen 12739) (P3) are relatively widespread within the Study Area.

Records from the survey include one bioregional extension, *Maireana lanosa*, although only 44 km north of the known population. Records of two taxa represent range extensions; *Corymbia zygophylla* and *Euphorbia schultzii*. These taxa represent the extent of the distribution of their species and are also of conservation significance.

7.2 VEGETATION

One Priority 1 PEC, West Angelas Cracking-Clays, occurs within the Study Area. In this survey it was identified as vegetation unit *AlAp* (*Aristida* and *Astrebla* grassland). The boundaries of the larger area depicted in Figure 6.1 have been ground-truthed in the field.

Vegetation units *SggIrTw* (rocky hilltops) and *AaEcTp* (sandy plains) support five individual threatened and/or priority taxa including *Lepidium catapycnon* (T). Collectively these units account for eight out of the 13 threatened and priority flora recorded. This identifies the significance of unit *SggIrTw* (where *L. catapycnon* occurs), whist also indicating that unit *AaEcTp* is of particular conservation significance.

Vegetation unit *AaPoTt* supports variable densities of *E. victrix* and therefore may be a vadophytic ecosystem (i.e. supporting plants that rely on moisture in the soil surface profile) or occasionally phreatophytic (i.e. supporting plants that rely on groundwater reservoirs), and on this basis has been qualified as a potential GDE. The vegetation unit *AaEcTp* (*Acacia* open woodland over *Eremophila* isolated shrubs over *Triodia* open grassland) supports groved and banded mulga communities and is considered likely to be sheet-flow dependent. Both of these units are sensitive to changes in hydrology.

The least extensive vegetation units locally are *AaEffTp* (141.54 ha) and *AmTw* (108.7 ha), which represent 0.80 % and 0.62% of the Study Area respectively. These units are considered to be of local significance due to their limited representation in the local context.

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8 STUDY TEAM

The flora and vegetation assessment in this report was planned, coordinated and executed by:

Project Staff and Qualifications		
Kellie Honczar	BSc	Principal Ecologist
Renee Young	PhD (Botany)	Senior Botanist
Andrew Craigie	PhD (Botany)	Taxonomist and Botanist
Udani Sirisena	PhD (Botany)	Taxonomist
Matthew Macdonald	PhD (Botany)	Senior Botanist
Christopher Parker	BSc	Botanist
Heather Broad	BSc	Botanist

Licences - "Licence to Take Flora for Scientific Purposes"		
The vegetation and flora assessment described in this report was conducted under the authorisation of the following licences issued by the DEC:		
	Permit Number	**Valid Until**
Matthew Macdonald	SL 009996	30/04/2013
Andrew Craigie	SL 009990	30/04/2013
Christopher Parker	SL 009992	30/04/2013
Michelle Holmes	SL009998	30/04/2013
Matthew Macdonald	SL009996	30/04/2013
Heather Broad	SL009976	30/04/2013

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APPENDIX A EPBC AND DEC CONSERVATION CATEGORIES

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Table D.1 – Definition of codes for Threatened Ecological Communities

Code	Definition
PD: Presumed Totally Destroyed	An ecological community that has been adequately searched for but for which no representative occurrences have been located. The community has been found to be totally destroyed or so extensively modified throughout its range that no occurrence of it is likely to recover its species composition and/or structure in the foreseeable future. An ecological community will be listed as presumed totally destroyed if there are no recent records of the community being extant
CR: Critically Endangered	An ecological community that has been adequately surveyed and found to have been subject to a major contraction in area and/or that was originally of limited distribution and is facing severe modification or destruction throughout its range in the immediate future, or is already severely degraded throughout its range but capable of being substantially restored or rehabilitated. An ecological community will be listed as Critically Endangered when it has been adequately surveyed and is found to be facing an extremely high risk of total destruction in the immediate future.
EN: Endangered	An ecological community that has been adequately surveyed and found to have been subject to a major contraction in area and/or was originally of limited distribution and is in danger of significant modification throughout its range or severe modification or destruction over most of its range in the near future. An ecological community will be listed as Endangered when it has been adequately surveyed and is not Critically Endangered but is facing a very high risk of total destruction in the near future.
VU: Vulnerable	An ecological community that has been adequately surveyed and is found to be declining and/or has declined in distribution and/or condition and whose ultimate security has not yet been assured and/or a community that is still widespread but is believed likely to move into a category of higher threat in the near future if threatening processes continue or begin operating throughout its range. An ecological community will be listed as Vulnerable when it has been adequately surveyed and is not Critically Endangered or Endangered but is facing a high risk of total destruction or significant modification in the medium to long-term future.

Table D.2 – Definition of codes for Priority Ecological Communities (DEC)

Code	Definition
P1: 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.
P2: 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.
P3: 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: (ii) Communities known from a few widespread occurrences, which are either large or within significant remaining areas of habitat in which other occurrences may occur, much of it not under imminent threat, or; (iii) Communities made up of large, and/or widespread occurrences that may or not be represented in the reserve system, but are under threat of modification across much of their range from processes such as grazing by domestic and/or feral stock, and inappropriate fire regimes. Communities may be included if they are comparatively well known from several localities but do not meet adequacy of survey requirements and/or are not well defined, and known threatening processes exist that could affect them.
P4: Priority Four	Ecological communities that are adequately known, Rare but not threatened or meet criteria for Near Threatened, or that have been recently removed from the threatened list. These communities require regular monitoring. (a) Rare. Ecological communities known from few occurrences that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection, but could be if present circumstances change. These communities are usually represented on conservation lands. (b) Near Threatened. Ecological communities that are considered to have been adequately surveyed and that do not qualify for Conservation Dependent, but that are close to qualifying for Vulnerable. (c) Ecological communities that have been removed from the list of threatened communities during the past five years. P5: Priority Five 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.
P5: Priority Five	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.

Table D.3 – Definition of Threatened Flora Species Categories under the *EPBC Act*

Conservation Code	Definition
Extinct	A species is extinct if there is no reasonable doubt that the last member of the species has died.
Extinct in the wild	A species is categorised as extinct in the wild if it is only known to survive in cultivation, in captivity or as a naturalised population well outside its past range; or if it has not been recorded in its known/expected habitat, at appropriate seasons, anywhere in its past range, despite exhaustive surveys over a time frame appropriate to its life cycle and form.
Critically Endangered	The species is facing an extremely high risk of extinction in the wild in the immediate future.
Endangered	The species is likely to become extinct unless the circumstances and factors threatening its abundance, survival or evolutionary development cease to operate; or its numbers have been reduced to such a critical level, or its habitats have been so drastically reduced, that it is in immediate danger of extinction.
Vulnerable	Within the next 25 years, the species is likely to become endangered unless the circumstances and factors threatening its abundance, survival or evolutionary development cease to operate.
Conservation Dependent	The species is the focus of a specific conservation program, the cessation of which would result in the species becoming vulnerable, endangered or critically endangered within a period of five years.

Table D.4 – Definition of Declared Rare and Priority Flora Categories under the *WC Act*

Conservation Code	Definition
DRF	Declared Rare Flora-Extant Taxa. Taxa which have been adequately searched for and are deemed to be in the wild either rare, in danger of extinction, or otherwise in need of special protection, and have been gazetted as such.
P1: Priority One	Poorly Known Taxa. 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. 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. Taxa which are known from several populations, and the taxa are not believed to be under immediate threat (i.e. not currently endangered), either due to the number of known populations (generally >5), or known populations being large, and either widespread or protected. Such taxa are under consideration for declaration as 'rare flora' but are in need of further survey.
P4: Priority Four	Rare Taxa. 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.

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APPENDIX B COORDINATES OF FLORA QUADRATS

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Quadrat	Botanist	Date	Zone	Easting	Northing
2	Heather Broad	15/07/2012	50	677155	7439160
3	Christopher Parker	11/07/2012	50	664250	7434166
4	Renee Young	23/08/2012	50	676312	7432796
5	Matthew Macdonald	22/08/2012	50	677245	7438185
6	Heather Broad	15/07/2012	50	676964	7439410
7	Andrew Craigie	15/07/2012	50	677143	7440336
8	Renee Young	15/07/2012	50	677224	7439706
9	Renee Young	15/07/2012	50	676777	7439888
10	Andrew Craigie	15/07/2012	50	677202	7440980
11	Renee Young	11/07/2012	50	664936	7432362
12	Heather Broad	12/07/2012	50	669588	7436085
14	Heather Broad	11/07/2012	50	666335	7435014
15	Christopher Parker	11/07/2012	50	666386	7434420
16	Matthew Macdonald	23/08/2012	50	665255	7435767
17	Renee Young	11/07/2012	50	666127	7435443
18	Christopher Parker	13/07/2012	50	670256	7440041
19	Andrew Craigie	13/07/2012	50	670827	7440121
20	Heather Broad	11/07/2012	50	666544	7432889
21	Andrew Craigie	12/07/2012	50	668832	7436351
22	Renee Young	23/08/2012	50	675401	7433583
23	Heather Broad	23/08/2012	50	676745	7433348
24	Andrew Craigie	12/07/2012	50	665179	7437844
25	Heather Broad	11/07/2012	50	666551	7432511
26	Heather Broad	22/08/2012	50	665892	7437188
27	Andrew Craigie	12/07/2012	50	665237	7437562
28	Heather Broad	12/07/2012	50	663809	7437790
29	Christopher Parker	12/07/2012	50	663304	7437192
30	Andrew Craigie	23/08/2012	50	668967	7433839
31	Andrew Craigie	23/08/2012	50	666346	7432772
33	Matthew Macdonald	23/08/2012	50	668560	7433940
34	Heather Broad	23/08/2012	50	676579	7433252
35	Christopher Parker	13/07/2012	50	673632	7438909
36	Renee Young	13/07/2012	50	670777	7438782
37	Heather Broad	14/07/2012	50	687029	7442744
38	Heather Broad	14/07/2012	50	687256	7442411
40	Renee Young	14/07/2012	50	687384	7441660
41	Heather Broad	16/07/2012	50	687019	7440818
42	Matthew Macdonald	22/08/2012	50	676916	7438381
43	Andrew Craigie	13/07/2012	50	669629	7439904
44	Andrew Craigie	13/07/2012	50	672747	7439755
45	Heather Broad	10/07/2012	50	687314	7433554
46	Heather Broad	10/07/2012	50	687705	7433591
47	Andrew Craigie	22/08/2012	50	676625	7435967
48	Heather Broad	23/08/2012	50	673159	7435134
49	Renee Young	22/08/2012	50	670111	7435914
50	Christopher Parker	13/07/2012	50	673669	7437233
51	Christopher Parker	10/07/2012	50	687533	7432652
52	Andrew Craigie	10/07/2012	50	688661	7432669
53	Andrew Craigie and Heather Broad	12/07/2012	50	667899	7436212
54	Christopher Parker	12/07/2012	50	667459	7436044
55	Christopher Parker	15/07/2012	50	693252	7440857
56	Christopher Parker	15/07/2012	50	678032	7441255
57	Renee Young	22/08/2012	50	669044	7438284
58	Heather Broad	22/08/2012	50	666744	7437057
59	Andrew Craigie	22/08/2012	50	677184	7437539

Quadrat	Botanist	Date	Zone	Easting	Northing
60	Matthew Macdonald	22/08/2012	50	676676	7437576
61	Renee Young	13/07/2012	50	673215	7437869
62	Andrew Craigie	21/08/2012	50	675036	7437340
63	Heather Broad	21/08/2012	50	674380	7436772
64	Renee Young	22/08/2012	50	668923	7437248
65	Renee Young	13/07/2012	50	667686	7439468
66	Heather Broad	22/08/2012	50	671181	7437165
67	Andrew Craigie	15/07/2012	50	675707	7438599
68	Christopher Parker	15/07/2012	50	675904	7438645
69	Heather Broad	13/07/2012	50	671233	7439484
70	Christopher Parker	12/07/2012	50	662974	7436737
71	Renee Young	12/07/2012	50	663032	7439901
72	Renee Young	12/07/2012	50	662967	7439466
74	Heather Broad	12/07/2012	50	662935	7437760
75	Andrew Craigie	23/08/2012	50	664518	7436326
76	Heather Broad	15/07/2012	50	674804	7438827
77	Heather Broad	13/07/2012	50	672224	7439689
78	Heather Broad	13/07/2012	50	672023	7439634
79	Andrew Craigie	15/07/2012	50	675187	7438908
80	Matthew Macdonald	23/08/2012	50	664777	7435780
81	Andrew Craigie	23/08/2012	50	664292	7435990
82	Renee Young	15/07/2012	50	673920	7438834
84	Heather Broad	13/07/2012	50	667450	7440007
85	Matthew Macdonald	22/08/2012	50	674706	7436370
86	Christopher Parker	13/07/2012	50	670711	7439869
87	Christopher Parker	13/07/2012	50	673420	7439350
89	Renee Young	13/07/2012	50	672580	7439183
90	Renee Young	13/07/2012	50	672525	7439032
91	Andrew Craigie	22/08/2012	50	677313	7437373
92	Christopher Parker	11/07/2012	50	671795	7434819
93	Andrew Craigie	11/07/2012	50	665188	7433774
94	Christopher Parker	15/07/2012	50	675043	7439279
95	Matthew Macdonald	22/08/2012	50	676930	7437844
96	Heather Broad	15/07/2012	50	674566	7439117
97	Andrew Craigie	13/07/2012	50	672930	7439386
98	Andrew Craigie	10/07/2012	50	690021	7434193
99	Renee Young	10/07/2012	50	692404	7434579
100	Andrew Craigie	11/07/2012	50	665048	7433112
102	Andrew Craigie	11/07/2012	50	673591	7434348
103	Renee Young	11/07/2012	50	665617	7432674
104	Andrew Craigie	22/08/2012	50	676037	7437964
105	Christopher Parker	10/07/2012	50	689329	7433993
106	Andrew Craigie	10/07/2012	50	690813	7434491
107	Renee Young	10/07/2012	50	691959	7434259
108	Andrew Craigie	10/07/2012	50	687622	7432995
109	Renee Young	10/07/2012	50	692133	7434084
110	Renee Young	10/07/2012	50	688061	7433951
111	Andrew Craigie	10/07/2012	50	690781	7434606
112	Christopher Parker	10/07/2012	50	689514	7433871
113	Renee Young	10/07/2012	50	687687	7434485
114	Heather Broad	10/07/2012	50	691391	7433665
115	Heather Broad	10/07/2012	50	691478	7433848
116	Matthew Macdonald	25/08/2012	50	689743	7432298
117	Matthew Macdonald	25/08/2012	50	692296	7432269
118	Matthew Macdonald	25/08/2012	50	691903	7432228
119	Christopher Parker	10/07/2012	50	687390	7432574
120	Renee Young	25/08/2012	50	688668	7435466
121	Heather Broad	25/08/2012	50	690898	7435543

Quadrat	Botanist	Date	Zone	Easting	Northing
122	Heather Broad	25/08/2012	50	690568	7435562
123	Andrew Craigie	18/07/2012	50	691442	7435304
124	Andrew Craigie	18/07/2012	50	690998	7435051
125	Renee Young	25/08/2012	50	689448	7435600
126	Heather Broad	18/07/2012	50	692362	7435225
127	Heather Broad	18/07/2012	50	691897	7435262
128	Renee Young	14/07/2012	50	687617	7441806
129	Andrew Craigie	16/07/2012	50	687534	7441102
130	Andrew Craigie	12/07/2012	50	689733	7439848
131	Christopher Parker	17/07/2012	50	690405	7440055
132	Heather Broad	17/07/2012	50	690710	7440192
133	Heather Broad	17/07/2012	50	690774	7440465
134	Andrew Craigie	17/07/2012	50	689997	7440750
135	Christopher Parker	14/07/2012	50	694775	7442645
136	Andrew Craigie	14/07/2012	50	695085	7442608
137	Christopher Parker	14/07/2012	50	693742	7442990
138	Andrew Craigie	14/07/2012	50	694996	7443069
139	Christopher Parker	17/07/2012	50	691396	7441959
140	Heather Broad	16/07/2012	50	692860	7442223
141	Christopher Parker	16/07/2012	50	677807	7440841
142	Andrew Craigie	17/07/2012	50	691561	7441218
143	Heather Broad	24/08/2012	50	692043	7440355
144	Heather Broad	24/08/2012	50	691601	7440107
145	Christopher Parker	17/07/2012	50	690919	7440001
146	Andrew Craigie; Christopher Parker and Heather Broad	17/07/2012	50	689963	7441587
147	Heather Broad	17/07/2012	50	690015	7442078
148	Andrew Craigie	15/07/2012	50	694100	7441820
149	Andrew Craigie	16/07/2012	50	694618	7441708
151	Christopher Parker	14/07/2012	50	693738	7443431
152	Andrew Craigie	14/07/2012	50	695697	7443107
153	Heather Broad	16/07/2012	50	692827	7441627
154	Christopher Parker	16/07/2012	50	693821	7440864
155	Matthew Macdonald	24/08/2012	50	689478	7442994
156	Matthew Macdonald	24/08/2012	50	688740	7443153
160	Christopher Parker	16/07/2012	50	687010	7441224
200	Renee Young	23/08/2012	50	673438	7437317
201	Renee Young and Heather Broad	23/08/2012	50	677257	7442559

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APPENDIX C FLORA SPECIES RECORDED AT WEST ANGELAS

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Family	Taxon	Observation
Acanthaceae	*Dicladanthera forrestii*	
	Dipteracanthus australasicus subsp. *australasicus*	
	Harnieria kempeana subsp. *muelleri*	
Aizoaceae	*Trianthema glossostigma*	
Amaranthaceae	*Achyranthes aspera*	
	Alternanthera nana	
	Amaranthus cuspidifolius	
	Amaranthus mitchellii	
	Gomphrena affinis subsp. *pilbarensis*	
	Gomphrena canescens	
	Gomphrena cunninghamii	
	Gomphrena kanisii	
	Ptilotus aervoides	
	Ptilotus astrolasius	
	Ptilotus auriculifolius	
	Ptilotus calostachyus	
	Ptilotus carinatus	
	Ptilotus clementii	
	Ptilotus fusiformis	
	Ptilotus gomphrenoides	
	Ptilotus helipteroides	
	Ptilotus nobilis subsp. *nobilis*	
	Ptilotus obovatus	
	Ptilotus polystachyus	
	Ptilotus roei	
	Ptilotus rotundifolius	
	Ptilotus schwartzii var. *schwartzii*	
Apocynaceae	*Cynanchum floribundum*	
	Marsdenia australis	
	Rhyncharrhena linearis	
	Sarcostemma viminale subsp. *australe*	
Araliaceae	*Astrotricha hamptonii*	
	Trachymene oleracea subsp. *oleracea*	
	Trachymene pilbarensis	
Asteraceae	*Bidens bipinnata*	Invasive
	Brachyscome sp. Wanna Munna Flats (S. van Leeuwen 4662)	P1
	Calocephalus knappii	
	Calotis multicaulis	
	Calotis porphyroglossa	
	Chrysocephalum apiculatum	
	Chrysocephalum eremaeum	
	Chrysocephalum gilesii	
	Chrysocephalum pterochaetum	
	Flaveria trinervia	Invasive
	Peripleura arida	
	Peripleura hispidula var. *setosa*	
	Peripleura obovata	
	Pluchea dentex	
	Pluchea dunlopii	
	Pterocaulon serrulatum	
	Pterocaulon sphacelatum	
	Rhodanthe citrina	
	Rhodanthe floribunda	
	Rhodanthe margarethae	
	Sigesbeckia orientalis	Invasive

Family	Taxon	Observation
Asteraceae	*Streptoglossa bubakii*	
	Streptoglossa decurrens	
	Streptoglossa liatroides	
	Streptoglossa odora	
	Streptoglossa tenuiflora	
	Vittadinia eremaea	
Boraginaceae	*Halgania gustafsenii*	
	Heliotropium chrysocarpum	
	Heliotropium cunninghamii	
	Heliotropium heteranthum	
	Heliotropium inexplicitum	
	Heliotropium pachyphyllum	
	Heliotropium tenuifolium	
	Trichodesma zeylanicum	
	Trichodesma zeylanicum var. *zeylanicum*	
Brassicaceae	*Lepidium catapycnon*	T
	Lepidium pedicellosum	
	Lepidium phlebopetalum	
	Lepidium pholidogynum	
	Lepidium platypetalum	
Campanulaceae	*Isotoma petraea*	
	Lobelia heterophylla	
	Wahlenbergia tumidifructa	
Capparaceae	*Capparis lasiantha*	
	Capparis mitchellii	
	Capparis spinosa var. *nummularia*	
Caryophyllaceae	*Polycarpaea corymbosa*	
	Polycarpaea holtzei	
	Polycarpaea longiflora	
Celastraceae	*Denhamia cunninghamii*	
	Maytenus sp. Mt Windell (S. van Leeuwen 846)	
	Stackhousia intermedia	
Chenopodiaceae	*Dissocarpus paradoxus*	
	Dysphania glomulifera	
	Dysphania glomulifera subsp. *eremaea*	
	Dysphania kalpari	
	Dysphania rhadinostachya subsp. *rhadinostachya*	
	Enchylaena tomentosa var. *tomentosa*	
	Maireana georgei	
	Maireana lanosa	
	Maireana melanocoma	
	Maireana planifolia	
	Maireana tomentosa	
	Maireana triptera	
	Maireana villosa	
	Rhagodia eremaea	
	Rhagodia sp. Hamersley (M. Trudgen 17794) PN	P3
	Salsola australis	
	Sclerolaena convexula	
	Sclerolaena cornishiana	
	Sclerolaena eriacantha	
	Sclerolaena tetragona	
Cleomaceae	*Cleome viscosa*	
Convolvulaceae	*Convolvulus clementii*	
	Duperreya commixta	
	Evolvulus alsinoides	
	Evolvulus alsinoides var. *decumbens*	
	Evolvulus alsinoides var. *villosicalyx*	

Family	Taxon	Observation
	Ipomoea muelleri	
	Ipomoea polymorpha	
	Operculina aequisepala	
	Polymeria ambigua	
Cucurbitaceae	*Cucumis variabilis*	
Cyperaceae	*Bulbostylis barbata*	
	Cyperus cunninghamii subsp. *cunninghamii*	
	Fimbristylis dichotoma	
	Fimbristylis simulans	
Euphorbiaceae	*Adriana tomentosa* var. *tomentosa*	
	Euphorbia alsiniflora	
	Euphorbia australis	
	Euphorbia biconvexa	
	Euphorbia boophthona	
	Euphorbia drummondii	
	Euphorbia schultzii	
Fabaceae	*Acacia adoxa* var. *adoxa*	
	Acacia adsurgens	
	Acacia ancistrocarpa	
	Acacia aptaneura	
	Acacia atkinsiana	
	Acacia ayersiana	
	Acacia bivenosa	
	Acacia catenulata subsp. *occidentalis*	
	Acacia citrinoviridis	
	Acacia colei var. *colei*	
	Acacia cowleana	
	Acacia dictyophleba	
	Acacia eriopoda	
	Acacia hamersleyensis	
	Acacia inaequilatera	
	Acacia incurvaneura	
	Acacia macraneura	
	Acacia maitlandii	
	Acacia marramamba	
	Acacia minyura	
	Acacia monticola	
	Acacia pachyacra	
	Acacia pruinocarpa	
	Acacia pteraneura	
	Acacia pyrifolia	
	Acacia pyrifolia var. *pyrifolia*	
	Acacia rhodophloia	
	Acacia sibirica	
	Acacia aff. *subtiliformis*	P3
	Acacia synchronicia	
	Acacia tenuissima	
	Acacia tetragonophylla	
	Acacia validinervia	
	Crotalaria medicaginea var. *neglecta*	
	Crotalaria novae-hollandiae subsp. *novae-hollandiae*	
	Cullen leucochaites	
	Gastrolobium grandiflorum	
	Glycine canescens	
	Gompholobium oreophilum	
	Indigofera fractiflexa	
	Indigofera georgei	
	Indigofera sp. Gilesii (M.E. Trudgen 15869)	P3

Family	Taxon	Observation
Fabaceae	*Indigofera monophylla*	
	Indigofera rugosa	
	Isotropis forrestii	
	Mirbelia viminalis	
	Petalostylis labicheoides	
	Rhynchosia minima	
	Senna artemisioides subsp. *filifolia*	
	Senna artemisioides subsp. *hel*MSii	
	Senna artemisioides subsp. *oligophylla*	
	Senna artemisioides subsp. *x artemisioides*	
	Senna ferraria	
	Senna glutinosa subsp. *glutinosa*	
	Senna glutinosa subsp. *pruinosa*	
	Senna glutinosa subsp. *x luerssenii*	
	Senna hamersleyensis	
	Senna notabilis	
	Senna pleurocarpa var. *angustifolia*	
	Senna sericea	
	Senna sp. Meekatharra (E. Bailey 1-26)	
	Senna stricta	
	Senna symonii	
	Swainsona kingii	
	Swainsona maccullochiana	
	Templetonia egena	
	Tephrosia clementii	
	Tephrosia densa	
	Tephrosia rosea var. *glabrior*	
	Tephrosia supina	
	Vachellia farnesiana	Invasive
	Vigna sp. Hamersley Clay (A.A. Mitchell PRP 113)	
Goodeniaceae	*Brunonia* sp. long hairs (D.E. Symon 2440) PN	P1
	Dampiera candicans	
	Goodenia microptera	
	Goodenia muelleriana	
	Goodenia nuda	P4
	Goodenia scaevolina	
	Goodenia stellata	
	Goodenia stobbsiana	
	Goodenia tenuiloba	
	Goodenia triodiophila	
	Scaevola browniana subsp. *browniana*	
	Scaevola parvifolia	
	Scaevola parvifolia subsp. *pilbarae*	
	Scaevola spinescens	
Gyrostemonaceae	*Codonocarpus cotinifolius*	
Haloragaceae	*Haloragis gossei*	
	Haloragis gossei var. *gossei*	
	Haloragis gossei var. *inflata*	
Hemerocallidaceae	*Corynotheca micrantha*	
Lamiaceae	*Clerodendrum floribundum*	
	Clerodendrum floribundum var. *angustifolium*	
	Newcastelia sp. *Hamersley Range (S. van Leeuwen 4264)*	
	Spartothamnella teucriiflora	
Lauraceae	*Cassytha capillaris*	
Loranthaceae	*Amyema hilliana*	
	Amyema miquelii	
Malvaceae	*Abutilon amplum*	
	Abutilon cryptopetalum	

Family	Taxon	Observation
Malvaceae	*Abutilon cunninghamii*	
	Abutilon dioicum	
	Abutilon fraseri subsp. *fraseri*	
	Abutilon lepidum	
	Abutilon leucopetalum	
	Abutilon macrum	
	Abutilon otocarpum	
	Abutilon oxycarpum	
	Abutilon trudgenii MS	
	Androcalva luteiflora	
	Corchorus crozophorifolius	
	Corchorus lasiocarpus	
	Corchorus lasiocarpus subsp. *parvus*	
	Corchorus sidoides subsp. *sidoides*	
	Corchorus tridens	
	Gossypium australe	
	Gossypium robinsonii	
	Hibiscus burtonii	
	Hibiscus coatesii	
	Hibiscus gardneri	
	Hibiscus sturtii	
	Hibiscus sturtii var. *campylochlamys*	
	Hibiscus sturtii var. *platychlamys*	
	Hibiscus trionum	
	Keraudrenia velutina	
	Malvastrum americanum	Invasive
	Melhania oblongifolia	
	Sida arenicola	
	Sida arsiniata	
	Sida echinocarpa	
	Sida ectogama	
	Sida fibulifera	
	Sida sp. Barlee Range (S. van Leeuwen 1642) PN	P3
	Sida sp. dark green fruit (S. van Leeuwen 2260)	
	Sida sp. Golden calyces glabrous (H.N. Foote 32)	
	Sida sp. Pilbara (A.A. Mitchell PRP 1543)	
	Sida sp. Shovelanna Hill (S. van Leeuwen 3842)	
	Sida sp. spiciform panicles (E. Leyland s.n. 14/8/1990	
	Sida sp. Supplejack Station (T.S. Henshall 2345)	
	Sida sp. verrucose glands (F.H. Mollemans 2423)	
	Sida spinosa	
	Sida trichopoda	
	Triumfetta leptacantha	
	Waltheria indica	
Marsileaceae	*Marsilea hirsuta*	
Moraceae	*Ficus brachypoda*	
Myrtaceae	*Calytrix carinata*	
	Corymbia candida	
	Corymbia deserticola subsp. *deserticola*	
	Corymbia hamersleyana	
	Corymbia zygophylla	
	Eucalyptus gamophylla	
	Eucalyptus leucophloia	
	Eucalyptus leucophloia subsp. *leucophloia*	
	Eucalyptus pilbarensis	
	Eucalyptus socialis subsp. *eucentrica*	
	Eucalyptus trivalva	
	Eucalyptus victrix	

Family	Taxon	Observation
Myrtaceae	*Eucalyptus xerothermica*	
	Melaleuca eleuterostachya	
Nyctaginaceae	*Boerhavia coccinea*	
	Boerhavia paludosa	
Oleaceae	*Jasminum didymum* subsp. *lineare*	
Phyllanthaceae	*Notoleptopus decaisnei*	
	Phyllanthus erwinii	
	Phyllanthus maderaspatensis	
Pittosporaceae	*Pittosporum angustifolium*	
Poaceae	*Acrachne racemosa*	
	Amphipogon sericeus	
	Aristida burbidgeae	
	Aristida contorta	
	Aristida holathera var. *holathera*	
	Aristida ingrata	
	Aristida jerichoensis var. *subspinulifera*	P1
	Aristida latifolia	
	Aristida lazaridis	P2
	Aristida obscura	
	Astrebla pectinata	
	Bothriochloa ewartiana	
	Brachyachne ciliaris	
	Brachyachne convergens	
	Cenchrus ciliaris	Invasive
	Chloris pectinata	
	Chrysopogon fallax	
	Cymbopogon ambiguus	
	Cymbopogon obtectus	
	Cymbopogon procerus	
	Dichanthium sericeum	
	Digitaria brownii	
	Digitaria ctenantha	
	Enneapogon avenaceus	
	Enneapogon caerulescens	
	Enneapogon intermedius	
	Enneapogon lindleyanus	
	Enneapogon pallidus	
	Enneapogon polyphyllus	
	Enneapogon robustissimus	
	Eragrostis cumingii	
	Eragrostis desertorum	
	Eragrostis dielsii	
	Eragrostis eriopoda	
	Eragrostis falcata	
	Eragrostis pergracilis	
	Eragrostis setifolia	
	Eragrostis tenellula	
	Eragrostis xerophila	
	Eriachne helmsii	
	Eriachne lanata	
	Eriachne mucronata	
	Eriachne pulchella subsp. *dominii*	
	Eriachne pulchella subsp. *pulchella*	
	Eulalia aurea	
	Ischaemum albovillosum	
	Iseilema eremaeum	
	Iseilema membranaceum	
	Iseilema vaginiflorum	

Family	Taxon	Observation
Poaceae	*Panicum decompositum*	
	Panicum effusum	
	Panicum laevinode	
	Paraneurachne muelleri	
	Paspalidium basicladum	
	Paspalidium clementii	
	Paspalidium constrictum	
	Paspalidium rarum	
	Perotis rara	
	Setaria dielsii	
	Setaria surgens	
	Sporobolus australasicus	
	Themeda sp. Hamersley Station (M.E. Trudgen 11431) PN	P3
	Themeda triandra	
	Tragus australianus	
	Triodia basedowii	
	Triodia brizoides	
	Triodia longiceps	
	Triodia melvillei	
	Triodia pungens	
	Triodia sp. Mt Ella (M.E. Trudgen 12739)	P3
	Triodia wiseana	
	Tripogon loliiformis	
	Triraphis mollis	
	Urochloa occidentalis var. *occidentalis*	
	Yakirra australiensis	
	Yakirra australiensis var. *australiensis*	
Polygalaceae	*Polygala isingii*	
Portulacaceae	*Calandrinia* sp. The Pink Hills (F. Obbens FO 19/06)	
	Portulaca oleracea	Invasive
Proteaceae	*Grevillea berryana*	
	Grevillea stenobotrya	
	Grevillea wickhamii	
	Grevillea wickhamii subsp. *hispidula*	
	Hakea chordophylla	
	Hakea lorea subsp. *lorea*	
Pteridaceae	*Cheilanthes lasiophylla*	
	Cheilanthes sieberi subsp. *sieberi*	
Rhamnaceae	*Cryptandra monticola*	
	Ventilago viminalis	
Rubiaceae	*Oldenlandia crouchiana*	
	Psydrax latifolia	
	Psydrax suaveolens	
	Spermacoce brachystema	
Santalaceae	*Exocarpos sparteus*	
	Santalum lanceolatum	
	Santalum spicatum	
Sapindaceae	*Dodonaea coriacea*	
	Dodonaea lanceolata var. *lanceolata*	
	Dodonaea pachyneura	
	Dodonaea viscosa subsp. *mucronata*	
	Dodonaea viscosa subsp. *spatulata*	
Scrophulariaceae	*Eremophila caespitosa*	
	Eremophila clarkei	
	Eremophila cuneifolia	
	Eremophila exilifolia	
	Eremophila forrestii subsp. *forrestii*	
	Eremophila forrestii subsp. Pingandy (M.E. Trudgen 2662)	P2

Family	Taxon	Observation
Scrophulariaceae	*Eremophila fraseri* subsp. *fraseri*	
	Eremophila galeata	
	Eremophila jucunda subsp. *pulcherrima*	
	Eremophila lanceolata	
	Eremophila latrobei	
	Eremophila latrobei subsp. *filiformis*	
	Eremophila latrobei subsp. *latrobei*	
	Eremophila longifolia	
	Eremophila phyllopoda subsp. *obliqua*	
	Eremophila platycalyx subsp. *pardalota*	
	Eremophila tietkensii	
Solanaceae	*Nicotiana benthamiana*	
	Nicotiana occidentalis	
	Nicotiana simulans	
	Solanum centrale	
	Solanum horridum	
	Solanum lasiophyllum	
	Solanum phlomoides	
	Solanum sturtianum	
Surianaceae	*Stylobasium spathulatum*	
Violaceae	*Hybanthus aurantiacus*	
Zygophyllaceae	*Tribulus astrocarpus*	
	Tribulus hirsutus	
	Tribulus macrocarpus	
	Tribulus occidentalis	
	Tribulus suberosus	
	Zygophyllum eichleri	
	Zygophyllum iodocarpum	

APPENDIX D COORDINATES OF PRIORITY FLORA AT WEST ANGELAS

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Species	Status	Zone	Easting	Northing	Number of plants
Acacia aff. *subtiliformis*	P3	50	668980	7438136	120
		50	668950	7438192	10
		50	668906	7438285	120
Aristida jerichoensis var. *subspinulifera*	P1	50	677203	7440980	10
		50	687314	7433555	30
		50	673160	7435134	5
		50	688661	7432670	10
		50	662974	7436737	5
		50	673920	7438834	5
		50	677314	7437374	10
		50	691479	7433849	10
		50	689743	7432298	10
		50	691904	7432228	10
		50	687390	7432574	5
		50	691443	7435305	10
		50	693821	7440864	5
		50	689229	7432625	20
		50	688666	7443264	1
		50	691399	7432870	10
		50	687804	7432698	6
		50	691532	7432839	5
		50	687467	7432718	100
		50	687911	7433195	50
		50	687463	7433153	20
		50	691430	7432855	20
		50	687528	7433614	50
		50	688590	7432715	50
		50	688445	7432704	30
		50	691194	7432900	1
		50	687468	7433386	100
		50	691475	7432849	5
		50	690693	7432924	1
		50	687835	7433535	1
		50	688387	7432677	50
		50	689426	7432862	6
		50	688612	7433353	20
		50	687809	7432691	100
		50	689375	7432556	1000
		50	688885	7432701	5
		50	688301	7432615	1
		50	689526	7432891	2
		50	687463	7433153	100
		50	691662	7432824	10
		50	690208	7435391	50
		50	689267	7432603	30
		50	687468	7433386	20
		50	688741	7432699	5
Aristida lazaridis	P2	50	694996	7443069	5
		50	689585	7432449	20
		50	688575	7432716	2
Brachyscome sp. Wanna Munna Flats (S. van Leeuwen 4662) PN	P1	50	688703	7432676	1
		50	674380	7436772	2
Brunonia sp. long hairs (D.E. Symon 2440) PN	P1	50	664936	7432362	2
		50	663304	7437192	5
		50	663032	7439901	2
		50	673669	7437233	5
		50	677224	7439706	2

Species	Status	Zone	Easting	Northing	Number of plants
		50	673438	7437317	15
		50	669408	7433885	1
		50	691903	7432228	1
		50	668858	7438440	1
		50	668657	7437327	2
Eremophila forrestii subsp. Pingandy (M.E. Trudgen 2662)	P2	50	676965	7438393	1
Goodenia nuda	P4	50	673438	7437317	5
		50	688964	7435518	2
Indigofera sp. Gilesii (M.E. Trudgen 15869)	P3	50	690781	7434606	15
		50	689514	7433871	2
		50	689653	7433877	3
		50	689632	7433869	10
		50	689310	7433800	16
		50	678032	7441255	15
		50	689963	7441587	16
		50	690998	7441857	1
		50	691049	7441944	1
		50	691203	7441994	10
		50	691229	7441997	4
		50	691240	7441996	1
		50	688927	7443254	100
		50	690382	7441946	12
		50	690401	7441890	10
		50	690408	7441885	10
		50	689919	7441031	1
		50	687791	7434256	2
		50	688725	7433695	5
		50	689007	7435225	1
		50	689050	7434996	15
		50	689055	7434985	14
		50	689065	7434969	15
Lepidium catapycnon	T	50	688710	7443257	20
		50	688715	7443269	1
		50	688716	7443281	1
		50	688685	7443292	7
Rhagodia sp. Hamersley (M. Trudgen 17794) PN	P3	50	691478	7433848	2
		50	671233	7439484	2
		50	672580	7439183	2
		50	676135	7435721	3
		50	676538	7435987	1
		50	677340	7435770	5
		50	676625	7435967	5
		50	674706	7436370	5
		50	676519	7435975	5
		50	688643	7443253	1
		50	688669	7443262	1
		50	688772	7443255	1
		50	688894	7443243	4
		50	688927	7443254	6
		50	688948	7443252	4
		50	688962	7443250	3
		50	689046	7443256	4
		50	691903	7432228	5
		50	687430	7432920	5
		50	687435	7432957	1
		50	687437	7432975	1
		50	687435	7432990	1

Species	Status	Zone	Easting	Northing	Number of plants
		50	687474	7433203	5
		50	687803	7434230	1
		50	687917	7433186	2
		50	688055	7432954	8
		50	688511	7433194	6
		50	690364	7432322	1
		50	691515	7432320	4
		50	691647	7432290	1
		50	691872	7432200	1
Sida sp. Barlee Range (S. van Leeuwen 1642) PN	P3	50	694100	7441820	5
		50	668560	7433940	10
		50	691335	7441998	3
		50	691350	7441983	1
		50	692537	7442144	1
		50	692644	7442173	4
		50	692649	7442186	30
Themeda sp. Hamersley Station (M.E. Trudgen 11431) PN	P3	50	675904	7438645	5
		50	675043	7439279	15
		50	675036	7437340	15
		50	677034	7437867	~500
		50	672958	7437985	1000
		50	674453	7438046	1000
		50	674839	7437923	1000
Triodia sp. Mt Ella (M.E. Trudgen 12739)	P3	50	690781	7434606	30
		50	668560	7433940	5
		50	675528	7433693	50
		50	668709	7434062	100
		50	676312	7432796	32
		50	691966	7442312	50
		50	691899	7442318	20
		50	691875	7442317	50

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APPENDIX E RARE AND PRIORITY FLORA REPORT FORMS

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APPENDIX F WEED CATEGORIES

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Table G.1 - Control Codes for Declared Plants in Western Australia

Priority	Requirements
P1 Prohibits movement	The movement of plants or their seeds is prohibited within the State. This prohibits the movement of contaminated machinery and produce including livestock and fodder.
P2 Aim is to eradicate infestation	Treat all plants to destroy and prevent propagation each year until no plants remain. The infested area must be managed in such a way that prevents the spread of seed or plant parts on or in livestock, fodder, grain, vehicles and/or machinery.
P3 Aims to control infestation by reducing area and/or density of infestation	The infested area must be managed in such a way that prevents the spread of seed or plant parts within and from the property on or in livestock, fodder, grain, vehicles and/or machinery. Treat to destroy and prevent seed set for all plants:- - Within 100 metres inside of the boundaries of the infestation. - Within 50 metres of roads and high-water mark on waterways. - Within 50 metres of sheds, stock yards and houses. Treatment must be done prior to seed set each year. Of the remaining infested area:- - Where plant density is 1-10 per hectare treat 100% of infestation. - Where plant density is 11-100 per hectare treat 50% of infestation. - Where plant density is 101-1000 per hectare treat 10% of infestation. Properties with less than 2 hectares of infestation must treat the entire infestation. Additional areas may be ordered to be treated.
P4 Aims to prevent infestation spreading beyond existing boundaries of infestation	The infested area must be managed in such a way that prevents the spread of seed or plant parts within and from the property on or in livestock, fodder, grain, vehicles and/or machinery. Treat to destroy and prevent seed s*et al*. l plants:- - Within 100 metres inside of the boundaries of the infested property - Within 50 metres of roads and high-water mark on waterways - Within 50 metres of sheds, stock yards and houses Treatment must be done prior to seed set each year. Properties with less than 2 hectares of infestation must treat the entire infestation. Additional areas may be ordered to be treated. Special considerations In the case of P4 infestations where they continue across property boundaries there is no requirement to treat the relevant part of the property boundaries as long as the boundaries of the infestation as a whole are treated. There must be agreement between neighbours in relation to the treatment of these areas.
P5	Infestations on public lands must be controlled.

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APPENDIX G LOCATION OF WEEDS RECORDED AT WEST ANGELAS

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Taxon	Zone	Easting	Northing
Acetosa vesicaria	50	670282	7439512
Bidens bipinnata	50	688661	7432669
	50	692404	7434579
	50	687622	7432995
	50	691478	7433848
	50	666551	7432511
	50	671795	7434819
	50	669588	7436085
	50	662967	7439466
	50	663340	7437261
	50	670256	7440041
	50	670827	7440121
	50	669629	7439904
	50	672747	7439755
	50	673669	7437233
	50	671233	7439484
	50	667450	7440007
	50	673420	7439350
	50	672580	7439183
	50	672525	7439032
	50	672930	7439386
	50	677143	7440336
	50	676777	7439888
	50	693252	7440857
	50	674804	7438827
	50	675187	7438908
	50	675043	7439279
	50	674566	7439117
	50	687534	7441102
	50	677807	7440841
	50	689733	7439848
	50	690405	7440055
	50	690919	7440001
	50	691442	7435304
	50	674380	7436772
	50	665892	7437188
	50	676625	7435967
	50	670111	7435914
	50	677184	7437539
	50	668923	7437248
	50	671181	7437165
	50	676037	7437964
	50	666346	7432772
	50	670282	7439512
	50	676538	7435978
	50	670245	7439842
	50	670290	7439432
	50	694470	7443294
	50	676131	7435725
	50	675457	7438797
	50	677339	7435770
	50	690693	7439991
	50	693338	7440912
	50	663126	7437338
	50	674534	7439138

Taxon	Zone	Easting	Northing
	50	671919	7439437
Bidens bipinnata	50	671996	7439530
	50	672245	7439314
	50	674681	7438937
	50	670797	7438950
	50	685963	7441614
	50	677188	7440257
	50	671144	7436941
	50	672760	7437834
	50	671976	7437503
	50	671876	7437376
	50	671720	7437424
	50	671667	7437390
	50	671508	7437270
	50	671595	7437248
	50	671643	7437271
	50	672628	7437571
	50	672742	7437635
Cenchrus ciliaris	50	676037	7437964
Cenchrus setiger	50	677095	7440194
Flaveria trinervia	50	671233	7439484
	50	677143	7440336
Malvastrum americanum	50	663340	7437261
	50	670827	7440121
	50	669629	7439904
	50	667450	7440007
	50	673420	7439350
	50	672930	7439386
	50	677143	7440336
	50	674804	7438827
	50	674566	7439117
	50	677807	7440841
	50	689733	7439848
	50	690919	7440001
	50	676037	7437964
	50	666346	7432772
	50	689097	7440761
	50	670282	7439512
	50	670290	7439432
	50	663126	7437338
	50	674534	7439138
	50	671919	7439409
	50	674681	7438937
	50	677245	7440321
Portulaca oleracea	50	687622	7432995
	50	668832	7436351
	50	662974	7436737
	50	669629	7439904
	50	673669	7437233
	50	671233	7439484
	50	672580	7439183
	50	694775	7442645
	50	677143	7440336
	50	674804	7438827
	50	675043	7439279
	50	687019	7440818

Taxon	Zone	Easting	Northing
	50	677807	7440841
	50	689733	7439848
	50	675036	7437340
Portulaca oleracea	50	676131	7435725
	50	687031	7441098
Sigesbeckia orientalis	50	665237	7437562
	50	687534	7441102
	50	694100	7441820
	50	691064	7441959
Vachellia farnesiana	50	677203	7437782
	50	674110	7437917

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APPENDIX H SITE DESCRIPTIONS

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APPENDIX I SPECIES X SITE MATRIX

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