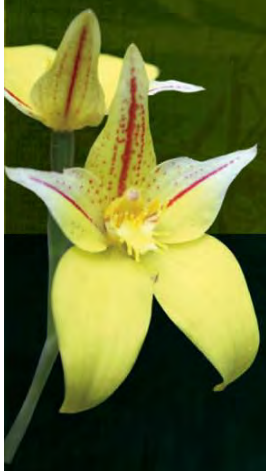
JULY 2012



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ACRONYMS

ARRP Act	*Agriculture and Related Resources Protection Act 1976*
BIF	Banded Iron Formation
CALM	Department of Conservation and Land Management (now Department of Environment and Conservation)
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*
FMG	Fortescue Metals Group Limited
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

Fortescue Metal Group Limited (FMG) intends to expand its current operations to include the development of a magnetite deposit, North Star, together with support infrastructure including waste dumps, tailings dam and access corridors. The North Star proposal is located approximately 100 km south east of Port Hedland and 25 km east of the Fortescue Main Line between Port Hedland and Christmas Creek.

Methods

The vegetation and flora of the North Star Study Area were surveyed over 91 person days. The area was divided into a southern area, incorporating proposed pits, waste dumps and access corridor, and a northern area incorporating additional waste dumps, tailings dam and part of the corridor leading to the proposed water resource. Survey timing was as follows:

- 1st to 7th of April 2011 (Phase 1, southern portion, 22 person days, 104 quadrats completed);
- 27th June to 6th July 2011 (Phase 1, northern portion, 30 person days, 102 quadrats);
- 17th to 22nd August 2011 (Phase 2 southern portion, 18 person days, 29 new quadrats and 45 quadrats resurveyed); and
- 12th to 19th September 2011 (Phase 2, northern portion, 21 person days, 37 new quadrats and 53 quadrats resurveyed).

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

Two hundred and seventy two quadrats 2500 m^2 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, known or potentially conservation significant taxa encountered were also recorded.

Vegetation condition and fire history

The majority of the North Star Study Area is located on Unallocated Crown Land (UCL), with the western portion traversing Wallareenya and Kangan Stations. Much of the area is not subject to active grazing, although some grazing from stock in adjacent pastoral leases occurs due to the absence of fencing at boundaries. The majority of quadrats were assessed as in excellent or very good condition. The disturbances most commonly observed were grazing and weeds, primarily within drainage channels, 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 55% of quadrats assessed as burnt more than 5 years ago or with no evidence of fire. The pattern of burning appears sporadic and localised.

Flora

A total of 472 taxa were recorded from the Study Area. The families and genera represented are considered typical of surveys within the Pilbara during favourable seasonal conditions, with the exception of the relatively high representation of the family Cyperaceae. An unusually high diversity

of sedges were recorded in this survey as a result of the relative abundance of water sources, many of which were in excellent condition due to the absence or low intensity of grazing by cattle.

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 89% and 96% of the taxa present were recorded.

Species richness within quadrats varied from 4 to 62 taxa, with a mean species richness of 25.67 ± 0.70 (n= 272). The highest species richness of 62 taxa was recorded in Quadrat 86, located within Vegetation Unit *ApTp* (*Acacia pyrifolia*, *Acacia acradenia* and *Tephrosia rosea* mid shrubland over *Triodia pungens* open hummock grassland), while the lowest species richness of taxa was recorded from Quadrat 34 in Vegetation Unit *Tw*[4] (*Triodia wiseana* hummock grasslands). The most floristically diverse vegetation units were Vegetation Units *GwTp* (*Grevillea wickhamii* sparse tall shrubland over *Triodia pungens* open hummock grassland) and *Ap* (*Acacia pyrifolia*, *Gossypium robinsonii* and *Tephrosia rosea* mid shrubland), with mean species richness of 46.1 and 42.8 respectively. Vegetation Unit *AtEm* (*Acacia tumida*, *Acacia orthocarpa* and *Grevillea wickhamii* open shrubland over *Eriachne mucronata* isolated tussock grasses) and *AoTb* (*Acacia orthocarpa* and *Indigofera monophylla* open shrubland over *Triodia basedowii* open hummock grassland) were the least diverse, with mean species richness of 15.5 and 13.5 respectively.

No EPBC listed or State listed Threatened (formerly Declared Rare Flora) taxa were recorded within the Study Area. Eight Priority Flora taxa were recorded during this survey: three Priority 1 taxa (*Abutilon pritzelianum*, *Heliotropium muticum* and *Pityrodia* sp. Marble Bar), one Priority 2 species (*Euphorbia clementii*), two Priority 3 species (*Acacia glaucocaesia* and *Gymnanthera cunninghamii*) and two Priority 4 species (*Goodenia nuda* and *Ptilotus mollis*). Two of these taxa have previously been recorded within the Study Area (*Pityrodia* sp. Marble Bar and *Gymnanthera cunninghamii*). Of the nine priority taxa, *Pityrodia* sp. Marble Bar appears to be the most restricted in distribution, with only two other collections lodged at the West Australian Herbarium, both within the North Star Study Area and 2 km of each other. In addition there are 15 locations from approximately 10 km to the east of the Study Area identified as "*Pityrodia* sp. Panorama" (Mattiske 2007), comprising in excess of 257 plants (URS 2007). This taxon is not recognised within FloraBase and to date no specimens have been lodged, however on the basis of habitat and proximity appears likely to represent an additional population of *Pityrodia* sp. Marble Bar.

Pityrodia sp. Marble Bar is relatively abundant within the North Star Study Area, with 541 plants recorded to date from 14 loci (i.e. records separated by more than 500 metres). The records from the current survey represent a very minor south-western extension to the taxon's range and a significant increase to the known abundance. The taxon appears to favour steep hill slopes and is considered likely to extend further within this habitat than current records suggest.

Two other Priority Flora species recorded within the Study Area are restricted to the Pilbara Bioregion based on current records; *Heliotropium muticum* (P1) and *Euphorbia clementii* (P2).

No Weeds of National Significance (WONS) or Declared Weeds were recorded. Nine weeds were recorded within the Study Area, seven of which have been assessed within the Department of Environment and Conservation (DEC) classification of Environmental Weeds within the Pilbara. Two species are ranked as a high threat; **Aerva javanica* and **Cenchrus ciliaris*. The latter is by far the most abundant species, recorded from 42 (15%) of all quadrats.

Vegetation

Based on multivariate analysis, interpretation of aerial imagery and ground truthing, 33 vegetation communities were described and mapped within the Study Area.

No vegetation or floristic community classified as a Threatened Environmental Community (TEC) or Priority Ecological Community is present within 40 km the Study Area.

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 extensively or moderately well represented elsewhere. Unit 619 (*Eucalyptus* woodland over *Acacia* mixed, isolated shrubs) is poorly represented in the conservation estate. However, based on the digitisation of this mapping (DAFWA, 2006) the area of this unit within the Study Area is <1% of its total representation.

The vegetation units mapped in the current survey were compared to those identified in the survey of the FMG Main Line corridor (Biota, 2004), in which 122 vegetation types ere identified in a corridor extending from Port Hedland down to Mindy Mindy and Christmas Creek. Thirty three quadrats from the FMG survey, located within a 50 km zone around the North Star Study Area were co-analyzed with the current survey data using multivariate analysis.

There were four units which correlate closely at the relatively high scale of resolution that has been applied to both vegetation maps:

- Riparian communities. These units shared some dominant and associated species, but were also linked statistically by the prevalence of the introduced species **Cenchrus ciliaris,* which is widespread in riparian communities that have been grazed;
- *Acacia acradenia* shrublands over *Triodia wiseana*. These units are relatively common in both study areas*;*
- *Acacia orthocarpa* shrublands over *T. wiseana*; and
- *Corymbia hamersleyana* open low woodland over *Acacia bivenosa* mid shrubland over *Triodia pungens*.

The vegetation units at North Star were compared to those from the Panorama Copper-Zinc Project at Sulphur Springs, approximately 10 km east of the North Star Study Area (Mattiske 2007). Eight of the 18 vegetation associations described for the Panorama Project correspond to vegetation units at North Star:

- Communities of rivers and major creeks;
- *Acacia tumida* shrubby creeklines;
- *Eucalyptus leucophloia* trees over *Acacia* spp. shrubs over *Triodia* sp.;
- *Corymbia hamersleyana* open low woodland over *Acacia* spp. shrubland over *Triodia* spp.;
- *Acacia* spp. shrubland over *Triodia* spp.;
- *Acacia* spp. shrubland; and
- *Acacia inaequilatera* shrubs over *Triodia wiseana* hummock grassland.

The vegetation units mapped at North Star were compared to those units recorded during the Brockman rail corridor survey (ecologia, 2011). This corridor largely overlaps a portion of the FMG rail corridor, running north from the Brockman Marillana mining lease for approximately 78 km, with two spur options heading east to connect to the FMG rail corridor to Christmas Creek.

There were four units which correlated closely to the units mapped in this study (Table 6.6):

- Riparian communities;
- *Acacia tumida*, *Grevillea wickhamii* and *Indigofera monophylla* shrubland;
- *Corymbia hamersleyana* open low woodland over *Acacia bivenosa* mid shrubland over *Triodia pungens* open hummock grassland; and
- *Eucalyptus leucophloia* isolated low trees over *Acacia ptychophylla* and *Grevillea wickhamii* shrubland over *Eriachne mucronata* isolated tussock grasses (ecologia Unit *ElApEm,* Brockman Unit H4). These units represent 891 ha (0.12%) of the North Star Study Area and 57 ha (0.73%) of the Brockman Rail Corridor respectively.

The relatively low level of correlation between vegetation units mapped regionally is considered to be primarily a function of two factors:

- The high level of resolution of vegetation mapping of these three studies; and
- The two rail corridors from which data was available for regional comparison both intersect only the western edge of the North Star Study Area, so correspondence with the eastern section is not necessarily expected, and conversely, the Vegetation of Panorama Project to the east would not be expected to correspond well with vegetation to the west of the Study Area.

Vegetation is also of conservation significance if it has "a role as a key habitat for threatened species" (EPA 2004, page 30). In this context *Pityrodia* sp. Marble Bar (P1) appears to have a moderately high specificity to the vegetation unit *AaTw4* and to a lesser extent *SpTl, Tl* and *GwTe,* all of which units occur on rocky slopes. Similarly *Gymnanthera cunninghamii* (P3) demonstrates high specificity for the vegetation unit *GwTp* with 83% of all plants recorded in this unit, which occurs in sandy drainage channels. A high proportion of *Goodenia nuda* (P4) plants were recorded in the units *GwTp* and *ImTp* which correspond to drainage channels and associated floodplains respectively.

In a local context vegetation can be considered significant if it is locally uncommon or provides habitats of local significance. The least extensive vegetation units locally are *GaTw* (basalt dyke) and *FpAtCo* (escarpment springs) which account for 0.8% and 0.4% respectively of the total area mapped. While both units are expected to extend locally beyond the boundaries of the Study Area, the escarpment springs in particular is likely to be restricted to very small areas and to be of particular habitat significance to local fauna and to support a number of flora such as *Ficus platypoda* which have high habitat specificity and are therefore locally restricted, but do not have Priority status.

Conclusions

Of the eight Priority Flora taxa recorded from the survey area, *Pityrodia* sp. Marble Bar has the most restricted distribution and on the basis of current records may be locally endemic. Investigating the full extent at known locations and the identification of new locations of this taxon are high priority actions. A regional survey is proposed to occur in March 2012.

The Vegetation Unit *FpAtCo* growing around escarpment springs and cascades is the most significant vegetation community identified in the North Star Study Area. It is the least extensive of all

vegetation communities mapped in the North Star Study Area, being restricted to small patches where water cascades over escarpments from areas higher in the landscape. This combination of relatively high levels of moisture and a sheltered site provide conditions rarely found in the region.

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1 INTRODUCTION

Fortescue Metals Group Limited (Fortescue) is developing the Pilbara Iron Ore and Infrastructure Project, which includes a series of iron ore mines in the Pilbara region of Western Australia and associated rail and port infrastructure.

Fortescue intends to expand its current operations to include the development of a magnetite deposit, North Star, together with support infrastructure including waste dumps, tailings dam and rail and road access. The North Star proposal is located approximately 100 km south east of Port Headland and 25 km east of the Fortescue Rail Line (Figure 1.1).

As part of the environmental approvals processes for Fortescues North Star mine, baseline flora and vegetation surveys of the proposed rail corridors, infrastructure and mine site are required to assess potential impacts and identify appropriate management strategies. These surveys will also assist with environmental approvals for proposed exploration and development.

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*) and the Western Australian *Wildlife Conservation Act 1950* (*WC Act*) and *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.

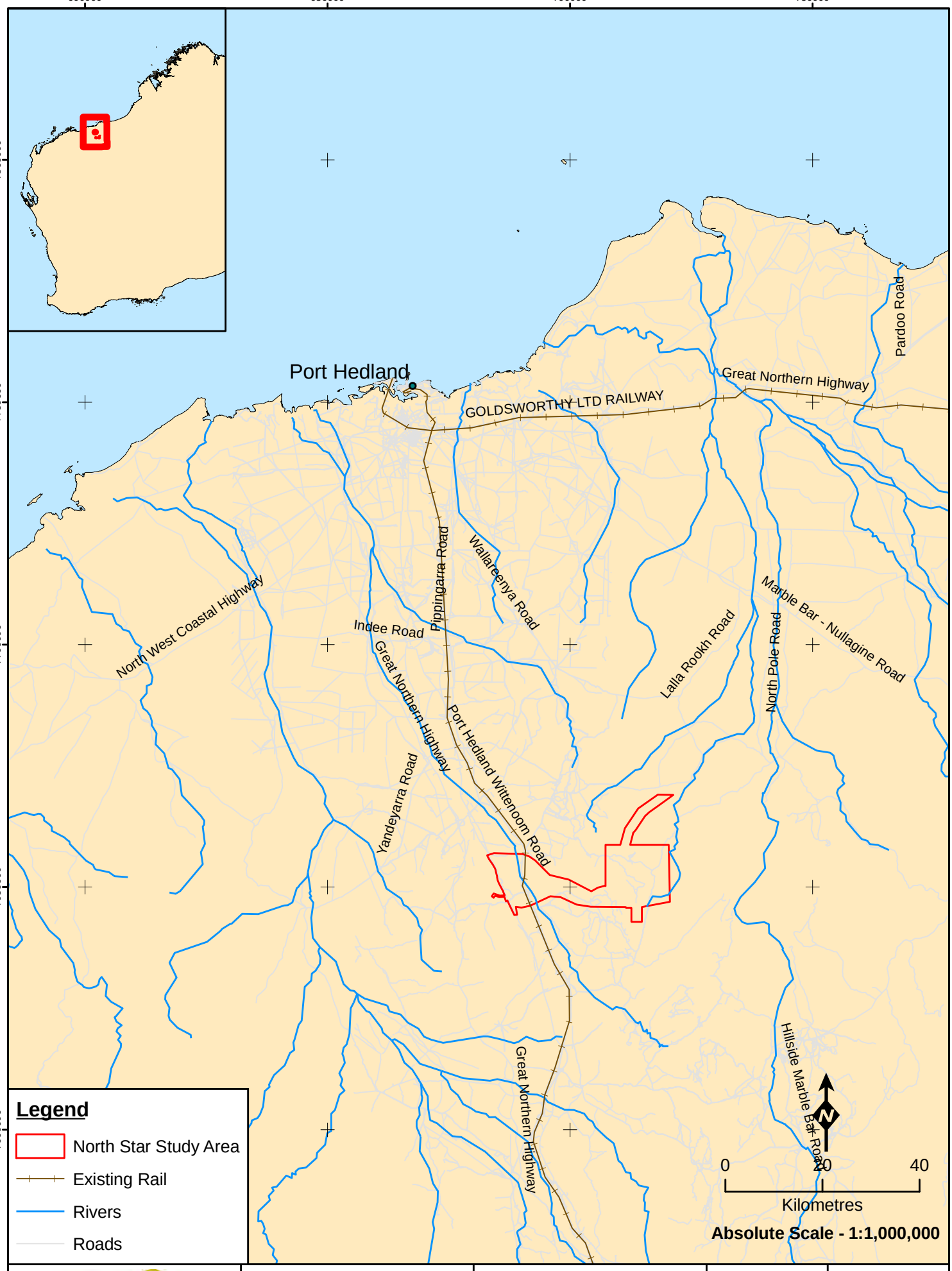
Furthermore, floristic surveys undertaken as part of the Environmental Impact Assessment (EIA) process are required to address the following:

- Environmental Protection Authority's (EPA's) Position Statement No. 3: Terrestrial Biological Surveys as an Element of Biodiversity Protection (Environmental Protection Authority 2002);
- 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 the 17th of February 2012.



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North Star Study Area Location

Figure: 1.1	**Drawn: RT**
Project ID: 1321	**Date: 16/12/2011**

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

Unique Map ID: RT036

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NS-AS-EN-0001

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 biological 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 will 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 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 study.
- 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) stations for which both rainfall and temperature data are available are Marble Bar (Site No. 004106), 71 km to the northeast, and Redmont (Site No. 004043), 80.9 km to the southwest of the Study Area. Redmont and Marble Bar stations have an average annual rainfall of 311 mm and 362 mm respectively (BOM 2011). Both locations have a typical Pilbara climate of hot summers with sporadic summer storms and warm dry winters (Figure 2.1).

Rainfall data in the period preceding and during which the surveys occurred is also available for Hillside Station (Site No 004015) and Wallareenya (Site no 004038), located 61 km and 62 km south east and southwest of the Study Area respectively (Table 2.1). These two stations provide a more reliable indication of local conditions. Summer rainfall to the east of the Study Area occurred later in the season and was consistently lower than the long term average. However rainfall at Wallareenya during January and February 2011 was significantly above average, falling to below average for most of the following months, a pattern which is consistent with that observed during Phases 1 and 2 of the floristic survey. The higher than average rainfall preceding Phase 1 of the survey was conducive to flowering and therefore favourable for the floristic survey.

Table 2.1 – Rainfall at Wallareenya and Hillside Meteorological Stations.

Total rainfall (mm)	Hillside		Wallareenya	
	Monthly total	Monthly average (1917-2011)	Monthly total	Monthly average (1908-2011)
December 2010	14	24.2	0	23.2
January 2011	63.4	72.1	114.3	64.9
February 2011	12	80.0	312.0	86.3
March 2011	18.2	52.8	42.2	64.6
April 2011	4.6	21.4	11.6	17.8
May 2011	0	19.1	24	22.2
June 2011	0	19.6	2	25.4
July 2011	13	12.3	2	9.4
August 2011	0	7.1	0	4.5
September 2011	n/a	1.2	0	1.8

(BOM 2011)

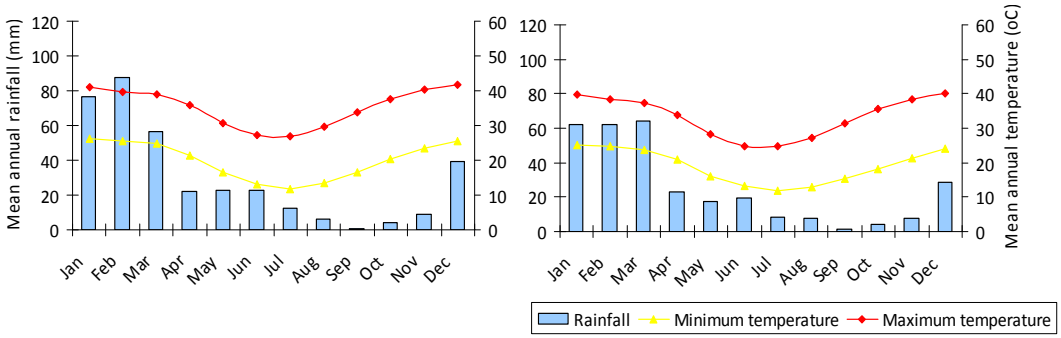


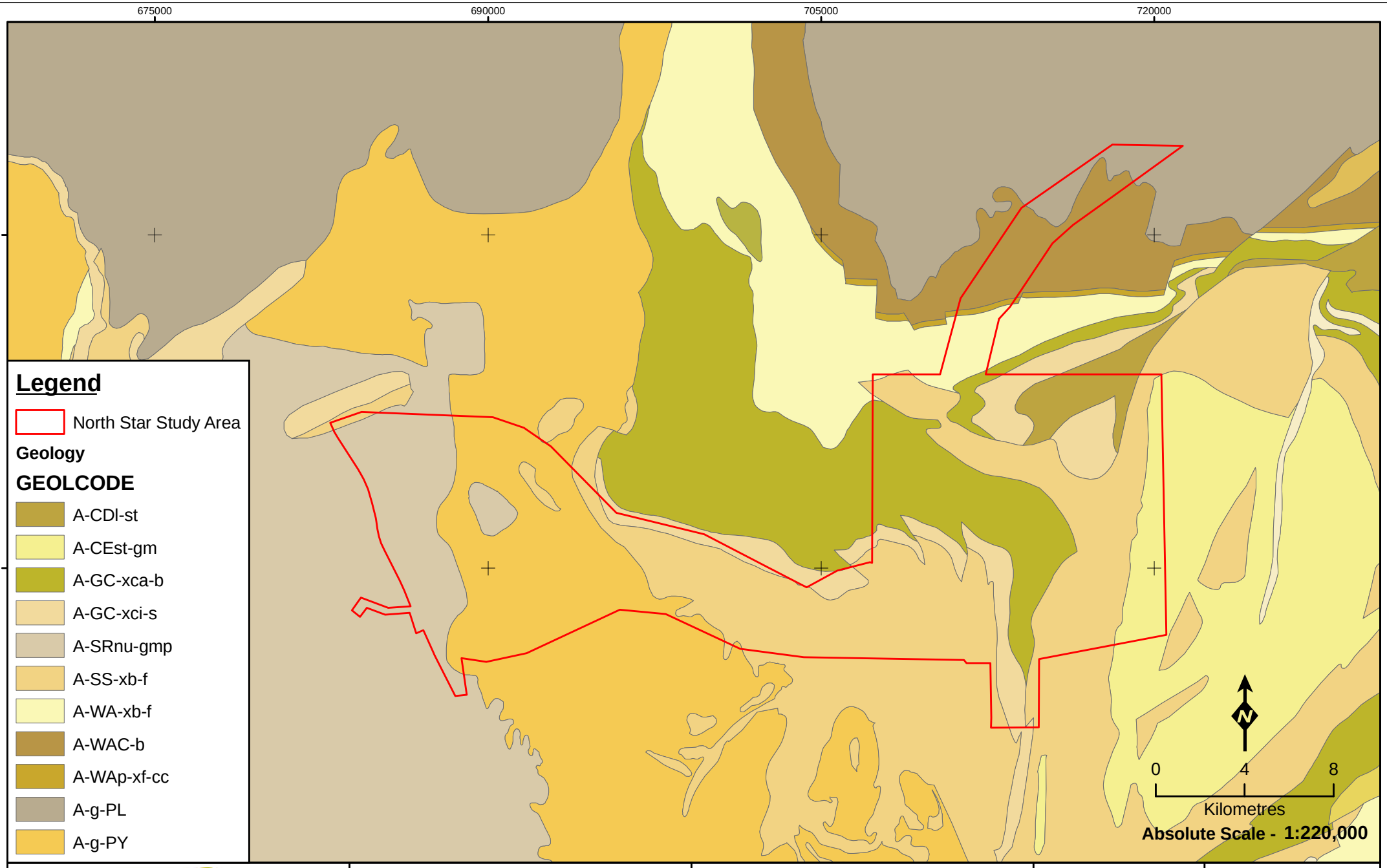
Figure 2.1 – Mean Monthly Climate Data for Marble Bar (left) and Redmont (right).

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 of WA is relatively continuous, with similar geological processes occurring across the region which have resulted in the enrichment of the iron deposits.

The main source of the magnetic mineralization of the FMG North Star mine is the Pincunah Formation, which is one of the prominent Banded Ironstone Formations (BIF) within the greenstone belts of the Pilbara Craton. The geological units of North Star and the surrounding areas are presented in Figure 2.2 (Hickman and Kranendonk 2008) with definitions of the geological unit codes provided in Table 2.2. North Star is comprised of five geological units, most of which are metamorphosed and include regions of medium- to coarse-grained feldspar (-quartz) porphyritic monzogranite; massive to weakly foliated; local flow-aligned feldspar phenocrysts; local garnet-bearing pegmatite and granite dykes; mafic and felsic volcanic rocks and minor sedimentary rock; mafic, ultramafic, and felsic volcanic and intrusive rocks, and sedimentary rocks; undivided granitic rock; and granitic rock (Hickman and Kranendonk 2008).



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FMG Fortescue The New Force in Iron Ore

Geology of the North Star Study Area

Figure: 2.2
Project ID: 1321

Drawn: RT
Date: 16/12/2011

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

Unique Map ID: RT037

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Table 2.2 – Geology of North Star and Surrounding Areas.

Geological Code	Definition of code
A-CD-swa	Wacke; dominantly subarkosic; fine- to coarse-grained; well-developed graded units; turbiditic; metamorphosed
A-CDc-sh	Laminated shale; includes minor beds of poorly sorted subarkose; metamorphosed
A-CDl-st	Sandstone containing conglomerate, and minor siltstone and shale; metamorphosed
A-CEst-gm	Hornblende-biotite monzogranite, granophyric monzogranite, and subvolcanic granitoid intrusions; metamorphosed
A-DA-xo-a	Undivided; mafic and ultramafic intrusive rocks; metamorphosed
A-FOh-xs-f	Sedimentary and felsic volcanic rocks; local intrusive rocks
A-FOk-b	Undivided; massive, amygdaloidal, and vesicular basalt and basaltic andesite; local komatiitic basalt, dacite and rhyolite
A-FOr-b	Basaltic volcanic rocks; local volcaniclastic and siliciclastic rocks
A-GC-xca-b	Unassigned; banded iron formation, chert, siliciclastic sedimentary rocks, and mafic volcanic rocks; metamorphosed
A-GC-xci-s	Undivided; banded iron-formation and siliciclastic sedimentary rock; metamorphosed
A-GCe-ca	Chert and banded iron-formation; minor felsic volcaniclastic rock; metamorphosed
A-PI-b	Mafic rock, undivided; metamorphosed
A-SRnu-gmp	Medium- to coarse-grained feldspar(-quartz) porphyritic monzogranite; massive to weakly foliated; local flow-aligned feldspar phenocrysts; local garnet-bearing pegmatite and granite dykes
A-SS-xb-f	Mafic and felsic volcanic rocks; minor sedimentary rock; metamorphosed
A-STki-gmp	Monzogranite; undeformed to foliated; medium-grained, equigranular to weakly porphyritic; weakly metamorphosed
A-WA-xb-f	Mafic, ultramafic, and felsic volcanic and intrusive rocks, and sedimentary rocks; metamorphosed
A-WAC-b	Mafic volcanic rocks; local felsic and ultramafic rocks; metamorphosed
A-WAC-f	Felsic volcanic rocks; metamorphosed
A-WAp-xf-cc	Felsic volcanic and sedimentary rocks overlain by strelley pool chert; metamorphosed
A-g-PL	Undivided granitic rock; metamorphosed
A-g-PY	Granitic rock; metamorphosed
A-od-PEP	Dolerite in dykes and sills; metamorphosed

2.2.2 Soils

Twenty-one broad soil groups have been identified within Van Vreeswyk *et al.* (2004) survey area in the Pilbara. Soils are predominantly red and shallow with stony mantles.

The most extensive soils 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).

2.3 LAND USE HISTORY

2.3.1 Overview

Pastoralism is the most extensive land use in the Pilbara. Forty-four pastoral leases fall wholly or partly within the survey area and collectively occupy about 105,240 km^2 (58% of the area). Areas set aside for nature conservation at the time of survey covered approximately 16,629 km^2 (9% of the area) consisting of the Karijini and Millstream-Chichester National Parks, the Mungaroona Range and Cane River Nature Reserves and the Meentheena pastoral lease which has been purchased by the Department of Conservation and Land Management (CALM, now DEC), destocked and is proposed to be incorporated into the conservation estate (Van Vreeswyk *et al.* 2004).

The Aboriginal reserves of Abydos, Jigalong, Woodstock and Yandeyarra, and the special lease for Aboriginal use, Callawa, occupy about 9,740 km^2 (5% of the area). Mining is an important land use which is largely confined to ironstone ranges and greenstone belts throughout the survey area. There are also large tracts of Unallocated Crown Land which account for about 48,840 km^2 or 27% of the area (Van Vreeswyk *et al.* 2004).

The remaining 1% of the Van Vreeswyk *et al*. (2004) survey area consists of town commons and various reserves.

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.

The Pilbara produces 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). Development of the iron ore rich deposits was accelerated in the 1960s after the Commonwealth lifted the 1938 export embargo on iron ore.

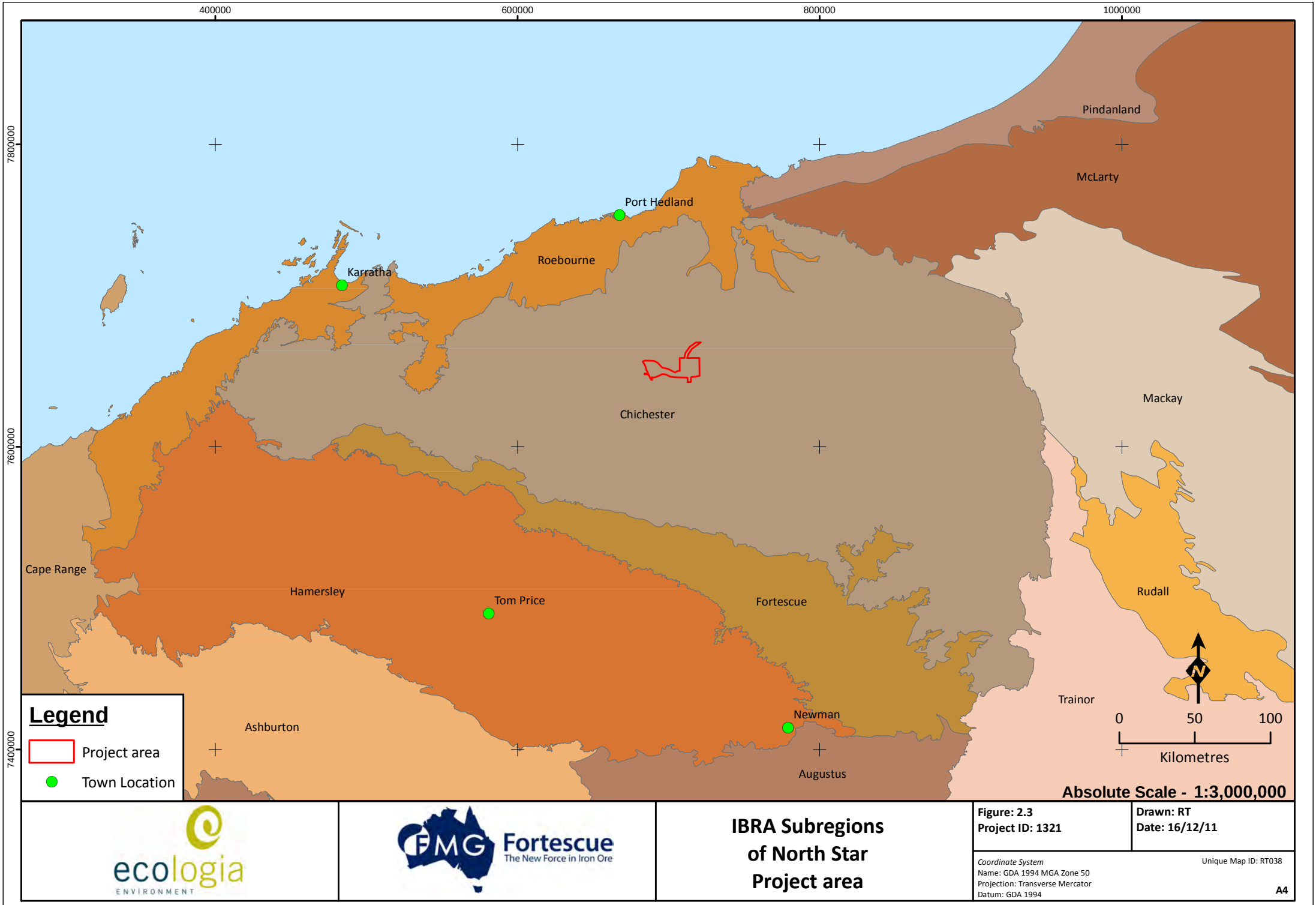
2.3.2 Local land use

The majority of the North Star Study Area is located on vacant crown land (VCL), with the western portion traversing Wallareenya and Kangan Stations. Due to an absence of fencing at pastoral lease boundaries some grazing by stray cattle occurs with the VCL portion. Exploration leases are located within 5-10 km of the northern, eastern, western and southern boundaries of the Study Area.

2.4 PILBARA BIOGEOGRAPHIC REGION

The North Star Study Area is situated within the Pilbara Region of the Interim Biogeographic Regionalisation of Australia, IBRA 6.1 (Australian Government 2004). The Pilbara biogeographic region comprises four subregions: Hamersley, Fortescue Plains, Chichester and Roebourne. The Study Area is situated in the Chichester subregion (Figure 2.3).

The Chichester subregion comprises the northern section of the Pilbara Craton. Undulating Archaean granite and basalt plains include significant areas of basaltic ranges. Plains support a shrub steppe characterised by *Acacia inaequilatera* over *Triodia wiseana* hummock grasslands, while *Eucalyptus leucophloia* tree steppes occur on ranges. The climate is semi desert tropical and receives 300 mm of rainfall annually. Drainage occurs to the north via numerous rivers (e.g. De Grey, Oakover, Nullagine, Shaw, Yule and Sherlock). The subregional area is 9,044,560 ha (Kendrick and McKenzie 2001).



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IBRA Subregions of North Star Project area

Figure: 2.3
Project ID: 1321

Drawn: RT
Date: 16/12/11

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

Unique Map ID: RT038

A4

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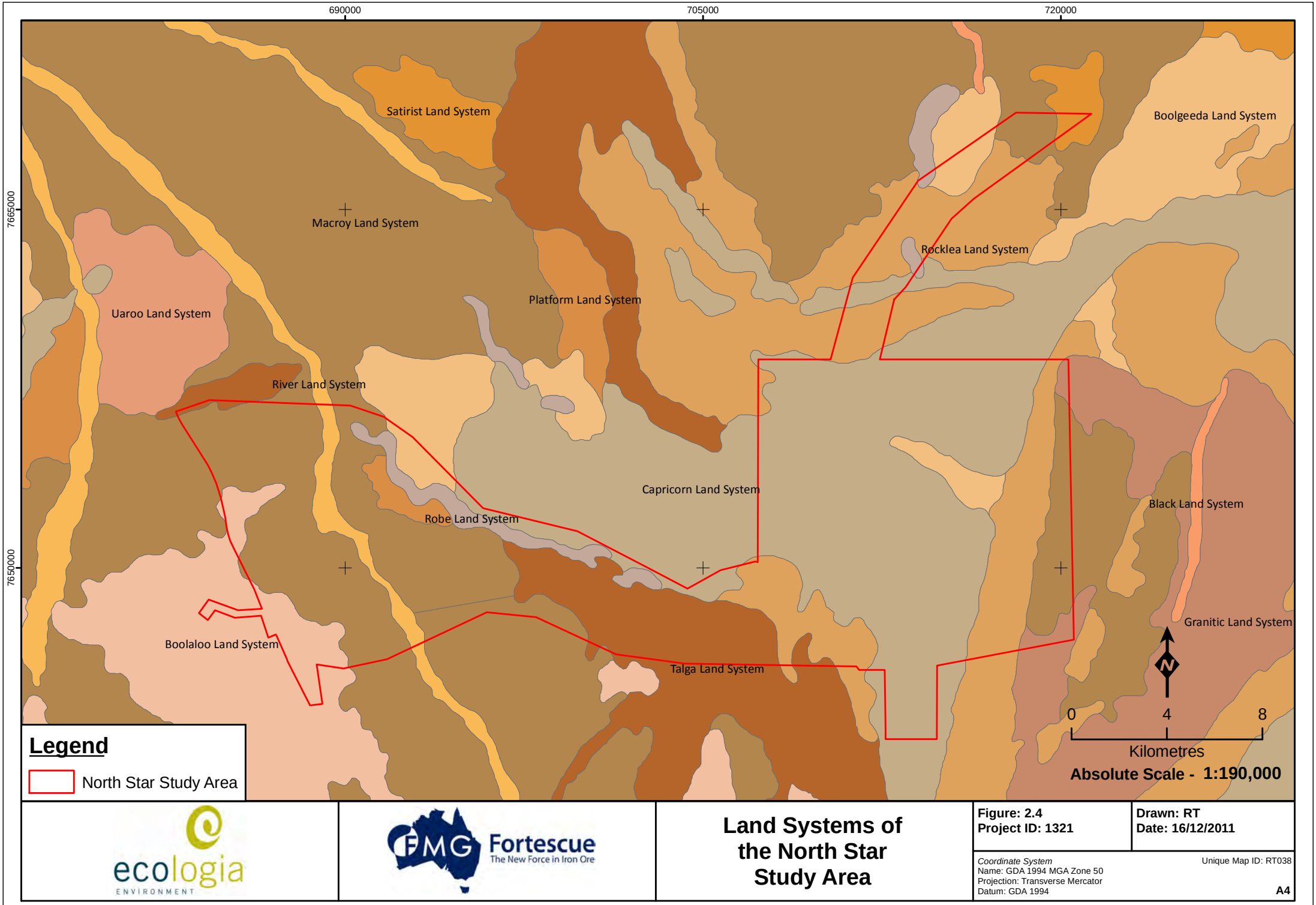
2.5 LAND SYSTEMS

Van Vreeswyk *et al.* (2004) undertook a regional inventory of the Pilbara rangelands to document the land systems present and their condition. The Pilbara Regional Inventory (PIR) covered 181,723 km^2, bounded by the Indian Ocean and Roebourne Plains to the north and west, extending to Broome in the north-east and the Ashburton River catchment in the south. The extent of each of the land systems vary greatly, with almost half the area comprised of just six land systems: Little Sandy, Macroy, Newman, Nita, Rocklea and Uaroo (Van Vreeswyk *et al.* 2004).

The proposed mine site and associated infrastructure traverses eleven land systems (Table 2.3, Figure 2.4), each of which has been further classified into subtypes and assessed for vegetation condition.

Table 2.3 – Extent of Land Systems Present Within the Study Area.

Land System	Description	Area within Pilbara (km^2)	Percent of Pilbara (%)	Area within Proposal Area (km^2)	Percent of Land System (%)
Boolaloo	Granite hills, domes and tor fields and sandy plains with shrubby spinifex grasslands.	1,502	0.8	12.8	0.849
Boolgeeda	Stony lower slopes and plains below hill systems supporting hard and soft spinifex grasslands and mulga shrublands.	7,748	4.3	12.3	0.159
Capricorn	Hills and ridges of sandstone and dolomite supporting shrubby hard and soft spinifex grasslands.	5,296	2.9	125.3	2.366
Granitic	Rugged granitic hills supporting shrubby hard and soft spinifex grasslands.	4,020	2.12	2.5	0.062
Macroy	Stony plains and occasional tor fields based on granite supporting hard and soft spinifexes.	13,096	7.2	91.2	0.696
Platform	Dissected slopes and raised plains supporting hard spinifex grasslands.	1,570	0.9	3.9	0.247
River	Active flood plains and major rivers supporting grassy eucalypt woodlands, tussock grasslands and soft spinifex grasslands.	4,088	2.3	7.2	0.176
Robe	Low limonite mesas and buttes supporting soft spinifex (and occasionally hard spinifex) grasslands.	865	0.5	9.8	1.131
Rocklea	Basalt hills, plateaux, lower slopes and minor stony plains supporting hard spinifex (and occasionally soft spinifex) grasslands.	22,993	12.7	51.8	0.225
Satirist	Stony plains and low rises supporting hard spinifex grasslands, and gilgai plains supporting tussock grasslands.	377	0.2	0.8	0.003
Talga	Hills and ridges of greenstone and chert and stony plains supporting hard and soft spinifex grasslands.	2,124	1.2	31.0	1.459



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Land Systems of the North Star Study Area

Figure: 2.4
Project ID: 1321

Drawn: RT
Date: 16/12/2011

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

Unique Map ID: RT038

A4

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2.6 THREATENED ECOLOGICAL COMMUNITIES

2.6.1 Nationally Threatened Ecological Communities

Ecological communities are naturally occurring biological assemblages associated with a particular type of habitat. At a national level, flora and Threatened Ecological Communities (TECs) are protected under the *EPBC Act*. No Commonwealth listed TECs occur in the vicinity of the Study Area.

2.6.2 State Threatened Ecological Communities and Priority Ecological Communities

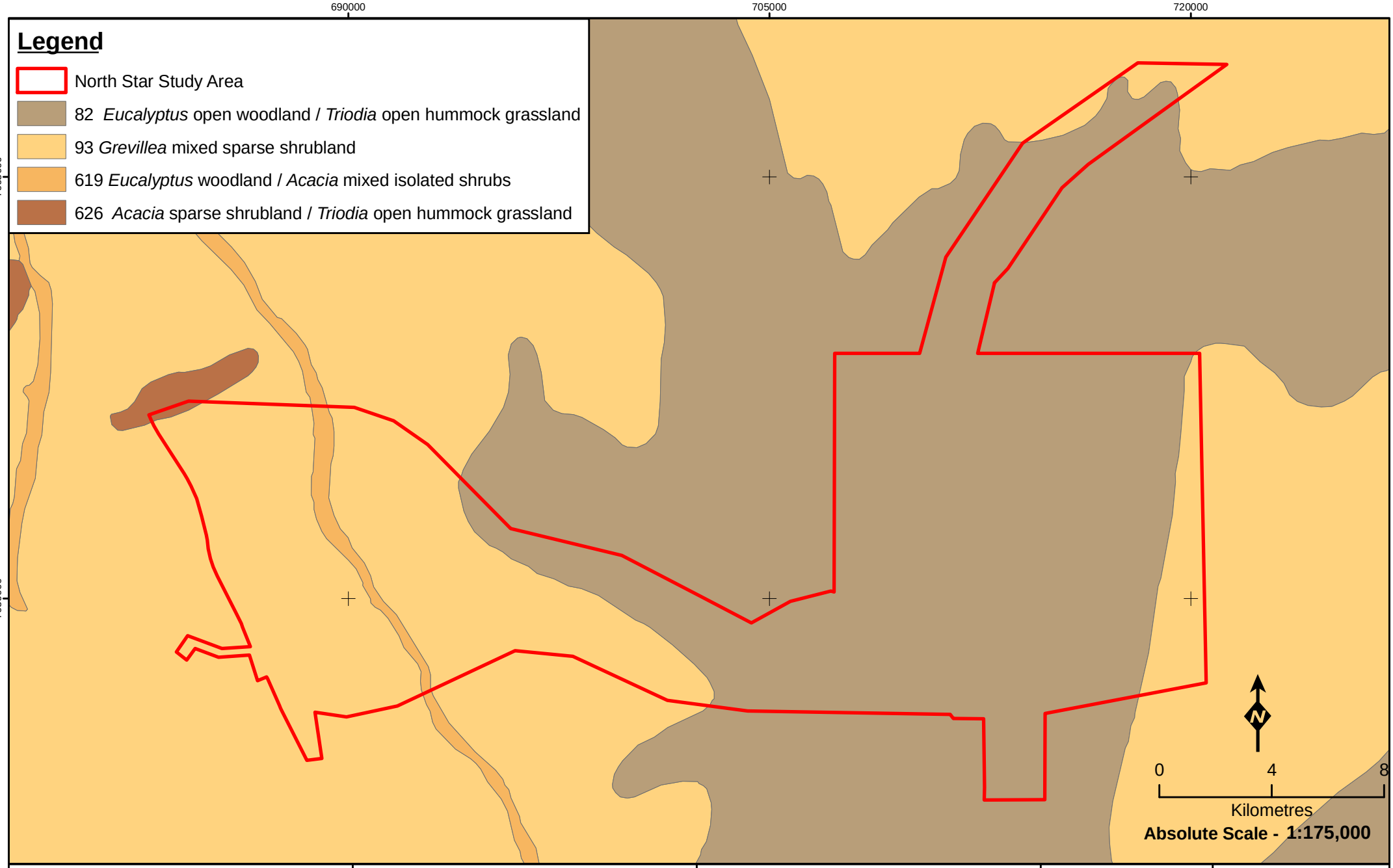
The Western Australian DEC maintains a list of TECs and a list of Priority Ecological Communities (PECs). PECs include potential TECs that do not meet survey criteria, or that are not adequately defined. As at February 2011, no state-listed TECs or PECs occur in the Study Area or within a 40 km buffer zone of the boundary.

2.7 PREVIOUS VEGETATION SURVEYS

2.7.1 Beard Vegetation Descriptions

The Study Area lies within Beard's (1975) Pilbara region of the Eremaean Botanical Province, part of a series of maps completed by Beard *et al.* from 1974 to 1981 throughout Western Australia. The vegetation mapping was subsequently reinterpreted to reflect the National Vegetation Information System (Department of Environment and Water Resources 2012) standards and revised taxonomy for some species and digitised (Shepherd *et al.* 2001). Four vegetation units are mapped within the Study Area, the distributions of which are detailed in Figure 2.5:

- 82 *Eucalyptus* open woodland/*Triodia* open hummock grassland;
- 93 *Grevillea* mixed sparse shrubland;
- 619 *Eucalyptus* woodland/*Acacia* mixed isolated shrubs; and
- 626 *Acacia* sparse shrubland/*Triodia* open hummock grassland.



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FMG Fortescue The New Force in Iron Ore

Shepherd *et al.* (2001) Vegetation Units in the North Star Study Area

Figure: 2.5
Project ID: 1321

Drawn: CM
Date: 16/12/2011

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

Unique Map ID: CM041

A4

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2.7.2 Land Systems of North Star (Van Vreeswyk *et al.* 2004)

Eleven land systems mapped by (Van Vreeswyk *et al.* 2004) within the Pilbara Regional Inventory (PRI) are present within the Study Area, each of which has been further classified by landform, soil, vegetation and drainage patterns (Table 2.4)

The regional condition of vegetation within each land system was also assessed by Van Vreeswyk *et al*. (2004). The majority of land systems present are regionally in very good condition due to their inaccessibility and unpalatable vegetation. The exception is the River Land System, with only 56% assessed as in very good condition. Tussock grasses, annual grasses, forbs and shrubs on this system are preferred by grazing animals but not prone to degradation unless overgrazed and overstocked. The presence of the introduced grass **Cenchrus ciliaris* (Buffel grass) was not considered a negative indicator of condition in this assessment due to its perceived foraging value to pastoralists, hence the proportion of this land system in poor condition in an environmental context is likely to be significantly higher and the value of areas not impacted by grazing higher. This land system represents 2.3% of the total area within the PRI survey area and 2.1% of the North Star Study Area.

2.7.3 Vegetation of the FMG Main Line

Biota (2004) conducted a survey of the FMG rail corridor from Port Hedland, bifurcating to the proposed Mindy Mindy mine and to Christmas Creek and Mt Nicholas, approximately 345 km south south east of Port Hedland. The corridor intersects the current Study Area near its western boundary. Ninety seven quadrats were surveyed and 122 vegetation types were defined. The vegetation units defined in this study have been compared to those described within the Study Area in Section 6.2 to provide regional context.

2.7.4 Vegetation of the Panorama (Sulphur Springs) Project

The vegetation units at North Star were compared to those from the Panorama Copper-Zinc Project at Sulphur Springs, approximately 10 km east of the North Star Study Area (Mattiske 2007). Mattiske (2007) reviewed and reinterpreted the vegetation mapping of previous flora and vegetation surveys (Trudgen *et al.* 2002; Trudgen 2006, 2007). However the number of quadrats surveyed, the site by species matrix and the extent of each vegetation association was not provided (Mattiske 2007). Nevertheless, similarities between the vegetation of the two survey areas are summarised in Section 6.2 of this report.

2.7.5 Vegetation of the Brockman Marillana Rail Options

The vegetation units mapped at North Star were also compared to those units recorded during the Brockman rail corridor survey (*ecologia* 2011). This corridor largely overlaps a portion of the FMG Port Hedland rail corridor, running north from the Brockman Marillana mining lease for approximately 78 km, with two options heading east to connect to the FMG rail corridor to Christmas Creek.

Table 2.4 – Land Systems at North Star.

Land System and % of Pilbara	% of Study Area	Description	Vegetation Condition Assessment	Landform (and % of Land system)	Vegetation Community
Boolaloo 0.8	3.7	Granite hills, domes and tor fields and sandy plains with shrubby spinifex grasslands	Very good 100% Hills and tor heaps are poorly accessible to livestock, elsewhere on the system the spinifex vegetation is not usually prone to grazing induced degradation but is subject to fairly frequent burning	Hills, tor heaps and hill slopes (70%)	Scattered hummocks of *Triodia pungens* (soft spinifex) with isolated *Acacia* spp. and other shrubs, occasional *Terminalia canescens* trees.
				Sandy plains (10%)	Hummock grasslands of *Triodia* sp. (hard spinifex) with very scattered to scattered *Acacia* spp. and other shrubs. Occasionally *T. pungens* (soft spinifex).
				Stony plains (13%)	Hummock grasslands of *T. wiseana, T. brizoides* (hard spinifex) or *T. pungens* (soft spinifex) with very scattered shrubs such as *Acacia orthocarpa, A. maitlandii*.
				Tracts receiving run-on (5%)	Hummock grasslands of *T. pungens* with scattered *Acacia* spp. and other shrubs.
				Narrow drainage floors and channels (2%)	Scattered shrublands or hummock grasslands with *Acacia* spp. and *Triodia* spp. (soft and hard spinifex). Larger channels have fringing woodlands of eucalypts and melaleucas.
Boolgeeda 4.3	3.5	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*.

Land System and % of Pilbara	% of Study Area	Description	Vegetation Condition Assessment	Landform (and % of Land system)	Vegetation Community
Capricorn 2.9	35.9	Hills and ridges of sandstone and dolomite supporting shrubby hard and soft spinifex.	Very good 94%, good 4%, fair 2%. Rugged poorly accessible area with a low pastoral potential.	Ridges, hills and upper slopes (70%)	Hummock grasslands of *T. wiseana*, *T. brizoides* or *T. pungens* with scattered *Acacia inaequilatera* and other *Acacia* spp. and *Grevillea wickhamii*.
				Lower foot slopes (20%)	Hummock grasslands of *T. wiseana*, *T. brizoides* or *T. pungens* with scattered *Acacia inaequilatera* and other *Acacia* spp. and *Grevillea wickhamii*.
				Stony plains (5%)	Hummock grasslands of *T. wiseana* or *T. pungens* with scattered *Acacia* spp. shrubs.
				Narrow drainage floors and channels (5%)	Scattered tall shrublands or low woodlands with *Acacia* spp., *Corymbia hamersleyana*, numerous other shrubs and soft spinifex.
Granitic 2.2	0.7	Rugged granitic hills supporting shrubby hard and soft spinifex grasslands.	Very good 97%, good 2%, fair 1%. Much of the system is poorly accessible; hard spinifex vegetation is not preferred by livestock, soft spinifex is moderately preferred. The system is subject to fairly frequent burning and is not susceptible to erosion.	Hills, ridges, domes and upper slopes (40%)	Hummock grasslands predominantly *Triodia* spp. (hard spinifex), less frequently *Triodia pungens* (soft spinifex) with isolated or very scattered shrubs such as *Acacia inaequilatera* (kanji), *A. trachycarpa* and other acacias.
				Lower slopes - very gently to gently inclined rocky slopes (40%)	Hummock grasslands as for unit 1. Occasionally low or mid height shrublands of *Acacia* and *Eremophila* spp. with prominent ground layer of *Triodia* spp.
				Stony plains - gently undulating stony or gritty surfaced plains (15%)	Hummock grassland of *Triodia pungens* (soft spinifex) or *Triodia wiseana* (hard spinifex) with very scattered acacia shrubs. Less frequently acacia shrublands with soft spinifex understorey
				Narrow drainage floors and channels (5%)	Small floors have hummock grasslands of soft or hard spinifex with scattered shrubs. Larger floors with channels support moderately close to close tall shrublands/woodlands with *Acacia, Eucalyptus* and *Melaleuca* spp. with hummock or tussock grasses
				Drainage foci (<1%)	Close tall shrublands of *Acacia tumida* (pindan wattle) or other acacias with variable mid and low shrubs and tussock grasses
Macroy	26.2	Stony plains and occasional tor fields	Very good 85%, good 9%, fair 5%, poor 1%.	Low hills and ridges	Patchy hummock grasses *T. pungens* or *Triodia* spp. with isolated or very scattered shrubs.

Land System and % of Pilbara	% of Study Area	Description	Vegetation Condition Assessment	Landform (and % of Land system)	Vegetation Community
7.2		based on granite supporting hard or soft spinifex grasslands.	Mature spinifex vegetation not preferred by grazing animals.	Stony plains and interfluves	Hummock grasslands of *T. wiseana*, *T. lanigera* or *T. pungens* in about equal proportions; isolated to scattered *A. inaequilatera* and other *Acacia* spp. shrubs.
				Sandy plains	Hummock grasslands of *T. pungens*, *T. lanigera* with very scattered to scattered shrubs *A. inaequilatera* and *A. stellaticeps*.
				Calcrete plains	Hummock grasslands of *T. wiseana* or *T. plurinervata* with isolated *Acacia* spp. shrubs or *Corymbia hamersleyana* trees.
				Drainage floors and channels	Hummock grasslands of *Triodia* spp. with isolated to scattered *Acacia* spp. shrubs and occasional eucalypt trees. Also tussock grasslands or shrublands/woodlands with tussock grass understorey with *Chrysopogon fallax*, occasionally **Cenchrus ciliaris*. Channels have fringing grassy woodlands with *Eucalyptus camaldulensis* and *A. coriacea*.
Platform 0.9	1.1	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 acacias, occasional eucalypt trees, numerous low shrubs including *Senna* spp. (cassias), *Ptilotus obovatus* (cotton bush), *Corchorus walcottii* (grey corchorus) and *Triodia pungens* (soft spinifex)
River 2.3	2.1	Active flood plains and major rivers supporting grassy eucalypt woodlands, tussock grasslands and soft spinifex	Very good 56%, good 26%, fair 13%, poor 5%. Buffel grass and soft spinifex on this system are highly and moderately preferred	Sandy levees and sand sheets -narrow (generally <300 m wide) (15%)	Hummock grasslands of *Triodia pungens* (soft spinifex) with very scattered to moderately close shrubs such as *Acacia trachycarpa* (miniritchie) and *A. inaequilatera* (kanji). Tussock grasslands of **Cenchrus ciliaris* (buffel grass), *Eragrostis eriopoda* (woolly butt) with very scattered to scattered acacia shrubs and trees (APBG) or open eucalypt woodlands with grass understorey of **C. ciliaris*

Land System and % of Pilbara	% of Study Area	Description	Vegetation Condition Assessment	Landform (and % of Land system)	Vegetation Community
		grasslands.	respectively by livestock. The system is largely stabilised by buffel and spinifex and accelerated erosion is uncommon.	Upper terraces - level, upper terraces (5%)	Hummock grasslands of *Triodia* spp. (hard spinifex) or *T. pungens* (soft spinifex) frequently with no shrubs, occasionally isolated to very scattered *Acacia* spp. shrubs and trees such as *Hakea suberea* (corkwood)
				Flood plains and lower terraces -level flood plains and terraces flanking single and multiple channels of the major rivers, commonly 300-800 m wide (50%)	Tussock grasslands of **Cenchrus ciliaris* (buffel grass) or hummock grasslands mainly of *Triodia pungens* (soft spinifex). Also scattered to moderately close *Eucalyptus victrix* (coolibah) or acacia woodlands/tall shrublands with prominent tussock grass understorey of **C. ciliaris, Chrysopogon fallax* (ribbon grass), *Eulalia aurea* (silky brown top) and others or hummock grass understorey of *Triodia pungens*.
				Stony plains - level to very gently inclined plains (10%)	Hummock grasslands of *Triodia* spp. (soft and hard spinifex) with very scattered to scattered acacia shrubs. Also woodlands/tall shrublands with *Eucalyptus victrix, Acacia* spp. and tussock and hummock grasses.
				Minor and major channels - channels 30-1,000 m wide between sandy banks (20%)	closed fringing woodlands with *Eucalyptus camaldulensis* (river red gum), *E. victrix, Melaleuca argentea* (cadjeput), *M. glomerata, Sesbania formosa* (white dragon tree), *Acacia coriacea* (river jam) with understorey of sedges and grasses including *Cyprus vaginatus, *Cenchrus ciliaris* and *Triodia pungens*.
Robe 0.5	2.8	Low limonite mesas and buttes supporting soft spinifex (and occasionally hard spinifex) grasslands.	Very good 86%, good 6%, fair 6%, poor 2%. Soft spinifex vegetation is moderately preferred by grazing animals. The system is not generally susceptible to vegetation degradation or erosion.	Low plateaux, mesas and buttes (60%)	Hummock grasslands of *T. pungens* with isolated to scattered *Acacia* and *Senna* spp. shrubs and occasional *Eucalyptus leucophloia* trees.
				Lower slopes (20%)	Hummock grasslands of *T. wiseana*, *T. longiceps* with isolated to very scattered *Acacia* and *Senna* spp. shrubs. Occasionally hummock grasslands of *T. pungens*.
				Gravelly plains (15%)	Hummock grasslands of *T. wiseana*, *T. longiceps* with isolated to very scattered *Acacia* and *Senna* spp. shrubs. Occasionally hummock grasslands of *T. pungens*.
				Drainage floors and channels (5%)	Hummock grasslands of *T. pungens* with very scattered to moderately close *Acacia* spp. shrubs. Also moderately close eucalypt or *Acacia* woodlands/tall shrublands with *T. pungens* understorey.

Land System and % of Pilbara	% of Study Area	Description	Vegetation Condition Assessment	Landform (and % of Land system)	Vegetation Community
Rocklea 12.7	14.9	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.
Satirist 0.2	0.2	Stony plains and low rises supporting hard spinifex grasslands, and gilgai plains supporting tussock grasslands.	Very good 82%, good 6%, fair 8%, poor 4%. Predominantly hard spinifex vegetation on the system is not preferred by livestock. Minor areas of tussock grasslands are preferentially grazed and are prone to degradation. The system is generally not susceptible to erosion.	Low rises and upper plains (20%)	Hummock grasslands of *Triodia wiseana* and other *Triodia* spp. (hard spinifex) with isolated shrubs such as *Acacia bivenosa* (two vein wattle), *A. pyrifolia* (fire wattle).
				Calcrete plains - level plains (5%)	Hummock grasslands of *Triodia wiseana* (hard spinifex) with very scattered trees and shrubs.
				Stony plains - level plains extending for up to 2 km, mostly non-gilgaied surfaces (55%)	Hummock grasslands of *Triodia longiceps, T. wiseana* (hard spinifex), less frequently *T. pungens* (soft spinifex) with isolated shrubs on non-gilgaied surfaces. Tussock grasslands of *Eragrostis xerophila* (Roebourne Plains grass) with isolated shrubs on gilgaied areas.
				Gilgai plains - level plains up to 500 m in extent with gilgai microrelief (15%)	Tussock grasslands of *Eragrostis xerophila, Eriachne benthamii* (swamp grass) and other perennial grasses with isolated to very scattered shrubs such as *Acacia farnesiana* (mimosa bush), *A. victoriae* (prickly acacia) and *Senna artemisioides* subsp. *oligophylla* (blood bush).

Land System and % of Pilbara	% of Study Area	Description	Vegetation Condition Assessment	Landform (and % of Land system)	Vegetation Community
				Drainage tracts and minor channels - narrow up to 200 m wide drainage	Hummock grasslands of *Triodia pungens* with scattered *Acacia* spp. shrubs and eucalypt trees. Also tall shrublands of *Acacia xiphophylla* (snakewood) with patchy spinifex understorey (ASHS). Larger channels may have fringing grassy woodlands.
Talga 1.2	8.9	Hills and ridges of greenstone and chert and stony plains supporting hard and soft spinifex grasslands.	Very good 93%, good 4%, fair 3%. Much of the system is poorly accessible. Hard spinifex vegetation is not preferred by grazing animals but soft spinifex is moderately preferred for a few years following fire. The system is prospective and localised areas have been disturbed by exploration and mining activity. The system is not susceptible to erosion.	Hills and ridges (50%)	Hummock grasslands of *Triodia wiseana, T. lanigera, T.* spp., (hard spinifex) or, less frequently, *Triodia pungens* (soft spinifex) with isolated to scattered shrubs such as *Acacia inaequilatera* (kanji), *A. orthocarpa* and *Senna* spp. (cassias).
				Lower foot slopes (30%)	Hummock grasslands of *Triodia wiseana, T. plurinervata, T.* spp. or, less frequently, *Triodia pungens* with isolated to scattered shrubs particularly *Acacia inaequilatera* (kanji) and *Senna* spp.
				Stony plains - gently undulating plains (15%)	Hummock grasslands of *Triodia wiseana, T. lanigera, T. plurinervata* or, less frequently, *T. pungens* with isolated to scattered shrubs of *Acacia* and *Senna* spp.
				Drainage floors and channels - drainage lines as small channels (2-5 m wide) (5%)	Hummock grasslands of *Triodia pungens* with isolated to very scattered shrubs (ASSG). Scattered to moderately close tall shrublands/woodlands of *Acacia* spp., *Eucalyptus victrix* (coolibah), *E. camaldulensis* (river red gum) with understorey of *T. pungens* or tussock grasses including *Chrysopogon fallax* (ribbon grass) and **Cenchrus ciliaris* (buffel grass)

2.7.6 Previous Records of Priority Flora at North Star

Searches of the Department of Environment and Conservation (DEC) database, the Department's Threatened Flora Database (DEFL), and the WA Herbarium's (WAHERB) specimen database were conducted within a polygon encompassing the North Star Study Area with a 40 km buffer zone around the boundary. No EPBC Listed, Threatened Flora (Declared Rare Flora) have previously been recorded from the search area. Twelve priority flora taxa have previously been recorded (Table 2.5) within the database search area, including two species, *Pityrodia* sp. Marble Bar (G. Woodman & D. Coultas GWDC Opp4) (P1) and *Gymnanthera cunninghamii* (P3) within the Study Area (**Error! Reference source not found.**).

The likelihood of occurrence of each taxon within the Study Area was assessed based on distribution and known habitat preference (Table 2.5), using the following rankings:

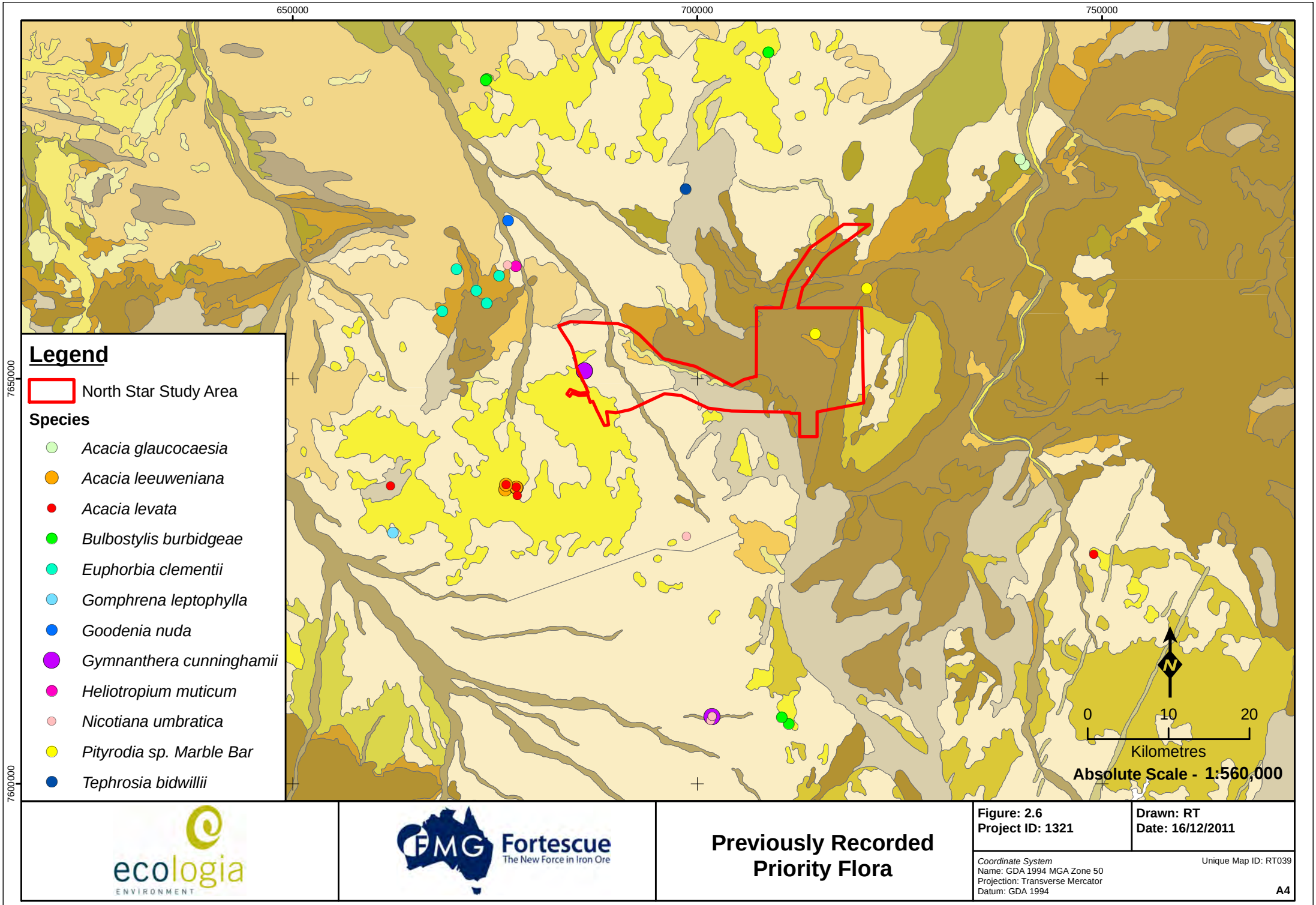
Table 2.5 – Criteria used to Assess Likelihood of Occurrence of Significant Flora at North Star.

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.

In addition to the DEC records, there are also 15 locations of "*Pityrodia* sp. Panorama" from the Panorama project located approximately 10 km east of the North Star Study Area (Trudgen *et al.* 2002 cited in; Mattiske 2007). These records represent in excess of 257 individual plants, seven of these individuals are located within areas to be cleared (URS 2007). While no specimen appears to have been lodged at the Western Australian Herbarium from these collections, it is likely that they represent additional locations of *Pityrodia* sp. Marble Bar.

Table 2.5 – Priority Flora Previously Recorded in the Vicinity of the North Star.

Conservation Status	Taxon	Family	Source	Bio-region	Habitat (WA Herbarium 2011)	Nearest Localities or Towns	Flowering Period	Likelihood of Occurrence
P1	*Acacia leeuweniana*	Fabaceae	DEFL, WAHERB	PIL	Gritty, skeletal red-grey sandy loam, light orange-brown gravelly sand, granite	Approximately 120 km S of Port Hedland	Apr-May, Oct	Possible
P1	*Heliotropium muticum*	Boraginaceae	WAHERB	PIL	Red silty sand	Northern central PIL, c. 70 km S of Port Hedland	Unknown	Likely
P1	*Pityrodia* sp. Marble Bar (G. Woodman & D. Coultas GWDC Opp 4)	Lamiaceae	WAHERB	PIL	Ironstone hill slopes	Marble Bar	Aug	Certain
P2	*Euphorbia clementii*	Euphorbiaceae	DEFL, WAHERB	PIL	Sandplains, gravelly hillsides, stony grounds	Ashburton and Yule River	Unknown	Likely
P3	*Acacia glaucocaesia*	Fabaceae	DEFL, WAHERB	PIL, GSD, DL	Red loam, sandy loam, clay. Floodplains	Between Fortescue and De Grey rivers	July, Sep	Possible
P3	*Acacia levata*	Fabaceae	DEC, DEFL, WAHERB	PIL	Sand or sandy loam over granite. Hillslopes	Marble Bar, Woodstock H/S, Hillside	May	Possible
P3	*Gomphrena leptophylla*	Amaranthaceae	DEC, WAHERB	PIL,DL	Open flats, sandy creek beds, edges salt pans & marshes, stony hillsides.	Yandeyarra, Nerrima Stn, Marble Bar	May, Sep	Possible
P3	*Gymnanthera cunninghamii*	Apocynaceae	DEFL, WAHERB	PIL, CAR, GSD	Sandy soils along watercourses	Woodstock Station	Jan-Dec	Certain
P3	*Nicotiana umbratica*	Solanaceae	WAHERB	PIL	Rocky outcrops	Newman, Karijini N.P., Marble Bar, Woodstock, Abydos	Apr, Jun, Sept	Likely
P3	*Tephrosia bidwillii*	Fabaceae	WAHERB	PIL, GSD	Red-brown loam	North-eastern PIL	May, Aug	Possible
P4	*Bulbostylis burbidgeae*	Cyperaceae	DEC, DEFL, WAHERB	PIL	Granitic soils. Granite outcrops, cliff bases.	Mount Edgar, Gorge Creek, Abydos-Woodstock	Mar, Jun-Aug	Possible
P4	*Goodenia nuda*	Goodeniaceae	WAHERB	PIL	Sandy soils along drainage lines, watercourses	Widespread in PIL	Apr-Aug	Possible



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Previously Recorded Priority Flora

Figure: 2.6
Project ID: 1321

Drawn: RT
Date: 16/12/2011

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

Unique Map ID: RT039

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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) on terrestrial biological surveys as an element of biodiversity protection;
- Guidance Statement 51 (Environmental Protection Authority 2004) on terrestrial flora and vegetation surveys for environmental impact assessment; and
- 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 February 2011 prior to the field survey, to determine species 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 Environment and Water Resources Protected Matters Database.

3.3 VEGETATION AND FLORA ASSESSMENT

The two-phase survey involved a combination of sampling within bounded quadrats 2500 m^2 in area, in accordance with Guidance Statement 51, supplemented by a series of linked field traverses. Linked traverses are a more time efficient method than bounded quadrats to maximise the floristic inventory and thus increase the probability of locating flora of potential significance. However standardised quadrats allow the vegetation to be consistently characterised and facilitate multivariate analysis of the vegetation. Both methods contributed to the delineation of small scale vegetation units and to a comprehensive floristic inventory of the Study Area.

3.3.1 Survey Timing

The vegetation and flora of the North Star Study Area were surveyed over 91 person days. The area was divided into a southern area, incorporating proposed pits, waste dumps, transport corridor and infrastructure, and a northern area incorporating additional waste dumps, tailings dam and part of the corridor leading to a construction water supply. Survey timing was as follows:

- 1st to 7th of April 2011 (Phase 1, southern portion, 22 person days);
- 27th June to 6th July 2011 (Phase 1, northern portion, 30 person days);
- 17th to 22nd August 2011 (Phase 2 southern portion, 18 person days); and
- 12th to 19th September 2011 (Phase 2, northern portion, 21 person days).

The objectives of these surveys were to provide:

- Inventory of vascular plant species;
- Description and mapping of plant communities;
- 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 weeds; and
- Review of the significance of the plant communities within a local, regional, and state context.

3.3.2 Quadrat based sampling

Two hundred and seventy two quadrats were surveyed, distributed throughout the Study Area as detailed in Figure 3.1. This includes 104 quadrats in the April survey, 102 in the June/July survey, 29 new quadrats and 45 resurveyed quadrats in the August survey and 37 new quadrats and 53 resurveyed quadrats in the September survey. 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.

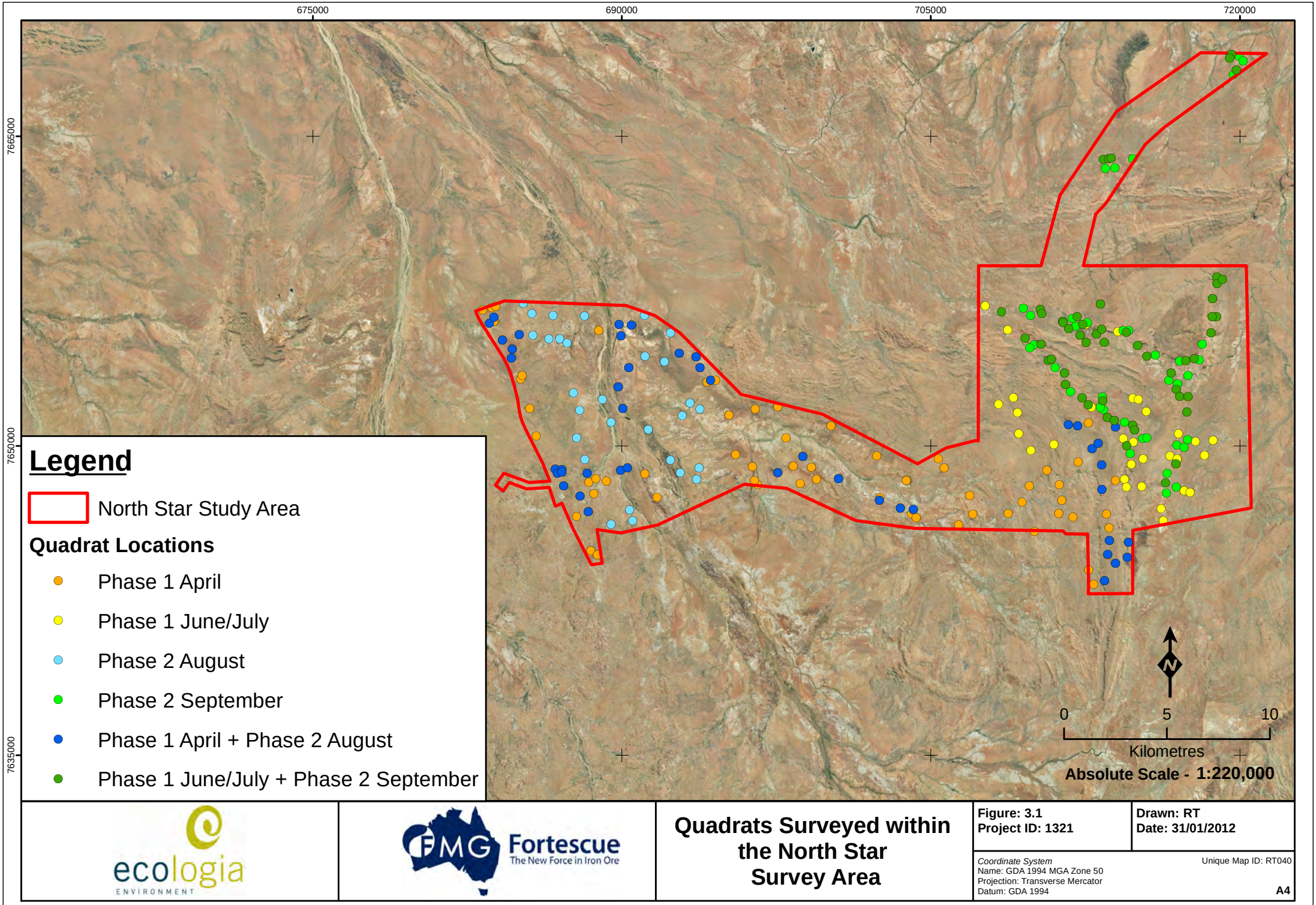
Coordinates for all quadrats are detailed in Appendix A.

For each quadrat, the following were 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.

The majority of quadrats were permanently marked at the north-western and south-eastern corner using galvanised fence droppers.

At least one specimen of all taxa recorded was collected for subsequent verification of identity. Nomenclature and taxonomy follow the conventions currently adopted by the Western Australian Herbarium (Western Australian Herbarium 1998-2012).



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Quadrats Surveyed within the North Star Survey Area

Figure: 3.1
Project ID: 1321

Drawn: RT
Date: 31/01/2012

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

Unique Map ID: RT040

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3.3.3 Transects

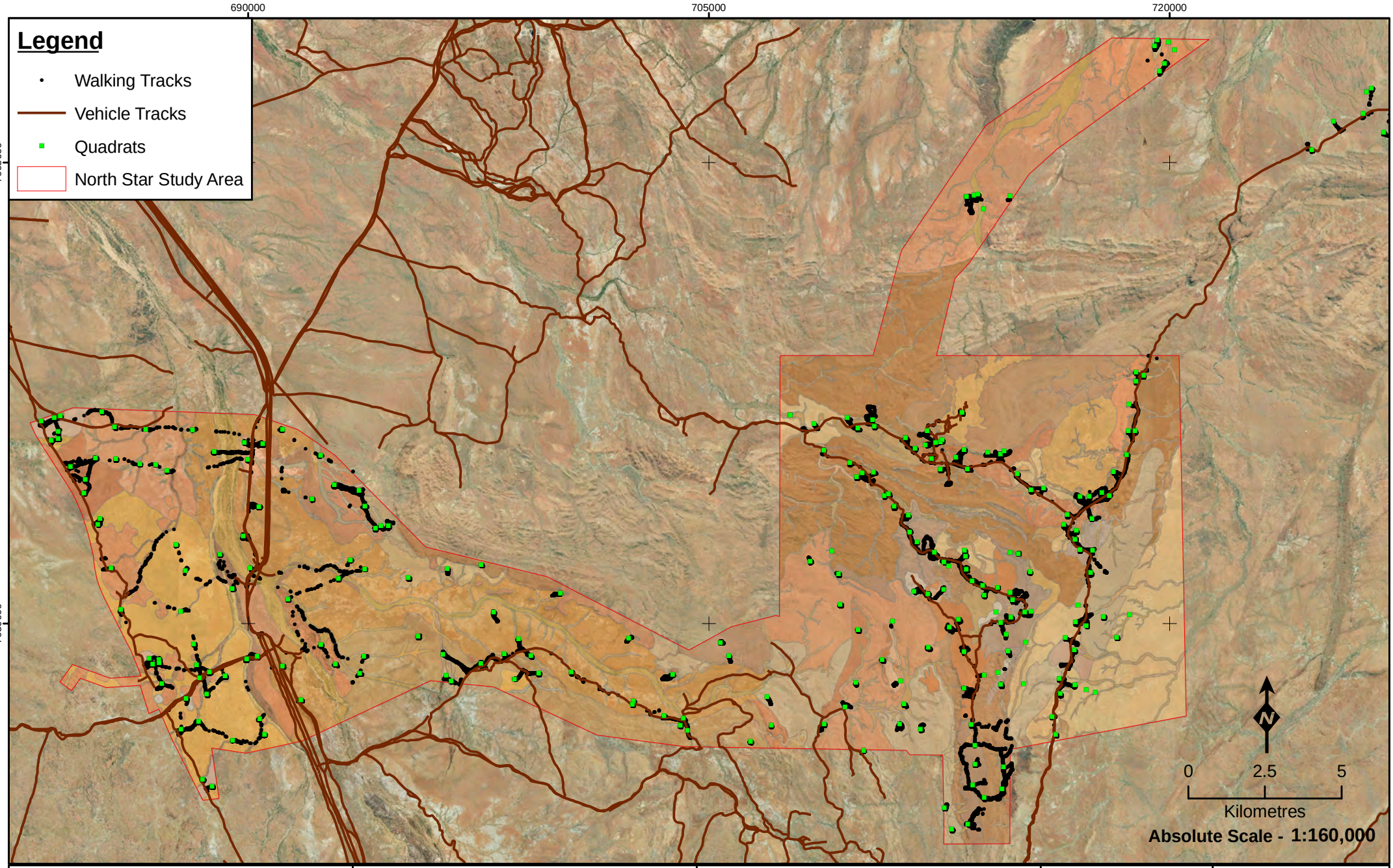
While walking between quadrats, opportunistic collections were made of taxa not recorded within the quadrats. Locations of any introduced flora, known or potentially conservation significant taxa encountered were also recorded, and notes were made on the boundaries of the vegetation communities to facilitate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

3.3.4 Vegetation Condition

Vegetation condition was assessed at each quadrat using the condition scale (Department of Environmental Protection 2000) 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.



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Transects Walked Within the North Star Study Area

Figure: 3.2 **Project ID: 1321**	**Drawn: MM** **Date: 31/01/2012**
Coordinate System Name: GDA 1994 MGA Zone 50 Projection: Transverse Mercator Datum: GDA 1994	Unique Map ID: MM046 **A4**

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3.3.5 Vegetation Mapping

Vegetation mapping is the delineation of plant communities based on distinctive characteristics that these communities share such as the vegetation structure, dominant species and species composition. A combination of multivariate analysis of species composition of quadrats and ground truthing was employed to define communities. 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 boundaries of communities were then extrapolated to the entire Study Area based on their appearance in aerial imagery.

Multivariate analysis was conducted using the species matrix data from quadrats completed during Phase 1 of the survey, conducted in April and June/July 2011. This was the most extensive survey phase (206 quadrats) and was completed in optimal seasonal conditions during which widespread flowering occurred. 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.

Multivariate analysis was also used to compare the vegetation assemblages present in the Study Area to those previously defined in the Biota survey of the FMG Main Line (Biota 2004b). Ninety seven quadrats from this survey were co-analysed with 272 quadrats from the current survey using a presence-absence species by site matrix.

A combination of aerial photography, multivariate analysis and ground truthing was used to interpret the vegetation patterns of the Study Area.

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4 VEGETATION RESULTS

4.1 VEGETATION CONDITION

The majority of the North Star Study Area is located on vacant crown land (VCL), with the western portion traversing Wallareenya and Kangan Stations. Much of the area is not subject to active grazing, although some grazing from stock in adjacent pastoral leases occurs due to the absence of fencing at boundaries. The low levels of grazing from introduced species is reflected in the assessment of vegetation condition in surveyed quadrats, 57% and 26% of which were assessed as in excellent or very good condition respectively using the condition rating scale Trudgen (BushForever, 2000). The remaining quadrats were assessed as good (8%), poor (6%) or very poor (2%) with the disturbance most commonly attributed to grazing and weeds, with a small number of areas subject to disturbance from previous exploration activities. Figure 4.1 details the condition rankings of all quadrats assessed within the Study Area. The majority of quadrats ranked as in poor or very poor condition are located in the drainage system in the west of the Study Area, with an additional small area of disturbance near the southern boundary due to small scale mining.

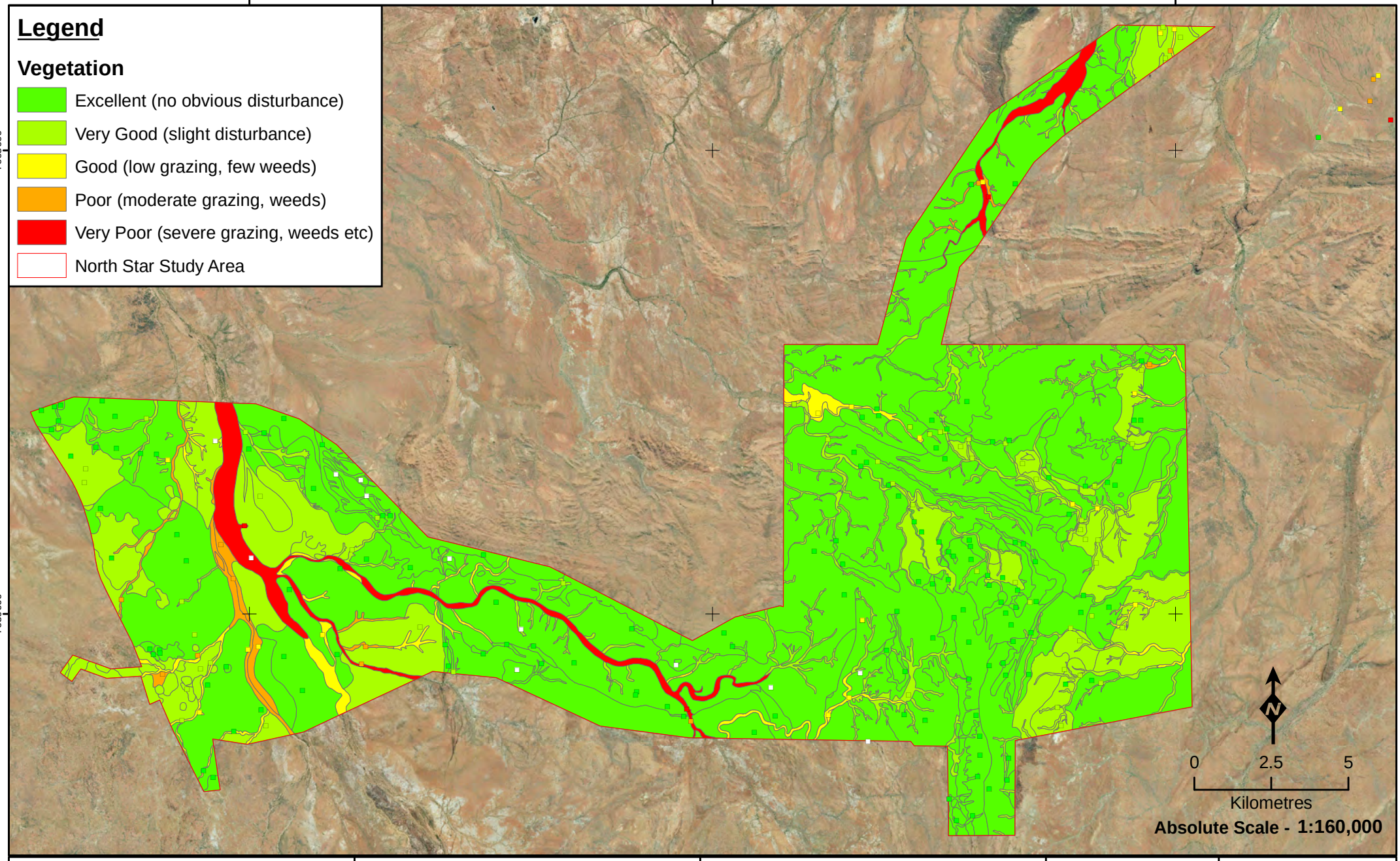
4.2 FIRE HISTORY OF THE STUDY AREA

The majority of the Study Area has not been recently burnt (i.e. burnt less than 2 years ago), with 55% of quadrats assessed as burnt more than 5 years ago or with no evidence of fire. The pattern of burning appears sporadic and localised (Figure 4.2), 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.

4.3 VEGETATION COMMUNITIES

Based on multivariate analysis of the cover weighted species by site matrix, interpretation of aerial imagery and ground truthing, 33 vegetation communities were described and delineated within the Study Area, the characteristics of which are summarised in Table 4.1. The distribution of each vegetation unit is mapped in Figures 4.3 to 4.7 and the relative similarity of quadrats as determined by multivariate analysis is detailed in Figure 4.8. The structure and floristic composition of each quadrat is detailed in Appendix B.

The cluster analysis used in this study is based on species composition and abundance; therefore quadrats are arranged into groups overwhelmingly based on the dominant *Triodia* species present. The largest branch of the dendrogram (at the top of the figure) consists primarily of *Triodia wiseana* communities. The central section of the dendrogram consists of sites from sandy and gravely plains dominated by *Triodia basedowii, T. schinzii* and *T. lanigera.* The lower section of the dendrogram consists largely of *T. pungens* dominated communities, but is further divided into the sites of granite plains and outcrops and the sites along rivers, gorges, creeks and drainage lines and floodplains, and sties from two rocky outcrop communities, including the locally significant gully (*FpAtCo*) and dyke (*GaTw*) communities.



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Vegetation Condition North Star

Figure: 4.1
Project ID: 1321

Drawn: MM
Date: 31/01/2012

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

Unique Map ID: MM045

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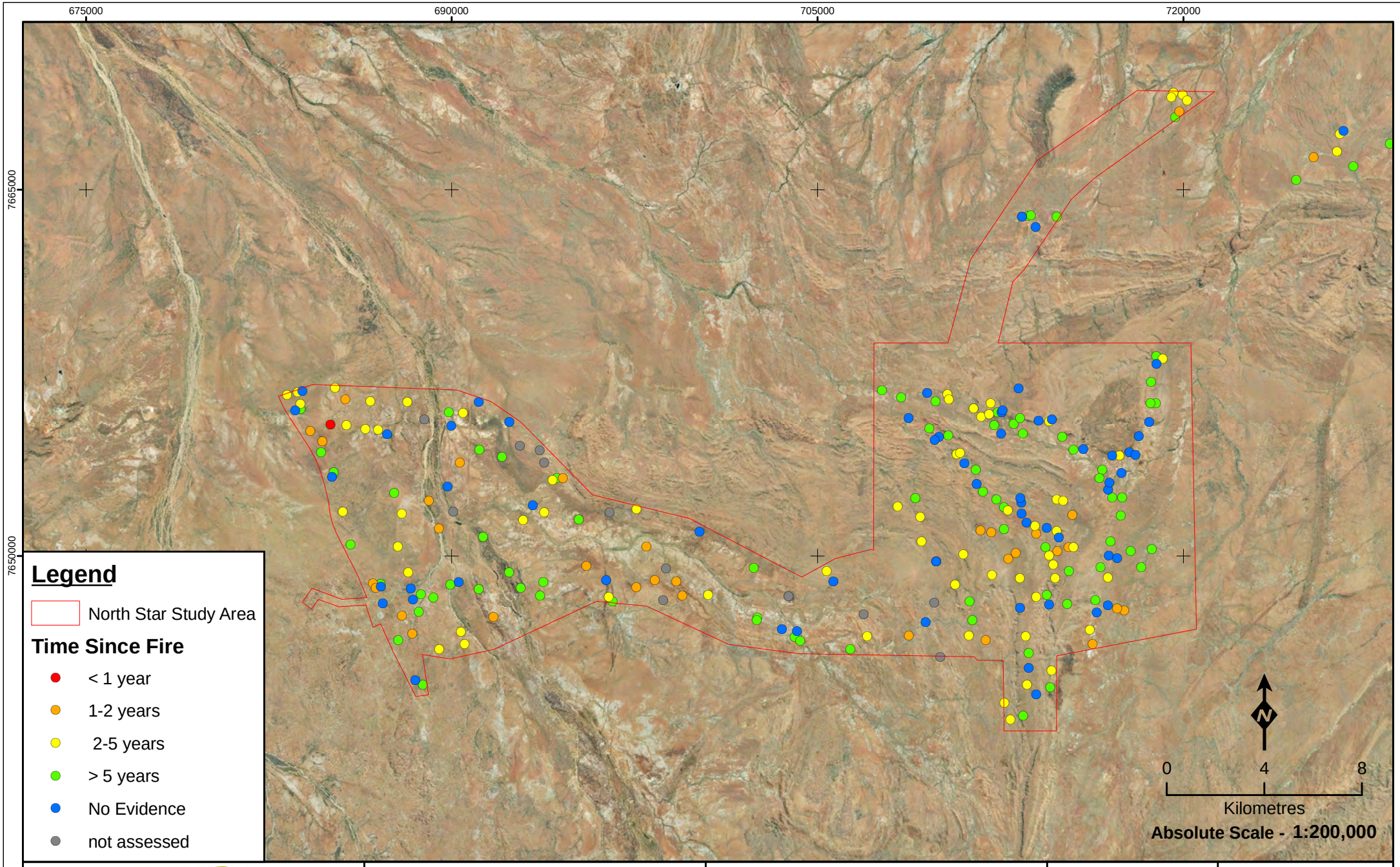

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FMG Fortescue The New Force in Iron Ore

Fire History of the Project Area

Figure: 4.2
Project ID: 1321

Drawn: RT
Date: 16/12/2011

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

Unique Map ID: RT035

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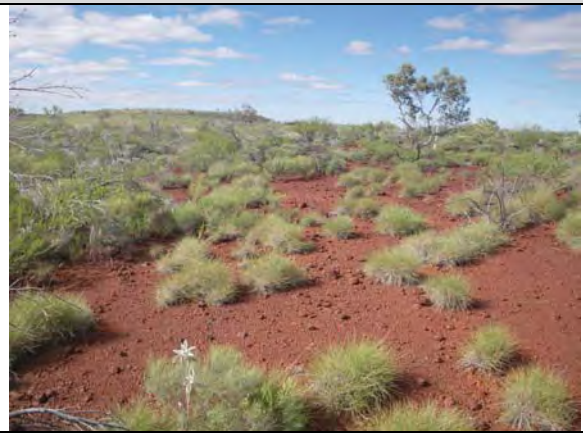
Table 4.1 – Vegetation Units of North Star.

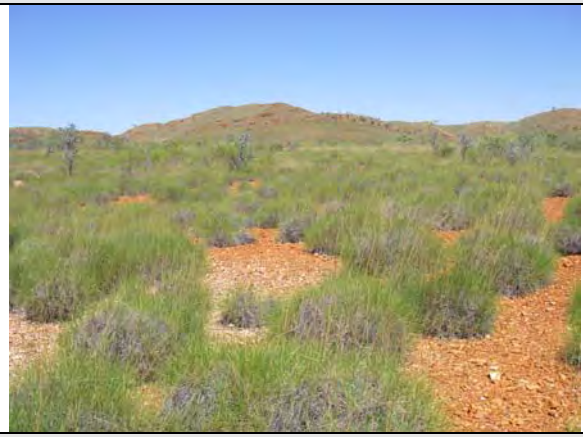
Vegetation unit mapping code	Quadrats	Vegetation description (NVIS Level III and Level V)	Associated species	Area (% of Study Area)	Photograph
Rocky hills and plains					
ElApEm	104 155 160	*Acacia* shrubland *Eucalyptus leucophloia* isolated low trees, over *Acacia ptychophylla* and *Grevillea wickhamii* shrubland, over *Eriachne mucronata* isolated tussock grasses Average species richness: 20.5 ± 4.9 (n=4)	*Acacia adoxa* *Cleome viscosa* *Cymbopogon obtectus* *Euphorbia australis* *Indigofera monophylla* *Ptilotus calostachyus* *Tribulus macrocarpus* *Triodia wiseana*	871 ha (2.50%)	

Vegetation unit mapping code	Quadrats	Vegetation description (NVIS Level III and Level V)	Associated species	Area (% of Study Area)	Photograph
AaTw[1]	145 235 237	*Acacia* sparse shrubland *Acacia acradenia, Grevillea wickhamii* and *Acacia orthocarpa* sparse mid shrubland, over *Triodia wiseana* sparse hummock grassland Average species richness: 31.3 ± 4.8 (n=3)	*Acacia adoxa* *Acacia tumida* *Bulbostylis barbata* *Cleome viscosa* *Corchorus incanus* *Cymbopogon obtectus* *Cyperus hesperius* *Dampiera candicans* *Eriachne helmsii* *Eriachne mucronata* *Eucalyptus leucophloia* *Goodenia stobbsiana* *Gossypium robinsonii* *Indigofera monophylla* *Oldenlandia crouchiana* *Petalostylis labicheoides* *Polycarpaea holtzei* *Ptilotus calostachyus* *Senna glutinosa* subsp. *glutinosa* *Solanum phlomoides* *Tribulus macrocarpus* *Triodia schinzii*	77 ha (0.22%)	

Vegetation unit mapping code	Quadrats	Vegetation description (NVIS Level III and Level V)	Associated species	Area (% of Study Area)	Photograph
AtEm	157 226 228 256 281	*Acacia* open shrubland *Acacia tumida*, *Acacia orthocarpa* and *Grevillea wickhamii* open shrubland, over *Eriachne mucronata* isolated tussock grasses Average species richness: 15.5 ± 3.8 (n=4)	*Cyperus hesperius* *Dampiera candicans* *Eriachne ciliata* *Eriachne pulchella* *Goodenia stobbsiana* *Indigofera monophylla* *Petalostylis labicheoides* *Polycarpaea holtzei* *Solanum phlomoides* *Triodia pungens* *Triodia schinzii* *Triodia wiseana*	902 ha (2.59%)	
AtTw	148 149 151 153 164	*Acacia* open shrubland *Acacia tumida* and *Grevillea wickhamii* open tall shrubland, over *Triodia wiseana* open hummock grassland Average species richness: 26 ± 5 (n=2)	*Eriachne mucronata* *Goodenia stobbsiana* *Cleome viscosa* *Tephrosia rosea* var. *rosea* *Solanum phlomoides* *Polycarpaea holtzei* *Cymbopogon obtectus* *Hybanthus aurantiacus* *Fimbristylis simulans*	80 ha (0.23%)	

Vegetation unit mapping code	Quadrats	Vegetation description (NVIS Level III and Level V)	Associated species	Area (% of Study Area)	Photograph
AoTw	141 154 156 220 222 246 252	*Acacia* open shrubland *Acacia orthocarpa* open tall shrubland, over *Triodia wiseana* open hummock grassland Average species richness: 24.8 ± 2.5 (n=9)	*Acacia tumida* *Bonamia media* *Dampiera candicans* *Eriachne pulchella* *Eucalyptus leucophloia* *Goodenia stobbsiana* *Grevillea wickhamii* *Petalostylis labicheoides* *Polycarpaea holtzei* *Solanum phlomoides* *Tephrosia spechtii*	588 ha (1.69%)	
Tw[1]	218 232 244 247 266	*Triodia* hummock grassland *Triodia wiseana* and *Triodia schinzii* hummock grassland Average species richness; 26.7 ± 4.3 (n=4)	*Acacia acradenia* *Acacia adoxa* *Acacia inaequilatera* *Acacia ptychophylla* *Acacia spondylophylla* *Bonamia media* *Bulbostylis barbata* *Corchorus laniflorus* *Dampiera candicans* *Eriachne mucronata* *Eriachne pulchella* *Grevillea wickhamii* *Oldenlandia crouchiana* *Petalostylis labicheoides* *Polycarpaea holtzei* *Polygala isingii* *Senna glutinosa* subsp. *glutinosa* *Solanum phlomoides* *Tribulus suberosus*	195 ha (0.56%)	

Vegetation unit mapping code	Quadrats	Vegetation description (NVIS Level III and Level V)	Associated species	Area (% of Study Area)	Photograph
ElApTw	127 147 158 159 206	*Triodia* hummock grassland *Eucalyptus leucophloia* isolated trees, over *Acacia ptychophylla* sparse shrubland, over *Triodia wiseana* open hummock grassland Average species richness: 21.0 ± 2.7 (n=7)	*Acacia adoxa* *Acacia inaequilatera* *Dampiera candicans* *Dodonaea coriacea* *Fimbristylis simulans* *Goodenia stobbsiana* *Grevillea wickhamii* *Mollugo molluginea* *Polycarpaea holtzei* *Sida* sp. Pilbara (A.A. Mitchell PRP 1543) *Solanum phlomoides*	582 ha (1.67%)	
Tw[2]	96 129 161 212 259 289	*Triodia* hummock grassland *Triodia wiseana* open hummock grassland Average species richness: 27.4 ± 3.7 (n=7)	*Acacia inaequilatera* *Bonamia media* *Bulbostylis barbata* *Eriachne pulchella* *Fimbristylis simulans* *Goodenia stobbsiana* *Grevillea wickhamii* *Mollugo molluginea* *Oldenlandia crouchiana* *Polycarpaea holtzei* *Polygala isingii* *Ptilotus calostachyus* *Triodia basedowii*	1964 ha (5.63%)	

Vegetation unit mapping code	Quadrats	Vegetation description (NVIS Level III and Level V)	Associated species	Area (% of Study Area)	Photograph
Calcrete					
Tw[3]	69 103 113 118 122	*Triodia* hummock grassland *Triodia wiseana* and *Triodia basedowii* hummock grassland Average species richness: 21.4 ± 2.6 (n=11)	*Cassytha filiformis* *Corchorus laniflorus* *Corymbia hamersleyana* *Goodenia stobbsiana* *Hakea chordophylla* *Hibiscus sturtii* *Hybanthus aurantiacus* *Petalostylis labicheoides*	4,236 ha (12.15%)	
Rocky hills and plains					
AaTw[2]	50 52 64 78 87 88 124 133 143 146 152 219 260 270 274	*Triodia* hummock grassland *Acacia acradenia* open mid shrubland, over *Triodia wiseana* hummock grassland Average species richness; 18.8 ± 1.9 (n=18)	*Acacia inaequilatera* *Bonamia media* *Corchorus laniflorus* *Eriachne pulchella* *Grevillea wickhamii* *Hybanthus aurantiacus*	2,206 ha (6.33%)	

Vegetation unit mapping code	Quadrats	Vegetation description (NVIS Level III and Level V)	Associated species	Area (% of Study Area)	Photograph
Tw[4]	60 90 99 119 139 140 202 207 300	*Triodia* hummock grassland *Triodia wiseana* hummock grassland Average species richness: 16.4 ± 1.9 (n=16)	*Acacia acradenia* *Acacia bivenosa* *Acacia inaequilatera* *Acacia stellaticeps* *Acacia synchronicia* *Acacia tumida* *Bulbostylis barbata* *Corchorus laniflorus* *Eriachne pulchella* *Eucalyptus leucophloia* *Petalostylis labicheoides* *Polycarpaea holtzei* *Ptilotus astrolasius* *Senna glutinosa* subsp. *glutinosa*	4,549 ha (13.05%)	
AaTw[3]	94 123 150 203 215 221 230 240 250 254 258 264 267 268 275 296 298	*Triodia* hummock grassland *Acacia acradenia, Acacia tumida* and *Grevillea wickhamii open* shrubland, over *Triodia wiseana* hummock grassland Average species richness: 24.5 ± 2.5 (n=20)	*Acacia inaequilatera* *Bonamia media* *Corchorus parviflorus* *Corymbia hamersleyana* *Eriachne pulchella* *Gossypium robinsonii* *Indigofera monophylla* *Indigofera monophylla* *Mollugo molluginea* *Oldenlandia crouchiana* *Petalostylis labicheoides* *Senna glutinosa* subsp. *glutinosa* *Senna notabilis*	2,770 ha (7.95%)	

Vegetation unit mapping code	Quadrats	Vegetation description (NVIS Level III and Level V)	Associated species	Area (% of Study Area)	Photograph
AaTw[4]	6 208 216a 216b 224 273 305 306	*Triodia* hummock grassland *Acacia acradenia* and *Acacia inaequilatera* sparse mid shrubland over *Triodia wiseana* and *Triodia lanigera* hummock grassland Average species richness: 23.1 ± 2.2 (n=12)	*Bonamia media* *Eriachne pulchella* *Fimbristylis simulans* *Goodenia stobbsiana* *Grevillea wickhamii* *Mollugo molluginea* *Polycarpaea holtzei* *Polygala isingii* *Senna glutinosa* subsp. *glutinosa*	4,244 ha (12.17%)	
Shrubby drainage-lines					
At	128 163 165 229 238 277 278 299	*Acacia* shrubland *Acacia tumida*, *Grevillea wickhamii* and *Indigofera monophylla* shrubland Average species richness: 33.9 ± 6.7 (n=8)	*Acacia acradenia* *Cajanus cinereus* *Cleome viscosa* *Corymbia hamersleyana* *Cymbopogon obtectus* *Cyperus hesperius* *Dampiera candicans* *Hybanthus aurantiacus* *Petalostylis labicheoides* *Senna glutinosa* subsp. *glutinosa* *Triodia longiceps* *Triodia pungens*	444 ha (1.27%)	

Vegetation unit mapping code	Quadrats	Vegetation description (NVIS Level III and Level V)	Associated species	Area (% of Study Area)	Photograph
Sandy and gravely plains					
ImTs	3 5 136 263	*Triodia* hummock grassland *Indigofera monophylla* isolated low shrubs, over *Triodia schinzii* open hummock grassland Average species richness: 24.7 ± 2.1 (n=4)	*Acacia acradenia* *Acacia inaequilatera* *Acacia tumida* *Aristida holathera* *Bonamia erecta* *Bonamia linearis* *Bulbostylis barbata* *Chrysopogon fallax* *Cleome viscosa* *Corchorus laniflorus* *Corymbia opaca* *Eragrostis eriopoda* *Goodenia stobbsiana* *Grevillea wickhamii* *Hybanthus aurantiacus* *Polycarpaea holtzei* *Ptilotus astrolasius* *Ptilotus fusiformis* *Trianthema pilosa* *Triodia basedowii* *Yakirra australiensis*	110 ha (0.32%)	

Vegetation unit mapping code	Quadrats	Vegetation description (NVIS Level III and Level V)	Associated species	Area (% of Study Area)	Photograph
AsTl	38 59 110 269 302 309	*Triodia* hummock grassland *Acacia stellaticeps* sparse low shrubland, over *Triodia longiceps* hummock grassland Average species richness: 22.0 ± 10.9 (n=4)	*Acacia inaequilatera* *Bulbostylis barbata* *Cassytha filiformis* *Corchorus laniflorus* *Corymbia hamersleyana* *Grevillea wickhamii* *Indigofera monophylla* *Mollugo molluginea* *Triodia pungens*	53 ha (0.15%)	
Cl	41 91	*Corchorus* shrubland *Corchorus laniflorus, Grevillea wickhamii* and *Solanum phlomoides* sparse shrubland Average species richness: 23.0 ± 11.0 (n=2)	*Acacia acradenia* *Acacia orthocarpa* *Adriana tomentosa* *Bonamia media* *Bonamia pannosa* *Bulbostylis barbata* *Cleome viscosa* *Corymbia hamersleyana* *Eucalyptus leucophloia* *Euphorbia boophthona* *Indigofera monophylla* *Senna notabilis* *Sida* sp. Pilbara (A.A. Mitchell PRP 1543) *Tephrosia spechtii* *Tribulus platypterus*	156 ha (0.45%)	

Vegetation unit mapping code	Quadrats	Vegetation description (NVIS Level III and Level V)	Associated species	Area (% of Study Area)	Photograph
AaTb	63 108	*Acacia* shrubland *Acacia acradenia*, *Petalostylis labicheoides* and *Corchorus laniflorus* sparse shrubland, over *Triodia basedowii* sparse hummock grassland Average species richness: 39.0 ± 8.0 (n=2)	*Bonamia erecta* *Chrysopogon fallax* *Hybanthus aurantiacus* *Mollugo molluginea* *Polycarpaea corymbosa* *Polymeria ambigua* *Ptilotus astrolasius* *Sida* sp. Pilbara (A.A. Mitchell PRP 1543)	158 ha (0.45%)	
AiTb	8 10 11 27 73 84 132 166 209 227 257 284	*Triodia* hummock grassland *Acacia inaequilatera*, *Acacia acradenia* and *Grevillea wickhamii* sparse shrubland, over *Triodia basedowii* and *Triodia wiseana* hummock grassland Average species richness : 20.0 ± 2.5 (n=11)	*Acacia ancistrocarpa* *Bonamia media* *Corchorus laniflorus* *Eriachne pulchella* *Fimbristylis simulans* *Goodenia stobbsiana* *Mollugo molluginea* *Polygala isingii* *Ptilotus calostachyus* *Solanum phlomoides*	1,140 ha (3.27%)	

Vegetation unit mapping code	Quadrats	Vegetation description (NVIS Level III and Level V)	Associated species	Area (% of Study Area)	Photograph
AoTb	1 26 45	*Acacia* shrubland *Acacia orthocarpa* and *Indigofera monophylla* open shrubland, over *Triodia basedowii* open hummock grassland Average species richness: 13.5 ± 1.9 (n=4)	*Bulbostylis barbata* *Eriachne pulchella* *Senna glutinosa* subsp. *glutinosa* *Yakirra australiensis*	158 ha (0.45%)	
Drainage-lines					
GwTe	223 225	*Triodia* hummock grassland *Grevillea wickhamii* sparse mid shrubland, over *Triodia epactia* or *Triodia schinzii* open hummock grassland Average species richness: 18.4 ± 3.6 (n=5)	*Acacia acradenia* *Acacia bivenosa* *Acacia hilliana* *Bulbostylis barbata* *Cassytha filiformis* *Corchorus parviflorus* *Cyperus hesperius* *Eriachne ciliata* *Fimbristylis dichotoma* *Oldenlandia crouchiana* *Polycarpaea holtzei* *Templetonia hookeri* *Trachymene oleracea* *Triumfetta maconochieana*	1,313 ha (3.77%)	

Vegetation unit mapping code	Quadrats	Vegetation description (NVIS Level III and Level V)	Associated species	Area (% of Study Area)	Photograph
GwTp	35 279 307	*Triodia* hummock grassland *Grevillea wickhamii* sparse tall shrubland, over *Triodia pungens* open hummock grassland Average species richness: 46.1 ± 2.9 (n=7)	*Acacia orthocarpa* *Acacia stellaticeps* *Bulbostylis barbata* *Cassytha filiformis* *Chrysopogon fallax* *Cyperus squarrosus* *Drosera indica* *Eragrostis cumingii* *Eragrostis tenellula* *Eucalyptus victrix* *Euphorbia boophthona* *Goodenia nuda* *Haloragis gossei* *Lipocarpha microcephala* *Oldenlandia galioides* *Phyllanthus maderaspatensis* *Pluchea dentex* *Stemodia grossa* *Stemodia viscosa* *Triodia longiceps* *Triumfetta chaetocarpa*	211 ha (0.60%)	

Vegetation unit mapping code	Quadrats	Vegetation description (NVIS Level III and Level V)	Associated species	Area (% of Study Area)	Photograph
Ap	138 204 214 231 233 261	*Acacia* shrubland *Acacia pyrifolia*, *Gossypium robinsonii* and *Tephrosia rosea* mid shrubland Average species richness: 42.9 ± 2.8 (n=9)	*Acacia acradenia* *Acacia bivenosa* *Acacia tumida* *Cajanus cinereus* *Cassytha filiformis* *Chrysopogon fallax* *Corchorus parviflorus* *Cyperus vaginatus* *Eriachne helmsii* *Eucalyptus victrix* *Euphorbia biconvexa* *Grevillea wickhamii* *Hybanthus aurantiacus* *Indigofera monophylla* *Melaleuca glomerata* *Melaleuca linophylla* *Petalostylis labicheoides* *Phyllanthus maderaspatensis* *Polymeria ambigua* *Stemodia grossa* *Themeda triandra* *Triodia longiceps*	316 ha (0.91%)	

Vegetation unit mapping code	Quadrats	Vegetation description (NVIS Level III and Level V)	Associated species	Area (% of Study Area)	Photograph
ApTp	144 200 201 210 213 262 265 271 272	*Acacia* shrubland *Acacia pyrifolia*, *Acacia acradenia* and *Tephrosia rosea* mid shrubland, over *Triodia pungens* open hummock grassland Average species richness: 38.2 ± 3.2 (n=13)	*Acacia bivenosa* *Acacia tumida* *Bonamia linearis* *Corchorus parviflorus* *Corymbia hamersleyana* *Grevillea wickhamii* *Hybanthus aurantiacus* *Jasminum didymum* *Mollugo molluginea* *Petalostylis labicheoides* *Polymeria ambigua* *Ptilotus astrolasius* *Waltheria virgata*	1,011 ha (2.90%)	
Rocky outcrops					
TI	109 211 234 255	*Triodia* hummock grassland *Triodia lanigera* open hummock grassland Average species richness: 26.4 ± 4.3 (n=7)	*Acacia inaequilatera* *Acacia tumida* *Bulbostylis barbata* *Cleome viscosa* *Corchorus laniflorus* *Cymbopogon obtectus* *Cyperus hesperius* *Eriachne ciliata* *Eriachne mucronata* *Gossypium australe* *Grevillea wickhamii* *Indigofera monophylla* Average species richness 26.4 ± 4.3 (n=7)	193 ha (0.55%)	

Vegetation unit mapping code	Quadrats	Vegetation description (NVIS Level III and Level V)	Associated species	Area (% of Study Area)	Photograph
GaTw	97 98	*Triodia* hummock grassland *Gossypium australe* sparse mid shrubland, over *Triodia wiseana* open hummock grassland Average species richness: 25.0 ± 1.0 (n=2)	*Acacia inaequilatera* *Amaranthus undulatus* *Cajanus cinereus* *Corchorus laniflorus* *Cymbopogon obtectus* *Eriachne pulchella* *Gomphrena cunninghamii* *Indigofera colutea* *Mollugo molluginea* *Tribulus platypterus* *Triumfetta chaetocarpa*	28 ha (0.08%)	
Rivers, gorges, creeks and floodplains					
FpAtCo	111 120 205 295	*Ficus* open woodland *Ficus platypoda* open woodland, over *Acacia tumida* and *Gossypium robinsonii* sparse tall shrubland, over *Cymbopogon obtectus* and *Eriachne mucronata* sparse tussock grassland Average species richness: 29.0 ± 6.0 (n=2)	*Acacia pruinocarpa* *Cajanus cinereus* *Cleome viscosa* *Clerodendrum floribundum* *Cyperus hesperius* *Ehretia saligna* var. *saligna* *Eucalyptus leucophloia* *Senna glutinosa* subsp. *glutinosa*	14 ha (0.04%)	

Vegetation unit mapping code	Quadrats	Vegetation description (NVIS Level III and Level V)	Associated species	Area (% of Study Area)	Photograph
ChAbTp	58 276 288	*Corymbia* open woodland *Corymbia hamersleyana* open low woodland, over *Acacia bivenosa* mid shrubland, over *Triodia pungens* open hummock grassland *ChAbTp*	*Acacia acradenia* *Cenchrus ciliaris* *Chrysopogon fallax* *Corchorus parviflorus* *Corchorus tridens* *Cucumis maderaspatanus* *Cyperus vaginatus* *Eucalyptus victrix* *Euphorbia biconvexa* *Pluchea ferdinandi-muelleri* *Rhynchosia minima* *Sporobolus australasicus* Average species richness 28.0 ± 4.0 (n=2)	42 ha (0.12%)	
EvCc	51 57 125 126 283 287 293 301	*Eucalyptus* open woodland ± *Eucalyptus victrix* ± *Eucalyptus camaldulensis* open mid woodland, over *Cenchrus ciliaris* tussock grassland Average species richness: 29.7 ± 3.4 (n=7)	*Acacia pyrifolia* *Acacia trachycarpa* *Acacia tumida* *Aerva javanica* *Atalaya hemiglauca* *Bulbostylis barbata* *Chrysopogon fallax* *Cleome viscosa* *Cyperus vaginatus* *Euphorbia drummondii* *Hybanthus aurantiacus* *Indigofera monophylla* *Notoleptopus decaisnei* *Polycarpaea corymbosa* *Polymeria ambigua* *Sporobolus australasicus* *Tephrosia rosea* *Triodia pungens Acacia bivenosa*	1,355 ha (3.89%)	

Vegetation unit mapping code	Quadrats	Vegetation description (NVIS Level III and Level V)	Associated species	Area (% of Study Area)	Photograph
PfTp	42 48 61 93	*Pluchea* open shrubland *Pluchea ferdinandi-muelleri* open low shrubland, over *Triodia pungens* sparse hummock grassland Average species richness: 33.2 ± 3.4 (n=5)	*Acacia stellaticeps* *Cenchrus ciliaris* *Chrysopogon fallax* *Eragrostis cumingii* *Eriachne lanata* *Goodenia nuda* *Sporobolus australasicus*	163 ha (0.47%)	
Granite sandy plains and outcrops					
Tp	4 14 19 22 29 30 31 43	*Triodia* open hummock grassland *Triodia pungens* open hummock grassland Average species richness: 24.8 ± 2.9 (n=14)	*Bulbostylis barbata* *Cleome viscosa* *Cyperus squarrosus* *Dactyloctenium radulans* *Eriachne lanata* *Eriachne pulchella* *Hybanthus aurantiacus* *Polycarpaea holtzei*	1,501 ha (4.31%)	

Vegetation unit mapping code	Quadrats	Vegetation description (NVIS Level III and Level V)	Associated species	Area (% of Study Area)	Photograph
ImTp	2 13 15 44 46 106 107	*Triodia* open hummock grassland *Indigofera monophylla* and *Solanum phlomoides* sparse shrubland, over *Triodia pungens* and *Triodia basedowii* open hummock grassland Average species richness: 24.6 ± 2.4 (n=16)	*Acacia stellaticeps* *Bonamia linearis* *Bulbostylis barbata* *Cleome uncifera* *Corchorus tectus* *Eriachne pulchella* *Fimbristylis microcarya* *Goodenia microptera* *Hibiscus leptocladus* *Hibiscus sturtii* *Mollugo molluginea* *Polycarpaea corymbosa* *Polycarpaea holtzei* *Trianthema triquetra* *Yakirra australiensis*	2,557 ha (7.33%)	
SpTl	217 239 248 249 282 286	*Triodia* open hummock grassland *Solanum phlomoides* isolated low shrubs, over *Triodia lanigera* open hummock grassland Average species richness: 22.6 ± 2.1 (n=10)	*Acacia bivenosa* *Bonamia media* *Bulbostylis barbata* *Corchorus parviflorus* *Polycarpaea holtzei* *Polygala isingii* *Ptilotus calostachyus*	670 ha (1.92%)	

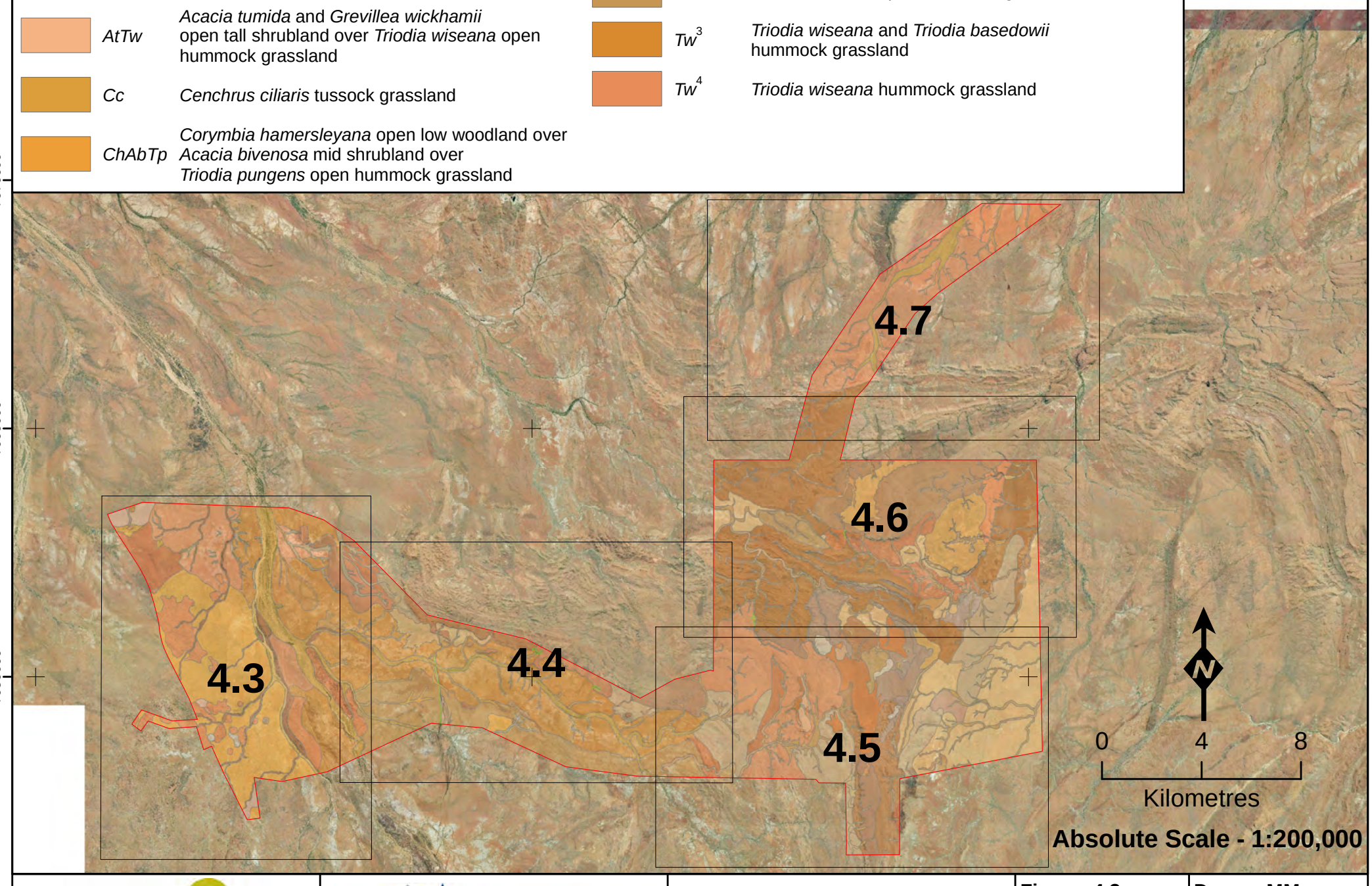
680000 700000 720000

7710000 7700000 7690000 7680000 7670000 7660000 7650000

Legend

Vegetation Units

- *AaTb* — *Acacia acradenia*, *Petalostylis labicheoides* and *Corchorus laniflorus* sparse shrubland over *Triodia basedowii* sparse hummock grassland
- *AaTw*[1] — *Acacia acradenia*, *Grevillea wickhamii* and *Acacia orthocarpa* sparse mid shrubland over *Triodia wiseana* sparse hummock grassland
- *AaTw*[2] — *Acacia acradenia* open mid shrubland over *Triodia wiseana* hummock grassland
- *AaTw*[3] — *Acacia acradenia*, *Acacia tumida* and *Grevillea wickhamii* open shrubland over *Triodia wiseana* hummock grassland
- *AaTw*[4] — *Acacia acradenia* and *Acacia inaequilatera* sparse mid shrubland over *Triodia wiseana* and *Triodia lanigera* hummock grassland
- *AiTb* — *Acacia inaequilatera*, *Acacia acradenia* and *Grevillea wickhamii* sparse shrubland over *Triodia basedowii* and *Triodia wiseana* hummock grassland
- *AoTb* — *Acacia orthocarpa* and *Indigofera monophylla* open shrubland over *Triodia basedowii* open hummock grassland
- *AoTw* — *Acacia orthocarpa* open tall shrubland over *Triodia wiseana* open hummock grassland
- *Ap* — *Acacia pyrifolia*, *Gossypium robinsonii* and *Tephrosia rosea* mid shrubland
- *ApTp* — *Acacia pyrifolia*, *Acacia acradenia* and *Tephrosia rosea* mid shrubland over *Triodia pungens* open hummock grassland
- *AsTl* — *Acacia stellaticeps* sparse low shrubland over *Triodia longiceps* hummock grassland
- *At* — *Acacia tumida*, *Grevillea wickhamii* and *Indigofera monophylla* shrubland
- *AtEm* — *Acacia tumida*, *Acacia orthocarpa* and *Grevillea wickhamii* open shrubland over *Eriachne mucronata* isolated tussock grasses
- *AtTw* — *Acacia tumida* and *Grevillea wickhamii* open tall shrubland over *Triodia wiseana* open hummock grassland
- *Cc* — *Cenchrus ciliaris* tussock grassland
- *ChAbTp* — *Corymbia hamersleyana* open low woodland over *Acacia bivenosa* mid shrubland over *Triodia pungens* open hummock grassland
- *Cl* — *Corchorus laniflorus*, *Grevillea wickhamii* and *Solanum phlomoides* sparse shrubland
- *ElApEm* — *Eucalyptus leucophloia* isolated low trees over *Acacia ptychophylla* and *Grevillea wickhamii* shrubland over *Eriachne mucronata* isolated tussock grasses
- *ElApTw* — *Eucalyptus leucophloia* isolated trees over *Acacia ptychophylla* sparse shrubland over *Triodia wiseana* open hummock grassland
- *FpAtCo* — *Ficus platypoda* open woodland over *Acacia tumida* and *Gossypium robinsonii* sparse tall shrubland over *Cymbopogon obtectus* and *Eriachne mucronata* sparse tussock grassland
- *GaTw* — *Gossypium australe* sparse mid shrubland over *Triodia wiseana* open hummock grassland
- *GwTe* — *Grevillea wickhamii* sparse mid shrubland over *Triodia epactia* or *Triodia schinzii* open hummock grassland
- *GwTp* — *Grevillea wickhamii* sparse tall shrubland over *Triodia pungens* open hummock grassland
- *ImTp* — *Indigofera monophylla* and *Solanum phlomoides* sparse shrubland over *Triodia pungens* and *Triodia basedowii* open hummock grasssland
- *ImTs* — *Indigofera monophylla* isolated low shrubs over *Triodia schinzii* open hummock grassland
- *PfTp* — *Pluchea ferdinandi-muelleri* open low shrubland over *Triodia pungens* sparse hummock grassland
- *SpTl* — *Solanum phlomoides* isolated low shrubs over *Triodia lanigera* open hummock grassland
- *Tl* — *Triodia* lanigera open hummock grassland
- *Tp* — *Triodia pungens* open hummock grassland
- *Tw*[1] — *Triodia wiseana* and *Triodia schinzii* hummock grassland
- *Tw*[2] — *Triodia wiseana* open hummock grassland
- *Tw*[3] — *Triodia wiseana* and *Triodia basedowii* hummock grassland
- *Tw*[4] — *Triodia wiseana* hummock grassland



Absolute Scale - 1:200,000

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FMG Fortescue The New Force in Iron Ore

North Star Vegetation Units

Figure: 4.3
Project ID: 1321

Drawn: MM
Date: 22/12/2011

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

Unique Map ID: MM024

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685000

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7655000

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7645000

Legend

Vegetation Units

- AaTb
- AaTw[1]
- AaTw[2]
- AaTw[3]
- AaTw[4]
- AiTb
- AoTb
- AoTw
- Ap
- ApTp
- AsTl
- At
- AtEm
- AtTw
- Cc
- ChAbTp
- Cl
- ElApEm
- ElApTw
- FpAtCo
- GaTw
- GwTe
- GwTp
- ImTp
- ImTs
- PfTp
- SpTl
- Tl
- Tp
- Tw[1]
- Tw[2]
- Tw[3]
- Tw[4]

0 0.75 1.5

Kilometres

Absolute Scale - 1:40,000

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FMG Fortescue The New Force in Iron Ore

North Star Vegetation Units

Figure: 4.4
Project ID: 1321

Drawn: MM
Date: 22/12/2011

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

Unique Map ID: MM019

A3

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695000 700000 705000

7655000 7650000

Legend

Vegetation Units

- AaTb
- AaTw1
- AaTw2
- AaTw3
- AaTw4
- AiTb
- AoTb
- AoTw
- Ap
- ApTp
- AsTl
- At
- AtEm
- AtTw
- Cc
- ChAbTp
- Cl
- ElApEm
- ElApTm
- ElApTw
- FpAtCo
- GaTw
- GwTe
- GwTp
- ImTp
- ImTs
- PfTp
- SpTl
- Tl
- Tp
- Tw1
- Tw2
- Tw3
- Tw4

0 0.75 1.5

Kilometres

Absolute Scale - 1:40,000

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FMG Fortescue The New Force in Iron Ore

North Star Vegetation Units

Figure: 4.5
Project ID: 1321

Drawn: MM
Date: 22/12/2011

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

Unique Map ID: MM020

A3

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705000 710000 715000 720000

7650000

7645000

Legend

Vegetation Units

AaTb	AiTb	At	ElApEm	ImTp	Tw^1
$AaTw^1$	AoTb	AtEm	ElApTw	ImTs	Tw^2
$AaTw^2$	AoTw	AtTw	FpAtCo	PfTp	Tw^3
$AaTw^3$	Ap	Cc	GaTw	SpTl	Tw^4
$AaTw^4$	ApTp	ChAbTp	GwTe	Tl	
	AsTl	Cl	GwTp	Tp	

0 0.75 1.5

Kilometres

Absolute Scale - 1:40,000

ecologia ENVIRONMENT

FMG Fortescue The New Force in Iron Ore

North Star Vegetation Units

Figure: 4.6
Project ID: 1321

Drawn: MM
Date: 22/12/2011

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

Unique Map ID: MM021

A3

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710000 715000 720000

7660000

7655000

N

0 0.75 1.5

Kilometres

Absolute Scale - 1:40,000

Legend

Vegetation Units

- AaTb
- AaTw1
- AaTw2
- AaTw3
- AaTw4
- AiTb
- AoTb
- AoTw
- Ap
- ApTp
- AsTl
- At
- AtEm
- AtTw
- Cc
- Cl
- ChAbTp
- ElApEm
- ElApTw
- FpAtCo
- GaTw
- GwTe
- GwTp
- ImTp
- ImTs
- PfTp
- SpTl
- Tl
- Tp
- Tw1
- Tw2
- Tw3
- Tw4

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			Coordinate System Name: GDA 1994 MGA Zone 50 Projection: Transverse Mercator Datum: GDA 1994 / Unique Map ID: MM022 / **A3**

NS-AS-EN-0001

710000 715000 720000

7665000

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Legend

Vegetation Units

- AaTb
- AaTw1
- AaTw2
- AaTw3
- AaTw4
- AiTb
- AoTb
- AoTw
- Ap
- ApTp
- AsTl
- At
- AtEm
- AtTw
- Cc
- ChAbTp
- Cl
- ElApEm
- ElApTw
- FpAtCo
- GaTw
- GwTe
- GwTp
- ImTp
- ImTs
- PfTp
- SpTl
- Tl
- Tp
- Tw1
- Tw2
- Tw3
- Tw4

0 0.75 1.5

Kilometres

N

Absolute Scale - 1:40,000

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FMG Fortescue The New Force in Iron Ore

North Star Vegetation Units

Figure: 4.8
Project ID: 1321

Drawn: MM
Date: 22/12/2011

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

Unique Map ID: MM023

A3

NS-AS-EN-0001

Landform	Vegetation Code	Site	Dendrogram
Rocky hills and plains	*ElApE*	160, 104, 155	
	AaTw¹	237, 235, 145	
	AtEm	228, 226, 256, 157, 281	
	AtTw²	148, 151, 149, 153, 164	
	AoTw	156, 154, 141, 246, 252, 222, 220	
	Tw¹	247, 244, 218, 232, 266	
	ElApTw	206, 127, 159, 147, 158	
	Tw²	96, 289, 212, 161, 129, 259	
Calcrete	*Tw³*	69, 113, 122, 118, 103	
Rocky hills and plains	*AaTw²*	152, 146, 124, 52, 274, 270, 260, 219, 143, 133, 87, 88, 78, 50, 64	
	Tw⁴	202, 207, 119, 90, 99, 300, 139, 60, 140	
	AaTw³	267, 258, 240, 230, 203, 250, 264, 254, 296, 298, 275, 268, 215, 221, 150, 94, 123	
	AaTw⁴	6, 305, 216.1, 216, 306, 273, 208, 224	
Shrubby drainage-lines	*At*	165, 128, 299, 238, 278, 277, 229, 163	
Sandy and gravelly plains	*ImTs*	3, 5, 136, 263	
	AsTl	303, 309, 38, 110, 59, 269	
	Cl	41, 91	
	AaTb	108, 63	
	AiTb	284, 10, 11, 8, 73, 27, 132, 166, 84, 227, 257, 209	
	AoTb	45, 26, 1	
Drainage-lines	*GwTe*	223, 225	
	GwTp	279, 307, 35	
	Ap	261, 204, 138, 233, 214, 231	
	ApTp	213, 210, 200, 265, 201, 262, 144, 272, 271	
Rocky outcrops	*Tl*	211, 255, 109, 234	
	GaTw	97, 98	
Rivers, gorges, creeks and floodplains	*FpAtCo*	205, 120, 111, 295	
	ChAbTp	276, 58, 288	
	EvCc	293, 283, 287, 126, 301, 51, 125, 57	
	PfTp	61, 48, 42, 93	
Granite sandy plains and outcrops	*Tp*	43, 22, 30, 29, 14, 19, 4, 31, 47, 304, 308, 302, 280, 102, 142, 297, 292, 285, 290, 291	
	ImTp	107, 46, 13, 15, 44, 2, 106	
	SpTl	282, 249, 248, 239, 217, 286	

0.2 0.4 0.6 0.8 1.0

5 FLORA RESULTS

A total of 453 taxa were recorded from the North Star Study Area. Nineteen taxa included within this total were identified to species level only but could potentially be specimens of subspecies also collected in the survey, and twenty collections could not be identified beyond genus due to a lack of reproductive material but are likely to be repeats of taxa already collected.

Four-hundred and four fully identified taxa were recorded in the quadrats of Phase 1 and 2 combined. The composition of the species inventory is summarised in Table 5.1. A complete list of the flora recorded in the Study Area is included as Appendix C.

Table 5.1 – 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
272	453	55	168	19	90

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 5.2. This pattern of representation is typical of surveys within the Pilbara during favourable seasonal conditions, with the exception of the unusually high representation of the family Cyperaceae. An unusually high diversity of sedges were recorded in this survey as a result of the relative abundance of semi permanent and permanent water sources, many of which had abundant water at the time of survey due to the high rainfall, and were in excellent condition due to the absence or low intensity of grazing by cattle.

Table 5.2 – Most Frequently Recorded Families, Genera and Taxa in the Current Survey

Most Common Families	Most Common Genera	Most Frequently Recorded Taxa
Fabaceae (75 taxa)	*Acacia* (29 taxa)	*Grevillea wickhamii* (248 quadrats, 91 %)
Poaceae (69 taxa)	*Ptilotus* (14 taxa)	*Triodia wiseana* (199 quadrats, 73 %)
Malvaceae (47 taxa)	*Heliotropium* (11 taxa)	*Acacia acradenia* (195 quadrats, 71 %)
Amaranthaceae (22 taxa)	*Eriachne* (10 taxa)	*Indigofera monophylla* (178 quadrats, 65 %)
Asteraceae (19 taxa)	*Eragrostis* (9 taxa)	*Bulbostylis barbata* (171 quadrats, 62 %)
Cyperaceae (18 taxa)	*Sida* (8 taxa)	*Eriachne pulchella* (163 quadrats, 59 %)
Myrtaceae (17 taxa)	*Triodia* (8 taxa)	*Solanum phlomoides* (161 quadrats, 59 %)
		Acacia inaequilatera (158 quadrats, 58 %)
		Polycarpaea holtzei (152 quadrats, 55 %)

Species richness within quadrats varied from 4 to 62 taxa, with a mean species richness of 25.67 ± 0.70 (n= 272). The highest species richness of 62 taxa was recorded in Quadrat 86, located within Vegetation Unit *ApTp* (*Acacia pyrifolia*, *Acacia acradenia* and *Tephrosia rosea* mid shrubland over *Triodia pungens* open hummock grassland), while the lowest species richness of taxa was recorded from Quadrat 34 in Vegetation Unit *Tw*[4] (*Triodia wiseana* hummock grasslands). The most floristically diverse vegetation units were Vegetation Units *GwTp* (*Grevillea wickhamii* sparse tall shrubland over *Triodia pungens* open hummock grassland) and *Ap* (*Acacia pyrifolia*, *Gossypium robinsonii* and *Tephrosia rosea* mid shrubland), with mean species richness of 46.1 and 42.8 respectively. Vegetation Unit *AtEm* (*Acacia tumida*, *Acacia orthocarpa* and *Grevillea wickhamii* open shrubland over *Eriachne mucronata* isolated tussock grasses) and *AoTb* (*Acacia orthocarpa* and *Indigofera monophylla* open shrubland over *Triodia basedowii* open hummock grassland) were the least diverse,

with mean species richness of 15.5 and 13.5 respectively.

Table 5.3 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 is the 2006 and 2008 survey of the Roy Hill Stage 1 Mining Lease (*ecologia* 2008b) which is of a similar area and for which a similar number of quadrats were surveyed under comparable seasonal conditions. The total inventory of each survey is very similar.

As is typical of linear surveys, which frequently encompass a broader range of vegetation communities, a number of the rail corridor surveys (Biota 2004a; *ecologia* 2011) have recorded a higher number of taxa per number of quadrats surveyed.

Table 5.3 – A Comparison of Floristic Richness of Study Area with Nearby Studies.

Study Site	Number Taxa Recorded	Number Quadrats Surveyed	Date Surveyed
Current survey	**453**	**272**	**Apr -Sept 2011**
Brockman Rail Corridor (*ecologia* 2011)	499	220	May-July 2010 & Aug 2011
Roy Hill Stage 1 (*ecologia* 2008b)	477	258	May 2006, March 2008
Yandi to Kurrajurra Rail Line (*ecologia* 2008d)	175	9	March 2008
Kurrajurra to Cowra Siding (*ecologia* 2007)	206	36	Oct 2007
Chichester Deviation Rail Line (*ecologia* 2008a)	306	84	Oct 2007 & May 2008
Yandi Mine Extension (*ecologia* 2008c)	333	119	Nov 2007 & Mar 2008
FMG Stage B Rail Corridor & Mine Areas (Biota 2004a)	599	206	June & Oct 2004
Brockman Service Corridor (*ecologia* 2010)	215	91	April & May 2010
Brockman Marillana (*ecologia* 2009)	302	137	June & Sept 2008

5.1.1 Sampling Adequacy

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 number of species recorded becomes asymptotic. At the point where there is a minimal increase in species inventory with continued sampling effort, the survey size is deemed sufficient.

5.1.2 Sampling Adequacy for the Study Area

Flora sampling adequacy was estimated using SAC analysis (Colwell 2009) and extrapolation of the curve to the asymptote using Michaelis-Menten modelling (Figure 5.1). Using this analysis, the incidence-based coverage estimators of species richness; ICE Mean, Chao 2 Mean were determined as 454 and 456. The total number of taxa collected in the Study Area quadrats (excluding opportunistic collections) was 396 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 87% of the taxa present were recorded. Lines represent sampled species (black), ICE Means (red) and Chao2 Means (green).

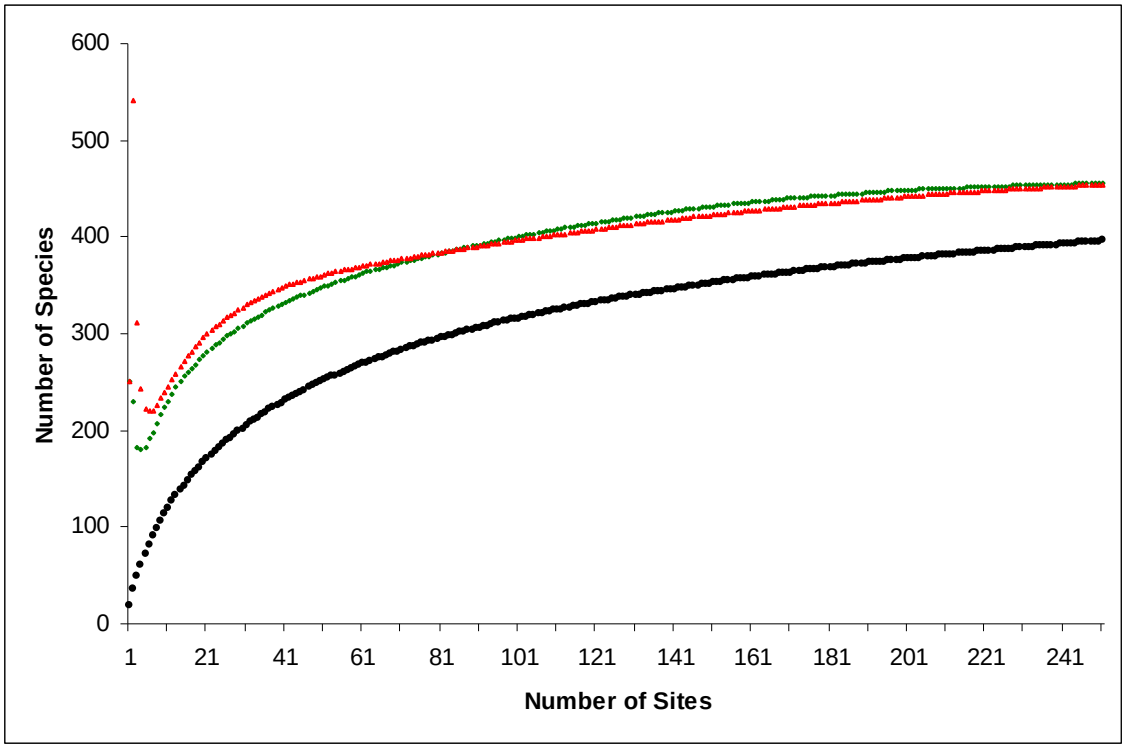


Figure 5.1 – Average Randomised Species Acccumulation Curve for North Star. Lines represent sampled species (black), ICE Means (red) and Chao2 Means (green).

5.2 FLORA OF CONSERVATION SIGNIFICANCE

5.2.1 *Environmental Protection and Biodiversity Conservation Act,* 1999 (Commonwealth of Australia)

At a Commonwealth level, flora are protected under the *EPBC Act 1999*, which lists species that are considered Critically Endangered, Endangered, Conservation Dependant, Extinct, or Extinct in the Wild (Appendix D).

There are two EPBC listed taxa known to occur within the Pilbara, *Lepidium catapycnon* and *Thryptomene wittweri* (both Vulnerable). Neither species was recorded within the North Star Study Area. Although suitable habitat for both species is present, the absence of previous records within the database search area surrounding the Study Area and the absence of records, despite the relatively high intensity of survey, suggests they are unlikely to be present.

5.2.2 *Wildlife Conservation Act, 1950* (Western Australia)

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, 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
- 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, neither species is considered likely to occur within the North Star Study Area.

5.2.3 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, 123 Priority Flora taxa are listed as occurring in the Pilbara region, including 41 Priority 1, 20 Priority 2, 54 Priority 3, and eight Priority 4 taxa (Western Australian Herbarium 1998-2012).

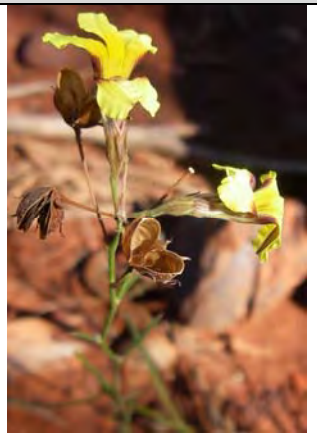
Eight Priority taxa were recorded in the Study Area during the current survey, details of which are summarised in Table 5.4. The distribution of records within the Study Area is illustrated in Figure 5.2 and coordinates of records and Rare Flora Report Forms are provided in Appendices E and F respectively.

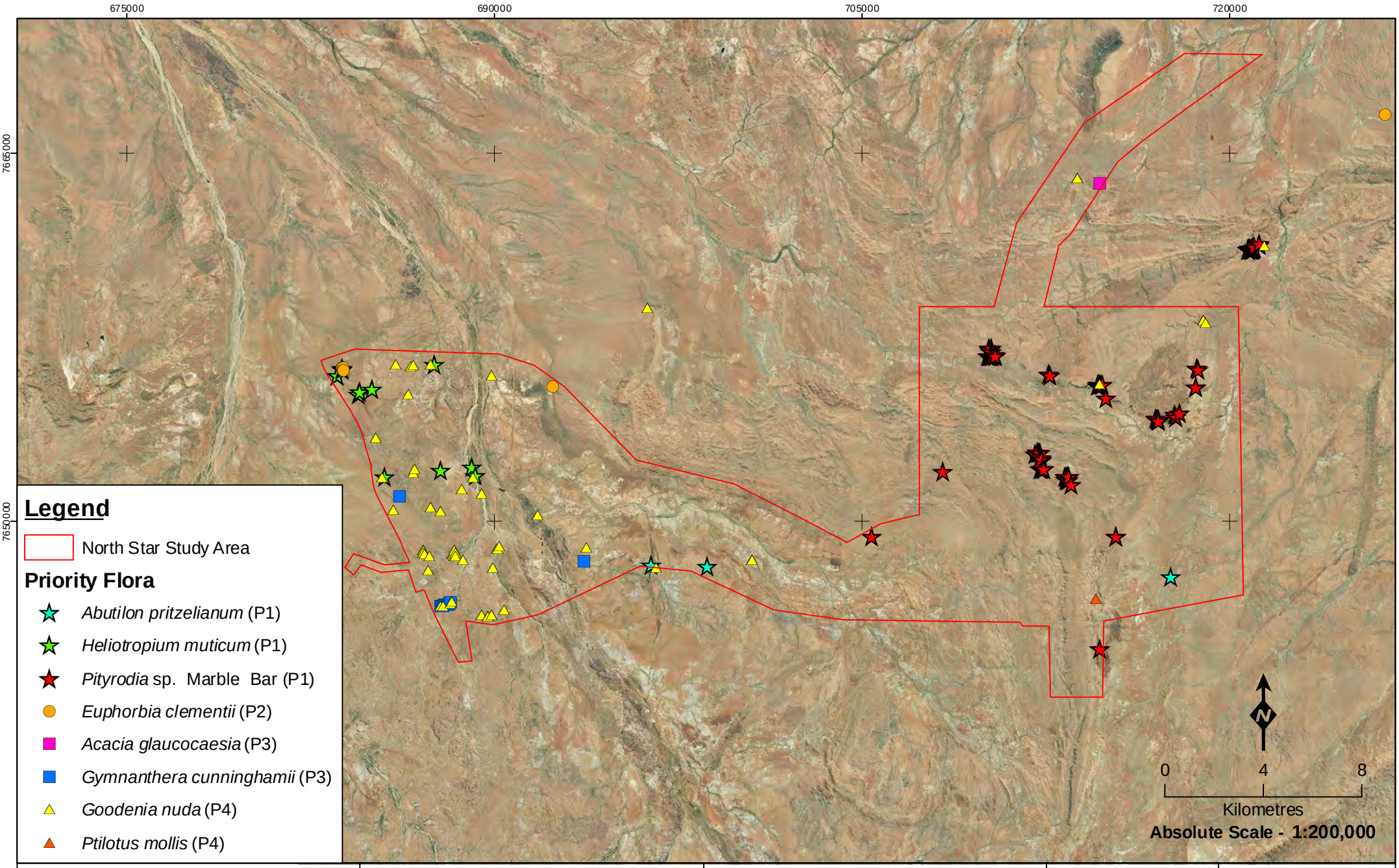
Table 5.4 – Priority Flora Recorded Within the North Star Study Area

Conservation Status	Taxon	Family	No. of records (individuals) within Study Area	Habitat (WA Herbarium 2011)	Distribution	Flower Period	Picture
P1	*Abutilon pritzelianum* A shrub ranging from 1 to 1.5 m tall with yellow flowers.	Malvaceae	3 (3)	Red sand, low in landscape, sand plains, gently undulating with dunes.	Karratha, Port Headland, Whim Creek, Lake McLeod	Aug	 (ecologia 2011)
P1	*Heliotropium muticum* An open, spreading shrub with white flowers and very short but stiff, spiny hairs, grows up to 0.3 m tall.	Boraginaceae	12 (20)	Abundant bedrock outcrop, brown sandy loam and red silty sand.	Karratha, Port Headland	-	 (ecologia 2011)

Conservation Status	Taxon	Family	No. of records (individuals) within Study Area	Habitat (WA Herbarium 2011)	Distribution	Flower Period	Picture
P1	*Pityrodia* sp. Marble Bar (G. Woodman & D. Coultas GWDC Opp 4) A shrub to 2 m high with silver densely hairy leaves and pink flowers.	Lamiaceae	73 (541)	Base of sandstone hill slopes with Skeletal brown sandy loam over sandstone.	Marble Bar	Aug	 (ecologia 2011)
P2	*Euphorbia clementii* An erect herb to 0.6 m high.	Euphorbiaceae	5 (6)	Distal colluvium in outwash fans with red brown sandy loam.	Marble Bar, Port Headland, Yandeyarra	Apr	 (ecologia 2011)

Conservation Status	Taxon	Family	No. of records (individuals) within Study Area	Habitat (WA Herbarium 2011)	Distribution	Flower Period	Picture
P3	*Acacia glaucocaesia* A dense, glabrous shrub or tree that ranges from 1.8–6 m high with yellow flowers.	Fabaceae	1 (1)	Hard red-brown clay on flat plain and stony brown loam	Karratha, Port Headland, Roebourne	Jul to Sep	 (ecologia 2011)
P3	*Gymnanthera cunninghamii* An erect multi stemmed shrub (pale tubercules on brown stem) to 1.5m with pendulous foliage and milky sap and varnished leaves.	Apocynaceae	12 (24)	Sand plain, red sandy soil, dark red sandy clay loam, limestone outcrops, beach and river sands	Port Headland, Boundaries Landing	Jan to Dec	 (Ecologia 2011)

Conservation Status	Taxon	Family	No. of records (individuals) within Study Area	Habitat (WA Herbarium 2011)	Distribution	Flower Period	Picture
P4	*Goodenia nuda* An erect herb with yellow flowers with a maroon centre.	Goodeniaceae	48 (785)	Dry brown-red sand – loam occasionally in areas of recent burns	Port Headland, Newman, Onslow	Apr to Aug	 (ecologia 2011)
P4	*Ptilotus mollis* A compact, perennial shrub with soft grey foliage. Up to 50 cm in height.	Amaranthaceae	1 (20)	Stony hills and scree	Port Headland, Tom Price, Paraburdoo, Marble Bar	May to Sep	 (FloraBase 2012)



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FMG Fortescue The New Force in Iron Ore

Priority Flora at North Star

Figure: 5.2
Project ID: 1321

Drawn: MM
Date: 25/07/2012

Coordinate System
Name: GDA1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994

Unique Map ID: MM034

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5.2.4 Range Extensions Recorded in the Study Area

Five records from the current survey represent range extensions of more than 100 km to the taxon's previously known distribution (Table 5.5), based on collection records lodged at the WA Herbarium (Western Australian Herbarium 1998-2012). In some instances range extensions can represent poorly collected taxa particularly given the relative paucity of records from the eastern portion of the Chichester sub-region. Specimens from these taxa will be lodged with the WA Herbarium (forms provided in Appendix F).

Table 5.5 – Taxa with Range Extensions Greater than 100 km.

Species	Approximate distance and Direction of Extension	Bioregions in which Species Known to Occur	Number of Records (Florabase)
Acacia tumida var. *tumida*	250 km north-north-western extension.	Northern: CK, DL, NK, OVP and VB. Eremaean: PIL and TAN.	197
Isotoma petraea	100 km northern extension	Eremaean: COO, CR, GAS, GD, GVD, MUR, PIL and YAL. South-west: AW and MAL.	153
Portulaca cyclophylla	100 km northern extension	Eremaean: MUR and PIL.	18
Scaevola browniana subsp. *browniana*	100 km northern extension of southern population	Northern: CK, NK, OVP and VB. Eremaean: GAS, LSD, PIL and TAN.	32
Schoenoplectus lateriflorus	100 km northern extension	Northern: CK, DL, NK, OVP and VB. Eremaean: CAR, GAS, PIL and YAL.	30

Bioregion codes:
Northern: Central Kimberley (CK), Dampierland (DL), Northern Kimberley (NK), Ord-Victoria Plains (OVP) and Victoria Bonaparte (VB).
Eremaean: Carnarvon (CAR), Central Ranges (CR), Coolgardie (COO), Gascoyne (GAS), Gibson Desert (GD), Great Sandy Desert (GSD), Great Victoria Desert (GVD), Hampton (HAM), Little Sandy Desert (LSD), Murchison (MUR), Nullarbor (NUL) Pilbara (PIL), Tanami (TAN) and Yalgoo (YAL).
South-west: Avon Wheatbelt (AW), Esperance Plains (ESP), Geraldton Sandplains (GS), Jarrah Forest (JF), Mallee (MAL), Swan Coastal Plain (SWA), Warren (WAR).

5.3 INTRODUCED FLORA

5.3.1 Weeds of National Significance (WONS)

At a national level there are twenty weed species listed as Weeds of National Significance (WONS). *The Commonwealth National Weeds Strategy: A Strategic Approach to Weed Problems of National Significance* (2011) describes broad goals and objectives to manage these species. Of these species, three are currently recorded within the Pilbara (Mesquite, *Prosopis* spp.; Athel Pine, *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.

5.3.2 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* 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 municipal districts can use different priority levels. 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 Study Area.

5.3.3 Environmental Weeds

A third and much more extensive categorisation of weeds has been developed by the Department of Environment and Conservation (DEC), formerly the Department of Conservation and Land Management (CALM) in an 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.

Nine weed species were recorded within the Study Area;

- **Aerva javanica*;
- **Bidens bipinnata*;
- **Cenchrus ciliaris*;
- **Cucumis melo* subsp. *agrestis*;
- **Digitaria ciliaris*;
- **Indigofera oblongifolia*;
- **Malvastrum americanum*;
- **Portulaca oleracea*; and
- **Sonchus oleraceus*

The locations at which these species were recorded are listed in Appendix H and mapped in Figure 5.3. The characteristics and broad distributions of these species are summarised in Table 5.6 and Table 5.7.

Table 5.6 – Environmental Status of Introduced Species Recorded in the Study Area

Taxa	DEC Environmental Threat Assessment for the Pilbara Bioregion (DEC, 2011)								Quadrats at which Species was Observed
	Env. Rating	Current Distrib.	Abundance	Ecological Impact	Invasiveness	Feasibility of Control	General Trend	Status	
**Aerva javanica*	High	Moderate	Abundant	High	Rapid	High-Moderate	Increasing	Established	276; 287; 126, 301; 86 ;300; 55; 165; 125; 51; 274
**Bidens bipinnata*	Unrated	High	-	Unknown	Rapid	Low	-		35
**Cenchrus ciliaris*	High	High	Abundant	High	Rapid	Low	Increasing	Established	51; 39; 58; 93; 138; 301; 69; 61; 231; 82; 287; 283; 55; 126; 291; 362; 300; 76; 283; 299; 42; 283; 125; 354; 262; 59; 43; 54; 288; 43; 57; 293; 298; 276; 51; 83; 22; 86; 48; 384; 204; 373
**Cucumis melo subsp. agrestis*	not listed								125; 97
**Digitaria ciliaris*	Low	Low	Common	High	Rapid	Unknown	Increasing	Established	143; 152; 306; 152; 150
**Indigofera oblongifolia*	Moderate	Moderate	Common	High	Rapid	Unknown	Increasing	Established	143; 152; 306; 152; 150
**Malvastrum americanum*	Moderate	High	Abundant	High	Rapid	Low	Increasing	Established	281; 278; 299
**Portulaca oleracea*	Low	-	-	Low	-	-	-	-	29; 88; 259; 54; 291; 79; 309; 57; 44; 69; 285; 11; 292; 99; 287; 8
**Sonchus oleraceus*	Moderate	Low	-	Low	Rapid	Low	-	-	261

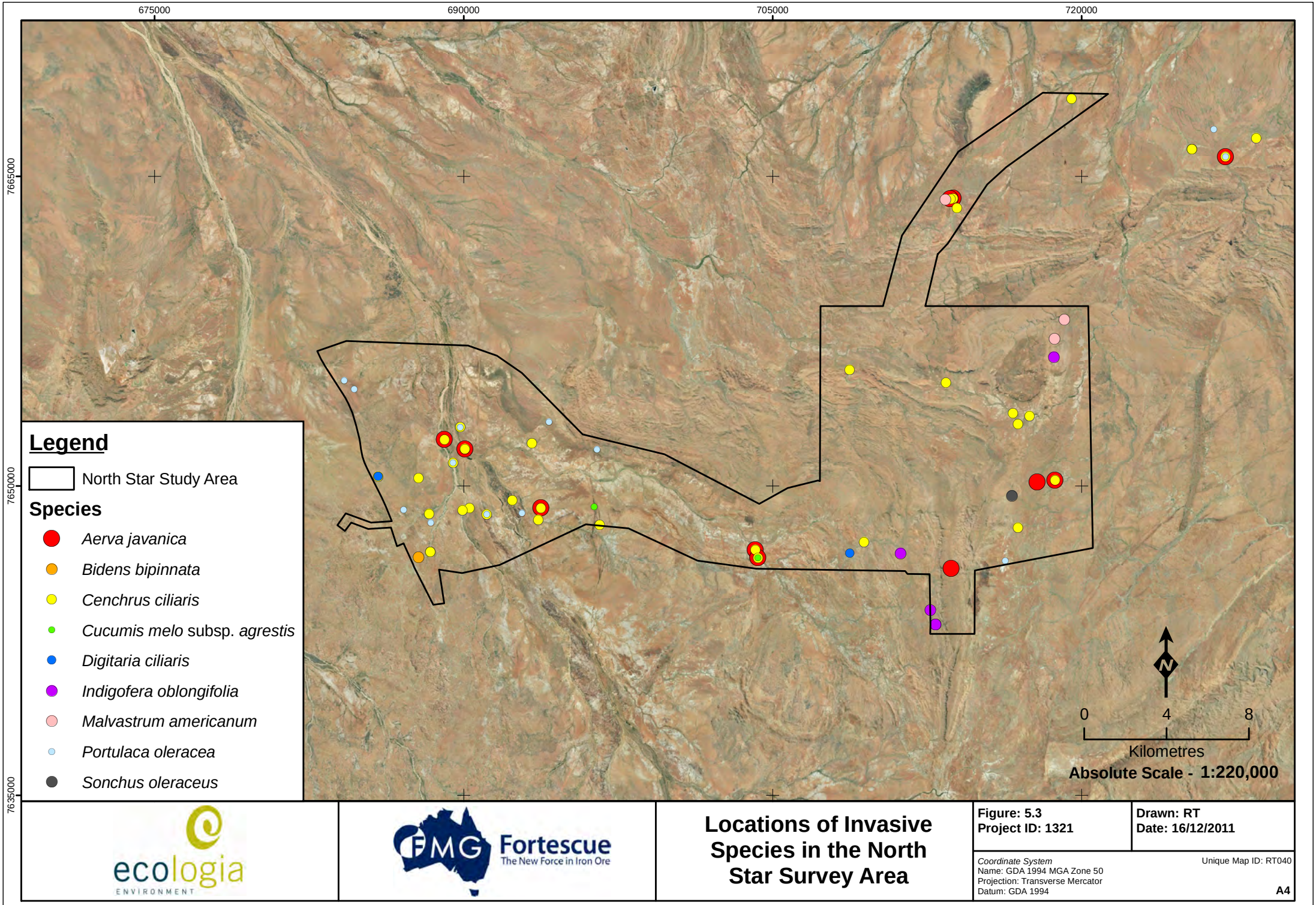
Table 5.7 – Introduced Flora Recorded in the Study Area.

Taxa	Description	Picture
**Aerva javanica* Amaranthaceae (kapok bush)	**Aerva javanica* is an erect, much-branched perennial herb that flowers from January to October, 0.4 to 1.6 m high. It is densely covered in short, branched hairs that give it a grey appearance. **A. javanica* occurs often on sandy soils and along drainage lines. It currently spreads from the Kimberley to Carnarvon. It is native to northern Africa and south east Asia, and was introduced to assist with the revegetation of degraded rangelands.	 *ecologia* (2011)
**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. It grows on alluvium, clay, loam over sandstone, limestone, along rivers and creeks, coastal areas and rocky hillsides. *B. bipinnata* is found worldwide and in Western Australia it is distributed in the Northern, Eremaean and South-West.	 Florabase (2011)
**Cenchrus ciliaris* Poaceae (Buffel grass)	*C. ciliaris* is a tufted, often tussocky perennial grass up to 1 m high. The inflorescence is cylindrical, with purple flowers produced from February to October. 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. Apart from being widely distributed in Western Australia, it is present in all States and territories of continental Australia. Native to Africa and India.	 *ecologia* (2011)

Taxa	Description	Picture
**Cucumis melo subsp. agrestis* Cucurbitaceae (ulcardo melon)	*C. melo* is a trailing annual herb or climber with yellow flowers from February to June or September to October. Its fruit is a melon ca. 5 to 15 cm wide, yellow and light green in colour. The species is distributed in the Northern and Eremaean regions of Western Australia.	 *ecologia* (2011)
**Digitaria ciliaris* Poaceae (Summer Grass)	**Digitaria ciliaris* is a decumbent, tufted annual, grass-like or herb, 0.02–1 m high with green flowers, occurring between November and June. It commonly grows in sand, clay, alluvium and sandstone. Native to the tropics, *D. ciliaris* is now a weed of crops and disturbed areas.	 www.shirleydenton.com
**Indigofera oblongifolia* Fabaceae	**Indigofera oblongifolia* is an erect, spreading shrub, to 2 m high with pink and yellow flowers present in Apr or Jun or September. It prefers sandy clay, white clay over limestone, alluvial soils in coastal areas or on roadsides. It is confined to the Eremaean region in the Pilbara, Western Australia.	 Florabase (2011)
**Malvastrum americanum* Amaranthaceae (Spiked Malvastrum)	**Malvastrum americanum* is an erect perennial herb or shrub from 0.5 to 1.3 m high. The flowers are yellow to orange in a dense terminal spike, open from April to July. It occurs in various soil types, including sands, clays, limestone and calcrete and can be found along drainage lines, floodplains, stony ridges and hillsides. Distributed in the Northern and Eremaean regions of Western Australia.	 Hussey et. al (2011)

Taxa	Description	Picture
**Portulaca oleracea* Portulaceae (Purslane)	**Portulaca oleracea* is a succulent, prostrate to decumbent annual, herb growing to 0.2 m high. It has yellow flowers from Apr to May. It commonly grows in clay loam and sand. It is often found growing in disturbed sites. **P. oleracea* is widespread throughout Western Australia, growing in the Northern, Eremaean and South-west Bioregions.	 Florabase (2011)
**Sonchus oleraceus* Asteraceae (Sowthistle)	**Sonchus oleraceus* is an erect annual, herb growing to 1.5 m high. It has a yellow flower present from Jan to Dec. It can be found growing successfully in a wide variety of soil types in areas of weed of waste and disturbed ground. **Sonchus oleraceus* has a widespread range throughout the Northern, Eremaean and South-west Bioregions of WA, although it is concentrated in the South-west.	 Florabase (2011)

(Hussey *et al.* 1997; Western Australian Herbarium 1998-2012; The Royal Botanic Gardens and Domain Trust 1999-2012)



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FMG Fortescue The New Force in Iron Ore

Locations of Invasive Species in the North Star Survey Area

Figure: 5.3
Project ID: 1321

Drawn: RT
Date: 16/12/2011

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

Unique Map ID: RT040

A4

NS-AS-EN-0001

5.4 SURVEY LIMITATIONS AND CONSTRAINTS

According to the EPA Guidance Statement (No. 51) for 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 5.8.

Table 5.8 – 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 also broad scale regional information on vegetation communities based on land systems. Information at a local context is more limited due to the relatively low number of accessible, detailed surveys in the vicinity. The survey of the FMG Main Line (Biota, 2004) provides data at a comparable scale for vegetation present in the west of the Study Area.
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. The survey scope was prepared in consultation with the relevant government agencies.
Proportion of flora collected and identified (based on sampling, timing and intensity)	Nil	Species accumulation curve analysis suggests that between 89-96% of the taxa expected to be present were recorded. Survey timing was considered optimal, rainfall experienced prior to Phase 1 (April-May) was above average and a high proportion of plants were flowering.
Completeness and further work which might be needed *(e.g.* was the relevant area fully surveyed)	Minimal	The quadrat density of 1 quadrat per 1.28 km^2 is considered adequate, with a relatively even coverage throughout the Study Area. Ideally a larger number of quadrats would be surveyed within Vegetation Unit *FpAtCo* (escarpment springs) for which only 2 quadrats were surveyed, however access to this landform is difficult due to the steep topography. The distribution of quadrats is consistent with Guidance Statement 51 which stipulates a minimum of two sites per vegetation unit. Further information regarding the regional distribution of the Priority taxon *Pityrodia* sp. Marble Bar (G. Woodman & D. Coultas GWDC Opp 4) is required to determine the significance of the populations present in the North Star Study Area. A regional survey is planned for 2012.
Mapping reliability	Nil	High resolution aerial imagery was available and the number and distribution of quadrats was considered adequate for definition of vegetation within the Study Area.
Timing/weather/season/cycle	Nil	A two phase survey was conducted following higher than average rainfall and a high proportion of vascular species were in flower. The number of specimens that would not be identified due to their condition was extremely low.
Disturbances *(e.g*. fire, flood, accidental human intervention)	Nil	There were no natural or man-made interventions that constrained the survey.
Intensity (in retrospect, was the intensity adequate?)	Nil	The species accumulation curve suggests that 89-96 % of species present were collected. All vegetation units were mapped were represented by at least two quadrats. Quadrats were distributed relatively evenly across the Study Area at a density of 1 quadrat per 1.28 km^2.

Aspect	Constraint	Comment
Resources	Nil	A total of 91 person-days was expended across the 4 survey periods which, given the use of a helicopter for a subset of the survey, was sufficient to provide adequate coverage.
Access problems	Minimal	A helicopter was used for a subset of the first and second phase. Due to the steepness of the topography and some limitations due to wind some areas were difficult to access even with helicopter access; however the majority of the Study Area was readily accessed.
Experience levels (*e.g*. degree of expertise in plant identification to taxon level)	Nil	The project manager has 20 years experience within the Pilbara. Other botanists engaged in survey work have between 1 and 10 years experience in biological surveys. The two taxonomists responsible for identifications both have Doctorates in botanical taxonomy and have completed identifications for multiple projects within the Pilbara.

6 DISCUSSION

The significance of the vegetation and flora of the Study Area has been assessed at four spatial 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. In particular, species listed as Threatened under the *WC Act* (1950) and TECs and Priority Ecological Communities (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 regional level. Species or habitat types that are endemic to the Chichester 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 specialised habitat type that is not common in the local area and whose disturbance or removal may lead to local extinction.

6.1 FLORA CONSERVATION SIGNIFICANCE

6.1.1 Flora of National Significance

No taxa listed under the *EPBC Act* (1999) have been recorded in the North Star Study Area.

6.1.2 Flora of State Significance

No taxa listed under *WC Act* (1950) have been recorded in the North Star Study Area.

6.1.3 Flora of Regional Significance

Eight Priority Flora taxa were recorded by *ecologia* during the current survey within the Study Area, two of which have previously been recorded within the Study Area.

Table 6.1 summarises the known distribution and abundance of these taxa from all sources, including DEC records. Of the eight taxa, *Pityrodia* sp. Marble Bar appears to be the most restricted in distribution, with only two other collections lodged at the West Australian Herbarium, located within the North Star Study Area and within 2 km of each other. This taxon is relatively abundant within the North Star Study Area, with 541 plants recorded to date from 14 loci (i.e. records separated by more than 500 metres). The records from the current survey represent a very minor south-western extension to the taxon's range and a significant increase to the known population. *Pityrodia* sp. Marble Bar appears to favour steep hill slopes and is considered likely to extend further within this habitat than current records suggest. In addition to the two records lodged at the Western Australian Herbarium, there are 15 locations from approximately 10 km to the east of the Study Area identified as "*Pityrodia* sp. Panorama" (Mattiske 2007), comprising a population in excess of 257 plants (URS 2007). This taxon is not recognised within FloraBase and to date no specimens have been

lodged, however on the basis of habitat and proximity appears likely to represent an additional population of *Pityrodia* sp. Marble Bar. The identity these plants will be investigated during the regional targeted survey.

Two other Priority taxa are restricted to the Pilbara bioregion based on current records; *Heliotropium muticum* and *Euphorbia clementii*. *Ptilotus mollis* has one record from within Karijini National Park.

Table 6.1 – Regional Distribution of Priority Flora Recorded during the Current Survey

Species	Status	Number of locations (and individuals) recorded in this study	Number of other records regionally (Florabase)	Bioregions in which Recorded	Records within Con. Estate	Recorded abundance elsewhere
Abutilon pritzelianum	P1	3 (3)	10	PIL, CAR	0	Common at some locations
Heliotropium muticum	P1	12 (20)	6	PIL	0	Rare when abundance recorded
Pityrodia sp. Marble Bar (G. Woodman & D. Coultas GWDC Opp 4)	P1	73 (541)	2 in close proximity to each other (1 inside, 1 outside Study Area)	PIL	0	Approximately 77 plants (~50 inside, ~27 outside Study Area)
Euphorbia clementii	P2	5 (6)	5	PIL	0	Common to rare where recorded
Acacia glaucocaesia	P3	1 (1)	19	PIL, GSD	0	Scarce to common
Gymnanthera cunninghamii	P3	12 (24)	13	CAR, GSD, PIL	0	Rare to common
Goodenia nuda	P4	48 (785)	At least 28	PIL, GAS	0	Common at some locations
Ptilotus mollis	P4	1 (20)	11	PIL, LSD	1	Common at some locations

As detailed in Table 5.5, the collections for 5 taxa are range extensions of more than 100 km from any collection previously lodged with the Western Australian Herbarium: *Acacia tumida* var. *tumida*, *Isotoma petraea*, *Portulaca cyclophylla*, *Scaevola browniana* subsp. *browniana* and *Schoenoplectus lateriflorus*.

6.2 VEGETATION CONSERVATION SIGNIFICANCE

6.2.1 Vegetation of National Significance

No TECs of national significance occur within 40 km of the Study Area.

6.2.2 Vegetation of State Significance

No vegetation classified as a TEC or PEC is present within 40 km the Study Area.

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 2009) and the Biodiversity Audit of Western Australia (Department of Conservation and Land Management 2003).

Table 6.2 details the extent of these units within the Study Area, State and within land managed by the Department of Environment and Conservation. It can be seen that Units 82 and 93 occur extensively and that Units 82 and 626 are relatively well represented within the conservation estate. Unit 619 (*Eucalyptus* woodland over *Acacia* mixed, isolated shrubs) is moderately scarce and poorly represented in the conservation estate. The area of each of these units within the Study Area is <1% of its total representation and therefore at this broad scale the vegetation present within the Study Area is not of conservation significance.

Table 6.2 – Representation of Shepherd Vegetation Units Within the State and Study Area

Shepherd/Beard Units		Area* in Western Australia (ha)	Conservation Reserves		Representation Within the Study Area	
No.	Beard Description		Total Area Within DEC Managed Lands** (ha)	Total Extent within Cons. Reserves (%)	Extent* (ha)	Total Extent Within Study Area (%)
82	*Eucalyptus* open woodland/ *Triodia* open hummock grassland	2,565,573	269,302	10.5	21,152	0.82
93	*Grevillea* mixed sparse shrubland	3,044,249	58,958	1.9	13,113	0.43
619	*Eucalyptus* woodland/ *Acacia* mixed isolated shrubs	119,089	236	0.2	537	0.45
626	*Acacia* sparse shrubland/ *Triodia* open hummock grassland	117,724	18,348	15.6	52	0.04

*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 also 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 assessed (Table 6.3). *Pityrodia* sp. Marble Bar appear to have a moderately high specificity to the vegetation unit *AaTw4* and to a lesser extent *SpTl*, *Tl* and *GwTe,* accounting for 49%, 14%, 12% and 11% respectively of all plants recorded. All of these vegetation units occur on rocky slopes. Similarly *Gymnanthera cunninghamii* (P3) demonstrates high specificity for the vegetation unit *GwTp* with 83% of all plants recorded in this unit, which occurs in sandy drainage channels. A high proportion of *Goodenia nuda* (P4) plants were recorded in the units *GwTp* and *ImTp* (37% and 26%) which correspond again to drainage channels and associated floodplains.

Table 6.3 – Assessment of Specificity of Priority Taxa to North Star Vegetation

Taxon	Status	Vegetation Unit	Records		Individuals	
			Count	%	Count	%
Abutilon pritzelianum	P1	*ApTp*	1	33.3	1	33.3
		GaTw	1	33.3	1	33.3
		ImTp	1	33.3	1	33.3
Heliotropium muticum	P1	*ImTp*	4	33.3	6	30.0
		AiTb	2	16.7	5	25.0
		PfTp	2	16.7	5	25.0
		ImTs	2	16.7	2	10.0
		Tp	1	8.3	1	5.0
		Tw[4]	1	8.3	1	5.0
Pityrodia sp. Marble Bar	P1	*AaTw*[4]	19	26.0	264	48.8
		SpTl	15	20.5	76	14.0
		Tl	17	23.3	67	12.4
		GwTe	12	16.4	58	10.7
		AiTb	2	2.7	42	7.8
		AaTw[3]	2	2.7	16	3.0
		ApTp	1	1.4	10	1.8
		At	2	2.7	5	0.9
		AsTl	1	1.4	1	0.2
		ElApTw	1	1.4	1	0.2
		Tw[4]	1	1.4	1	0.2
Euphorbia clementii	P2	*ImTs*	2	40.0	3	50.0
		AoTb	2	40.0	2	33.3
		AaTw[2]	1	20.0	1	16.7
Acacia glaucocaesia	P3	*Tw*[4]	1	100.0	1	100.0
Gymnanthera cunninghamii	P3	*GwTp*	11	91.7	20	83.3
		EvCc	1	8.3	4	16.7
Goodenia nuda	P4	*GwTp*	19	39.6	288	36.7
		ImTp	6	12.5	207	26.4
		ChAbTp	1	2.1	100	12.7
		Tl	1	2.1	100	12.7
		PfTp	7	14.6	37	4.7
		AtEm	1	2.1	20	2.5
		EvCc	3	6.3	13	1.7
		Tw[4]	3	6.3	12	1.5
		Tp	5	10.4	6	0.8
		ApTp	1	2.1	1	0.1
		Tw[3]	1	2.1	1	0.1
Ptilotus mollis	P4	*ApTp*	1	100.0	20	100.0

6.2.3 Vegetation of Regional Significance

Broad scale mapping of the bioregion (Shepherd *et al.* 2001) suggests that the Vegetation Associations present within the Study Area are well represented elsewhere, although Unit 619 is poorly conserved. However vegetation community types defined at a higher level of resolution are likely to be less broadly distributed and less well conserved.

The vegetation units mapped in the current survey were compared to those identified in the survey of the FMG Main Line corridor (Biota 2004a). The rail corridor survey area extended south from Port Hedland, intersecting the western edge of the North Star Study Area (Figure 6.1), then branching to Mindy Mindy and to Christmas Creek and Mt Nicholas. Ninety seven quadrats and an additional 71 quadrats from the previously completed Hope Downs corridor were used to define 122 vegetation types within the corridor. Thirty-three quadrats from the FMG survey, located within 50 km of the North Star Study Area were co-analysed with the current survey data using the multivariate software SYSTAT™ and the species by site matrix. The resultant dendrogram is presented in Appendix I. The correlation of vegetation units with some similarity to those present within the North Star Study Area is summarised in Table 6.4.

A single taxonomic adjustment was made to the data prior to running the multivariate analysis. Although present in the species list, *Triodia pungens* was not listed within any of the vegetation units described within the FMG rail corridor survey, but was recorded at multiple locations at North Star. It seems likely that there have been some differences in the determinations of these two taxonomically similar species, despite the excellent seasonal conditions in which both surveys were conducted. For this reason *Triodia epactia* and *T. pungens* were aggregated in the matrix prior to the analysis.

There were four units which correspond closely at the relatively high scale of resolution that has been applied to both vegetation maps:

- Riparian communities (*ecologia* Unit *EvCc*, Biota Units Ac1, Ac2, Ac4, Ac6, Ac7 and Ac8). These showed similarity in both dominant and associated species, but were also linked together statistically by the prevalence of the introduced species **Cenchrus ciliaris,* which is widespread in riparian communities that have been grazed. These units represent 1355 ha (3.9%) of the North Star Study Area and 2830 ha of the Hope Downs and FMG Rail Corridors respectively;
- *Acacia acradenia* shrublands over *Triodia wiseana* (ecologia Units *AaTw*[1,] *AaTw*[2] and *AaTw*[3], Biota Unit Cc12). These units are relatively common in both study areas, accounting for 5,053 ha (14.5%) of the North Star Study Area. (The area of Cc12 has not been quantified);
- *Acacia orthocarpa* shrublands over *T. wiseana* (ecologia Unit *AoTw* and Biota Unit Aps3). These units represent 213 ha (1.7%) of the North Star Study Area and 1364 ha of the Hope Downs and FMG rail corridors respectively ; and
- *Corymbia hamersleyana* open low woodland over *Acacia bivenosa* mid shrubland over *Triodia pungens* (or *T. epactia* within the FMG rail corridor) open hummock grassland (ecologia Unit *ChAbTp,* Biota Unit Cc5). These units represent 42 ha (0.12%) of the North Star Study Area. (The area of Cc5 has not been quantified).

The vegetation units at North Star were compared to those from the Panorama Copper-Zinc Project at Sulphur Springs, approximately 10 km east of the North Star Study Area (Mattiske 2007). Eight of the 18 vegetation associations described for the Panorama Project correspond to vegetation units at North Star:

- Communities of rivers and major creeks (ecologia Unit *EvCc* and Mattiske Alliances 1 and 2);
- *Acacia tumida* shrubby creeklines (ecologia Unit *At* and Mattiske Alliance 4);
- *Eucalyptus leucophloia* trees over *Acacia* spp. shrubs over *Triodia* sp. (ecologia Unit *ElApTw* and Mattiske Association 5);
- *Corymbia hamersleyana* open low woodland over *Acacia* spp. shrubland over *Triodia* spp. (ecologia Unit *ChAbTp* and Mattiske Association 6);
- *Acacia* spp. shrubland over *Triodia* spp. (ecologia Unit *AaTw*^{1} and Mattiske Association 10);
- *Acacia* spp. shrubland (ecologia Unit *AaTw*^{3} and Mattiske Association 11); and
- *Acacia inaequilatera* shrubs over *Triodia wiseana* hummock grassland (ecologia Units *Tw*^{1}, *Tw*^{2} and *Tw*^{3} and Mattiske Association 13).

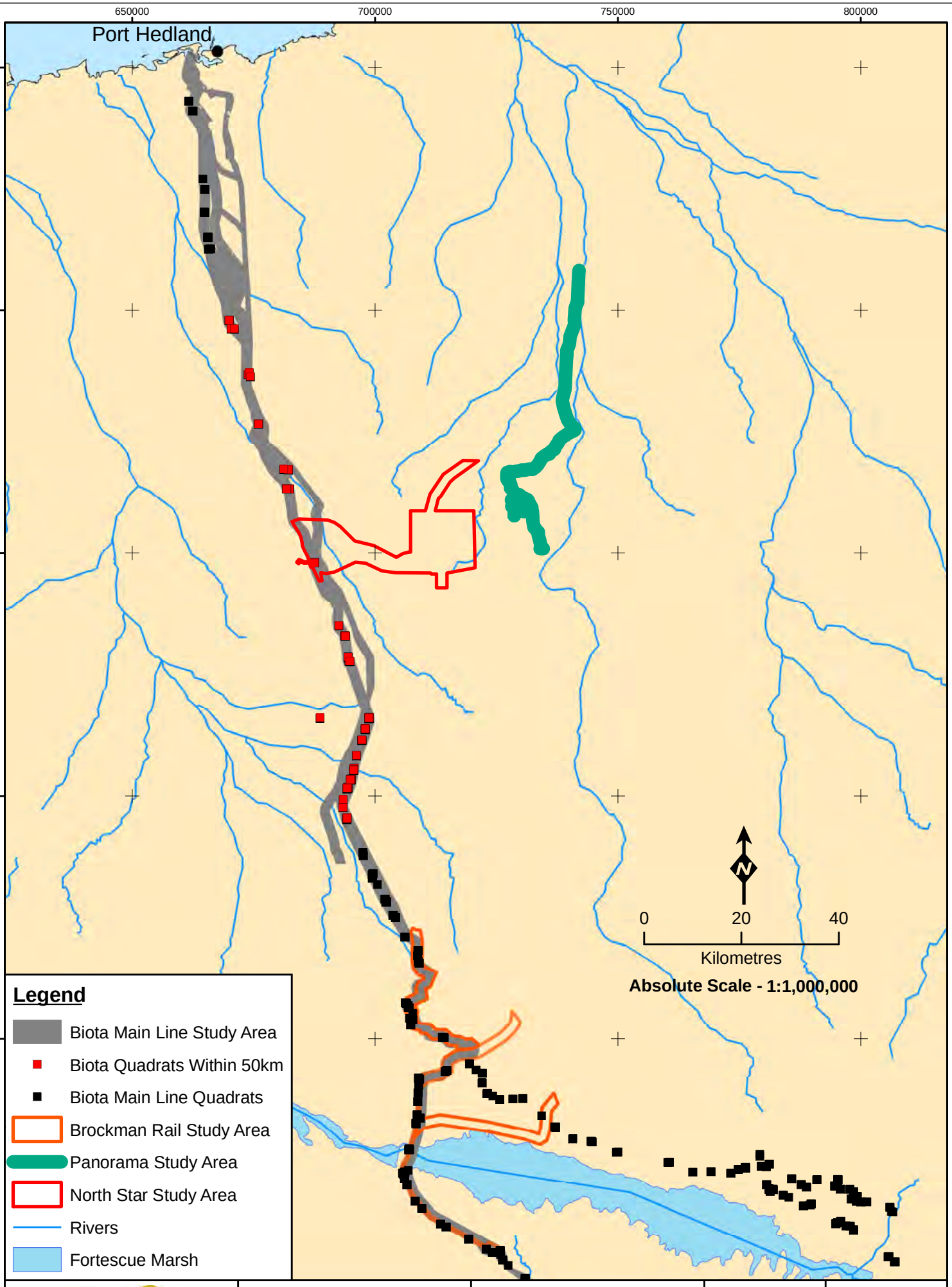
The vegetation units mapped at North Star were also compared to those units recorded during the Brockman rail corridor survey (*ecologia* 2011). This corridor largely overlaps a portion of the FMG rail corridor, running north from the Brockman Marillana mining lease for approximately 78 km, with two spur options heading east to connect to the FMG rail corridor to Christmas Creek (Figure 6.1)

There were four units which corresponded closely to the units mapped in this study (Table 6.6):

- Riparian communities (ecologia Unit *EvCc*, Brockman Units R7 and R8 representing 1355 ha (3.9%) of the North Star Study Area and 251 ha (3.2%) of the Brockman Rail Corridor respectively;
- *Acacia tumida, Grevillea wickhamii* and *Indigofera monophylla* shrubland (ecologia Units *At*, Brockman Unit R3). These units account for 444 ha (1.27%) of the North Star Study Area and 299 ha (3.79% of the Brockman Rail Corridor respectively;
- *Corymbia hamersleyana* open low woodland over *Acacia bivenosa* mid shrubland over *Triodia pungens* open hummock grassland (ecologia Unit *ChAbTp,* Brockman Units H2 and H3). These units represent 42 ha (0.12%) of the North Star Study Area and 794 ha (10.08%) of the Brockman Rail Corridor respectively; and
- *Eucalyptus leucophloia* isolated low trees over *Acacia ptychophylla* and *Grevillea wickhamii* shrubland over *Eriachne mucronata* isolated tussock grasses (ecologia Unit *ElApEm,* Brockman Unit H4). These units represent 891 ha (0.12%) of the North Star Study Area and 57 ha (0.73%) of the Brockman Rail Corridor respectively.

The relatively low level of correlation between vegetation units mapped regionally is probably a function of two factors:

- The high level of resolution of vegetation mapping of these studies; and
- The two rail corridors from which data was available for regional comparison both intersect only the western edge of the North Star Study Area, so correspondence with the eastern section is not necessarily expected, and conversely, the Vegetation of Panorama Project to the east would not be expected to correspond well with vegetation to the west of the Study Area.



ecologia ENVIRONMENT

FMG Fortescue The New Force in Iron Ore

North Star, Biota and Brockman Study Locations

Figure: 6.1
Project ID: 1321

Drawn: MM
Date: 30/1/2012

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

Unique Map ID: MM043

A4

NS-AS-EN-0001

Table 6.4 – Comparison of Vegetation Units with FMG Main Line Corridor.

Ecologia North Star Study Area				FMG & Hope Downs Corridors (Biota 2004)			
Unit	**Vegetation description (NVIS Level V)**	**Associated species**	**Area (ha)**	**Unit**	**Most similar vegetation unit**	**Associated species**	**Area (ha)**
AaTb	*Acacia acradenia*, *Petalostylis labicheoides* and *Corchorus laniflorus* sparse shrubland over *Triodia basedowii* sparse hummock grassland	*Bonamia erecta, Chrysopogon fallax, Hybanthus aurantiacus, Mollugo molluginea, Polycarpaea corymbosa, Polymeria ambigua, Ptilotus astrolasius, Sida sp. Pilbara (A.A. Mitchell PRP 1543)*	158	No equivalent unit			
AaTw[1]	*Acacia acradenia, Grevillea wickhamii* and *Acacia orthocarpa* sparse mid shrubland over *Triodia wiseana* sparse hummock grassland	*Acacia adoxa, Acacia tumida, Bulbostylis barbata, Cleome viscosa, Corchorus incanus, Cymbopogon obtectus, Cyperus hesperius, Dampiera candicans, Eriachne helmsii, Eriachne mucronata, Eucalyptus leucophloia, Goodenia stobbsiana, Gossypium robinsonii, Indigofera monophylla, Oldenlandia crouchiana, Petalostylis labicheoides, Polycarpaea holtzei, Ptilotus calostachyus, Senna glutinosa subsp. glutinosa, Solanum phlomoides, Tribulus macrocarpus, Triodia schinzii*	77	Cc12	*Acacia acradenia* open shrub over *Triodia wiseana* mid dense hummock grassland	No information available	1479
AaTw[2]	*Acacia acradenia* open mid shrubland over *Triodia wiseana* hummock grassland	*Acacia inaequilatera, Bonamia media, Corchorus laniflorus, Eriachne pulchella, Grevillea wickhamii, Hybanthus aurantiacus*	2206	Cc12	*Acacia acradenia* open shrub over *Triodia wiseana* mid dense hummock grassland	No information available	1479

Ecologia North Star Study Area				FMG & Hope Downs Corridors (Biota 2004)			
Unit	**Vegetation description (NVIS Level V)**	**Associated species**	**Area (ha)**	**Unit**	**Most similar vegetation unit**	**Associated species**	**Area (ha)**
AaTw[3]	*Acacia acradenia, Acacia tumida* and *Grevillea wickhamii open* shrubland over *Triodia wiseana* hummock grassland	*Acacia inaequilatera, Bonamia media, Corchorus parviflorus, Corymbia hamersleyana, Eriachne pulchella, Gossypium robinsonii , Indigofera monophylla, Mollugo molluginea, Oldenlandia crouchiana, Petalostylis labicheoides, Senna glutinosa subsp. glutinosa, Senna notabilis*	2770	Cc12	*Acacia acradenia* open shrub over *Triodia wiseana* mid dense hummock grassland	No information available	1479
AaTw[4]	*Acacia acradenia* and *Acacia inaequilatera* sparse mid shrubland over *Triodia wiseana* and *Triodia lanigera* hummock grassland	*Bonamia media, Eriachne pulchella, Fimbristylis simulans, Goodenia stobbsiana, Grevillea wickhamii, Mollugo molluginea, Polycarpaea holtzei, Polygala isingii, Senna glutinosa subsp. glutinosa*	4244	Cc12	*Acacia acradenia* open shrub over *Triodia wiseana* mid dense hummock grassland	No information available	1479
AiTb	*Acacia inaequilatera, Acacia acradenia* and *Grevillea wickhamii* sparse shrubland over *Triodia basedowii* and *Triodia wiseana* hummock grassland	*Acacia ancistrocarpa, Bonamia media, Corchorus laniflorus, Eriachne pulchella, Fimbristylis simulans, Goodenia stobbsiana, Mollugo molluginea, Polygala isingii, Ptilotus calostachyus, Solanum phlomoides*	1140	Apt18	*Acacia inaequilatera, A. ancistrocarpa* scattered tall shrubs over *Triodia basedowii*	*Bonamia rosea, Cajanus cinereus, Cassia glutinosa, C. notabilis, Isotropis atropurpurea, Pluchea tetranthera*	77
				Ch2	*Acacia inaequilatera, Cassia* spp. scattered tall shrubs over *Triodia wiseana* dense hummock grassland	*Corchorus lasiocarpus, Mollugo molluginis, Ptilotus calostachyus*	190
AoTb	*Acacia orthocarpa* and *Indigofera monophylla* open shrubland over *Triodia basedowii* open hummock grassland	*Bulbostylis barbata, Eriachne pulchella, Senna glutinosa subsp. glutinosa, Yakirra australiensis*	158	Ah1	*Acacia inaequilatera* scattered tall shrubs over *Triodia wiseana* hummock grassland to mid-dense hummock grassland	*Bonamia sp.* (HD94-6), *Cassia notabilis, Corymbia hamersleyana, Eriachne pulchella* subsp. *dominii, Indigofera monophylla, Mollugo molluginis, Ptilotus astrolasius*	1862

Ecologia North Star Study Area				FMG & Hope Downs Corridors (Biota 2004)			
Unit	**Vegetation description (NVIS Level V)**	**Associated species**	**Area (ha)**	**Unit**	**Most similar vegetation unit**	**Associated species**	**Area (ha)**
				Aps3	*Acacia orthocarpa* high open shrubland to high shrubland over *Triodia wiseana* mid-dense hummock grassland	Associated species: *Bonamia rosea, Cassia glutinosa, Eriachne pulchella* subsp. *dominii, Fimbristylis dichotoma, Goodenia stobbsiana, Polycarpaea holtzei, Scaevola browniana*	1364
AoTw	*Acacia orthocarpa* open tall shrubland over *Triodia wiseana* open hummock grassland	*Acacia tumida, Bonamia media, Dampiera candicans, Eriachne pulchella, Eucalyptus leucophloia, Goodenia stobbsiana, Grevillea wickhamii, Petalostylis labicheoides, Polycarpaea holtzei, Solanum phlomoides, Tephrosia spechtii*	588	Aps3	*Acacia orthocarpa* high open shrubland to high shrubland over *Triodia wiseana* mid-dense hummock grassland	*Bonamia rosea, Cassia glutinosa, Eriachne pulchella* subsp. *dominii, Fimbristylis dichotoma, Goodenia stobbsiana, Polycarpaea holtzei, Scaevola browniana.*	1364
Ap	*Acacia pyrifolia*, *Gossypium robinsonii* and *Tephrosia rosea* mid shrubland	*Acacia acradenia, Acacia bivenosa, Acacia tumida, Cajanus cinereus, Cassytha filiformis, Chrysopogon fallax, Corchorus parviflorus, Cyperus vaginatus, Eriachne helmsii, Eucalyptus victrix, Euphorbia biconvexa, Grevillea wickhamii, Hybanthus aurantiacus, Indigofera monophylla, Melaleuca glomerata, Melaleuca linophylla, Petalostylis labicheoides, Phyllanthus maderaspatensis, Polymeria ambigua, Stemodia grossa, Themeda triandra, Triodia longiceps*	316	No equivalent unit			

Ecologia North Star Study Area				FMG & Hope Downs Corridors (Biota 2004)			
Unit	**Vegetation description (NVIS Level V)**	**Associated species**	**Area (ha)**	**Unit**	**Most similar vegetation unit**	**Associated species**	**Area (ha)**
ApTp	*Acacia pyrifolia*, *Acacia acradenia* and *Tephrosia rosea* mid shrubland over *Triodia pungens* open hummock grassland	*Acacia bivenosa, Acacia tumida, Bonamia linearis, Corchorus parviflorus, Corymbia hamersleyana, Grevillea wickhamii, Hybanthus aurantiacus, Jasminum didymum, Mollugo molluginea, Petalostylis labicheoides, Polymeria ambigua, Ptilotus astrolasius, Waltheria virgata*	1011	No equivalent unit			
AsTl	*Acacia stellaticeps* sparse low shrubland over *Triodia longiceps* hummock grassland	*Acacia inaequilatera, Bulbostylis barbata, Cassytha filiformis, Corchorus laniflorus, Corymbia hamersleyana, Grevillea wickhamii, Indigofera monophylla, Mollugo molluginea, Triodia pungens*	53	Apt7	*Acacia* spp., *Pluchea ferdinandi-muelleri* scattered shrubs over *Triodia longiceps* mid-dense hummock grassland.	*Phyllanthus maderaspatensis, Pluchea tetranthera, Pterocaulum serrulatum, Salsola tragus, Trianthema triquetra, Triodia secunda.*	2591
				Apt10	*Acacia stellaticeps* scattered shrubs to low shrubland over *Triodia epactia* dense hummock grasslands	*Aristida holathera* var. *holathera, Cassia notabilis, Chrysopogon fallax, Corchorus incanus, Desmodium filiforme, Eriachne aristidea, Eucalyptus victrix, Goodenia lamprosperma, Pluchea tetranthera, Sida cardiophylla, Zornia muelleriana* subsp. *congesta*	1168
At	*Acacia tumida*, *Grevillea wickhamii* and *Indigofera monophylla* shrubland	*Acacia acradenia, Cajanus cinereus, Cleome viscosa, Corymbia hamersleyana, Cymbopogon obtectus, Cyperus hesperius, Dampiera candicans, Hybanthus aurantiacus, Petalostylis labicheoides, Senna glutinosa subsp. glutinosa, Triodia longiceps, Triodia pungens*	444	No equivalent unit			

Ecologia North Star Study Area				FMG & Hope Downs Corridors (Biota 2004)			
Unit	**Vegetation description (NVIS Level V)**	**Associated species**	**Area (ha)**	**Unit**	**Most similar vegetation unit**	**Associated species**	**Area (ha)**
AtEm	*Acacia tumida*, *Acacia orthocarpa* and *Grevillea wickhamii* open shrubland over *Eriachne mucronata* isolated tussock grasses	*Cyperus hesperius, Dampiera candicans, Eriachne ciliata, Eriachne pulchella, Goodenia stobbsiana, Indigofera monophylla, Petalostylis labicheoides, Polycarpaea holtzei, Solanum phlomoides, Triodia pungens, Triodia schinzii, Triodia wiseana*	902	No equivalent unit			
AtTw	*Acacia tumida* and *Grevillea wickhamii* open tall shrubland over *Triodia wiseana* open hummock grassland	*Eriachne mucronata, Goodenia stobbsiana, Cleome viscosa, Tephrosia rosea var. rosea, Solanum phlomoides, Polycarpaea holtzei, Cymbopogon obtectus, Hybanthus aurantiacus, Fimbristylis simulans*	80	No equivalent unit			
ChAbTp	*Corymbia hamersleyana* open low woodland over *Acacia bivenosa* mid shrubland over *Triodia pungens* open hummock grassland	*Acacia acradenia, Cenchrus ciliaris, Chrysopogon fallax, Corchorus parviflorus, Corchorus tridens, Cucumis maderaspatanus, Cyperus vaginatus, Eucalyptus victrix, Euphorbia biconvexa, Pluchea ferdinandi-muelleri, Rhynchosia minima, Sporobolus australasicus*	42	Cc5	*Corymbia hamersleyana* scattered trees over *Acacia bivenosa* high open shrubland over *Triodia epactia, T. longiceps* open hummock grassland	No information available	-
Cl	*Corchorus laniflorus, Grevillea wickhamii* and *Solanum phlomoides* sparse shrubland	*Acacia acradenia, Acacia orthocarpa, Adriana tomentosa, Bonamia media, Bonamia pannosa, Bulbostylis barbata, Cleome viscosa, Corymbia hamersleyana, Eucalyptus leucophloia, Euphorbia boophthona, Indigofera monophylla, Senna notabilis, Sida sp. Pilbara (A.A. Mitchell PRP 1543), Tephrosia spechtii, Tribulus platypterus*	156	No equivalent unit			

Ecologia North Star Study Area				FMG & Hope Downs Corridors (Biota 2004)			
Unit	**Vegetation description (NVIS Level V)**	**Associated species**	**Area (ha)**	**Unit**	**Most similar vegetation unit**	**Associated species**	**Area (ha)**
ElApEm	*Eucalyptus leucophloia* isolated low trees over *Acacia ptychophylla* and *Grevillea wickhamii* shrubland over *Eriachne mucronata* isolated tussock grasses	*Acacia adoxa, Cleome viscosa, Cymbopogon obtectus, Euphorbia australis, Indigofera monophylla, Ptilotus calostachyus, Tribulus macrocarpus, Triodia wiseana*	871	No equivalent unit			
ElApTw	*Eucalyptus leucophloia* isolated trees over *Acacia ptychophylla* sparse shrubland over *Triodia wiseana* open hummock grassland	*Acacia adoxa, Acacia inaequilatera, Dampiera candicans, Dodonaea coriacea, Fimbristylis simulans, Goodenia stobbsiana, Grevillea wickhamii, Mollugo molluginea, Polycarpaea holtzei, Sida sp. Pilbara (A.A. Mitchell PRP 1543), Solanum phlomoides*	582	No equivalent unit			
EvCc	± *Eucalyptus victrix* ± *Eucalyptus camaldulensis* open mid woodland over *Cenchrus ciliaris* tussock grassland	*Acacia bivenosa, Acacia pyrifolia, Acacia trachycarpa, Acacia tumida, Aerva javanica, Atalaya hemiglauca, Bulbostylis barbata, Chrysopogon fallax, Cleome viscosa, Cyperus vaginatus, Eucalyptus camaldulensis, Eucalyptus victrix, Euphorbia drummondii, Hybanthus aurantiacus, Indigofera monophylla, Notoleptopus decaisnei, Polycarpaea corymbosa, Polymeria ambigua, Sporobolus australasicus, Tephrosia rosea, Triodia pungens*	1355	Ac1	*Eucalyptus victrix, Melaleuca argentea* low woodland to low open woodland	*Acacia ampliceps, A. tumida, Cassia notabilis, Cenchrus ciliaris, Chrysopogon fallax, Cleome viscosa, Crotalaria cunninghamii, Euphorbia coghlanii, Ipomoea muelleri, Melaleuca glomerata, M. linophylla, Mukia maderaspatana, Pluchea rubelliflora*	558
				Ac2	*Eucalyptus camaldulensis* scattered low trees over *Melaleuca argentea* low open forest over *Melaleuca linophylla, Acacia ampliceps* high shrubland	*A. coriacea, Cyperus vaginatus, Eragrostis tenellula, Pluchea rubelliflora, Setaria verticillata, Stemodia grossa, Tinospora smilacina*	259

Ecologia North Star Study Area				FMG & Hope Downs Corridors (Biota 2004)			
Unit	**Vegetation description (NVIS Level V)**	**Associated species**	**Area (ha)**	**Unit**	**Most similar vegetation unit**	**Associated species**	**Area (ha)**
				Ac4	*Eucalyptus victrix* scattered low trees to low open woodland over *Melaleuca glomerata* high shrubland to open scrub over *Triodia epactia,* tussock grasses and patches of sedges	*Acacia pyrifolia, Atalaya hemiglauca, Cleome viscosa, Cymbopogon ambiguus, Cyperus vaginatus, Eragrostis tenellula, Eriachne tenuiculmis, Euphorbia coghlanii, Phyllanthus maderaspatensis, Stemodia grossa*	145
				Ac6	*Eucalyptus victrix* scattered trees over *Acacia coriacea* subsp. *pendens, Atalaya hemiglauca, Hakea lorea* subsp. *lorea* high open shrubland over **Cenchrus ciliaris* very open shrubland	*Cassia notabilis, Cleome viscosa, Hybanthus aurantiacus, Mukia maderaspatana, Petalostylis labicheoides*	753
				Ac7	Scoured creek bed	No species	226
				Ac8	*Eucalyptus victrix* scattered low trees over *Acacia trachycarpa* open scrub over *Triodia epactia* mid dense hummock grassland or **Cenchrus ciliaris* open to closed tussock grassland	*Acacia coriacea* subsp. *pendens, A. pyrifolia, Amaranthus pallidiflorus, Cleome viscosa, Crotalaria cunnignhamii, Euphorbia coghlanii, Euphorbia* sp.. (Site 1089), *Hybanthus aurantiacus, Phyllanthus maderaspatensis, Pluchea rubelliflora, Pterocaulon ?sphaeranthoides x sphacelatum, Ptilotus obovatus*	666

Ecologia North Star Study Area				FMG & Hope Downs Corridors (Biota 2004)			
Unit	**Vegetation description (NVIS Level V)**	**Associated species**	**Area (ha)**	**Unit**	**Most similar vegetation unit**	**Associated species**	**Area (ha)**
FpAtCo	*Ficus platypoda* open woodland over *Acacia tumida* and *Gossypium robinsonii* sparse tall shrubland over *Cymbopogon obtectus* and *Eriachne mucronata* sparse tussock grassland	*Acacia pruinocarpa, Cajanus cinereus, Cleome viscosa, Clerodendrum floribundum, Cyperus hesperius, Ehretia saligna var. saligna, Eucalyptus leucophloia, Senna glutinosa subsp. glutinosa*	14	No equivalent unit			
GaTw	*Gossypium australe* sparse mid shrubland over *Triodia wiseana* open hummock grassland	*Acacia inaequilatera, Amaranthus undulatus, Cajanus cinereus, Corchorus laniflorus, Cymbopogon obtectus, Eriachne pulchella, Gomphrena cunninghamii, Indigofera colutea, Mollugo molluginea, Tribulus platypterus, Triumfetta chaetocarpa*	28	Ar7	*Cajanus cinereus* shrubland over *Triodia epactia* hummock grassland	*Acacia ancistrocarpa, A. inaequilatera, Paraneurachne muelleri, Solanum phlomoides, Triumfetta maconochieana*	5
GwTe	*Grevillea wickhamii* sparse mid shrubland over *Triodia epactia* or *Triodia schinzii* open hummock grassland	*Acacia acradenia, Acacia bivenosa, Acacia hilliana, Bulbostylis barbata, Cassytha filiformis, Corchorus parviflorus, Cyperus hesperius, Eriachne ciliata, Fimbristylis dichotoma, Oldenlandia crouchiana, Polycarpaea holtzei, Templetonia hookeri, Trachymene oleracea, Triumfetta maconochieana*	1313	No equivalent unit			

Ecologia North Star Study Area				FMG & Hope Downs Corridors (Biota 2004)			
Unit	**Vegetation description (NVIS Level V)**	**Associated species**	**Area (ha)**	**Unit**	**Most similar vegetation unit**	**Associated species**	**Area (ha)**
GwTp	*Grevillea wickhamii* sparse tall shrubland over *Triodia pungens* open hummock grassland	*Acacia orthocarpa, Acacia stellaticeps, Bulbostylis barbata, Cassytha filiformis, Chrysopogon fallax, Cyperus squarrosus, Drosera indica, Eragrostis cumingii, Eragrostis tenellula, Eucalyptus victrix, Euphorbia boophthona, Goodenia nuda, Haloragis gossei, Lipocarpha microcephala, Oldenlandia galioides, Phyllanthus maderaspatensis, Pluchea dentex, Stemodia grossa, Stemodia viscosa, Triodia longiceps, Triumfetta chaetocarpa*	211	Ac8	*Eucalyptus victrix* scattered low trees over *Acacia trachycarpa* open scrub over *Triodia epactia* mid dense hummock grassland or **Cenchrus ciliaris* open to closed tussock grassland	*Acacia coriacea* subsp. *pendens, A. pyrifolia, Amaranthus pallidiflorus, Cleome viscosa, Crotalaria cunnignhamii, Euphorbia coghlanii, Euphorbia* sp.. (Site 1089), *Hybanthus aurantiacus, Phyllanthus maderaspatensis, Pluchea rubelliflora, Pterocaulon ?sphaeranthoides x sphacelatum, Ptilotus obovatus*	666
ImTp	*Indigofera monophylla* and *Solanum phlomoides* sparse shrubland over *Triodia pungens* and *Triodia basedowii* open hummock grassland	*Acacia stellaticeps, Bonamia linearis, Bulbostylis barbata, Cleome uncifera, Corchorus tectus, Eriachne pulchella, Fimbristylis microcarya, Goodenia microptera, Hibiscus leptocladus, Hibiscus sturtii, Mollugo molluginea, Polycarpaea corymbosa, Polycarpaea holtzei, Trianthema triquetra, Yakirra australiensis*	2557	Apt1	*Triodia epactia, T. secunda* mid-dense hummock grassland	*Bulbostylis barbarta, Eriachne sp.* Port Hedland, *Fimbristylis dichotoma, Pluchea tetranthera, Sporobolus australasius*	1269
				Aps1	*Acacia orthocarpa* high open shrubland to open scrub over *Triodia epactia* mid-dense hummock grassland	*Acacia ancistrocarpa A. bivenosa, Aristida contorta, Bonamia rosa, Bulbostylis barbata, Cassia glutinosa, Fimbristylis dichotoma, Mollugo molluginis, Tephrosia* sp. Bungaroo Creek.	1672
				Apt4	*Triodia longiceps, T. epactia* mid-dense hummock grassland	*Acacia inaequilatera, A. stellaticeps, Bulbostylis barbata, Mollugo molluginis, Polycarpaea corymbosa, Sporobolus australasicus*	2690

Ecologia North Star Study Area				FMG & Hope Downs Corridors (Biota 2004)			
Unit	**Vegetation description (NVIS Level V)**	**Associated species**	**Area (ha)**	**Unit**	**Most similar vegetation unit**	**Associated species**	**Area (ha)**
ImTs	*Indigofera monophylla* isolated low shrubs over *Triodia schinzii* open hummock grassland	*Acacia acradenia, Acacia inaequilatera, Acacia tumida, Aristida holathera, Bonamia erecta, Bonamia linearis, Bulbostylis barbata, Chrysopogon fallax, Cleome viscosa, Corchorus laniflorus, Corymbia opaca, Eragrostis eriopoda, Goodenia stobbsiana, Grevillea wickhamii, Hybanthus aurantiacus, Polycarpaea holtzei, Ptilotus astrolasius, Ptilotus fusiformis, Trianthema pilosa, Triodia basedowii, Yakirra australiensis*	110	No equivalent unit			
PfTp	*Pluchea ferdinandi-muelleri* open low shrubland over *Triodia pungens* sparse hummock grassland	*Acacia stellaticeps, Cenchrus ciliaris, Chrysopogon fallax, Eragrostis cumingii, Eriachne lanata, Goodenia nuda, Sporobolus australasicus*	163	No equivalent unit			
SpTl	*Solanum phlomoides* isolated low shrubs over *Triodia lanigera* open hummock grassland	*Acacia bivenosa, Bonamia media, Bulbostylis barbata, Corchorus parviflorus, Polycarpaea holtzei, Polygala isingii, Ptilotus calostachyus*	670	No equivalent unit			
Tl	*Triodia lanigera* open hummock grassland	*Acacia inaequilatera, Acacia tumida, Bulbostylis barbata, Cleome viscosa, Corchorus laniflorus, Cymbopogon obtectus, Cyperus hesperius, Eriachne ciliata, Eriachne mucronata, Gossypium australe, Grevillea wickhamii, Indigofera monophylla*	193	Ah5a	*Acacia inaequilatera* scattered tall shrubs over *Triodia* aff. *lanigera* mid-dense hummock grassland	*Acacia ancistrocarpa, Aristida holathera* var. *holathera, Paraneurachne muelleri, Ptilotus incanus*	490

Ecologia North Star Study Area				FMG & Hope Downs Corridors (Biota 2004)			
Unit	**Vegetation description (NVIS Level V)**	**Associated species**	**Area (ha)**	**Unit**	**Most similar vegetation unit**	**Associated species**	**Area (ha)**
Tp	*Triodia pungens* open hummock grassland	*Bulbostylis barbata, Cleome viscosa , Cyperus squarrosus, Dactyloctenium radulans, Eriachne lanata, Eriachne pulchella, Hybanthus aurantiacus, Polycarpaea holtzei*	1501	Ar1	*Ficus brachypoda, Flueggea virosa* subsp. *melanthesoides, Terminalia canescens, Clerodendrum* spp. scattered shrubs over *Triodia epactia* hummock grassland and **Cenchrus ciliaris* tussock grassland	*Boerhavia coccinea, Bulbostylis burbidgeae, Cleome viscosa, Cymbopogon ambiguus, Cyperus cunninghamii* subsp. *cunninghamii, Evolvulus alsinoides* var. *villosicalyx, Paspalidium tabulatum, Abutilon* aff. *dioicum, Cajanus cinereus, Cassia venusta, Cullen stipulaceum, Hibiscus goldsworthii, Solanum horridum Tinospora smilacina, Triumfetta maconochieana*	7.8
				Ar2	*Acacia tumida* high shrubland to open scrub over *Triodia epactia* hummock grassland	**Cenchrus ciliaris, Amaranthus pallidiflorus, Cajanus cinereus, Cymbopogon ambiguus, Eragrostis cumingii, Indigofera colutea, Tinospora smilacina.*	-
				Ar3	*Tripogon loliiformis* dwarf open grassland	*Cleome viscosa, Indigofera colutea, Polycarpaea corymbosa* var. *corymbosa, Cyperus squarrosus, Fimbristylis dichotoma, Perotis rara, Schizachyrium fragile, Yakirra australiensis* var. *australiensis*	-
				Ar4	*Bulbostylis burbidgeae* sedgeland		-

Ecologia North Star Study Area				FMG & Hope Downs Corridors (Biota 2004)			
Unit	**Vegetation description (NVIS Level V)**	**Associated species**	**Area (ha)**	**Unit**	**Most similar vegetation unit**	**Associated species**	**Area (ha)**
Tw[1]	*Triodia wiseana* and *Triodia schinzii* hummock grassland	*Acacia acradenia, Acacia adoxa, Acacia inaequilatera, Acacia ptychophylla, Acacia spondylophylla, Bonamia media, Bulbostylis barbata, Corchorus laniflorus, Dampiera candicans, Eriachne mucronata, Eriachne pulchella, Grevillea wickhamii, Oldenlandia crouchiana, Petalostylis labicheoides, Polycarpaea holtzei, Polygala isingii, Senna glutinosa subsp. glutinosa, Solanum phlomoides, Tribulus suberosus*	195	No equivalent unit			
Tw[2]	*Triodia wiseana* open hummock grassland	*Acacia inaequilatera, Bonamia media, Bulbostylis barbata, Eriachne pulchella, Fimbristylis simulans, Goodenia stobbsiana, Grevillea wickhamii, Mollugo molluginea, Oldenlandia crouchiana, Polycarpaea holtzei, Polygala isingii, Ptilotus calostachyus, Triodia basedowii*	1964	No equivalent unit			
Tw[3]	*Triodia wiseana* and *Triodia basedowii* hummock grassland	*Cassytha filiformis, Corchorus laniflorus, Corymbia hamersleyana, Goodenia stobbsiana, Hakea chordophylla, Hibiscus sturtii, Hybanthus aurantiacus, Petalostylis labicheoides*	4236	No equivalent unit			

Ecologia North Star Study Area				FMG & Hope Downs Corridors (Biota 2004)			
Unit	**Vegetation description (NVIS Level V)**	**Associated species**	**Area (ha)**	**Unit**	**Most similar vegetation unit**	**Associated species**	**Area (ha)**
Tw[4]	*Triodia wiseana* hummock grassland	*Acacia acradenia, Acacia bivenosa, Acacia inaequilatera, Acacia stellaticeps, Acacia synchronicia, Acacia tumida, Bulbostylis barbata, Corchorus laniflorus, Eriachne pulchella, Eucalyptus leucophloia, Petalostylis labicheoides, Polycarpaea holtzei, Ptilotus astrolasius, Senna glutinosa subsp. glutinosa*	4549	No equivalent unit			

Highlight indicates units for which match well.

Table 6.5 – Comparison of Vegetation Units with Panorama (Sulphur Springs) Project.

North Star Study Area				Panorama (Mattiske 2007)	
Unit	**Vegetation description (NVIS Level V)**	**Associated species**	**Area (ha)**	**Vegetation Alliance**	**Most Similar Vegetation Alliance**
EvCc	± *Eucalyptus victrix* ± *Eucalyptus camaldulensis* open mid woodland over *Cenchrus ciliaris* tussock grassland	*Acacia bivenosa, Acacia pyrifolia, Acacia trachycarpa, Acacia tumida, Aerva javanica, Atalaya hemiglauca, Bulbostylis barbata, Chrysopogon fallax, Cleome viscosa, Cyperus vaginatus, Euphorbia drummondii, Hybanthus aurantiacus, Indigofera monophylla, Notoleptopus decaisnei, Polycarpaea corymbosa, Polymeria ambigua, Sporobolus australasicus, Tephrosia rosea, Triodia pungens*	1355	1	Open forest to open woodland of *Eucalyptus camaldulensis, Melaleuca argentea* and *Eucalyptus victrix* with scattered tall shrubs of *Indigofera monophylla* over *Schoenus falcatus, Cyperus vaginatus* and *Triodia longiceps* sedgeland/grasslands in river beds.
				2	*Eucalyptus victrix* scattered trees to open woodland which may include *Melaleuca glomerata* and *Melaleuca linophylla* over open to closed scrub in creek beds and low slopes.

North Star Study Area				Panorama (Mattiske 2007)	
Unit	**Vegetation description (NVIS Level V)**	**Associated species**	**Area (ha)**	**Vegetation Alliance**	**Most Similar Vegetation Alliance**
At	*Acacia tumida*, *Grevillea wickhamii* and *Indigofera monophylla* shrubland	*Acacia acradenia, Cajanus cinereus Cleome viscosa, Corymbia hamersleyana, Cymbopogon obtectus Cyperus hesperius, Dampiera candicans, Hybanthus aurantiacus Petalostylis labicheoides, Senna glutinosa* subsp. *glutinosa, Triodia longiceps, Triodia pungens*	444	4	*Acacia tumida* high shrubland to low open forest in creeklines.
ElApTw	*Eucalyptus leucophloia* isolated trees, over *Acacia ptychophylla* sparse shrubland, over *Triodia wiseana* open hummock grassland	*Acacia adoxa, Acacia inaequilatera Dampiera candicans, Dodonaea coriacea, Fimbristylis simulans Goodenia stobbsiana, Grevillea wickhamii, Mollugo molluginea Polycarpaea holtzei, Sida* sp. Pilbara (A.A. Mitchell PRP 1543), *Solanum phlomoides*	582	5	*Eucalyptus leucophloia* scattered low trees over patches of *Acacia* shrubs over hummock grasslands of *Triodia* species, including *T. brizoides, T. wiseana* and *T. epactia* on ridge slopes.

North Star Study Area				Panorama (Mattiske 2007)	
Unit	**Vegetation description (NVIS Level V)**	**Associated species**	**Area (ha)**	**Vegetation Alliance**	**Most Similar Vegetation Alliance**
ChAbTp	*Corymbia hamersleyana* open low woodland, over *Acacia bivenosa* mid shrubland, over *Triodia pungens* open hummock grassland	*Acacia acradenia, Cenchrus ciliaris Chrysopogon fallax, Corchorus parviflorus, Corchorus tridens, Cucumis maderaspatanus, Cyperus vaginatus, Eucalyptus victrix, Euphorbia biconvexa, Pluchea ferdinandi-muelleri, Rhynchosia minima, Sporobolus australasicus*	42	6	*Corymbia hamersleyana* scattered low trees to low open woodland over tall shrubs to open shrubland of *Acacia* spp. and *Grevillea wickhamii* over hummock grasslands on creek banks, flood banks and distributing fans.
AaTw[1]	*Acacia acradenia, Grevillea wickhamii* and *Acacia orthocarpa* sparse mid shrubland, over *Triodia wiseana* sparse hummock grassland	*Acacia adoxa, Acacia tumida, Bulbostylis barbata, Cleome viscosa, Corchorus incanus, Cymbopogon obtectus, Cyperus hesperius, Dampiera candicans, Eriachne helmsii, Eriachne mucronata, Eucalyptus leucophloia, Goodenia stobbsiana, Gossypium robinsonii, Indigofera monophylla, Oldenlandia crouchiana, Petalostylis labicheoides Polycarpaea holtzei, Ptilotus calostachyus, Senna glutinosa* subsp. *glutinosa, Solanum phlomoides, Tribulus macrocarpus, Triodia schinzii*	77	10	Shrubland to open scrubland of *Acacia* species including *A. tumida, A. acradenia* and *A. orthocarpa* over hummock grasslands on upper and steep slopes.

North Star Study Area				Panorama (Mattiske 2007)	
Unit	**Vegetation description (NVIS Level V)**	**Associated species**	**Area (ha)**	**Vegetation Alliance**	**Most Similar Vegetation Alliance**
AaTw[3]	*Acacia acradenia, Acacia tumida* and *Grevillea wickhamii open* shrubland, over *Triodia wiseana* hummock grassland	*Acacia inaequilatera, Bonamia media, Corchorus parviflorus, Corymbia hamersleyana, Eriachne pulchella, Gossypium robinsonii, Indigofera monophylla, Indigofera monophylla Mollugo molluginea, Oldenlandia crouchiana, Petalostylis labicheoides, Senna glutinosa* subsp. *glutinosa, Senna notabilis*	2770	11	Shrubland to closed scrubland of *Acacia* species, including *A. acradenia, A. pyrifolia* and *A. tumida* along small creeklines and on the adjacent parts of valley floors and distributing fans.
Tw[1]	*Triodia wiseana* and *Triodia schinzii* hummock grassland	*Acacia acradenia, Acacia adoxa, Acacia inaequilatera, Acacia ptychophylla, Acacia spondylophylla, Bonamia media, Bulbostylis barbata Corchorus laniflorus, Dampiera candicans, Eriachne mucronata Eriachne pulchella, Grevillea wickhamii, Oldenlandia crouchiana, Petalostylis labicheoides, Polycarpaea holtzei, Polygala isingii, Senna glutinosa* subsp. *glutinosa, Solanum phlomoides, Tribulus suberosus*	195	13	*Acacia inaequilatera* scattered tall shrubs to high shrubland over *Triodia wiseana* hummock grasslands occurring mainly on gentle lower slopes.

North Star Study Area				Panorama (Mattiske 2007)	
Unit	**Vegetation description (NVIS Level V)**	**Associated species**	**Area (ha)**	**Vegetation Alliance**	**Most Similar Vegetation Alliance**
Tw[2]	*Triodia wiseana* open hummock grassland	*Acacia inaequilatera, Bonamia media, Bulbostylis barbata, Eriachne pulchella, Fimbristylis simulans, Goodenia stobbsiana, Grevillea wickhamii, Mollugo molluginea, Oldenlandia crouchiana, Polycarpaea holtzei, Polygala isingii, Ptilotus calostachyus, Triodia basedowii*	1964		
Tw[4]	*Triodia wiseana* hummock grassland	*Acacia acradenia, Acacia bivenosa, Acacia inaequilatera, Acacia stellaticeps, Acacia synchronicia, Acacia tumida, Bulbostylis barbata, Corchorus laniflorus, Eriachne pulchella, Eucalyptus leucophloia, Petalostylis labicheoides, Polycarpaea holtzei, Ptilotus astrolasius, Senna glutinosa* subsp. *glutinosa*	4549		

Table 6.6 – Comparison of Vegetation Units with Brockman Rail Corridor.

North Star Study Area				Brockman Rail Corridor (ecologia 2011)			
Unit	**Vegetation description (NVIS Level V)**	**Associated species**	**Area (ha)**	**Unit**	**Most similar vegetation unit**	**Associated species**	**Area (ha)**
EvCc	± *Eucalyptus victrix* ± *Eucalyptus camaldulensis* open mid woodland over *Cenchrus ciliaris* tussock grassland	*Acacia bivenosa, Acacia pyrifolia, Acacia trachycarpa, Acacia tumida, Aerva javanica, Atalaya hemiglauca, Bulbostylis barbata, Chrysopogon fallax, Cleome viscosa, Cyperus vaginatus, Eucalyptus camaldulensis, Eucalyptus victrix, Euphorbia drummondii, Hybanthus aurantiacus, Indigofera monophylla, Notoleptopus decaisnei, Polycarpaea corymbosa, Polymeria ambigua, Sporobolus australasicus, Tephrosia rosea, Triodia pungens*	1355	R7	*Eucalyptus victrix*, *Eucalyptus camaldulensis* subsp. *obtusa* mid to low woodland over *Acacia coriacea* subsp. *pendens* +/- *Melaleuca glomerata*, *Melaleuca linophylla*, *Acacia bivenosa*, *Acacia pyrifolia* shrubland over +/- **Cenchrus ciliaris* isolated clumps of tussock grasses over *Cyperus vaginatus* dominated open sedgeland +/- *Triodia pungens*, *Triodia melvillei* sparse hummock grassland.	*Atalaya hemiglauca, Acacia trachycarpa, Gossypium australe, Cymbopogon procerus*	201
				R8	*Eucalyptus victrix*, *Eucalyptus camaldulensis* subsp. *obtusa*, *Atalaya hemiglauca* low open woodland over *Acacia pyrifolia*, *Acacia trachycarpa*, *Melaleuca glomerata* +/- *Melaleuca linophylla* open shrubland over +/- **Cenchrus ciliaris* isolated clumps of tussock grasses over +/- *Cyperus vaginatus* sparse sedgeland over +/- *Triodia pungens*, *Triodia epactia* sparse hummock grassland.	*Cymbopogon procerus, Acacia sericophylla, Cymbopogon ambiguus, Indigofera monophylla, Euphorbia australis, Eriachne benthamii*	50

North Star Study Area				Brockman Rail Corridor (ecologia 2011)			
Unit	**Vegetation description (NVIS Level V)**	**Associated species**	**Area (ha)**	**Unit**	**Most similar vegetation unit**	**Associated species**	**Area (ha)**
At	*Acacia tumida*, *Grevillea wickhamii* and *Indigofera monophylla* shrubland	*Acacia acradenia, Cajanus cinereus, Cleome viscosa, Corymbia hamersleyana, Cymbopogon obtectus, Cyperus hesperius, Dampiera candicans, Hybanthus aurantiacus, Petalostylis labicheoides, Senna glutinosa subsp. glutinosa, Triodia longiceps, Triodia pungens*	444	R3	*Acacia tumida, Grevillea wickhamii* tall to mid shrubland over *Tephrosia rosea* var. *glabrior, Indigofera monophylla* low open shrubland over *Aristida holathera* var. *holathera, Themeda triandra* sparse tussock grassland over *Triodia pungens* sparse hummock grassland	*Acacia pyrifolia, Acacia maitlandii, Rulingia luteiflora, Gossypium robinsonii, Acacia bivenosa*	299
ChAbTp	*Corymbia hamersleyana* open low woodland over *Acacia bivenosa* mid shrubland over *Triodia pungens* open hummock grassland	*Acacia acradenia, Cenchrus ciliaris, Chrysopogon fallax, Corchorus parviflorus, Corchorus tridens, Cucumis maderaspatanus, Cyperus vaginatus, Eucalyptus victrix, Euphorbia biconvexa, Pluchea ferdinandi-muelleri, Rhynchosia minima, Sporobolus australasicus*	42	H2	*Eucalyptus leucophloia* subsp. *leucophloia*, *Corymbia hamersleyana* isolated clumps of trees over *Acacia bivenosa*, *Acacia inaequilatera* sparse shrubland over *Triodia pungens*, *Triodia epactia* hummock grassland	*Acacia ancistrocarpa, Hakea lorea subsp. lorea, Senna glutinosa* subsp. x *luerssenii*	725
				H3	*Corymbia hamersleyana* low isolated clumps of trees over /- *Acacia inaequilatera*, *Grevillea wickhamii*, *Acacia ancistrocarpa*, *Acacia dictyophleba* open shrubland over *Eriachne benthamii* sparse tussock grassland over *Triodia pungens* +/- *Triodia basedowii* open hummock grassland	*Acacia pruinocarpa, Acacia adsurgens, Cymbopogon ambiguus, Corchorus lasiocarpus Cenchrus ciliaris, Paraneurachne muelleri*	69

North Star Study Area				Brockman Rail Corridor (ecologia 2011)			
Unit	**Vegetation description (NVIS Level V)**	**Associated species**	**Area (ha)**	**Unit**	**Most similar vegetation unit**	**Associated species**	**Area (ha)**
ElApEm	*Eucalyptus leucophloia* isolated low trees over *Acacia ptychophylla* and *Grevillea wickhamii* shrubland over *Eriachne mucronata* isolated tussock grasses	*Acacia adoxa, Cleome viscosa, Cymbopogon obtectus, Euphorbia australis, Indigofera monophylla, Ptilotus calostachyus, Tribulus macrocarpus, Triodia wiseana*	871	H4	*Eucalyptus leucophloia* subsp. *leucophloia*, *Corymbia hamersleyana* low isolated clumps of trees over +/- *Grevillea wickhamii*, *Acacia inaequilatera*, *Hakea lorea* subsp. *lorea* tall sparse shrubland over +/- *Acacia hilliana*, *Acacia bivenosa* low isolated clumps of shrubs to open shrubland over +/- *Eriachne mucronata* isolated clumps of tussock grasses over *Triodia epactia* +/- *Triodia brizoides* hummock grassland	*Ptilotus calostachyus, Acacia aneura, Acacia pyrifolia, Senna glutinosa* subsp. *glutinosa*	57

6.2.4 Vegetation of Local Significance

In a local context vegetation can be considered significant if it is locally uncommon or provides habitats of local significance. The least extensive vegetation units locally are *FpAtCo* (escarpment springs) and *GaTw* (basalt dyke) which account for 0.4% and 0.8% respectively of the total area mapped. While both units are expected to extend locally beyond the boundaries of the Study Area, the *FpAtCo* in particular is likely to be restricted to very small areas and to be of particular habitat significance to local fauna and to support a number of flora which, whilst not of Priority status, have high habitat specificity and are therefore locally restricted such as *Ficus platypoda.*

Table 6.7 – Local Extent of Vegetation Units within the North Star Study Area.

Unit	Landform	Vegetation Description	Area (ha)	% Total
ElApEm	Rocky Slopes	*Eucalyptus leucophloia* isolated low trees over *Grevillea wickhamii* isolated mid shrubs over *Acacia ptychophylla* low shrubland over *Eriachne mucronata* isolated hummock grasses	871	2.50
AaTw[1]	Slope Shrubland	*Grevillea wickhamii*, *Acacia acradenia* and *Acacia orthocarpa* sparse mid shrubland over *Triodia wiseana* sparse hummock grassland over *Dampiera candicans* isolated herbs	77	0.22
AtEm	Hilltop Shrubland	*Acacia tumida* and *Grevillea wickhamii* open tall shrubland over *Acacia orthocarpa* open mid shrubland over *Eriachne mucronata* isolated tussock grasses over *Dampiera candicans* isolated herbs	902	2.59
AtTw	Ferrous Slopes	*Acacia tumida* and *Grevillea wickhamii* open tall shrubland over *Triodia wiseana* open hummock grassland	80	0.23
AoTw	Ferrous Plateaux	*Acacia orthocarpa* open tall shrubland over *Triodia wiseana* open hummock grassland and *Eriachne pulchella* isolated tussock grasses	588	1.69
Tw[1]	Plateaux Slopes	*Triodia wiseana* and *Triodia schinzii* hummock grassland and *Eriachne mucronata* isolated hummock grasses	195	0.56
ElApTw	Shrubby Plateaux	*Eucalyptus leucophloia* isolated trees over *Acacia ptychophylla* sparse shrubland over *Triodia wiseana* open hummock grassland over *Dampiera candicans* and *Polycarpaea holtzei* isolated herbs	582	1.67
Tw[2]	Spinifex slopes	*Triodia wiseana* open hummock grassland over *Bonamia media* isolated herbs	1964	5.63
Tw[3]	Calcrete Plains	*Triodia wiseana* and *Triodia basedowii* hummock grassland	4236	12.15
AaTw[1]	Calcrete Slopes	*Acacia acradenia* open mid shrubland over *Triodia wiseana* hummock grassland	2206	6.33
Tw[4]	Spinifex Hills	*Triodia wiseana* hummock grassland	4549	13.05
AaTw[3]	Slopes	*Acacia tumida* and *Grevillea wickhamii* sparse tall shrubland over *Acacia acradenia* open mid shrubland over *Triodia wiseana* hummock grassland	2770	7.95
AaTw[4]	Hill slopes	*Acacia acradenia* and *Acacia inaequilatera* sparse mid shrubland over *Triodia wiseana* and *Triodia lanigera hummock* grassland	4244	12.18
At	Shrubby Creeklines	*Acacia tumida* and *Grevillea wickhamii* tall shrubland over *Indigofera monophylla* sparse low shrubland	444	1.27
ImTs	Sandy Plains	*Indigofera monophylla* isolated low shrubs over *Triodia schinzii* open hummock grassland over *Ptilotus astrolasius* isolated herbs	110	0.32
AsTl	Low Rises	*Acacia stellaticeps* sparse low shrubland over *Triodia longiceps* hummock grassland over *Bulbostylis barbata* isolated sedges	53	0.15
Cl	Rocky Slopes	*Grevillea wickhamii* isolated tall shrubs over *Corchorus laniflorus* and *Solanum phlomoides* sparse shrubland	156	0.45

Unit	Landform	Vegetation Description	Area (ha)	% Total
AaTb	Sandy Plains	*Petalostylis labicheoides* and *Acacia acradenia* sparse mid shrubland over *Corchorus laniflorus* sparse low shrubland over *Chrysopogon fallax* sparse tussock grassland and *Triodia basedowii* sparse hummock grassland	158	0.45
AiTb	Low Rises	*Acacia inaequilatera* and *Grevillea wickhamii* sparse tall shrubland over *Acacia acradenia* sparse mid shrubland over *Triodia basedowii* and *Triodia wiseana* hummock grassland	1140	3.27
AoTb	Granite Rises	*Acacia orthocarpa* open mid shrubland over *Indigofera monophylla* sparse low shrubland over Triodia basedowii open hummock grassland	158	0.45
GwTe	Rocky Slopes	*Grevillea wickhamii* sparse mid shrubland over *Triodia epactia* or *Triodia schinzii* open hummock grassland and isolated *Eriachne ciliata* grasses and *Polycarpaea holtzei* herbs	1313	3.77
GwTp	Drainage-lines on Granite Sands	*Grevillea wickhamii* sparse tall shrubland over *Triodia pungens* open hummock grassland and isolated *Eragrostis cumingii* tussock grasses *Cyperus squarrosus* sedges and *Stemodia viscosa* herbs	211	0.61
Ap	Shrubby Creeklines	*Acacia pyrifolia*, *Gossypium robinsonii*, *Tephrosia rosea* and *Cajanus cinereus* mid shrubland	316	0.91
ApTp	Shrubby Drainage-lines and Floodplains	*Acacia pyrifolia*, *Acacia acradenia*, *Tephrosia rosea* and *Indigofera monophylla* mid shrubland, over *Triodia pungens* open hummock grassland	1011	2.90
Tl	Rocky Ridge	*Triodia lanigera* open hummock grassland, with *Cyperus hesperius* isolated sedges, *Eriachne ciliata* isolated grasses and *Cleome viscosa* isolated herbs	193	0.55
GaTw	Basalt Dyke	*Gossypium australe* sparse mid shrubland over *Triodia wiseana* open hummock grassland	28	0.08
FpAtCo	Escarpment Spring	*Ficus platypoda* open woodland over *Acacia tumida* and *Gossypium robinsonii* sparse tall shrubland over *Cymbopogon obtectus* and *Eriachne mucronata* sparse tussock grassland and *Cyperus hesperius* isolated sedges	14	0.04
ChAbTp	Low Slopes	*Corymbia hamersleyana* open low woodland over *Acacia bivenosa* mid shrubland over *Triodia pungens* open hummock grassland and **Cenchrus ciliaris* sparse tussock grassland	42	0.12
EvCc	Major Waterways	**Cenchrus ciliaris* tussock grassland	1355	3.89
PfTp	Gravely Floodplains	*Pluchea ferdinandi-muelleri* open low shrubland over *Triodia pungens* sparse hummock grassland and **Cenchrus ciliaris*, *Eriachne lanata* and *Chrysopogon fallax* open tussock grassland	163	0.47
Tp	Granite Rocks and Plains	*Triodia pungens* open hummock grassland	1501	4.31
ImTp	Granite Plains	*Indigofera monophylla* and *Solanum phlomoides* sparse open shrubland over *Triodia pungens* and *Triodia basedowii* sparse hummock grassland with *Mollugo molluginea* and *Bonamia linearis* isolated herbs	2557	7.34
SpTl	Rocky Slopes	*Solanum phlomoides* isolated low shrubs over *Triodia lanigera* open hummock grassland	670	1.92
TOTAL			34857	100.0

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

7 CONCLUSION

7.1 FLORA

Of the eight Priority Flora taxa recorded from the survey area, *Pityrodia* sp. Marble Bar has the most restricted distribution and is least well known. Previously known from only two locations, one within the North Star Study Area, the other from less than 3km to the north-east of the North Star Study Area, *Pityrodia* sp. Marble Bar may be a locally endemic species. Fifteen records identified as *Pityrodia* sp. Panorama Trudgen (cited in Mattiske 2007) from approximately seven to 13 km east of the North Star Study Area are likely to be the same taxon. The collection of voucher material from at least one of these locations, investigating the full extent around known locations and the identification of new locations of this taxon are high priority actions.

7.2 VEGETATION

The Vegetation Unit *FpAtCo* growing around escarpment springs and cascades is the most significant vegetation community identified in the North Star Study Area. It is the least extensive of all vegetation communities mapped in the North Star Study Area, being restricted to small patches where water cascades over escarpments from areas higher in the landscape. This combination of relatively high levels of moisture and a sheltered site provide conditions rarely found in the region. This vegetation community also represents habitat suitable for conservation significant fauna species, such as the Pilbara Olive Python and the Northern Quoll.

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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		
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Matthew Macdonald	PhD (Botany)	Senior Botanist
Renee Tuckett	PhD (Botany)	Senior Botanist
Shadila Venkatasamy	PhD (Botany)	Botanist
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Andrew Parker	B. Sci.	Botanist
Chris Knuckey	B. Sci.	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 009453	30th April 2012
Renee Tuckett	SL 009432	30th April 2012
Shadila Venkatasamy	SL 009433	30th April 2012
Andrew Parker	SL009445	30th April 2012
Chris Knuckey	SL009560	30th April 2012
Carol Macpherson	SL009765	30th April 2012

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APPENDIX A COORDINATES OF FLORA QUADRATS

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Site	Easting	Northing	Surveyed	Phase	Resurveyed
001	683254	7656583	April	1	
002	683583	7655952	April	1	August
003	683687	7656695	April	1	
004	683812	7656012	April	1	
005	683804	7656237	April	1	August
006	683880	7656747	April	1	
008	684210	7655104	April	1	August
010	684648	7654247	April	1	August
011	684695	7654685	April	1	August
013	685028	7655381	April	1	August
014	685096	7653219	April	1	
015	685171	7653404	April	1	
017	685227	7656886	August	2	
019	685535	7651801	April	1	
020	685642	7656391	August	2	
021	685688	7655354	August	2	
022	685852	7650454	April	1	
024	686467	7655178	August	2	
025	686667	7656321	August	2	
026	686776	7648860	April	1	August
027	686892	7648671	April	1	August
028	686991	7655159	August	2	
029	687092	7648831	April	1	August
030	687098	7648719	April	1	August
031	687180	7648048	April	1	August
034	687352	7654970	August	2	
035	687811	7646548	April	1	
036	687653	7652558	August	2	
037	687958	7651716	August	2	
038	687970	7647558	April	1	August
039	687806	7650389	August	2	
040	688215	7649315	August	2	
041	688188	7656288	August	2	
042	688324	7648647	April	1	August
043	688383	7646807	April	1	August
044	688413	7648215	April	1	
045	688509	7644913	April	1	
046	688650	7647689	April	1	
047	688821	7644701	April	1	
048	688740	7648407	April	1	
050	688885	7655584	April	1	
051	690057	7651800	April	1	August
052	689249	7648278	April	1	
053	689488	7646183	August	2	
054	689484	7651127	August	2	
055	689069	7652243	August	2	
057	689834	7652844	April	1	August
058	689881	7655884	April	1	August
059	689947	7648823	April	1	August
060	689980	7655333	April	1	August
061	690289	7648929	April	1	August
062	690374	7646891	August	2	
063	690348	7653800	April	1	August
064	690472	7655849	April	1	August

Site	Easting	Northing	Surveyed	Phase	Resurveyed
065	690531	7646374	August	2	
067	691113	7656312	August	2	
068	691137	7654343	August	2	
069	691119	7648618	April	1	
070	691289	7650782	August	2	
073	691717	7647504	April	1	
074	692075	7654058	August	2	
075	692359	7655470	August	2	
076	692366	7649302	August	2	
078	692799	7654499	April	1	August
079	692834	7648674	August	2	
081	692935	7651454	August	2	
082	693322	7652065	August	2	
083	693631	7648360	August	2	
084	693610	7654317	April	1	August
085	693791	7651770	August	2	
086	693755	7648925	August	2	
087	693803	7653799	April	1	August
088	694144	7653100	April	1	
090	694318	7653165	April	1	August
091	694560	7653170	April	1	
093	696605	7648107	April	1	
094	695215	7651482	April	1	
096	695531	7649571	April	1	
097	696345	7648991	April	1	
098	696443	7648299	April	1	
099	696484	7651766	April	1	
102	697575	7648694	April	1	August
103	697988	7650366	April	1	
104	697581	7651899	April	1	
106	698334	7649000	April	1	
107	698673	7648179	April	1	
108	698797	7649485	April	1	August
109	699211	7648944	April	1	
110	699467	7648367	April	1	
111	700169	7650976	April	1	
113	700521	7648396	April	1	August
118	702545	7647463	April	1	
119	702514	7647352	April	1	August
120	702392	7649510	April	1	
122	703537	7646990	April	1	August
123	704063	7646674	April	1	
124	703819	7648332	April	1	
125	704297	7646508	April	1	
126	704166	7646903	April	1	August
127	705379	7649367	April	1	
128	705656	7648933	April	1	
129	706351	7646149	April	1	
132	707039	7646683	April	1	
133	706896	7647597	April	1	
136	708755	7646717	April	1	
138	709438	7647277	April	1	
139	709788	7648064	April	1	
140	710041	7645848	April	1	
141	710649	7648811	April	1	
142	711245	7648119	April	1	

Site	Easting	Northing	Surveyed	Phase	Resurveyed
143	711215	7646723	April	1	
144	711359	7647367	April	1	
145	711687	7651028	April	1	August
146	711900	7646541	April	1	
147	712130	7650955	April	1	August
148	712155	7649207	April	1	
149	712835	7649860	April	1	August
150	712669	7643985	April	1	
151	712653	7651094	April	1	
152	712916	7643285	April	1	
153	713594	7644720	April	1	August
154	713130	7650118	April	1	August
155	713313	7647875	April	1	August
156	713306	7649076	April	1	August
157	713435	7643451	April	1	August
158	713538	7646688	April	1	
159	713675	7645402	April	1	August
160	713972	7644309	April	1	August
161	713970	7650910	April	1	August
163	713972	7648309	April	1	
164	714602	7645307	April	1	August
165	713665	7646017	April	1	
166	714550	7644598	April	1	August
200	707644	7656765	June/July	1	
202	708299	7652013	June/July	1	
203	708433	7656480	June/July	1	September
204	708742	7655628	June/July	1	
205	709013	7652343	June/July	1	
206	709225	7651595	June/July	1	
207	709278	7650593	June/July	1	
208	709590	7655208	June/July	1	September
209	709866	7649776	June/July	1	
210	710328	7656617	June/July	1	September
211	710363	7654909	June/July	1	September
212	710393	7656398	June/July	1	September
213	710713	7654145	June/July	1	September
214	710850	7654200	June/July	1	September
215	710985	7650053	June/July	1	
216	711410	7656023	June/July	1	September
216	711427	7655960	June/July	1	September
217	711495	7653515	June/July	1	September
218	711537	7652959	June/July	1	September
219	711711	7655681	June/July	1	September
220	712253	7655352	June/July	1	September
221	712347	7652308	June/July	1	September
222	712383	7655874	June/July	1	September
223	712109	7656249	June/July	1	September
224	712541	7655001	June/July	1	September
225	712658	7651992	June/July	1	September
226	712808	7651851	June/July	1	
227	713045	7655398	June/July	1	September
228	713244	7656852	June/July	1	September
229	713308	7655643	June/July	1	September
230	713361	7652166	June/July	1	September
231	713422	7655004	June/July	1	September
232	713577	7651363	June/July	1	September

Site	Easting	Northing	Surveyed	Phase	Resurveyed
233	713922	7651228	June/July	1	September
234	714079	7655546	June/July	1	
235	714356	7650348	June/July	1	
237	714412	7648388	June/July	1	
238	714503	7655493	June/July	1	September
239	714510	7647990	June/July	1	
240	714513	7650004	June/July	1	September
244	714747	7649077	June/July	1	
246	714809	7650998	June/July	1	September
247	714837	7650183	June/July	1	
248	714813	7652295	June/July	1	
249	714898	7650747	June/July	1	September
250	715044	7654854	June/July	1	September
252	715077	7652242	June/July	1	
254	715249	7648017	June/July	1	
255	715319	7649368	June/July	1	
256	715464	7651668	June/July	1	
257	715499	7654326	June/July	1	September
258	716177	7646951	June/July	1	
259	716293	7646367	June/July	1	
260	716406	7648183	June/July	1	September
261	716617	7649520	June/July	1	
262	716676	7653522	June/July	1	September
263	716911	7649116	June/July	1	September
264	716924	7652712	June/July	1	September
265	716970	7649353	June/July	1	
266	717091	7652389	June/July	1	September
267	717293	7647826	June/July	1	
268	717028	7650578	June/July	1	
269	717387	7654115	June/July	1	September
270	717441	7651631	June/July	1	September
271	717587	7647744	June/July	1	
272	717496	7652366	June/July	1	September
273	717800	7654234	June/July	1	September
274	717852	7650190	June/July	1	
275	718285	7649528	June/July	1	
276	718708	7650273	June/July	1	
277	718609	7655476	June/July	1	September
278	718684	7657118	June/July	1	September
279	718910	7658164	June/July	1	September
280	718906	7657862	June/July	1	September
281	719164	7658056	June/July	1	September
282	724631	7665395	June/July	1	
283	725346	7666318	June/July	1	
284	726310	7666572	June/July	1	
285	726420	7667283	June/July	1	
286	726577	7667401	June/July	1	
287	726983	7665956	June/July	1	
288	728485	7666863	June/July	1	
289	729703	7666903	June/July	1	
290	731391	7667364	June/July	1	
291	732571	7667726	June/July	1	
292	733086	7667935	June/July	1	
293	733293	7668219	June/July	1	
295	712546	7655882	June/July	1	
296	719605	7668968	June/July	1	September

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APPENDIX B SITE DESCRIPTIONS PHASES 1 & 2

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APPENDIX C FLORA SPECIES RECORDED AT NORTH STAR

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APPENDIX D 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 E COORDINATES OF PRIORITY FLORA AT NORTH STAR

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APPENDIX F RARE AND PRIORITY FLORA REPORT FORMS

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APPENDIX G WEEDS 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 H LOCATION OF WEEDS RECORDED AT NORTH STAR

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APPENDIX I DENDROGRAM OF REGIONAL VEGETATION ANALYSIS

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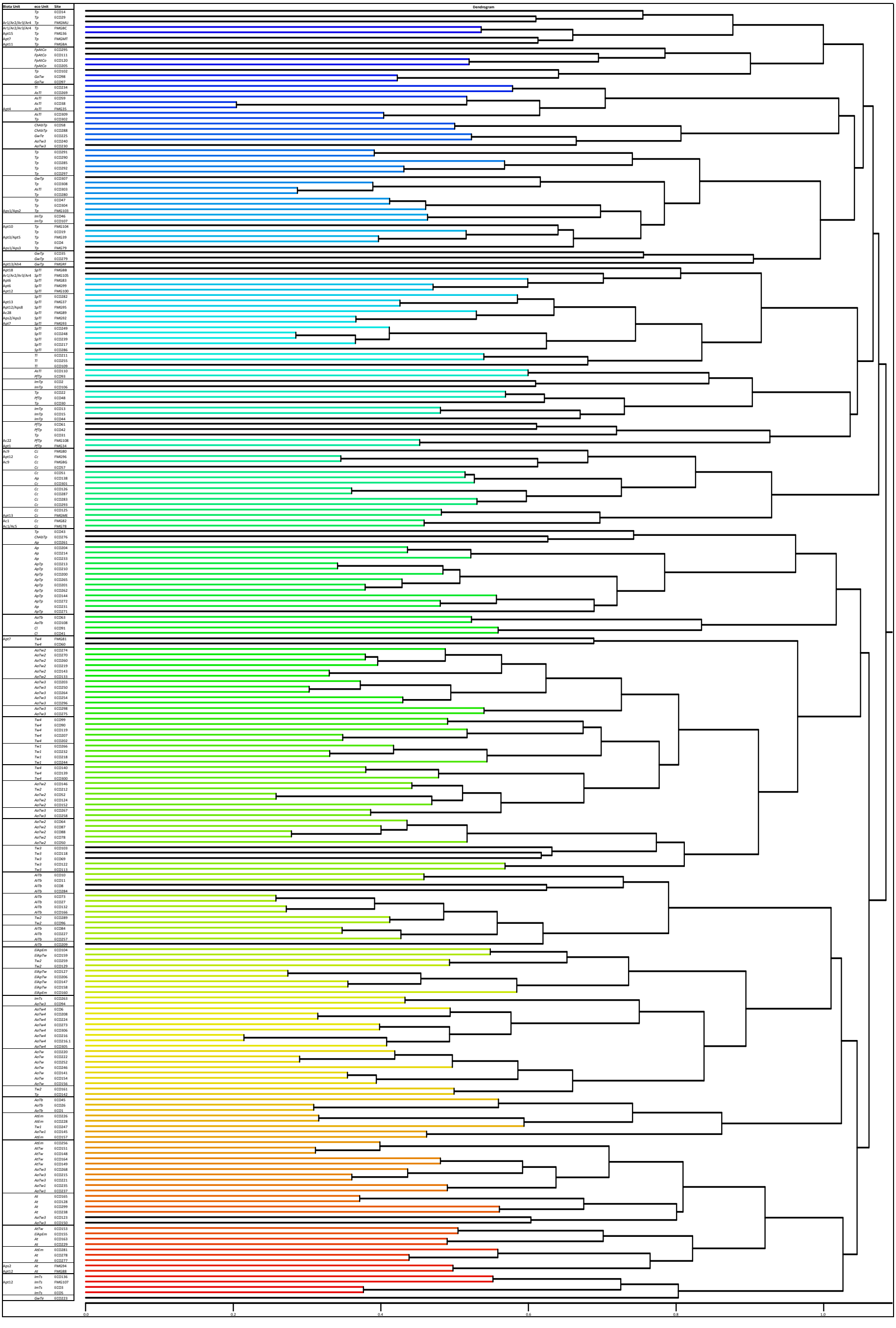
Biota Unit	eco Unit	Site
	Tp	ECO14
	Tp	ECO29
Ar1/Ar2/Ar3/Ar4	*Tp*	FMGMU
Ar1/Ar2/Ar3/Ar4	*Tp*	FMGBC
Apt15	*Tp*	FMG36
Apt7	*Tp*	FMGMT
Apt11	*Tp*	FMGBA
	FpAtCo	ECO295
	FpAtCo	ECO111
	FpAtCo	ECO120
	FpAtCo	ECO205
	Tp	ECO102
	GoTw	ECO98
	GoTw	ECO97
	Tl	ECO234
	AsTl	ECO269
	AsTl	ECO59
	AsTl	ECO38
Apt4	*AsTl*	FMG35
	AsTl	ECO309
	Tp	ECO302
	ChAbTp	ECO58
	ChAbTp	ECO288
	GwTe	ECO225
	AoTw3	ECO240
	AoTw3	ECO230
	Tp	ECO291
	Tp	ECO290
	Tp	ECO285
	Tp	ECO292
	Tp	ECO297
	GwTp	ECO307
	Tp	ECO308
	AsTl	ECO303
	Tp	ECO280
	Tp	ECO47
	Tp	ECO304
Aps1/Aps2	*Tp*	FMG103
	ImTp	ECO46
	ImTp	ECO107
Apt10	*Tp*	FMG104
	Tp	ECO19
Apt3/Apt5	*Tp*	FMG39
	Tp	ECO4
Aps1/Aps3	*Tp*	FMG79
	GwTp	ECO35
	GwTp	ECO279
Apt13/Alx4	*GwTp*	FMGRF
Apt18	*SpTl*	FMGBB
Ar1/Ar2/Ar3/Ar4	*SpTl*	FMG105
Apt6	*SpTl*	FMG83
Apt6	*SpTl*	FMG99
Apt12	*SpTl*	FMG100
	SpTl	ECO282
Apt13	*SpTl*	FMG37
Apt12/Aps8	*SpTl*	FMG95
Ac28	*SpTl*	FMG89
Aps2/Aps3	*SpTl*	FMG92
Apt7	*SpTl*	FMG93
	SpTl	ECO249
	SpTl	ECO248
	SpTl	ECO239
	SpTl	ECO217
	SpTl	ECO286
	Tl	ECO211
	Tl	ECO255
	Tl	ECO109
	AsTl	ECO110
	PfTp	ECO93
	ImTp	ECO2
	ImTp	ECO106
	Tp	ECO22
	PfTp	ECO48
	Tp	ECO30
	ImTp	ECO13
	ImTp	ECO15
	ImTp	ECO44
	PfTp	ECO61
	PfTp	ECO42
	Tp	ECO31
Ac22	*PfTp*	FMG108
Apt1	*PfTp*	FMG34
Ac9	*Cc*	FMG80
Apt12	*Cc*	FMG96
Ac9	*Cc*	FMGBG
	Cc	ECO57
	Cc	ECO51
	Ap	ECO138
	Cc	ECO301
	Cc	ECO126
	Cc	ECO287
	Cc	ECO283
	Cc	ECO293
	Cc	ECO125
Apt13	*Cc*	FMGME
Ac1	*Cc*	FMG82
Ac1/Ac5	*Cc*	FMG78
	Tp	ECO43
	ChAbTp	ECO276
	Ap	ECO261
	Ap	ECO204
	Ap	ECO214
	Ap	ECO233
	ApTp	ECO213
	ApTp	ECO210
	ApTp	ECO200
	ApTp	ECO265
	ApTp	ECO201
	ApTp	ECO262
	ApTp	ECO144
	ApTp	ECO272
	Ap	ECO231
	ApTp	ECO271
	AoTb	ECO63
	AoTb	ECO108
	Cl	ECO91
	Cl	ECO41
Apt7	*Tw4*	FMG81
	Tw4	ECO60
	AoTw2	ECO274
	AoTw2	ECO270
	AoTw2	ECO260
	AoTw2	ECO219
	AoTw2	ECO143
	AoTw2	ECO133
	AoTw3	ECO203
	AoTw3	ECO250
	AoTw3	ECO264
	AoTw3	ECO254
	AoTw3	ECO296
	AoTw3	ECO298
	AoTw3	ECO275
	Tw4	ECO99
	Tw4	ECO90
	Tw4	ECO119
	Tw4	ECO207
	Tw4	ECO202
	Tw1	ECO266
	Tw1	ECO232
	Tw1	ECO218
	Tw1	ECO244
	Tw4	ECO140
	Tw4	ECO139
	Tw4	ECO300
	AoTw2	ECO146
	Tw2	ECO212
	AoTw2	ECO52
	AoTw2	ECO124
	AoTw2	ECO152
	AoTw3	ECO267
	AoTw3	ECO258
	AoTw2	ECO64
	AoTw2	ECO87
	AoTw2	ECO88
	AoTw2	ECO78
	AoTw2	ECO50
	Tw3	ECO103
	Tw3	ECO118
	Tw3	ECO69
	Tw3	ECO122
	Tw3	ECO113
	AlTb	ECO10
	AlTb	ECO11
	AlTb	ECO8
	AlTb	ECO284
	AlTb	ECO73
	AlTb	ECO27
	AlTb	ECO132
	AlTb	ECO166
	Tw2	ECO289
	Tw2	ECO96
	AlTb	ECO84
	AlTb	ECO227
	AlTb	ECO257
	AlTb	ECO209
	ElApEm	ECO104
	ElApTw	ECO159
	Tw2	ECO259
	Tw2	ECO129
	ElApTw	ECO127
	ElApTw	ECO206
	ElApTw	ECO147
	ElApTw	ECO158
	ElApEm	ECO160
	ImTs	ECO263
	AoTw3	ECO94
	AoTw4	ECO6
	AoTw4	ECO208
	AoTw4	ECO224
	AoTw4	ECO273
	AoTw4	ECO306
	AoTw4	ECO216
	AoTw4	ECO216.1
	AoTw4	ECO305
	AoTw	ECO220
	AoTw	ECO222
	AoTw	ECO252
	AoTw	ECO246
	AoTw	ECO141
	AoTw	ECO154
	AoTw	ECO156
	Tw2	ECO161
	Tp	ECO142
	AoTb	ECO45
	AoTb	ECO26
	AoTb	ECO1
	AtEm	ECO226
	AtEm	ECO228
	Tw1	ECO247
	AoTw1	ECO145
	AtEm	ECO157
	AtEm	ECO256
	AtTw	ECO151
	AtTw	ECO148
	AtTw	ECO164
	AtTw	ECO149
	AoTw3	ECO268
	AoTw3	ECO215
	AoTw3	ECO221
	AoTw1	ECO235
	AoTw1	ECO237
	At	ECO165
	At	ECO128
	At	ECO299
	At	ECO238
	AoTw3	ECO123
	AoTw3	ECO150
	AtTw	ECO153
	ElApEm	ECO155
	At	ECO163
	At	ECO229
	AtEm	ECO281
	At	ECO278
	At	ECO277
Aps2	*At*	FMG94
Apt12	*At*	FMG88
	ImTs	ECO136
Apt12	*ImTs*	FMG107
	ImTs	ECO3
	ImTs	ECO5
	GwTe	ECO223



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APPENDIX J SPECIES X SITE MATRIX PHASE 1 QUADRATS

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APPENDIX K SPECIES X SITE MATRIX PHASE 2 QUADRATS

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