SHEFFIELD RESOURCES LTD
THUNDERBIRD DAMPIER PENINSULA PROJECT
LEVEL 1 FLORA AND FAUNA ASSESSMENT

Providing sustainable environmental strategies, management and monitoring solutions to industry and government.

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NOVEMBER 2012

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ACRONYMS

ARRP Act	*Agriculture and Related Resources Protection Act 1976*
BIF	Banded Iron Formation
BOM	Bureau of Meteorology
CALM	Department of Conservation and Land Management (now DEC)
DAFWA	Department of Agriculture and Food Western Australia
DEC	Department of Environment and Conservation
DEFL	Department of Environment and Conservation Threatened Flora Database
DSEWPaC	Department of Sustainability, Environment, Water, Population and Communities
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
IBRA	**I**nterim Biogeographic Regionalisation for Australia
NHMRC	National Health and Medical Research Council
NVIS	National Vegetation Information System
PRI	Pilbara Regional Inventory
PEC	Priority Ecological Community
SAC	Species Accumulation Curve
TEC	Threatened Ecological Community
UCL	Unallocated Crown Land
WAHERB	Western Australian Herbarium
WC Act	*Wildlife Conservation Act 1950*
WONS	Weeds of National Significance

EXECUTIVE SUMMARY

Sheffield Resources Limited (Sheffield) has commissioned *ecologia* Environment (*ecologia*) to undertake a desktop assessment, a Level 1 Survey, and Cultural Heritage Survey of its Thunderbird Project, located 70 kilometres west of Derby on the Dampier Peninsula. Sheffield seeks to gain an understanding of the flora and vertebrate fauna of the Study Area, and the environmental assessment implications of the Thuderbird Project. The Cultural Heritage Survey was completed by *ecologia* and Environmental, Heritage & Social Impact Services following the Flora and Fauna Assessment and will be provided to Sheffield in a separate report.

A single phase Level 1 flora and vertebrate fauna assessment was undertaken which combined the following methodological approaches:

- Desktop Assessment: to gather background information on the footprint or target area (i.e. search of literature, data and map-based information);
- Level 1 Survey: to enhance the level of knowledge of the flora and vegetation at the local scale and its local context or significance (if the broader scale is well known), and to ground truth the predicted fauna habitat types present in the Study Area and confirm the likelihood of occurrence for species of conservation significance; and
- Assess the proposed 2 km buffer (avoidance) zones surrounding creeklines and the temporary pool that have been recommended by the Traditional Owners.

A total of 155 flora taxa were recorded, including subspecies, varieties and hybrids. The highest species richness in the Study Area was recorded in quadrats 5 and 9. Lower species richness values were recorded in quadrats 11, 6 and 21. The sites with highest and lowest species richness were distributed across a range of vegetation types with no one vegetation unit having the highest or lowest species richness. Using Species Accumualtion Curve (SAC) analysis and extrapolation of the curve to the asymptote using Michaelis-Menten modelling, the incidence-based coverage estimator of species richness 245 (ICE Mean) and 249 (Chao 2 Mean). The 155 taxa recorded in the Study Area, represent between 60 and 67 % of the estimated flora species present. This level of survey effort may not satisfy the requirements of formal Environmental Impact Assessments, but is sufficient to meet the objectives of the current survey, primarily the requirements of the Traditional Owners. The optimal timing for flora and vegetation surveys in the Kimberley is directly following the wet season (generally March - April), which would increase the number of taxa recorded through the increased presence of annual and ephemeral taxa.

No *EPBC Act* listed flora species were recorded in the Study Area. No Threatened flora taxa were recorded in the Study Area. A database search of the DEC's Threatened (Declared Rare) Flora Database and the DEC's WAHERB Specimen Database indicates that 40 Priority Flora taxa have previously been recorded within a 50 km of the Study Area. Three Priority taxa were recorded by *ecologia* within the Study Area; *Eriachne* sp. Dampier Peninsula (P3), *Pterocaulon intermedium* (P3) and *Triodia caelestialis* (P3). Previously, *Triodia caelestialis* was only known from three records in the central and western Kimberely and on the very eastern edge of Dampierland. *Triodia caelestialis* has been recently described (2008) and is thought to occur widely in and around the Thunderbird Study Area. A regional survey for this species would assist in determining its extent in the eastern Dampier Peninsula.

The creeklines of the Thunderbird Study Area have been identified by the Traditional Owners as areas that have environmental cultural significance and a 2 km buffer surrounding each creekline has been suggested as adequate to protect these values. Multi-variate analysis of the quadrat data from this

survey did not distinguish the creeklines as separate vegetation units from the surrounding vegetation. The current drilling program is low intensity, with the drilling holes separated from each other by approximately 500-1000 m. As the soils of the Thunderbird Study Area are sand-based soils, it is thought that the drill holes will collapse following drilling and not affect the drainage of surface flow or alter the water table. To avoid disturbance to the drainage lines in the current drilling program, it is recommended that buffer (avoidance) zones of 150 m would be sufficient to prevent disturbance to the creekline vegetation composition, structure and function.

The vegetation of the ephemeral pool (EtMvSi) is dominated by *Eucalyptus tectifica* and *Melaleuca viridiflora* open woodland, over dense tussock grassland (*Sacciolepis indica*, *Sorghum plumosum*, *Fruiena ciliaris*). Many species of *Melaleuca* are known to be phreatophytic; that rely on the groundwater at least some of the year for survival. The vegetation unit EtMvSi appears to be localised to the ephemeral pool with a gradation to the vegetation unit MnMvAcEoTc (*Corymbia greeniana* and *Melaleuca nervosa* or *M. viridiflora* oopen woodland, over *Acacia colei* var. *colei* tall shrubland, over *Eriachne obtusa* tussock grassland and *Triodia caelestialis* hummock grassland) over a distance of approximately 250 m. The current drilling program maintains a buffer zone of 2 km from the temporary pool which is adequate to ensure that there is no adverse impact to this vegetation unit.

The impact to the *Melaleuca* vegetation communities (EtMvSi and MnMvAcEoTc) from the current drilling program should be minimal given the drilling program is of low intensity and the soils appear to largely be sandy and thought to collapse rapidly following drilling. The impact to the vegetation units ETMvSi and MnMvAcEoTc from an altered water table if the Thunderbird project is developed could be assessed through a seperate hydrological assessment.

The vertebrate fauna assessment, incorporating database searches and records of previous surveys from within 100 km of the Study Area, identified a total of 358 terrestrial vertebrate fauna species with potential to occur in the Study Area. This includes 33 native and 6 introduced mammal species, 232 bird species, 78 reptile species and 9 amphibian species. During the Level 1 Survey, 8 mammals (five native, three introduced), 59 birds, seven reptiles and one amphibian were recorded within the Study Area.

Results from the desktop assessment and Level 1 field survey indicate that 69 fauna species of conservation significance may potentially occur in the Study Area. Of these, one mammal and five birds have a medium to high likelihood of occurring in the Study Area.

During the current survey, three conservation significant species were recorded: Rainbow Bee-eater (EPBC Act Migratory, WC Act Schedule 3), Australian Bustard (DEC Priority 4) and Bush-stone Curlew (DEC Priority 4).

The habitat assessment revealed three main fauna habitat types within the Study Area:

- Rocky Hills;
- Pindan Plains; and,
- Savannah Woodlands.

This desktop assessment has identified that 20 flora taxa and six vertebrate fauna species of conservation significance have a medium to high likelihood of occuring within the Study Area. Further investigations to assess the impacts to these species are recommended to support future Environmental Impact Assessment of a development proposal at Thunderbird.

If the Thunderbird project is to be developed, it is recommended that Sheffield undertake;

- A single phase Level 2 Vertebrate Fauna Assessment which incorporates targeted conservation significant fauna surveys;
- A Level 2 Vegetation and Flora Assessment;
- A baseline Short-Range Endemic Fauna Assessment; and,
- A baseline Subterranean Fauna Assessment for Troglofauna and Stygofauna.

1 INTRODUCTION

1.1 PROJECT OVERVIEW

Sheffield Resources Limited (Sheffield) has commissioned *ecologia* Environment (*ecologia*) to undertake a Level 1 Flora and Fauna Survey of its Thunderbird Project, located 70 kilometres west of Derby on the Dampier Peninsula (Figure 1.1). Sheffield seeks to gain an understanding of the flora and vertebrate fauna of the Thunderbird area (Study Area) and identify the environmental assessment implications that the Project may have and address conditions 6 and 7 from the Work Program Clearance Heritage Survey Report.

1.2 LEGISLATIVE FRAMEWORK

The *Environmental Protection Act 1986* (*EP Act*) is "an Act to provide for an Environmental Protection Authority, for the prevention, control and abatement of environmental pollution, for the conservation, preservation, protection, enhancement and management of the environment and for matters incidental to or connected with the foregoing." Section 4a of this Act outlines five principles that are required to be addressed to ensure that the objectives of the Act are satisfied. Three of these principles are relevant to native fauna and flora:

- *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; and,

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

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

In addition to these principles, projects undertaken as part of the Environmental Impact Assessment (EIA) process are required to address guidelines produced by the Environmental Protection Authority (EPA), in this case Guidance Statement No. 56: *Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia* (EPA 2004b), principles outlined in EPA Position Statement No. 3: *Terrestrial Biological Surveys as an Element of Biodiversity Protection* (EPA 2002) and the *Technical Guide – Terrestrial Vertebrate Fauna Surveys for Environmental Impact Assessment* (EPA and DEC 2010).

Native flora and fauna in Western Australia that are formally recognised as rare, threatened with extinction, or as having high conservation value are protected at a federal level under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and at a state level under the *Wildlife Conservation Act 1950* (WC Act). International agreements include the Japan-Australian Migratory Bird Agreement (JAMBA) and the China-Australia Migratory Bird Agreement (CAMBA).

The *EPBC Act* was developed to provide for the protection of the environment, particularly 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 (and 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 *EPBC Act*, Section 3a of the *EPBC Act* includes a principle of ecologically sustainable development dictating that decision-making processes should effectively integrate both long-term and short-term economic, environmental, social and equitable considerations. Schedule 1 of the *EPBC Act* contains a list of species that are considered Extinct, Extinct in the Wild, Critically Endangered, Endangered, Vulnerable and Conservation Dependent. Definitions of categories relevant to fauna occurring or potentially occurring in the Study Area are provided in Appendix A.

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

In addition, the Department of Environment and Conservation (DEC) maintains a Threatened and Priority species list. Threatened flora and fauna that are listed under Schedule 1 of the WC Act are further ranked by the DEC according to their level of threat using IUCN Red List criteria. Species can be listed as Critically Endangered (CR), Endangered (EN) and Vulnerable (VU). Species that have not yet been adequately surveyed to be listed under Schedule 1 or 2 are listed as Priorities 1, 2 or 3, which are ranked in order of priority for survey and evaluation of conservation status so that consideration can be given to their declaration as Threatened species. Species that are adequately known, are rare but not threatened, or meet criteria for Near Threatened, or that have been recently removed from the threatened list for other than taxonomic reasons, are listed as Priority 4. These species require regular monitoring. Conservation Dependent species are listed as Priority 5. The three Threatened and five Priority codes are summarised in Appendix A.

Ecological communities are naturally occurring biological assemblages located in a particular type of habitat. At a national level, Threatened Ecological Communities (TECs) are protected under the *EPBC Act*. The DEC also maintains a list of TECs that are classified as being either 'Presumed Totally Destroyed', 'Critically Endangered', 'Endangered' or 'Vulnerable'. Definitions of these categories are given below. The DEC also maintains an additional list of Priority Ecological Communities (PECs), for communities that could potentially be classified as TECs, but are not currently adequately defined or surveyed. Communities are placed in this category while consideration can be given to their declaration as a TEC. The TEC and PEC codes are defined further in Appendix A.

1.3 SURVEY OBJECTIVES

Sheffield commissioned *ecologia* to undertake a desktop assessment and Level 1 Survey of the vertebrate fauna, vegetation and flora of the Thunderbird Study Area as part of an agreement with the Nyikina Mangala Native Title Claim Group (Traditional Owners). Specifically, *ecologia* was commissioned to address the following conditions from the Work Program Clearance Heritage Survey Report produced by Cox Anthropology (2012):

- **Condition 6**: Prior to the commencement of the proposed activity above, the team has instructed that a thorough flora and fauna study be conducted with advice and input from Traditional Owners; and,
- **Condition 7:** The survey team is concerned with regard to the proximity of the track-clearing and drill holes to water sources and waterways in the Study Area. The survey teams advise Sheffield Resources that they do not wish them to conduct any exploration activity involving

track clearing or drilling within two kilometers of waterways and water sources marked on government maps in the Study Area. Nor do they wish them to conduct these activities within areas that are two kilometers in proximity to water courses and water sources that are not marked on maps (e.g. a spring at E 0499665; N 8067419).

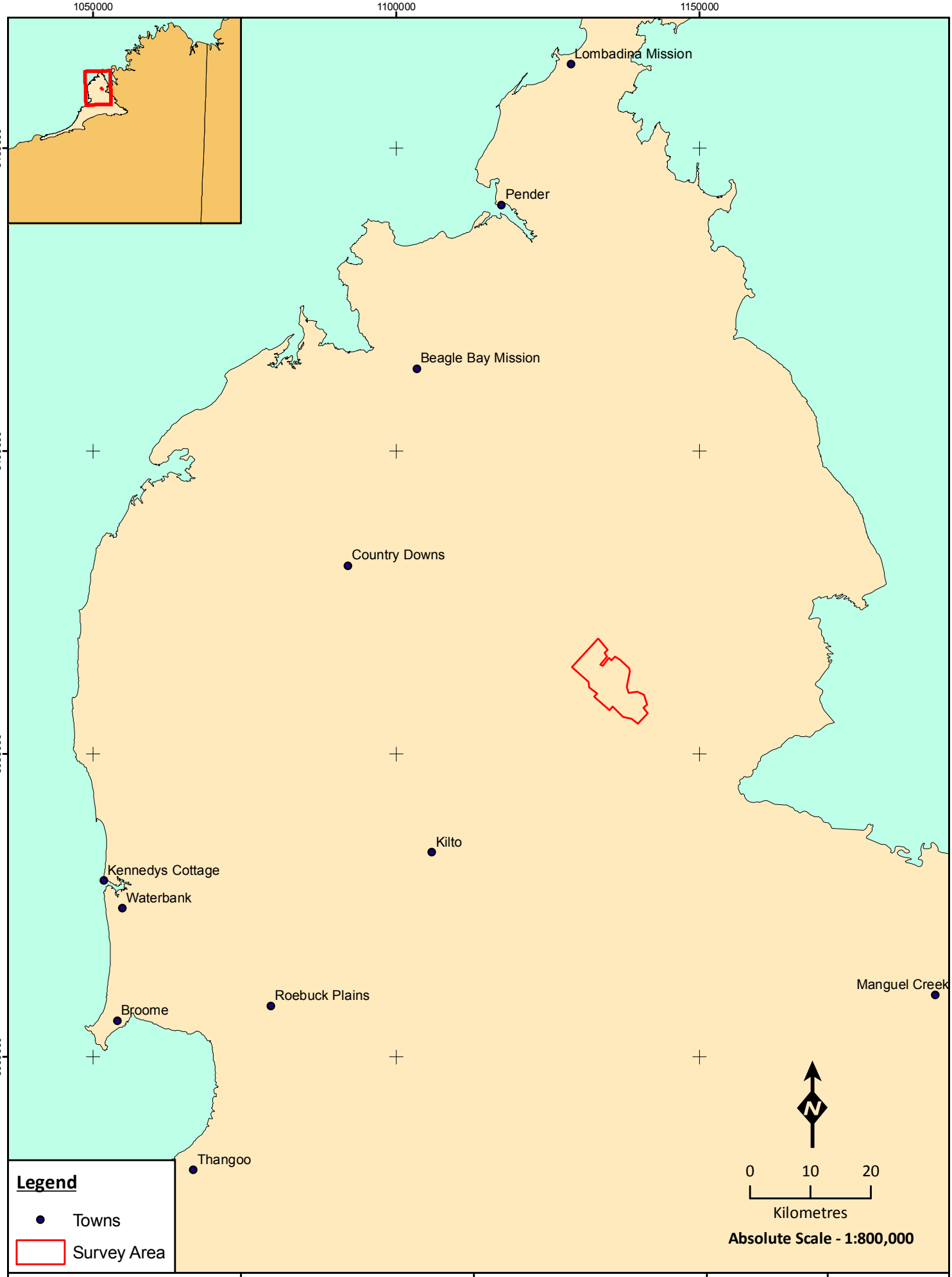
To address these conditions *ecologia* completed a Level 1 flora, vegetation and fauna assessment in line with the EPA's objectives. The EPA's objectives with regards to biological management are to:

- 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 terrestrial fauna and vegetation communities;
- Protect Threatened Flora (DRF) consistent with the provisions of the *WC Act*;
- Protect Specially Protected (Threatened) fauna, consistent with the provisions of the *WC Act*; and,
- Protect other flora species of conservation significance.

Further, the desktop assessment and Level 1 biological surveys will provide initial survey information to Sheffield to allow potential environmental issues that relate to flora and vertebrate fauna and potential impacts of the development the Study Area identified.

This survey was undertaken in a manner that complies with the requirements documented in the EPA's Guidance Statements 51 and 56, and Position Statement No. 3, thus providing:

- A review of background information, including literature and database searches;
- An inventory of species of biological and conservation significance (Flora and Fauna) recorded or likely to occur within the Study Area and surrounds;
- 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;
- An inventory of vertebrate fauna species potentially occurring in the Study Area, incorporating recent published and unpublished records;
- A map and detailed description of vegetation types occurring in the Study Area;
- A description of fauna habitats 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; and,
- A risk assessment to determine likely impacts of threatening processes on vegetation and flora within the Study Area.



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Location of Thunderbird Study Area

Figure: 1.1
Project ID: 1462

Drawn: RY
Date: 31/07/2012

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

Unique Map ID: RY111

A4

2 BIOPHYSICAL CLIMATE

2.1 CLIMATE

The Study Area is situated in the Kimberley region of WA at the south-east edge of the Dampier Peninsula. The area has a dry, hot, tropical climate with two distinct seasons: the 'wet' from around December to March, and the 'dry' for the rest of the year. Rainfall is highly variable in the region due to the inconsistent nature of the movement and occurrence of thunderstorms and tropical systems. Tropical cyclones can occur as late as April, but are most common in January and February. Rainfall during the cooler months is usually associated with cloud bands originating from tropical waters to the north-west (BoM 2011). The average temperature over summer is over 33 °C, with warm overnight minima of around 26 °C (BoM 2011). Winter temperatures are quite mild, with average maximum and minimum temperatures in July being 26.9 °C and 12.0 °C respectively (BoM 2011).

The closest Bureau of Meteorology (BoM) weather stations (with full data sets) to the Study Area is Derby Aero (BoM Station 3032) and Broome Airport (BoM Station 3003). Derby Aero is located 70 km east of the Study Area with Broome Airport located 95 km to the south-west. These stations were selected as a reference to provide the best indication of the local climatic conditions of the Study Area (Figure 2.1).

The mean annual rainfall for Broome is 607 mm, but highly variable with over 75% of the annual rainfall usually falling between January and March (BoM 2011). The mean number of rainfall days (≥1 mm) a year is only 35.1. Generally, the wettest month is February, with a mean of 179.1 mm falling over an average of 9.1 rainfall days. The hottest month is April and the coldest is July, with means of 34.3 °C and 28.8 °C respectively (Table 2.1).

The mean annual rainfall for Derby is 676.9 mm, with over 75% of the annual rainfall usually falling between January and March (BOM 2012). The mean number of rainfall days (≥1 mm) a year is 38.0. January and February are generally the wettest months of the year, with a mean of 196.3 and 199.8 mm over an average of 10.1 and 9.7 rain days resepctively. The hottest month is October and the coldest is June, with means of 37.0°C and 30.4 °C respectively (Table 2.1).

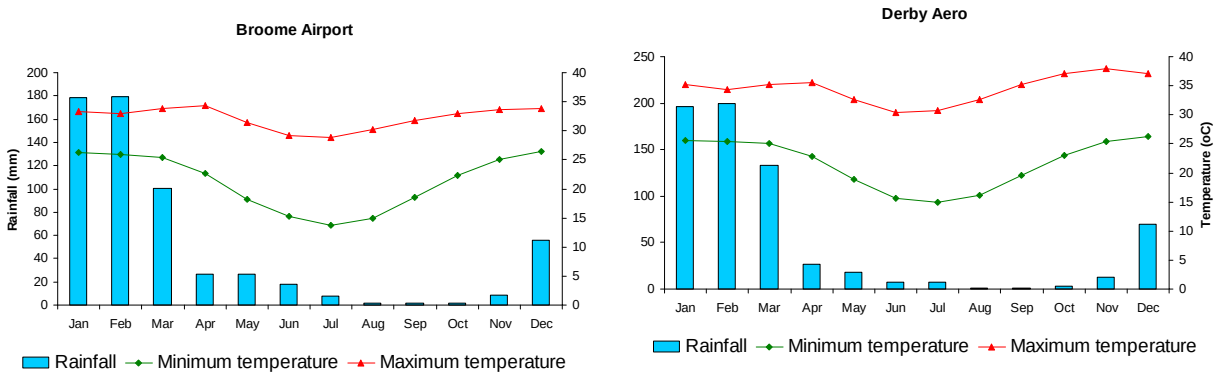


Figure 2.1 – Climate Data for Broome Airport and Derby Aero Weather Stations (BoM, 2012).

Table 2.1 – Climate Data for Broome Airport and Derby Aero Weather Station (BoM, 2012).

Broome Airport (003003)					**Commenced: 1939**					**Last record: 2012**			
Latitude: 17.95 °S					**Longitude: 122.24 °E**					**Elevation: 7m**			
Derby Aero (003032)					**Commenced: 1951**					**Last record: 2012**			
Latitude: 17.37 °S					**Longitude: 123.66 °E**					**Elevation: 6m**			
	Jan	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Annual**
Mean maximum temperature (°C)													
BME	33.3	32.9	33.9	34.3	31.5	29.1	28.8	30.3	31.8	32.9	33.6	33.8	32.3
DBY	35.2	34.3	35.2	35.5	32.7	30.4	30.7	32.6	35.2	37.0	38.0	37.1	34.5
Mean minimum temperature (°C)													
BME	26.3	26.0	25.4	22.6	18.2	15.2	13.7	14.9	18.5	22.3	25.1	26.5	21.2
DBY	25.6	25.4	25.0	22.8	18.9	15.6	14.9	16.2	19.6	23.0	25.4	26.3	21.6
Mean rainfall (mm)													
BME	178.5	179.1	100.8	26.7	26.4	17.8	7.3	1.7	1.4	1.4	8.9	56.0	602.1
DBY	196.3	199.8	132.6	26.5	18.1	7.9	7.8	0.8	1.1	2.7	13.0	69.9	676.9
Mean number of rain days													
BME	9.2	9.3	6.5	2.0	1.7	1.2	0.2	0.3	0.2	0.2	0.8	3.8	35.7
DBY	10.1	9.7	7.5	1.8	1.1	0.7	0.4	0.1	0.1	0.5	1.2	4.8	38
Mean 9am relative humidity (%)													
BME	70	74	69	56	48	47	46	45	49	54	58	64	57
DBY	71	75	69	52	42	40	38	37	43	47	51	61	52
Mean 9am wind speed (km/h)													
BME	13.8	12.9	11.4	11.7	13.9	14.3	14.3	13.9	13.9	13.9	14.2	14.5	13.6
DBY	13.1	11.8	11.2	10.9	13.7	14.6	14.0	13.0	12.9	13.0	12.7	12.7	12.8

Source: Bureau of Meteorology (August 2012)

2.2 SOILS AND GEOLOGY

The Dampier Peninsula is underlain by the Pre-Cambrian rocks of the Canning Basin. The major soil type on the Peninsula is pindan, which developed during the Quaternary period (the past two million years) on desert dune sandstone. The pindan soils form extensive undulating plains with little or no organised surface drainage. When the pindan soils dry out, they become very hard with a dusty

surface, and become soft and greasy when wet, with the potential to erode rapidly and form deep, steep-sided gullies (Kenneally *et al.* 1996).

2.3 VEGETATION

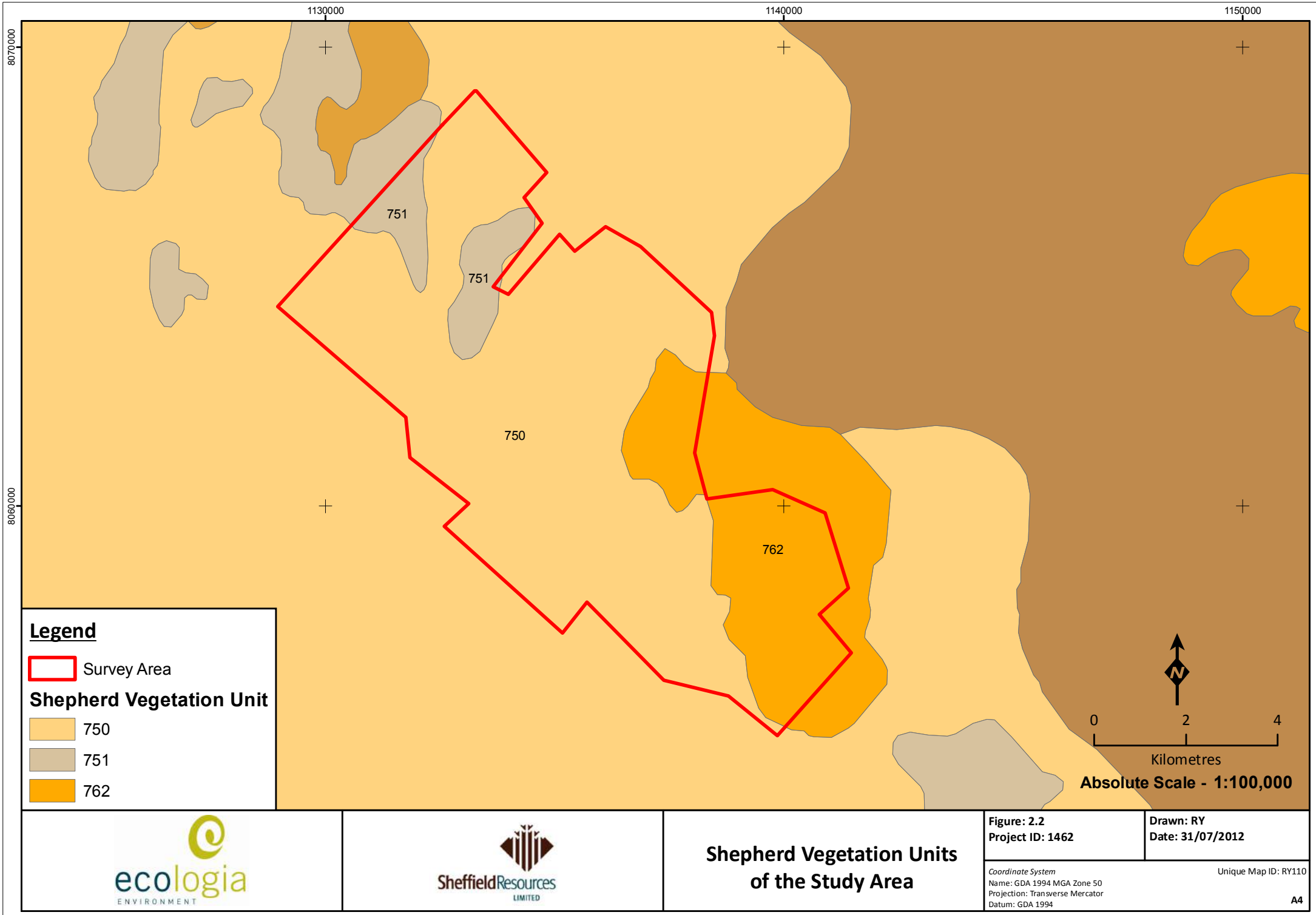
The Dampier Peninsula in which the Study Area s located lies within the Northern Botanical Province. The vegetation of Western Australia was originally mapped at the 1:1,000,000 scale by Beard (1979), and was subsequently reinterpreted and updated to reflect the National Vegetation Information System (NVIS) standards (Shepherd *et al.* 2002). Three of the vegetation types identified by Shepherd *et al.* (2002) are found within the Study Area: Vegetation Associations 750, 751 and 762. The majority of the the Study Area (76.27%) consists of vegetation type 750 (Table 2.2, Figure 2.2), which is described as Shrublands, pindan; *Acacia tumida* shrubland with grey box & cabbage gum medium woodland over ribbon grass & curly spinifex (Shepherd *et al.* 2002). The remaining area is comprised of Hummock grasslands, shrub steppe; *Acacia eriopoda* over soft spinifex (17.51 %) and Shrublands, pindan; *Acacia eriopoda* & *A. tumida* shrubland with scattered low *Eucalyptus confertifolia* over curly spinifex (6.22 %).

Table 2.2 – Representation of Broad Scale Vegetation Units within the Study Area.

Vegetation Association	Description	Total Area in the Dampierland Bio-region (ha)	Total Area in the Thunderbird Study Area (ha)	Percentage of the Thunderbird Study Area	Percentage of Vegetation Unit in Dampierland Impacted
750	Shrublands, pindan; Acacia tumida shrubland with grey box & cabbage gum medium woodland over ribbon grass & curly spinifex	1,232,039.34	5,641.91	76.27%	0.53%
751	Hummock grasslands, shrub steppe; Acacia eriopoda over soft spinifex	16,193.97	1,502.38	17.51%	9.28%
762	Shrublands, pindan; Acacia eriopoda & A. tumida shrubland with scattered low Eucalyptus confertifolia over curly spinifex	5,401.67	533.58	6.22%	9.88%

In a regional context, although over 76% of the Study Area comprises vegetation unit 750: Shrublands, pindan; *Acacia tumida* shrubland with grey box & cabbage gum medium woodland over ribbon grass & curly spinifex (Beard $e_{50,\ 51}$ Mi a_{29} Sc cp_3 Gi), this is a common and widespread vegetation unit, and represents 0.5% of the total area of the vegetation type within the Dampierland Bioregion.

Vegetation unit 751 comprises 17.5 % of the Study Area: Hummock grasslands, shrub steppe; *Acacia eriopoda* over soft spinifex (Beard a_{28} Sr t_1 Hi). This unit occurs throughout the Dampierland with 9.28 % found in the Study Area. Similarly, the remaining 6.22 % of the Study Area is comprised of vegetation unit 762: Shrublands, pindan; *Acacia eriopoda* & *A. tumida* shrubland with scattered low *Eucalyptus confertifolia* over curly spinifex (Beard e_{59} Lr $a_{28,\ 29}$ Sc p_3 Gi). This unit is less common on the Dampier Peninsula, with 9.88 % occuring within the Study Area (Figure 2.2).



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Shepherd Vegetation Units of the Study Area

Figure: 2.2
Project ID: 1462

Drawn: RY
Date: 31/07/2012

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

Unique Map ID: RY110

A4

2.4 LAND SYSTEMS

Land systems are described using the biophysical characteristic of geology, landform, vegetation and soils. The Study Area falls across four of these land systems (Figure 2.3), of which details are provided in Table 2.3 below.

Table 2.3 – Land Systems of the Study Area

Land System	Description	Total Area in Dampierland (ha)	Total Area within Thunderbird Study Area (ha)	Percentage of Land System in Thunderbird Study Area	Percentage of Land System in Dampierland Impacted
Fraser	Sand plain with irregular dunes and local stony surfaces, pindan and low grassy woodlands.	73,275	2801	36.49	3.82
Reeves	Sand plain with scattered hills and minor plateaux, reddish sandy soils, pindan.	44,794	3359	43.75	7.50
Waganut	Low lying sandplains and dune fields with through going drainage supporting pindan acacia shrublands with emergent eucalypt trees.	518,511	461	6.00	0.09
Yeeda	Sandplains with red and yellow sands supporting pindan acacia shrublands with emergent eucalypt trees.	1,653,086	1056	13.76	0.06

2.4.1 Fraser Land System

The Fraiser land system is characterised by sandplains and dunes with pindan woodlands and spinifex/tussock grasslands. Geologically, it is comprised of quanternary Aeolian sand with minor outcrops of gentle dipping Creataceous sandstone.

2.4.2 Reeves Land System

The Reeves land system is characterised by sandplaiins and scattered hills and minor plateaux, with pindan woodlands and spinifex/tussock grasslands. The geological formation is subhorizontal or gently dipping sandstone, sandy siltstone and silicified quartz sandstone of Creataceous age, with Quaternary Aeolian sand. Pindan vegetation can be subject to frequent fires, which induce short term changes in botanical composition, density and structure. The sandplains have minor susceptibility to wind erosion immediately after fire but stabilise rapidly after rain.

2.4.3 Waganut Land System

The Waganut land system is characterised by low-lying sandplains and dunefields qith through-going drainage, with pindan woodlands and spinifex/tussock grasslands. Its geological formation is made up of quaternary Aeolian sands. Vegetation is primarily dense wattle shrub with pindan pastures and is subject to fairly frequent fires, which induce short term changes in botanical composistion, density and structure.

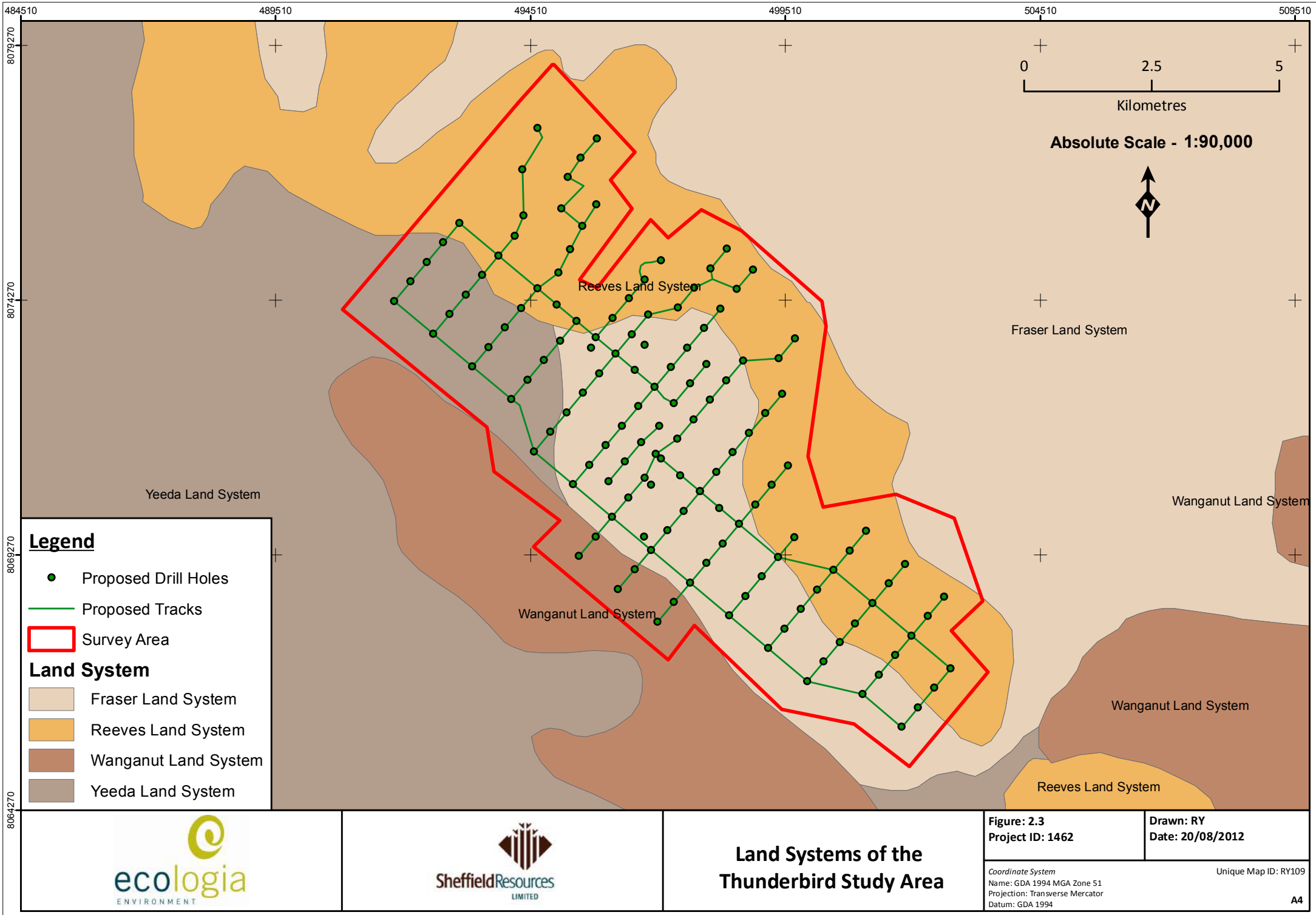
2.4.3.1 Yeeda Land System

TheYeeda land system is made up of sandplains and occasional dunes with shrubby spinifex grasslands or pindan woodlands. Geologically, it is comprised of quaternary Aeolian sands. It is generally not prone to degradation or erosion.

2.5 BIOGEOGRAPHY

The Interim Biogeographic Regionalisation for Australia (IBRA) classifies the Australian continent into regions (bioregions) of similar geology, landform, vegetation, fauna and climate characteristics (DSEWPC 2009). According to IBRA (Version 6.1), the Study Area lies within the Dampierland Bioregion. The Dampierland Bioregion is further subdivided into two subregions, these being the Fitzroy Trough (DL1) and Pindanland (DL2) subregions. The Study Area lies entirely within the Pindanland subregion of the Dampierland Bioregion (Figure 2.4).

The Pindanland subregion (Figure 2.4) covers approximately 59% of the Dampierland bioregion. This subregion consists of sandplains of a fine-textured sand-sheet with subdued dunes and includes the paleodelta of the Fitzroy River. The vegetation is described primarily as pindan (Graham 2002). The dominant land uses are grazing, unallocated crown land and crown reserves and native pastures.



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Land Systems of the Thunderbird Study Area

Figure: 2.3
Project ID: 1462

Drawn: RY
Date: 20/08/2012

Coordinate System
Name: GDA 1994 MGA Zone 51
Projection: Transverse Mercator
Datum: GDA 1994

Unique Map ID: RY109

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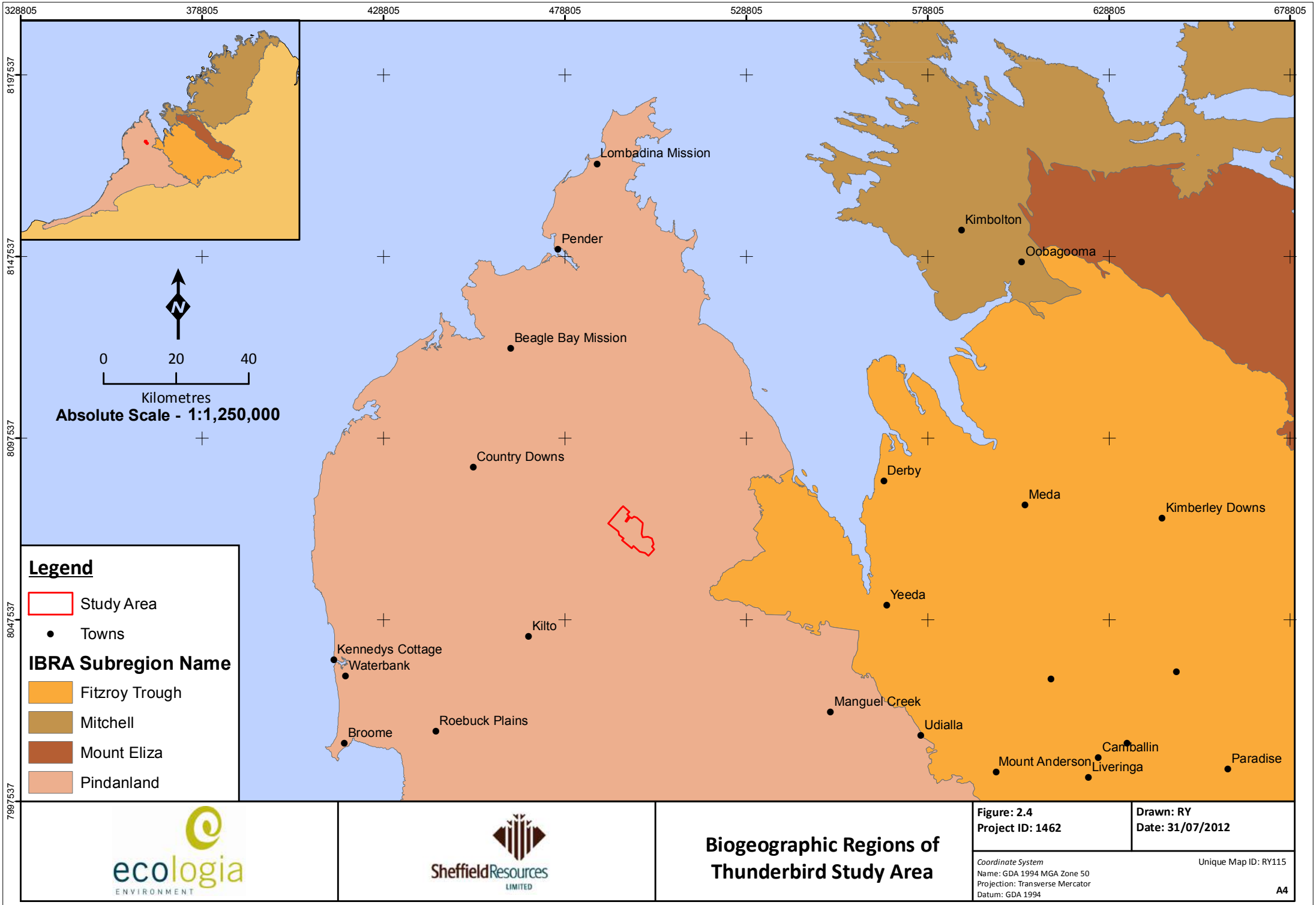

ecologia ENVIRONMENT

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Biogeographic Regions of Thunderbird Study Area

Figure: 2.4
Project ID: 1462

Drawn: RY
Date: 31/07/2012

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

Unique Map ID: RY115

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3 SURVEY METHODS

The survey methods of this survey were designed to be consistent with the recommendations of:

- Guidance Statement No. 51: Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia (EPA 2004a); and,
- EPA's Guidance Statement No. 56 (EPA 2004b), Position Statement No. 3 (EPA 2002) and *Technical Guide – Terrestrial Vertebrate Fauna Surveys for Environmental Impact Assessment* (EPA and DEC 2010).

A single phase Level 1 Survey was undertaken which combined the following methodological approaches:

- Desktop Assessment: to gather background information on the footprint or target area (i.e. search of literature, data and map-based information); and,
- Level 1 Survey: to enhance the level of knowledge of the flora and vegetation at the local scale and its local context or significance (if the broader scale is well known), and to ground truth the predicted fauna habitat types present in the Study Area and confirm the likelihood of occurrence for species of conservation significance.

3.1 LITERATURE REVIEW AND DATABASE SEARCHES

A search of government databases was undertaken to determine flora, vertebrate fauna, and vegetation communities of conservation significance previously recorded in the vicinity of the Study Area. A search with a 20 - 50 km buffer surrounding the Thunderbird Study Area was conducted on eight databases (Table 3.1).

Table 3.1 – Flora, Fauna and Ecological Community Database Searches.

Database	Search Details	Type of Search
Department of Environment and Conservation (DEC) Threatened Fauna Database	Records within 20 km of tenement E0402083	Fauna
DEC NatureMap	Records within 40 km of tenement E0402083	Flora and Fauna
Birds Australia Birdata	Records within 50 km of tenement E0402083	Fauna
Department of Sustainability, Environment, Water, Population and Community (DSEWPaC) protected matters database	Records within 50 km of tenement E0402083	Flora and Fauna
DEC Threatened (Declared Rare) Flora Database	Records within 50 km of tenement E0402083	Flora
DEC Western Australian Herbarium Specimen Database	Records within 50 km of tenement E0402083	Flora
DEC Declared Rare and Priority Flora List (Atkins)	Records within 50 km of tenement E0402083	Flora
DEC Threatened Ecological Community and Priority Ecological Community Databases	Records within 50 km of tenement E0402083	Ecologial Communities

In addition, ten publications reporting the vertebrate fauna conducted on the Dampier Peninsula were consulted (Table 3.2).

Table 3.2 – Previous Biological Survey Reports near the Study Area.

Survey Location and Author(s)	Distance to Study Area (km)	Comments
Beagle Bay Fauna Assessment (*ecologia* 2004)	44	1-phase Level 2 Survey
James Price Point Terrestrial Fauna Assessment (ecologia 2011)	83	1-phase Level 2 Survey
Perpendicular Head-North Head, Packer Island, Gourdon Bay and Coulomb-Quondong Vertebrate Fauna Assessment (ENV 2008)	72	1-phase Level 2 Survey
James Price Point Terrestrial Fauna Survey (Biota 2009)	83	1-phase Level 2 Survey
James Price Point Browse LNG Precinct Targeted Terrestrial Fauna Survey (Biota 2010)	83	1-phase Level 2 Survey
Supplementary Terrestrial Fauna and Habitat Assessment (AECOM 2010)	83	1-phase Level 1 Survey
Browse LNG Precinct Access Road: Targeted Fauna Survey – Greater Bilby (AECOM 2011)	86	Targeted Bilby survey
Monitoring Yellow Sea Migrants in Australia (MYSMA) (Rogers *et al.* 2009)	0 - 375	Targeted shorebird survey
Assessment of Birds Utilising Habitat within the Vine Thickets and Woodlands of James Price Point (Bamford 2011)	83	Targeted bird survey
Browse Project Greater Bilby Survey of the James Price Point Area - Summary Report (ENV 2011)	83	Targeted Bilby survey

3.2 CONSERVATION SIGNIFICANT SPECIES

After the results of the literature review, database searches and survey results were compiled, flora, and vertebrate fauna species that are listed under current legislative frameworks were identified. Recorded conservation significant fauna and flora taxa of the area were categorised into their conservation status under:

- *Environment Protection and Biodiversity Conservation Act 1999* (National)

Flora and fauna species are protected at a national level under the Commonwealth EPBC Act. The EPBC Act contains a list of species that are considered either 'Critically Endangered', 'Endangered', 'Vulnerable', 'Conservation Dependent', 'Extinct' or 'Extinct in the Wild' (Appendix A).

- *Wildlife Conservation Act 1950* (State)

Flora and fauna taxa protected under the *Western Australian Wildlife Conservation Notice* of the WC Act are known as Threatened taxa. This notice lists flora and fauna taxa that are extant and considered likely to become extinct or rare, defined as "taxa which have been adequately searched for and deemed to be either rare, in danger of extinction, or otherwise in need of special protection 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 A for category definitions).

- DEC Priority Flora and Fauna Lists (State)

The DEC maintains a list of Priority Flora and Fauna 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 the Threatened schedule. A Priority taxon is assigned to one of five priority categories (Atkins 2008) as defined in Appendix A.

The likelihood of a conservation significant species being present within the Study Area was determined by examining the following:

- potential fauna and flora habitats, and their condition, known to exist within the Study Area;
- distance of previously recorded locations from the Study Area;
- frequency of occurrence of records in the region; and,
- time elapsed since recorded within, or surrounding, the Study Area.

For each conservation significant species potentially occurring in the Study Area, the examined factors were collated and assigned to their corresponding category (Table 3.3).

Table 3.3 – Likelihood of Occurrence Categories.

HIGH/RECORDED	Species recorded within, or in proximity to, the Study Area within 50 years; suitable habitat occurs.
MEDIUM	Species recorded outside Study Area, but within 100 km; limited suitable habitat occurs.
LOW	Species rarely, or not, recorded within 100 km of the Study Area, and/or suitable habitat does not occur.

If a conservation significant species is located within the Study Area, the impact of disturbance to these individuals was assessed at a regional scale. All of these species are significant as they have been assigned a conservation status by the DEC, and any disturbance to populations located within the Study Area should be avoided where possible. The regional impact to each species was categorised into three levels (Table 3.4).

Table 3.4 – Regional Impact to the Conservation Significant Species.

HIGH	Disturbance to individuals will have a major regional impact as this is the only, or one of few, records within the region.
MEDIUM	There are some additional records for this species outside the Study Area within the region and the nature and scale of disturbance to these individuals would determine impact to the species at a regional scale.
LOW	The species has many records within the region and disturbance to individuals is unlikely to be regionally significant.

3.3 SURVEY TIMING

ecologia personnel assessed the Thunderbird Study Area between the 21st June and 26th June 2012.

The rainfall on the Dampier Peninsula in the six months preceeding the survey were higher than average, with Broome and Derby receiving 62.3 and 238.8 mm more than their long term average rainfall respectively. However, consistent with annual rainfall patterns, there was relatively little rainfall in the three months preceeding the survey (Table 3.5).

Table 3.5 – Rainfall received at Derby and Broome preceeding the survey.

Location		Jan	Feb	March	April	May	June	6 Month Total
Broome	2012	192.2	152.0	243.8	3.4	0.2	0	591.6
	Mean	178.5	179.1	100.8	26.7	26.4	17.8	529.3
Derby	2012	380.8	122.6	316.6	0	0	0	820
	Mean	196.3	199.8	132.6	26.5	18.1	7.9	581.2

3.4 QUADRAT SELECTION

3.4.1 Flora and Vegetation Quadrat Selection

Land system maps, aerial images, Shepherd vegetation maps, and maps provided by Sheffield with proposed drill lines and holes were reviewed and interpreted to assist in quadrat selection. Several well-established access tracks enabled most parts of the Study Area to be surveyed.

Seventeen flora quadrats were surveyed during the Level 1 assessment. The locations of these quadrats are depicted in Figure 3.1, listed in Table 3.6 and detailed in Appendix B.

Table 3.6 – Location of Flora Quadrats.

Quadrat	Location	
	Easting	Northing
TB Q 01	8074300	491807
TB Q 03	8074375	493242
TB Q 04	8074125	494332
TB Q 05	8073582	494080
TB Q 06	8073234	493955
TB Q 09	8068053	500545
TB Q 10	8067413	499677
TB Q 11	8067396	500022
TB Q 12	8067699	502523
TB Q 13	8075978	496085
TB Q 15	8075987	495950
TB Q 16	8074676	497409
TB Q 17	8068357	497314
TB Q 18	8071422	495997
TB Q 19	8071234	497776
TB Q 20	8071874	499829
TB Q 21	8073619	500192

Datum: MGA Zone 51 (GDA 94)

3.4.2 Fauna Site Selection

Previous survey information, aerial photographs, vegetation and land system maps of the Study Area were studied prior to the survey to determine the potential habitat types of the Study Area. Several sites were selected based on the potential habitats expected to occur in the Study Area. The habitats of the Study Area were confirmed and then mapped using information from on-site reconnaissance. Locations of fauna assessment sites are provided in Table 3.7, Figure 3.2 and described in Appendix E.

Table 3.7 – Location of Fauna Survey Sites.

Site	Location	
	Easting	Northing
TB OS 01	491805	8074295
TB OS 03	493234	8074381
TB OS 04	494327	8074118
TB OS 05	494448	8072731
TB OS 06	501991	8067685
TB OS 09	499829	8068232
TB OS 10	499681	8067419
TB OS 11	502522	8067699
TB OS 12	496082	8076026
TB OS 13	497451	8074696
TB OS 15	497289	8068337
TB OS 16	495995	8071421

Datum: MGA Zone 51 (GDA 94)

Figure 3.1 – Location of Flora Sites within the Study Area.

Figure 3.2 – Location of Fauna Sites within the Study Area.

3.5 SAMPLING METHODS

3.5.1 Flora sampling methods

The survey involved a combination of quadrat-based sampling and some additional opportunistic sampling from field traverses. Quadrats were utilised to determine the floristic composition within vegetation units, and the resultant species by quadrat matrix was used to conduct multivariate analysis. Both methods contributed to the delineation of small-scale vegetation communities and the floristic species inventory of the Study Area.

3.5.1.1 Floristic Quadrats

Seventeen quadrats were established over the Study Area with each quadrat equivalent to a polygon of 2,500 m^2.

The following information was recorded at each Quadrat:

1. **Location details, including GPS coordinates**: Quadrats were aligned along a north-south bearing with each corner of the quadrat recorded using a Garmin GPSmap 76Cx GDA84;
2. **Photograph of vegetation structure**: A photograph of the vegetation structure was taken from the north-west corner of the quadrat, with additional photographs taken throughout the area if needed to supplement the complexity of the quadrat;
3. **Topography, surface soil composition and colour, and surface lithology**: Information on habitats, slope, drainage lines, surface layers, soil colour, soil texture, rock type, rock size and rock abundance were recorded at each quadrat location;
4. **Structural information describing the vegetation community:** Vegetation type, life-form strata and percentage cover for each stratum were recorded using the NVIS vegetation classifications, as described in Appendix B;
5. **Height ranges and foliage canopy cover for each species recorded within the Quadrat**: Height ranges and foliage canopy cover for each species were recorded using the NVIS vegetation classifications, as described in Appendix B;
6. **Vegetation condition and the nature of disturbance:** Vegetation condition within the Study Area was assessed at each quadrat using the rankings indicated in Appendix B. Criteria considered when determining these levels were the presence of weeds, animal and vehicle tracks, litter, grazing, dust and any other ground disturbances, based on the criteria proposed by Trudgen (1988); and,
7. **The estimated time since the last fire at each quadrat.**

3.5.1.2 Opportunistic Collections

While walking between quadrats, opportunistic collections of introduced taxa and native taxa not recorded within the quadrats were made where possible to ensure a more comprehensive species inventory. The location and local percentage cover was recorded for each collection. The locations of introduced flora and notes on the boundaries of the vegetation communities were recorded to facilitate the mapping of the vegetation communities.

3.5.2 Fauna Sampling Methods

The survey was undertaken using the opportunistic sampling methods of bird surveying, hand searching for reptiles and mammals, spotlighting and recording bat calls with an Anabat system. Each of these methods is described below.

3.5.2.1 Bird Surveying

Records were made of bird species observed during the site and habitat assessments at each survey site. Opportunistic observations of birds made while travelling within the Study Area were also recorded.

3.5.2.2 Opportunistic Sightings

All vertebrate fauna species observed outside the survey sites, while searching and travelling within the Study Area were recorded. Tracks, diggings, scats, burrows and nests were recorded where possible.

3.6 ANIMAL ETHICS

Surveying was conducted as per *ecologia*'s Animal Ethics Code of Practice, which conforms to Section 5 of the *Australian code of practice for the care and use of animals for scientific purposes* (NHMRC 2004).

3.7 VEGETATION MAPPING

Vegetation mapping is the hierarchical delineation of vegetation into groups or associations. The distinctive characteristics that these groups or communities share include species dominance, stratum structure and species composition. The quadrats were analysed for similarity and grouped via a dendrogram (Appendix C). Vegetation communities identified were used to interpret aerial photography that was mapped through a series of GIS polygons.

The vegetation of the Study Area has been mapped at a scale of 1:15,000 on the basis of multivariate cluster analysis, field observation and aerial photography.

3.8 TAXONOMY AND NOMENCLATURE

3.8.1 Flora

Voucher specimens were collected from all quadrats, opportunistic collections and targeted searches, and assigned a unique code for later identification or verification. Specimens were pressed daily and subsequently dried. Identification and verification of specimens was completed by Dr Andrew Craigie and Dr Udani Sirisena with reference to specimens lodged at the Western Australian Herbarium (WAHERB). Botanical nomenclature follows the conventions currently adopted by the WAHERB (2010).

3.8.2 Fauna

Nomenclature for mammals, reptiles and amphibians follows *Western Australian Museum Checklist of the Vertebrates of Western Australia*, and for birds follows Christidis and Boles (2008). References used for fauna identification are listed in Table 3.8.

Table 3.8 – References used for Fauna Identification.

Fauna Group	Reference
Mammals	Menkhorst and Knight (2011), Van Dyck and Strahan (2008)
Bats	Churchill (1998), Menkhorst and Knight (2011)
Birds	Simpson and Day (2004)
Reptiles	Cogger (2000), Wilson and Swan (2010)
Geckos	Storr et al. (1990), Wilson and Swan (2010)
Skinks	Storr et al. (1999), Wilson and Swan (2010)
Dragons	Storr et al. (1983), Wilson and Swan (2010)
Varanids	Storr et al. (1983), Wilson and Swan (2010)
Legless Lizards	Storr et al. (1990), Wilson and Swan (2010)
Snakes	Storr et al. (2002), Wilson and Swan (2010)
Amphibians	Menkhorst and Knight (2011), Van Dyck and Strahan (2008)

3.9 SURVEY ADEQUACY AND ANALYSIS

3.9.1 Species Richness

The number of species present (species richness) is the simplest representation of species diversity (Fowler and Cohen 1990), and is a basic indicator of diversity used for this survey.

3.9.2 Randomised Species Accumulation Curves

There are three general methods of estimating species richness from sample data: extrapolating species accumulation curves (SACs), fitting parametric models of relative abundance, and using non-parametric estimators (Bunge and Fitzpatrick 1993; Colwell and Coddington 1994; Gaston 1996). In this report, the level of survey adequacy was estimated using SACs as computed by Mao Tao. In addition, a Michaelis-Menten enzyme kinetic curve was calculated. To eliminate features caused by random or periodic temporal variation, the sample order was randomised 1000 times. The estimator applied to the dataset was performed using EstimateS (version 8, Colwell 2009).

3.9.3 Vegetation Community Analysis

A quadrat by species matrix was created and formed the basis of the cluster analysis. Annual and weekly perennial species, species recorded once (unless dominant in the vegetation) and opportunistic collections beyond the boundaries of quadrats were excluded. Cluster analysis was performed using an association matrix of the Bray-Curtis coefficient. The similarity between quadrats and the similarity between the occurrences of species was analysed using the multivariate statistical programme SYSTAT™. These methods provide an objective means to classify vegetation communities based on groups with similar species composition. A dendrogram was produced to statistically delineate the floristic communities present. The dendrogram and quadrat by species matrix are provided electronically in Appendix C.

3.10 SURVEY TEAM

The vegetation and flora assessment described in this document was planned, coordinated and executed by Dr Renee Tuckett, and Dr Udani Sirisena. The vertebrate fauna assessment described

in this document was planned, coordinated and executed by Nigel Jackett and Damien Cancilla. Their qualifications are provided in Table 3.9, and licence details in Table 3.10.

Table 3.9 – Project Staff and Qualifications.

Staff Member	Position	Qualifications	Experience
Dr Renee Tuckett	Team Leader, Senior Botanist	Ph.D.	4 years
Dr Udani Sirisena	Taxonomist	Ph.D.	5 years
Damien Cancilla	Senior Zoologist	BSc (Hon)	7 years
Nigel Jackett	Level 2 Zoologist	BSc (Hon)	11 years

Table 3.10 – Relevent DEC Licence Details.

Name	Permit Type	Permit Number	Valid Until
Renee Tuckett	Flora Licence	SL009432	30/04/13
Nigel Jackett	Fauna Licence	SF008707	21/07/12

Mr Bob Bullen (Principal, Bat Call WA) identified the bat species present based on their acoustic calls recorded on Anabat devices. Mr Bullen has 16 years experience working directly with bats and has published a number of peer-reviewed journal articles on bat ecology and several other bat-related articles (see, for example, Bullen and McKenzie 2001, 2002, 2005).

3.11 SURVEY LIMITATIONS AND CONSTRAINTS

The survey limitations and constraints were analysed following the field trips. The surveys were reviewed for the following aspects:

- Scope (what faunal groups were sampled, and were some sampling methods not able to be employed because of constraints such as weather conditions);
- Sources of information (previously available information as distinct from new data);
- Competency/experience of the consultant carrying out the survey;
- The proportion of the task achieved and further work which might be needed;
- Proportion of fauna identified, recorded and/or collected;
- Proportion of flora collected and identified;
- Mapping reliability;
- Timing/weather/season/cycle;
- Intensity (in retrospect, was the intensity adequate);
- Completeness (e.g. was relevant area fully surveyed);
- Resources (e.g. degree of expertise available in animal identification to taxon level);
- Remoteness and/or access problems;
- Availability of contextual (e.g. biogeographic) information on the region; and,
- Efficacy of sampling methods (i.e. any groups not sampled by survey methods).

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4 RESULTS

4.1 SURVEY LIMITATIONS

Limitations of the current survey are summarised Table 4.1 below. Given the few limitations encountered, it can be confirmed that an adequate level of survey has been undertaken to meet the specific objectives of the study.

Table 4.1 – Flora Survey Limitations and Constraints

Aspect	Relevant (yes/no)	Comment
Sources of information and availability of contextual information (i.e. pre-existing background versus new material)	No	Information regarding vegetation at a regional scale is limited to the mapping of Beard (1975) at a scale of 1:1,000,000, and subsequently digitised and reinterpreted by Shepherd *et al.* (2001). More recently described, land systems (Van Vreeswyk *et al.* 2004) provide a good source of regional information on vegetation communities and condition, based on land systems, again at a relatively broad scale of 1:250,000.
The scope (i.e. what life forms were sampled)	No	Vascular flora of the Study Area was sampled.
Proportion of flora collected and identified (based on sampling, timing and intensity)	No	A total of 617 specimens were collected during the survey of the Study Area, from which 155 taxa were identified to species, subspecies or variety. Three taxa were limited to identification to genus level due to insufficient reproductive material. A SAC analysis indicated 60-67 % of the total vascular species likely to be present were recorded. The sampling timing was not optimal, however was sufficient to obtain baseline data to satisfy the requirements of the survey.
Completeness and further work which might be needed (e.g. was the relevant area fully surveyed)	No	The Study Area was surveyed at a density of one quadrat per 447 ha. To survey the vegetation at a level sufficient for environemtal approvals a higher density of quadrats would be required, although much of the area was covered and six vegetation units were described from the current survey. A large proportion of the Study Area in the north was recently burnt and would also require a greater survey effort.
Mapping reliability	No	Colour aerial imagery was used to select quadrats and to map the vegetation of the Study Area. Uncommon vegetation communities, which were not recognised in the pre-survey inspection of the aerial imagery, but were encountered during the survey, were opportunistically sampled.
Timing/weather/season/cycle	No	Rainfall recorded at Broome and Derby in the six months preceding they survey (June 2012) was 591.6 and 820 mm, 62.3 mm and 238.8 mm greater than the long-term mean for the same six months respectively. However, almost no rainfall was received in the between April-June and some species were not flowering. It is likely that there are annuals occurring within the Study Area that were not present during the current survey.
Disturbances (e.g. fire, flood, accidental human intervention)	Yes	A large area in the northern portion of the Study Area was burnt in 2012. This area had not regenerated and most species had not regenerated. Hence this area was not surveyed.
Intensity (in retrospect, was the intensity adequate?)	No	The objective of the survey was to obtain baseline data and satisfy the conditions of the Traditional Owners. To meet this requirement the intensity was sufficient. However, for statuatory environmental approvals a higher survey effort would be required.
Resources	No	Resources were adequate for the botanical survey; 6 person days were invested in the field survey.
Access problems	No	Tracks available in the Study Area were limited and thus the full Study Area could not be accessed through walking. However, since the survey was conducted, new tracks have been established and should be available for

Aspect	Relevant (yes/no)	Comment
		future surveys.
Experience levels (e.g. degree of expertise in plant identification to taxon level)	No	One botanist conducting the survey had sufficient experience in conducting botanical surveys in the Kimberley. Plant specimens were collected from each quadrat surveyed for verification. The taxonomist responsible is broadly experienced in identifying the flora of Western Australia and cryptic specimens were referred to the WAHERB. The project was overseen and reviewed by the Principal Botanist with 21 years of experience in EIA. Qualifications of the project staff are detailed in Section 3.11.1.

Table 4.2 – Fauna Survey Limitations and Constraints

Aspect	Relevant (yes/no)	Comment
Competency/experience of the consultant carrying out the survey.	No	All staff were experienced in identifying fauna and fauna habitats.
Scope (what groups were sampled and were some sampling methods not able to be employed because of constraints such as weather conditions).	No	All groups were surveyed using methods sufficient for Level 1 Surveys.
Proportion fauna identified, recorded and/ or collected.	No	All fauna observed were identified in the field.
Sources of information (previously available information as distinct from new data).	No	A number of previous Level 2 Surveys had been conducted within 100 km of the Study Area, as well as records available from public databases.
The proportion of the task achieved and further work which might be needed.	No	No additional work is required.
Timing/weather/season/cycle.	No	Weather and activity of fauna species is negligible for the current Level 1 Survey.
Disturbances which affected results of the survey (e.g. fire, flood, accidental human intervention).	No	No disturbances occurred.
Intensity (in retrospect was the intensity adequate).	No	The survey was developed following the guidelines for terrestrial surveys (EPA and DEC 2010).
Completeness (e.g. was relevant area fully surveyed).	No	Survey is complete.
Resources (e.g. degree of expertise available in animal identification to taxon level).	No	There were no resource constraints.
Remoteness and/or access problems.	No	Areas to be disturbed by the development were mainly accessible by tracks and on foot.
Availability of contextual (e.g. biogeographic) information on the region).	No	Sufficient contextual information was available for the Kimberley region and the Study Area.
Efficiency of sampling methods (i.e. any groups not sampled by survey methods).	No	The survey methods employed were effective to assess habitats within the Study Area.

4.2 VEGETATION RESULTS

4.2.1 Threatened Ecological Communities

No EPBC-listed TECs occur within the Study Area. No state-listed TECs occur within in the Study Area.

4.2.2 Priority Ecological Communities

No PECs occur within the Study Area.

4.2.3 Vegetation Condition of the Study Area

The vegetation condition of quadrats at Thunderbird ranged from poor to excellent, with the temporary pool being the most highly degraded with severe impacts from cattle. The remainder of the quadrats were classifiifed as either Good, Very Good, or Excellent with low impacts from weeds and cattle (tracks, grazing, faeces). Three introduced species were recorded within the Study Area; *Cynodon dactylon* (couch grass), *Stylosanthes hamata* and *Stylosanthes scabra*. The locations are listed in Table 4.10 and mapped in Figure 4.7. The characteristics and broad distribution of these species are summarised in Table 4.9.

4.2.3.1 Fire History of the Study Area

A large proportion of the Study Area had been burnt within a few months prior to the survey. These areas were not sampled as most species had not germinated or resprouted. This area was estimated to cover approximately 25% of the Study Area. Of the areas that had not been burnt in 2012, 24% had been burnt in the past 1-2 years, 41% in the past 2-5 years and 35% had no evidence or had not been burnt in the past 5 years.

4.2.4 Vegetation Communities of the Study Area

Six vegetation units were described for the Study Area. Each group is described, and notes on the habitat, land system, vegetation condition species richness are provided along with, a representative panoramic photograph of the vegetation type. The vegetation communities are mapped in Figures 4.15, 4.16 and 4.17.

4.2.4.1 Vegetation of Hills and Ridges

CdAdCpGt: ***Corymbia dendromerinx* woodland over *Acacia drepanocarpa* subsp. *latifolia* open shrubland over *Cymbopogon procerus*, *Eriachne obtusa* and *Sorghum plumosum* tussock grassland with *Glycine tomentella* creepers.**

Vegetation *Unit* Area: 213.73 ha

Habitat: Hill tops/ Ridge top

Land System: Reeves

Vegetation Condition: Very Good

Quadrats Surveyed: 5

Species Richness: 37

Associated Species:

Atalaya variifolia, Bonamia linearis, Calytrix extipulata, Cenchrus elymoides, Crotalaria medicaginea var. *neglecta, Cyperus microcephalus, Dicliptera armata, Eriachne* sp. *Dampier Peninsula, Eucalyptus tectifica, Ficus platypoda, Flueggea virosa* subsp. *melanthesoides, Gomphrena canescens* subsp. *canescens, Tinospora smilacina, Triumfetta breviaculeata* and *vigna lanceolata* var. *filiformis.*

Photograph

Figure 4.1 – Representative Photograph of Vegetation Unit CdAdCpGt.

4.2.4.2 Vegetation of Pindan Plains

CgApTcAh: ***Corymbia greeniana* and *Erythophleum chlorostachys* open woodland over *Acacia platycarpa* and *A. tumida* var *tumida* open shrubland, over *Triodia caelestialis* hummock grassland and *Aristida holathera* var *holathera*, *Crysopogon* sp., *Eriachne obtusa* and *Sorghum plumosum* tussock grassland.**

Vegetation *Unit* Area: 1610.09 ha

Habitat: Flat sandy plain

Land System: Reeves and Fraser

Vegetation Condition: Excellent to Good

Quadrats Surveyed: 3, 12, 13, 16

Species Richness: 31.5 ± 2.1

Associated Species:

Bauhinia cunninghamii, Brachychiton diversifolius subsp. *diversifolius, Dodonaea hispidula* var. *arida, Eucalyptus tectifica, Grevillea refracta* subsp. *refracta, Gomphrena canescens* subsp. *canescens Microstachys chamelea and Pterocaulon sphacelatum.*

Photograph

Figure 4.2 – Representative Photograph of Vegetation Unit CgApTcAh.

CzAtSpTc: ***Corymbia greeniana* and *C. zygophylla* open woodland over *Acacia tumida* var. *tumida* shrubland over *Sorghum plumosum* tussock grassland and *Triodia caelestialis* sparse hummock grassland.**

Vegetation *Unit* Area: 4033.45 ha

Habitat: Flat sandy plain

Land System: Reeves and Yeeda

Vegetation Condition: Excellent to Very Good

Quadrats Surveyed: 6, 11, 17, 21

Species Richness: 26.0 ± 2.9

Associated Species:

Acacia platycarpa, Brachychiton diversifolius subsp. *diversifolius, Buchnera linearis, Dodonaea hispidula* var. *arida, Dolichandrone heterophylla, Eriachne melicacea Erythrophleum chlorostachys, Terminalia canescens* and *Wrightia saligna.*

Photograph

Figure 4.3 – Representative Photograph of Vegetation Unit CzAtSpTc.

GpSpTc: ***Corymbia dendromerinx* and *C. greeniana* open woodland over *Grevillea pyramidalis* subsp. *pyramidalis* and *G. refracta* subsp *refracta* shrubland over *Sorghum plumosum* tussock grassland and *Triodia caelestialis* hummock grassland**

Vegetation *Unit* Area: 986.10 ha

Habitat: Plains, Gullies and Mid-slopes

Land System: Reeves and Yeeda

Vegetation Condition: Excellent to Very Good

Quadrats Surveyed: 4, 9, 10, 19

Species Richness: 35.5 ± 2.9

Associated Species:

Buchnera asperata, Corchorus sidoides subsp. *vermicularis, Dolichandrone heterophylla, Eriachne ciliata, Fimbristylis simulans, Glycine tomentella, Gomphrena canescens* subsp. *canescens, Hybanthus aurantiacus, Microstachys chamelea, Oldenlandia mitrasacmoides* subsp. *mitrasacmoides, Polycarpaea corymbosa, Pterocaulon sphacelatum, Ptilotus corymbosus, Terminalia canescens* and *Wrightia saligna.*

Photograph

Figure 4.4 – Representative Photograph of Vegetation Unit GpSpTc.

4.2.4.3 Vegetation of Clay-based Lowlands

MnMvAcEoTc: ***Corymbia greeniana*** **and** ***Melaleuca nervosa*** **or** ***M. viridiflora*** **open woodland, over** ***Acacia colei*** **var.** ***colei*** **tall shrubland, over** ***Eriachne obtusa*** **tussock grassland and** ***Triodia caelestialis*** **hummock grassland.**

Vegetation *Unit* Area: 750.05 ha

Habitat: Flat sandy-clay plains

Land System: Fraser and Waganut

Vegetation Condition: Excellent to Good

Quadrats Surveyed: 15, 20

Species Richness: 28 ± 3

Associated Species:

Buchnera asperata, Carissa lanceolata, Crotalaria crispata, Desmodium filiforme, Drosera derbyensis, Drosera indica, Ectrosia schultzii, Gomphrena canescens subsp. *canescens, Heliotropium cunninghamii, Oldenlandia mitrasacmoides* subsp*. mitrasacmoides, Paspalidium rarum, Pterocaulon serrulatum* var. *velutinum Spermacoce occidentalis, Stackhousia intermedia, Stemodia lathraia* and *Xyris complanata.*

Photograph

Figure 4.5 – Representative Photograph of Vegetation Unit MnMvAcEoTc.

EtMvSi: ***Eucalyptus tectifica*** **and** ***Melaleuca viridiflora*** **open woodland over** ***Sacciolepis indica*****,** ***Sorghum plumosum*****,** ***Fuirena ciliaris*** **tussock grassland.**

Vegetation *Unit* Area: 9.39 ha

Habitat: Flat sandy-clay plains

Land System: Fraser

Vegetation Condition: Poor

Quadrats Surveyed: 1

Species Richness: 33

Associated Species:

Blumea integrifolia, Byblis filifolia, Chamaecrista mimosoides, Cyperus ? *conicus, Digitaria bicornis, Drosera indica, Eleocharis geniculata, Fimbristylis dichotoma, Lipocarpha microcephala, Ludwigia perennis, Melochia corchorifolia, Mimulus uvedaliae* var. *lutea, Oldenlandia galioides, Phyllanthus virgatus, Rotala occultiflora, Sida hackettiana, Stackhousia intermedia, Stylosanthes hamata, Stylosanthes scabra* and *Thysanotus chinensis.*

Photograph

Figure 4.6 – Representative Photograph of Vegetation Unit EtMvSi.

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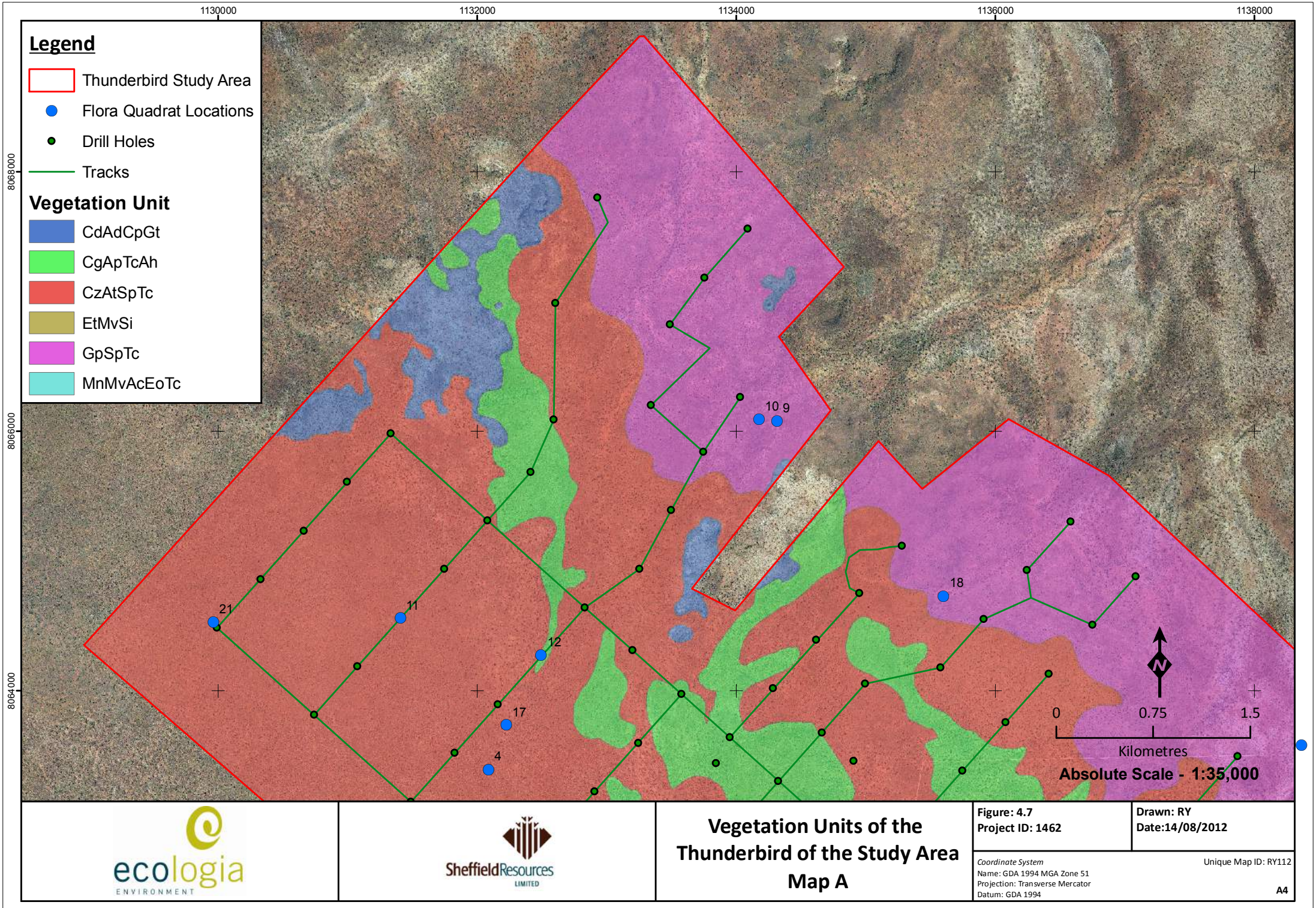

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Vegetation Units of the Thunderbird of the Study Area Map A

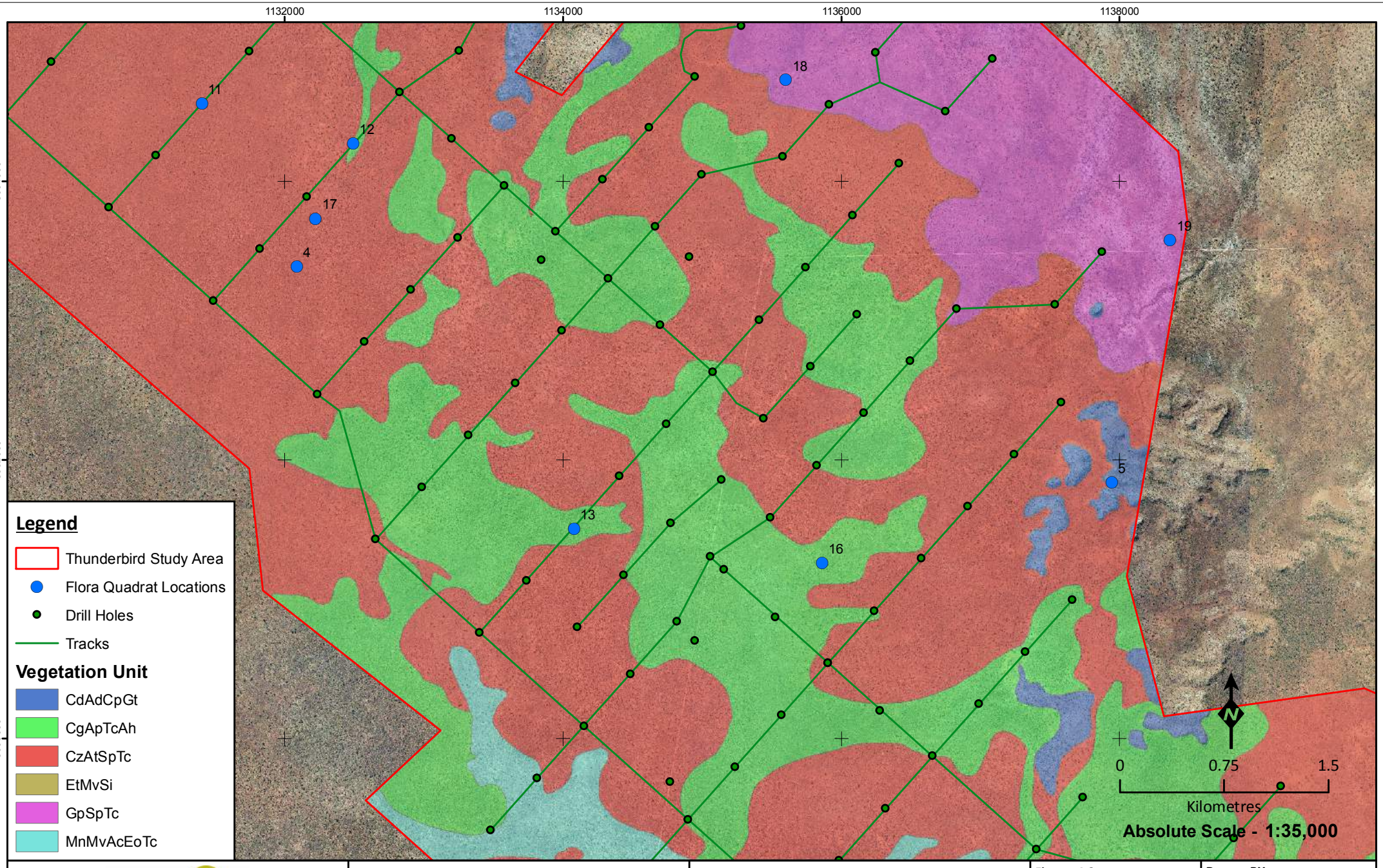
Figure: 4.7
Project ID: 1462

Drawn: RY
Date:14/08/2012

Coordinate System
Name: GDA 1994 MGA Zone 51
Projection: Transverse Mercator
Datum: GDA 1994

Unique Map ID: RY112

A4



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Vegetation Units of the Thunderbird of the Study Area Map B

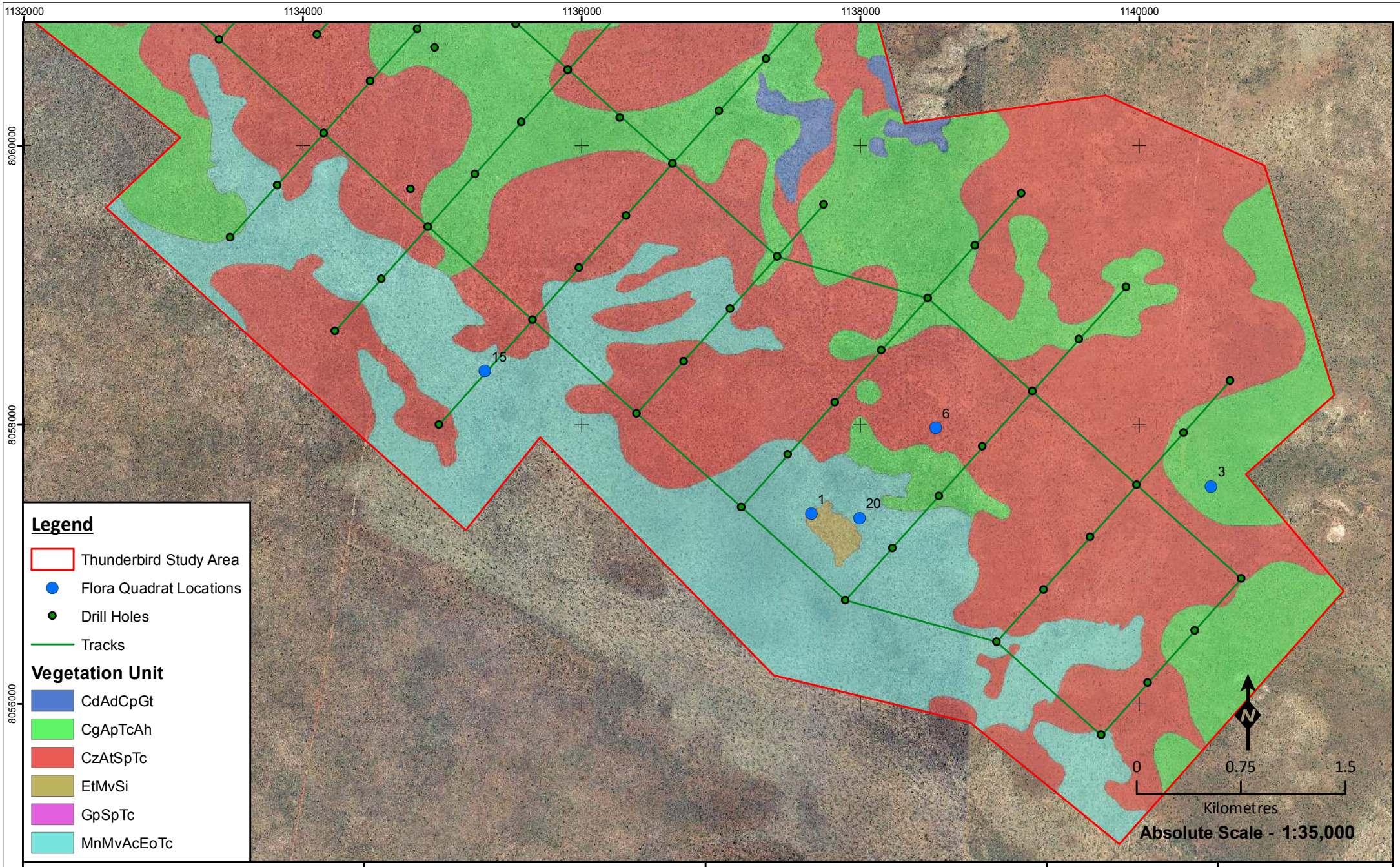
Figure: 4.8
Project ID: 1462

Drawn: RY
Date:14/08/2012

Coordinate System
Name: GDA 1994 MGA Zone 51
Projection: Transverse Mercator
Datum: GDA 1994

Unique Map ID: RT113

A4



ecologia ENVIRONMENT

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Vegetation Units of the Thunderbird of the Study Area Map C

Figure: 4.9
Project ID: 1462

Drawn: RY
Date:14/08/2012

Coordinate System
Name: GDA 1994 MGA Zone 51
Projection: Transverse Mercator
Datum: GDA 1994

Unique Map ID: RT114

A4

4.3 FLORA RESULTS

A total of 155 flora taxa were recorded and fully identified, including subspecies, varieties and hybrids, as detailed in Appendix D. The composition of the flora is summarised in Table 4.3.

Table 4.3 – Taxonomic Composition of the Flora of the Study 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
17	155	43	108	20	77

The families and genera represented by the greatest number of taxa and the most frequently recorded species in the Study Area are listed in Table 4.4.

Table 4.4 – Most Frequently Recorded Families, Genera and Taxa in the Study Area.

Most Common Families	Most Common Genera	Most Frequently Recorded Taxa
Fabaceae (28 taxa) Poaceae (25 taxa) Malvaceae (11 taxa) Cyperaceae (9 taxa) Myrtaceae (8 taxa)	*Acacia* (7 taxa) *Eriachne* (5 taxa) *Aristida* (4 taxa) *Tephrosia* (4 taxa)	*Triodia caelestialis* (18 taxa, P3) *Brachychiton diversifolius* subsp. *diversifolius* (16 taxa) *Sorghum plumosum* (16 taxa) *Corymbia greeniana* (15 taxa) *Gomphrena canescens* subsp. *canescens* (14 taxa) *Terminalia canescens* (14 taxa)

The highest species richness values in the Study Area were recorded in quadrats 5 and 9. Lower species richness values were recorded in quadrats 11, 6 and 21. The areas of highest and lowest vegetation units were from a range vegetation types, however on average the rocky hills (CdAdCpGt) were highest and vegetation unit CzAtSpTc of the Pindan plains was lowest in species richness.

4.3.1 Sampling Adequacy and Species Accumulation Curve Analysis for the Study Area

Using species Accumulation curve (SAC) analysis (Colwell 2009) and extrapolation of the curve to the asymptote using Michaelis-Menten modelling, the incidence-based coverage estimator of species richness (ICE Mean, Chao 2 Mean) was determined between 245 and 249 (Figure 4.10). A total of 155 taxa were recorded on the survey, estimating that between 60 and 67 % of the flora species potentially present within the Study Area were recorded. Given the level of survey required to meet the objectives of the current survey, the density of quadrats was fairly low and did not occur at the directly following the wet season (March-April) when then presence of annuals is highest in the Kimberley.

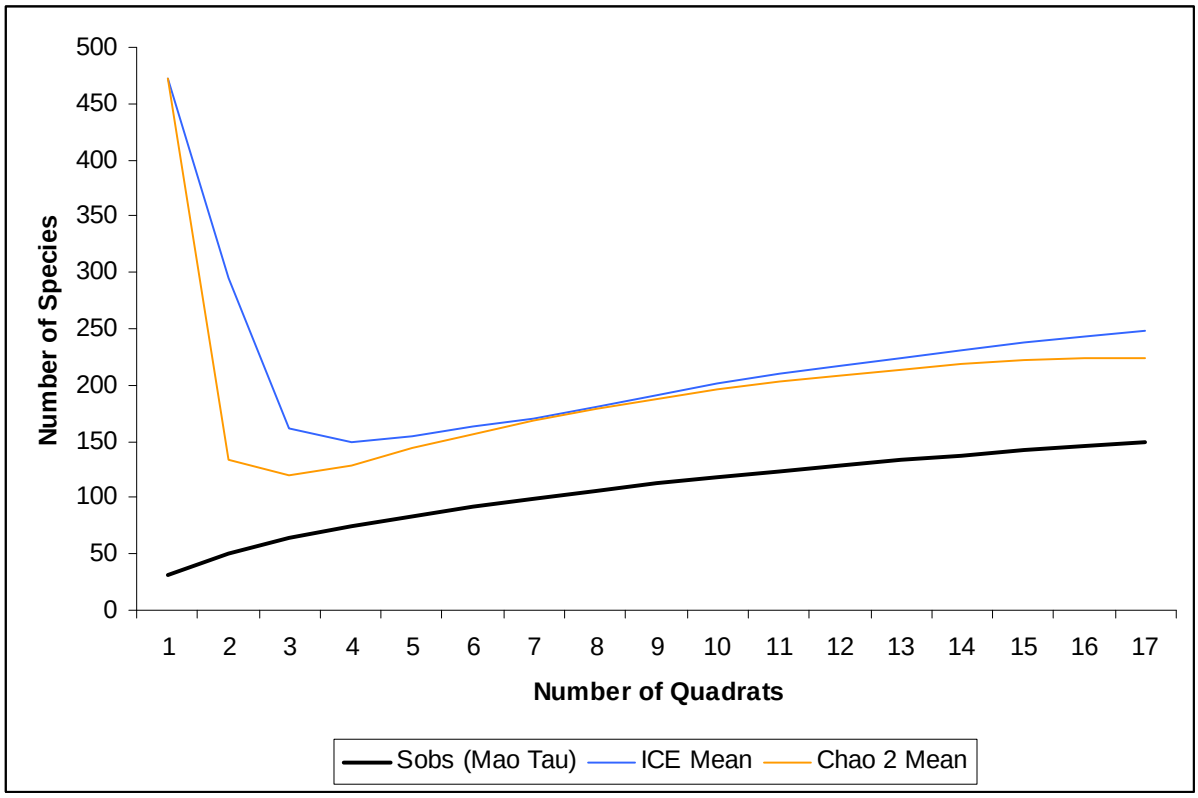


Figure 4.10 – Average Randomised SAC for the Study Area.

4.3.2 Flora of Conservation Significance

4.3.2.1 Environment Protection and Biodiversity Conservation Act 1999

No EPBC Act listed species were recorded in the Study Area.

4.3.2.2 Wildlife Conservation Act 1950

No Threatened taxa were recorded in the Study Area.

4.3.2.3 Priority Flora with Potential to Occur in the Study Area

Currently, 75 Priority Flora taxa are listed as occurring in Dampierland (WAHERB, August 2012). A database search of the DEC's Threatened (Declared Rare) Flora Database and the DEC's WAHERB Specimen Database indicated that 40 Priority Flora have previously been recorded within 50 km of the Study Area (Table 4.5). Twenty of these Priority Flora taxa are assessed to have a medium or high likelihood of occurrence within the Study Area.

Table 4.5 – Assessment of Potential of Priority Flora to Occur in the Study Area.

Taxon	DEC Conservation Code	Preferred Habitat	Distribution	Likelihood of Occurrence	Regional Impacts
Aizoaceae					
Tetragonia coronata	P3	Occurs on calcrete outcrops, red loamy soil, in the shade of larger shrubs.	Overlander Roadhouse, Hamelin Pool, Broome, Carey Downs Stn.	Medium	High
Amaranthaceae					
Gomphrena pusilla	P3	Occurs on coastal sand dunes, with either calcrete sands or fine shell grit	Dampier Peninsula, Pt Hedland	Low	Medium
Apocynaceae					
Parsonsia kimberleyensis	P1	Occurs on vine thicketts	Dampier Peninsula	Low	High
Araceae					
Colocasia esculenta var. *aquatilis*	P3	Occurs in wet grasslands which have perminant water	Theda Station Homestead, Doongan Station, Lady Forrest Ranges, Mt Hart Station Homested, Dampier Peninsula	Low	Medium
Asteraceae					
Pterocaulon intermedium (formally – *Pterocaulon* sp. A. Kimberley Flora (B.J. Carter 599))	P3	No information	Broome, Anna Plains, Anjo Peninsula, South Headland, Dampier Peninsula	High	Medium
Thespidium basiflorum	P1	Occurs in sandy soil creek beds	Dampier Peninsula	Medium	Medium
Byblidaceae					
Byblis guehoi	P1	Occurs in sand and silt-loam soils that are waterlogged in the wet season but dry soonafter.	Dampier Peninsula	Medium	High
Celastraceae					
Stackhousia clementii	P3	Occurs close to water on fine sand in limestone or calcrete areas.	Dampier Peninsula, Wiluna, Burrup Peninsula, Gnaraloo Homestead	Low	Medium

Taxon	DEC Conservation Code	Preferred Habitat	Distribution	Likelihood of Occurrence	Regional Impacts
Convolvulaceae					
Ipomoea gracilis	P1	Occurs on clay or irrigated sand, close to rivers.	Kununurra, Ord River.	Low	Medium
Ipomoea sp. A Kimberley Flora (L.J. Penn 84)	P1	Occurs in shallow soils on sandstone	Dampier Peninsula	Medium	High
Jacquemontia sp. Broome (A.A. Mitchell 3028)	P1	Occurs in woodlands on Pindan plain	Dampier Peninsula	Low	Medium
Cyperaceae					
Cyperus haspan subsp. *haspan*	P1	Occurs in peat bank on the edge of spring	Dampier Peninsula	Low	High
Fuirena incrassata	P3	Occurs in sand and claypans, generally close to water	Googhenama Creek, Broome	Medium	Low
Schoenus punctatus	P3	Occurs close to water, in both sand and clay	Nurrup Peninsula, Broome, Mt Barnett Stn	Low	Medium
Euphorbiaceae					
Croton aridus	P3	Occurs on sand plains in Pindan soil.	Edgar Range, Broome, Shay Gap	Medium	Medium
Fabaceae					
Acacia sp. Broome (B.R. Maslin 4918)	P3	Occurs on coastal cliffs and low lying areas	Broome, Camballin, Wallan Downs Stn.	High	Low
Acacia sp. Riddell Beach (T. Willing 71)	P3	Occurs on cliffs and gullys, and close to roads. In sand, loam and rocky soil.	Broome, Dampier Peninsula	Low	Medium
Aphyllodium glossocarpum	P3	Occurs in sand verging onto cleared areas and open grassland fringes	Dampier Peninsula	High	Medium
Aphyllodium parvifolium	P1	Occurs in san and clay, can be close to water.	Broome, McLarty Hills	Low	Medium
Glycine pindanica	P1	Occurs in disturbed open areas, in Pindan sand. Can be close to drainage areas.	Broome, Beagle Bay	Medium	High

Taxon	DEC Conservation Code	Preferred Habitat	Distribution	Likelihood of Occurrence	Regional Impacts
Tephrosia andrewii	P1	In dry sand Pindan soils, on hill sides and road verges.	Port Hedland-Broome	Low	High
Goodeniaceae					
Goodenia sepalosa var. *glandulosa*	P3	Occurs in Pindan sand or loam	Derby, Lake Argyle, Robinson River, Fitzroy Crossing, Yeeda	Medium	Low
Haemodoraceae					
Haemodorum gracile	P4	Occurs in sand, and sandy clay in open woodlands and creek banks	Cahmpagny Is., Yampi Peninsula, Dampier Peninsula, Edkins Range, Kimbolton Stn.,Prince Regnet River N.R., Derby	High	Low
Lentibulariaceae					
Utricularia stellaris	P1	Occurs in swampy areas, commonly submerged in water.	Wyndham, Dampier Peninsula, Mitchell Plateau	Medium	High
Loranthaceae					
Decaisnina signata subsp. *cardiophylla*	P1	Occurs in damp swamp areas and Banksia dentata	Napier Broome Bay, Theda Stn., Doongan Stn,	Low	High
Dendrophthoe odontocalyx	P3	Occurs in swamp areas and woodlands.	Koolan Is., Dampier Peninsula, Prince Regent N.R.,	Medium	Medium
Malvaceae					
Hibiscus kenneallyi	P3	Occurs in rocky outcrops	Prince Regent N.R., Middle Osborn Is., Roe River, Vansittart Bay, Bouganville Peninsula Calder River, Napier Broome Bay	Low	High
Keraudrenia exastia	T	Occurs on dunes and slight slopes in clay, and Pindan sand	Broome	Low	High
Keraudrenia katatona	P3	Occurs in dune areas on Pindan sand	Broome, Edgar Range, Wallal Downs, Canning Stock Route	Low	Medium
Menyanthaceae					
Nymphoides beaglensis	P2	In shallow freshwater. Edges of permanent waterholes or in seasonally inundated claypans & depressions.	Dampier Peninsular, Beagle Bay, Lake Campion, Yabbagoody Clay Pan	High	Low

Taxon	DEC Conservation Code	Preferred Habitat	Distribution	Likelihood of Occurrence	Regional Impacts
Myrtaceae					
Corymbia paractia	P1	Skeletal soils. In transition zone between coastal beach dunes & red pindan soils.	Broome, Cable Beach, Cape Boileau	Low	High
Lophostemon grandiflorus subsp. *grandiflorus*	P3	Occurs in damp habitats	Dampier Peninsula, Edgar Range	Medium	Low
Pandanaceae					
Pandanus spiralis var. *flammeus*	T	White clay. Springs.	Dampier Downs Station	Low	High
Pittosporaceae					
Pittosporum moluccanum	P4	White sand. Sand dunes	Dampier Peninsula, N of Broome, Berthier Is., Maret Is., N.T., SE Asia	Low	Medium
Poaceae					
Eriachne sp. Dampier Peninsula (K.F. Kenneally 5946)	P3	Plain. Red-brown sandy loam. Pindan Sands	Scattered on Dampierland an in the Fitzroyu Trough	High	Low
Phragmites karka	P3	Edges of pools and creeks	Scattered throughout the Kimberley and Pilbara	Low	Low
Triodia acutispicula	P3	Sandy soils. River levees, pindan plains, rocky hillslopes & outcrops.	Scattered throughtout Western Kimberley	High	Low
Sapindaceae					
Cupaniopsis anacardioides	P3	Vine thickets	Dampier Peninsula, Mitchell Plateau, Middle Osborn Is., Bouganville Peninsula, NT, QLD	Low	High
Solanaceae					
Nicotiana heterantha	P1	Black clay. Seasonally wet flats.	Broome, Dampier Peninsula, Roy Hill, Mandora, Anna Plains	Medium	Medium

Taxon	DEC Conservation Code	Preferred Habitat	Distribution	Likelihood of Occurrence	Regional Impacts
Stylidiaceae					
Stylidium costulatum	P3	Sandy or clayey soils. Creeks or seasonally wet areas.	Dampier Peninsula, Beverley Springs Stn, Mt Barnett Stn, Coulomb Point	Medium	Medium

4.3.2.4 Priority Flora Recorded in the Study Area

Three Priority Flora were recorded in the Study Area in this survey: *Pterocaulon intermedium* (P3); *Eriachne* sp. Dampier Peninsula (K.F. Kennealy 5946) (P3); and *Triodia caelestialis* (P3). Their locations and an illustrative picture are presented in Table 4.9. *Triodia caelestialis* was not identified as a Priority Flora with potential to occur within the Study Area from the DEC searches. However, this species has only recently been described (2008) and its distribution has not yet been fully established.

4.3.2.5 Range Extensions Recorded in the Study Area

Ten records from the current survey represent range extensions of more than 100 km from the nearest previously known record (Table 4.7), based on collection 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 Dampierland. Specimens from these taxa will be lodged with the WA Herbarium.

Table 4.6 – Priority Flora Recorded in the Study Area.

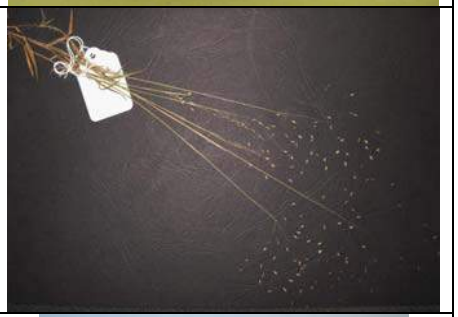
Family	Taxon	Status	Quadrat	Easting	Northing	Picture
Asteraceae	*Pterocaulon intermedium*	P3	13	495997	8071422	
Poaceae	*Eriachne* sp. Dampier Peninsula (K.F. Kennealy 5946)	P3	5 15 18	499829 497314 497409	8071874 8068357 8074676	
Poaceae	*Triodia caelestialis*	P3	3 4 6 9 10 11 12 13 15 16 17 18 19 20A 20B	502523 493955 500545 496085 495950 493242 494332 495997 497314 497776 494080 497409 500192 491807 500022	8067699 8073234 8068053 8075978 8075987 8074375 8074125 8071422 8068357 8071234 8073582 8074676 8073619 8074300 8067396	

Table 4.7 – 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)	Number of records by *ecologia*
Heliotropium dichotomum	135 km W of eastern population	DL NK OVP VP	13	2
Fimbristylis simulans	118 km NW of known Northern Province records	CK, DL,NK,OVP, PIL, TAN	30	4
Acacia drepanocarpa subsp. *latifolia*	128 km NW of southeastern record	CK, DL, GSD, OVP, PIL	19	1
Tephrosia forrestiana	417 km W of known population	CK, OVP, VB	9	2
Rotala occultiflora	200km WSW of known population	CK, CR, DL, NK, OVP, VB	27	1
Stemodia lythrifolia	653 km SW of known records	CK, DL, NK, OVP, VB	46	4
Cenchrus elymoides	120 km SW of known population	CK, NK, VB	59	5
Triodia caelestialis	197 km W of known population	CK, DL, NK	3	15
Triodia intermedia	152 km W of eastern population and 220 km NE of southwerstern record	CK, DL, GAS, GSD, OVP, PIL	26	2
Polygala linariifolia	116 km NW of Northern Province population	CK, DL, NK, OVP, PIL, TAN, VB	43	2
Trichodesma zeylanicum var. *zeylanicum*	Bridging extension 192 km W of eastern population and 523 km NE of Pilbara population	CAR, CK, DL, GAS, GD, GVD, LSD, NK, OVP, PIL, YAL	28	2

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).

4.3.3 Introduced Flora

4.3.3.1 Weeds of National Significance

At a national level there are 32 weed species listed as Weeds of National Significance (WONS). *The Commonwealth National Weeds Strategy: A Strategic Approach to Weed Problems of National Significance* describes broad goals and objectives to manage these species. Of these species, seven are currently recorded within the Kimberley (Athel Pine - *Tamarix aphylla*; Bellyachne bush – *Jatropha gossypiifolia*; Gamba Grass – *Andropogon gayanus*; Mesquite – *Prosopis* spp; Parkinsonia – *Parkinsonia aculeata;* Rubber Vine – *Cryptostegia grandiflora* and Salvinia – *Salvinia molesta*).

No WONS were recorded in the Study Area during *ecologia*'s 2011 survey.

4.3.3.2 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* as declared plants.

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

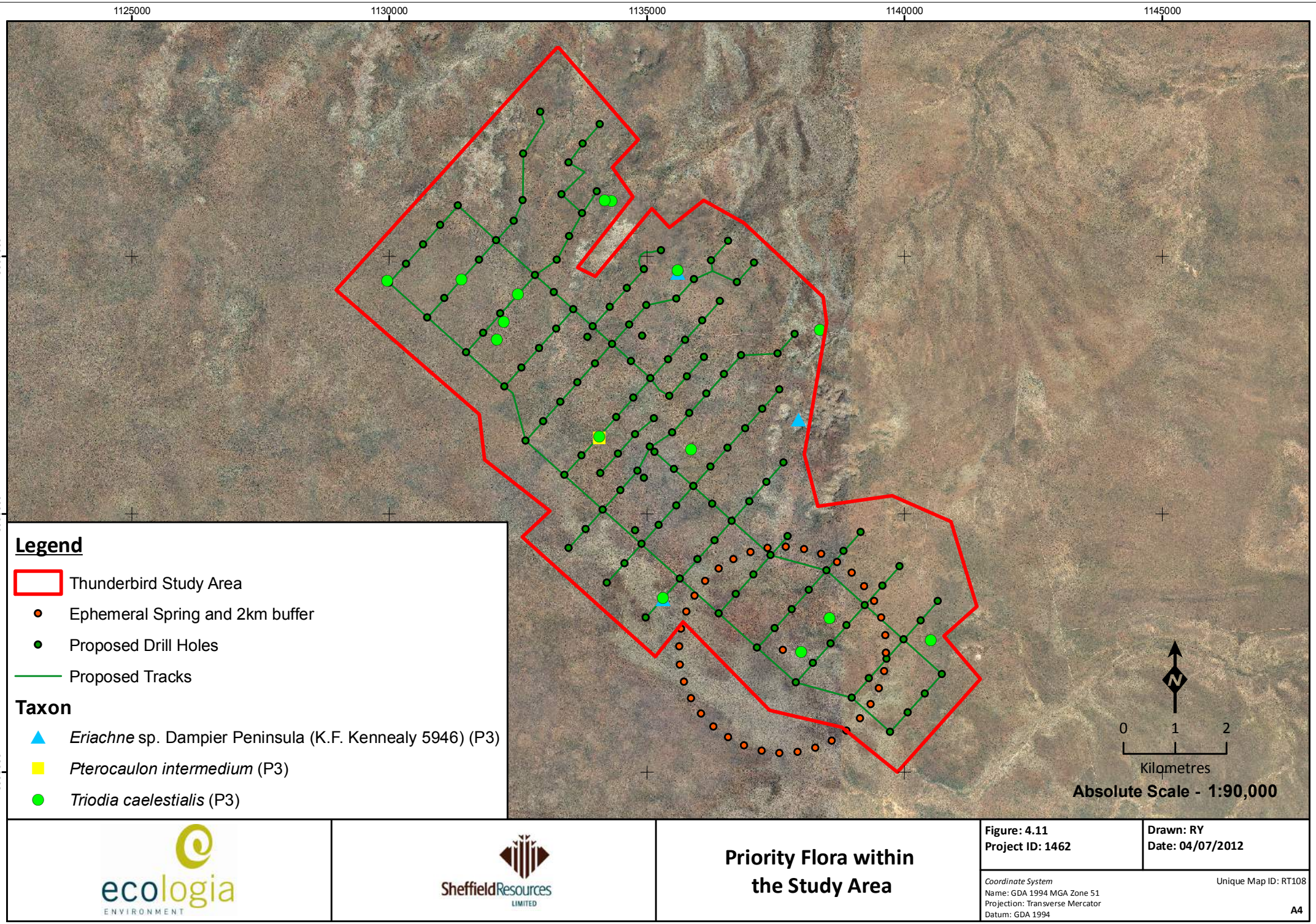
4.3.3.3 Environmental Weeds

A third and much more extensive categorisation of weeds has been developed by DEC, formerly the Department of Conservation and Land Management (CALM) in an Environmental Weed Strategy for Western Australia (CALM 1999). There are currently 270 recognised environmental weeds in the Kimberley.

Three introduced species were recorded within the Study Area; *Cynodon dactylon* (couch grass), *Stylosanthes hamata* and *Stylosanthes scabra*. The locations are listed in. Table 4.8. The attributes and characteristics of these species are summarised in Table 4.9 and Table 4.10.

Table 4.8 – Introduced Species Recorded in the Study Area and their Location.

Family	Species	Quadrat	Easting	Northing
Poaceae	**Cynodon dactylon*	3	502523	8067699
Fabaceae	**Stylosanthes hamata*	1	499677	8067413
Fabaceae	**Stylosanthes scabra*	1	499677	8067413
		19	500192	8073619



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Priority Flora within the Study Area

Figure: 4.11
Project ID: 1462

Drawn: RY
Date: 04/07/2012

Coordinate System
Name: GDA 1994 MGA Zone 51
Projection: Transverse Mercator
Datum: GDA 1994

Unique Map ID: RT108

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Table 4.9 – Attributes of Introduced Flora in the Study Area.

Family	Taxa	DEC Attribute Rankings Within Kimberley							
		Present in Dampierland	Current Distribution	Abundance	Ecological Impact	Invasiveness	Feasibility of Control	General Trend	Status
Fabaceae	*Stylosanthes hamata*	Yes	Extensive	Common	Moderate	Rapid	Low	Increasing	Established
	Stylosanthes scabra	Yes	Extensive	Common	Moderate	Rapid	Low	Increasing	Established
Poaceae	*Cynodon dactylon*	Yes	-	-	-	-	-	-	-

Table 4.10 – Characteristics of Introduced Flora Recorded in the Study Area

Taxa	Description	Picture
Cynodon dactylon Poaceae (Couch grass)	*Cynodon dactylon* is a rhizomatous or stoliniferous prostrate perennial, 5 to 30 cm high (WAHERB 2012). It invades wetlands and river edges and has been found in virtually all parts of Western Australia (Hussey *et al.* 2007). Native to the Kimberley and the tropics worldwide (Hussey *et al.* 2007).	 WAHERB (2011)
Stylosanthes hamata Fabaceae (Verano Stylo)	*S. hamata* is an erect or decumbent herb or shrub up to 70 cm high with yellow flowers (WAHERB 2012). It can be found in seepage areas, creek banks, pool edges, lawn and disturbed vegetation (WAHERB 2012). Native to Central and South America (Hussey *et al.* 2007).	 WAHERB (2012)
Stylosanthes scabra Fabaceae (Stylo)	*S. scabra* is an erect shrub ranging from 0.3 to 2 metres in height with yellow flowers (WAHERB 2012). It can be observed in levees adjacent to major rivers, flood prove areas, well-watered cultivated grounds and road verges (WAHERB 2012). Native to the Caribbean and South America (Hussey *et al.* 2007).	 www.hear.org (2012)

4.4 FAUNA RESULTS

4.4.1 Fauna Assemblages

The assessment of the potential fauna assemblage of the Study Area which incorporates database searches and records of previous surveys from within 100 km of the Study Area, has identified a total of 358 terrestrial vertebrate fauna species with potential to occur in the Study Area (Appendix F). This includes 33 native and six introduced mammal species, 232 bird species, 78 reptile species and nine amphibian species. A comparison of the number of species recorded during previous surveys is presented in Table 4.11. During the Level 1 Survey a total of eight mammals (five native, three introduced), 59 birds, seven reptiles and one amphibian were recorded within the Study Area (Table 4.12).

Table 4.11 – Comparison of Results of Previous Fauna Surveys.

Survey	Mammals Native (introduced)	Birds	Reptiles	Amphibians
ecologia (2004)	6 (1)	65	28	4
ecologia (2011)	11	82	33	2
AECOM (2010)	5 (3)	103	17	0
Biota (2009)	10 (2)	68	39	4
Biota (2010)	3 (1)	n/a	27	1
ENV (2008)	27 (6)	177	56	8
Rogers *et al.* (2009)	n/a	80	n/a	n/a
NatureMap	4	67	7	1
DEC Threatened and Priority Fauna Search	2	4	0	0
DSEWPaC Protected Matters Search	3	11	1	0
Birdata	n/a	219	n/a	n/a
This survey	5 (3)	59	7	1
Total	**33 (6)**	**232**	**78**	**9**

4.4.2 Conservation Significant Fauna Potentially Occurring in Study Area

Results from the desktop assessment and Level 1 Survey information indicate that 69 species of conservation significance may potentially occur in the Study Area, these species are summarised in Table 4.14. Of these, one mammal and five birds have a medium to high likelihood of occurring in the Study Area and are discussed in greater detail in Section 5.3. Previous regional records of conservation significant species are mapped in Figure 4.12 and Figure 4.13.

During the current survey, three conservation significant species were recorded: Rainbow Bee-eater (EPBC Migratory, WC Act Schedule 3), Australian Bustard (DEC Priority 4) and Bush-stone Curlew (DEC Priority 4).

Table 4.12 – Vertebrate Fauna Species Recorded During Current Survey Within Study Area.

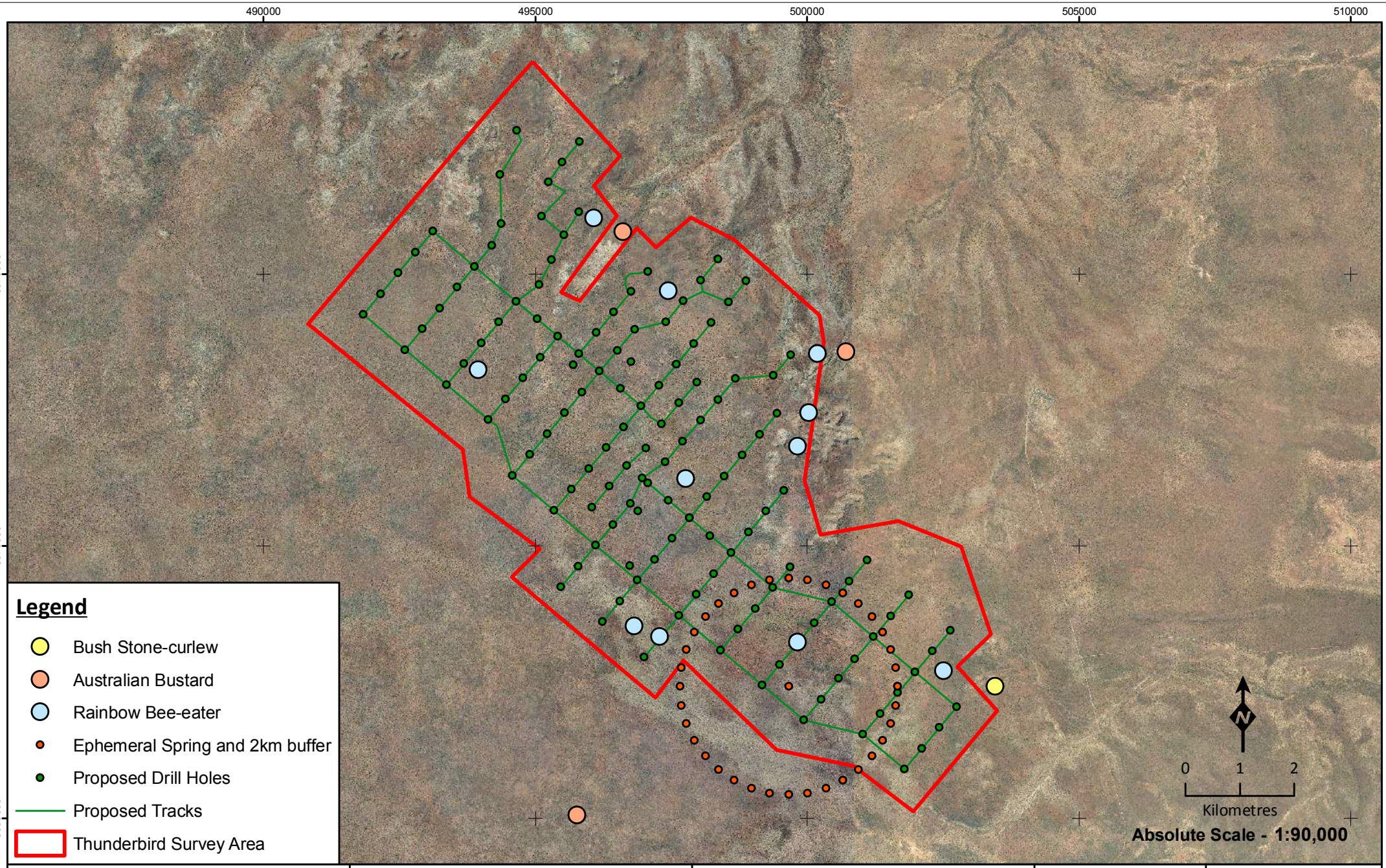
Family and Species Name	Common Name	Conservation Code
MAMMALS		
MACROPODIDAE		
Macropus robustus	Euro	
VESPERTILIONIDAE		
Chalinolobus gouldii	Gould's Wattled Bat	
Chalinolobus nigrogriseus	Hoary Wattled Bat	
Scotorepens greyii	Little Broad-nosed Bat	
MOLOSSIDAE		
Chaerophon jobensis	Northern Freetail Bat	
INTRODUCED MAMMALS		
Canis lupus	Dog/Dingo	
Felis catus	Cat	
Bos taurus	Cow	
BIRDS		
ANATIDAE		
†*Anas gracilis*	Grey Teal	
†*Anas superciliosa*	Pacific Black Duck	
COLUMBIDAE		
Ocyphaps lophotes	Crested Pigeon	
Geopelia cuneata	Diamond Dove	
Geopelia striata	Peaceful Dove	
PHALACROCORACIDAE		
†*Microcarbo melanoleucos*	Little Pied Cormorant	
ARDEIDAE		
†*Ardea pacifica*	White-necked Heron	
†*Egretta novaehollandiae*	White-faced Heron	
THRESKIORNITHIDAE		
†*Threskiornis spinicollis*	Straw-necked Ibis	
ACCIPITRIDAE		
Hamirostra melanosternon	Black-breasted Buzzard	
Haliastur sphenurus	Whistling Kite	
†*Milvus migrans*	Black Kite	
Accipiter fasciatus	Brown Goshawk	
Aquila audax	Wedge-tailed Eagle	
FALCONIDAE		
Falco cenchroides	Nankeen Kestrel	
Falco berigora	Brown Falcon	
GRUIDAE		
†*Grus rubicunda*	Brolga	
OTIDIDAE		
Ardeotis australis	Australian Bustard	DEC Priority 4
BURHINIDAE		

Family and Species Name	Common Name	Conservation Code
Burhinus grallarius	Bush Stone-curlew	DEC Priority 4
CHARADRIIDAE		
†*Elseyornis melanops*	Black-fronted Dotterel	
†*Vanellus miles*	Masked Lapwing	
TURNICIDAE		
Turnix velox	Little Button-quail	
CACATUIDAE		
Calyptorhynchus banksii	Red-tailed Black-Cockatoo	
Eolophus roseicapillus	Galah	
Cacatua sanguinea	Little Corella	
Nymphicus hollandicus	Cockatiel	
PSITTACIDAE		
Trichoglossus haematodus rubritorquis	Red-collared Lorikeet	
Psitteuteles versicolor	Varied Lorikeet	
Aprosmictus erythropterus	Red-winged Parrot	
Melopsittacus undulatus	Budgerigar	
CUCULIDAE		
Centropus phasianinus	Pheasant Coucal	
Chalcites basalis	Horsfield's Bronze-Cuckoo	
Cacomantis pallidus	Pallid Cuckoo	
STRIGIDAE		
Ninox novaeseelandiae	Southern Boobook	
HALCYONIDAE		
†*Dacelo leachii*	Blue-winged Kookaburra	
MEROPIDAE		
Merops ornatus	Rainbow Bee-eater	EPBC Act Migratory, WC Act Schedule 3
CLIMACTERIDAE		
Climacteris melanura	Black-tailed Treecreeper	
PTILONORHYNCHIDAE		
Ptilonorhynchus nuchalis	Great Bowerbird	
MALURIDAE		
Malurus melanocephalus	Red-backed Fairy-wren	
ACANTHIZIDAE		
Smicrornis brevirostris	Weebill	
Gerygone albogularis	White-throated Gerygone	
PARDALOTIDAE		
Pardalotus rubricatus	Red-browed Pardalote	
Pardalotus striatus	Striated Pardalote	
MELIPHAGIDAE		
Lichenostomus virescens	Singing Honeyeater	
Lichenostomus flavescens	Yellow-tinted Honeyeater	
Sugomel niger	Black Honeyeater	

Family and Species Name	Common Name	Conservation Code
Lichmera indistincta	Brown Honeyeater	
Melithreptus gularis	Black-chinned Honeyeater	
Philemon citreogularis	Little Friarbird	
POMATOSTOMIDAE		
Pomatostomus temporalis	Grey-crowned Babbler	
NEOSITTIDAE		
Daphoenositta chrysoptera	Varied Sittella	
CAMPEPHAGIDAE		
Coracina novaehollandiae	Black-faced Cuckoo-shrike	
Lalage sueurii	White-winged Triller	
PACHYCEPHALIDAE		
Pachycephala rufiventris	Rufous Whistler	
Colluricincla harmonica	Grey Shrike-thrush	
ORIOLIDAE		
Oriolus sagittatus	Olive-backed Oriole	
ARTAMIDAE		
Artamus personatus	Masked Woodswallow	
Artamus cinereus	Black-faced Woodswallow	
Artamus minor	Little Woodswallow	
Cracticus nigrogularis	Pied Butcherbird	
RHIPIDURIDAE		
Rhipidura albiscapa	Grey Fantail	
Rhipidura leucophrys	Willie Wagtail	
CORVIDAE		
Corvus orru	Torresian Crow	
MONARCHIDAE		
†*Myiagra inquieta*	Restless Flycatcher	
Grallina cyanoleuca	Magpie-lark	
PETROICIDAE		
Microeca fascinans	Jacky Winter	
MEGALURIDAE		
Cincloramphus mathewsi	Rufous Songlark	
HIRUNDINIDAE		
Petrochelidon ariel	Fairy Martin	
Petrochelidon nigricans	Tree Martin	
NECTARINIIDAE		
Dicaeum hirundinaceum	Mistletoebird	
ESTRILDIDAE		
Taeniopygia guttata	Zebra Finch	
REPTILES		
AGAMIDAE		
Pogona minor	Dwarf Bearded Dragon	
GEKKONIDAE		

Family and Species Name	Common Name	Conservation Code
Gehyra pilbara		
SCINCIDAE		
Carlia munda		
Cryptoblepharus ruber		
Ctenotus inornatus		
Lerista apoda		
Morethia sp. (*storri* or *ruficauda*)		
AMPHIBIANS		
HYLIDAE		
Litoria rothii	Northern Laughing Tree Frog	

† Species recorded just outside Study Area at Mt. Jowlaenga homestead/billabong



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Locations of Conservation Significant Fauna Recorded During the Survey

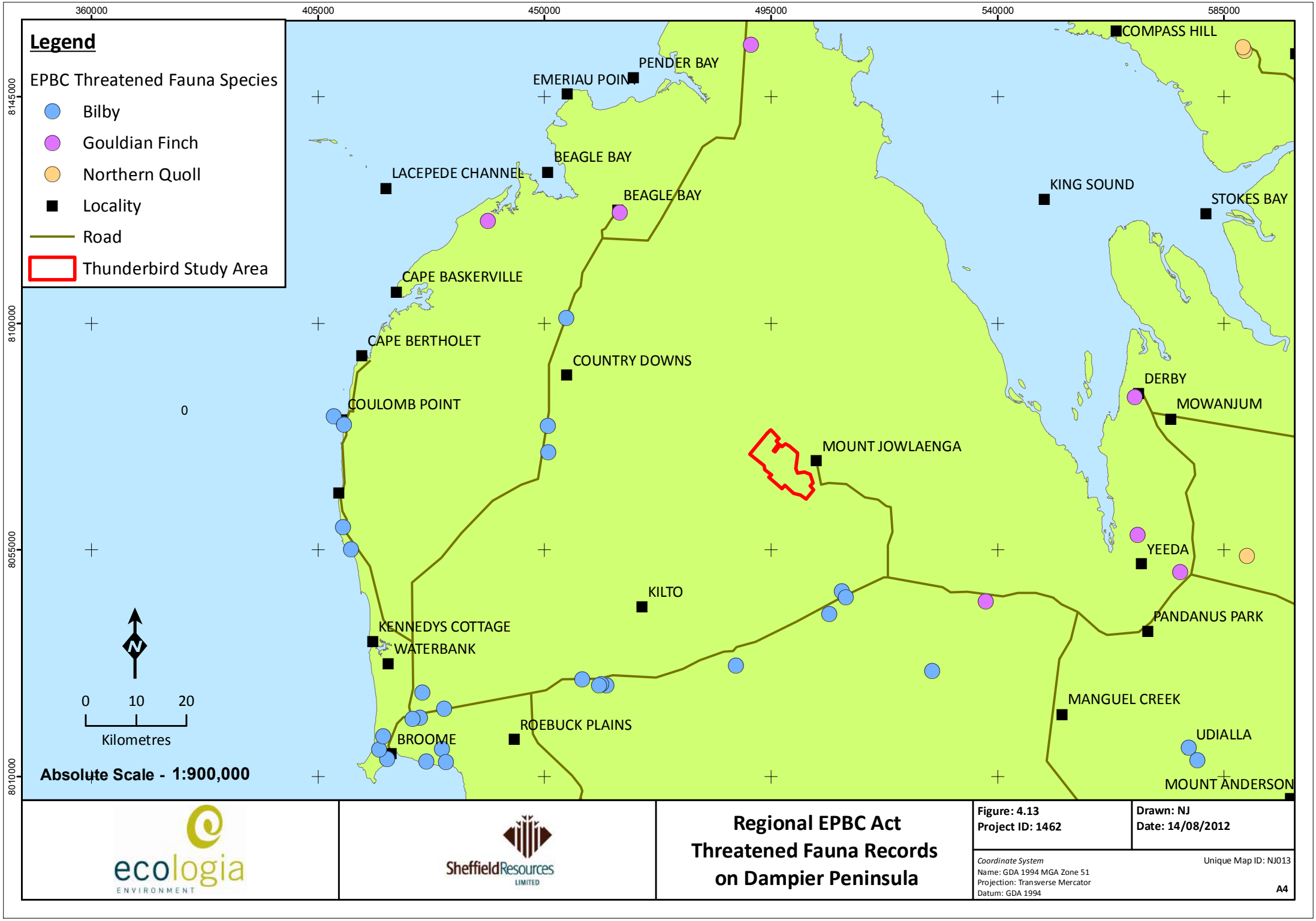
Figure: 4.1H
Project ID: 1462

Drawn: NJ
Date: 06/07/2012

Coordinate System
Name: GDA 1994 MGA Zone 51
Projection: Transverse Mercator
Datum: GDA 1994

Unique Map ID: NJ009

A4



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Regional EPBC Act Threatened Fauna Records on Dampier Peninsula

Figure: 4.13
Project ID: 1462

Drawn: NJ
Date: 14/08/2012

Coordinate System
Name: GDA 1994 MGA Zone 51
Projection: Transverse Mercator
Datum: GDA 1994

Unique Map ID: NJ013

A4

4.5 FAUNA HABITATS

The habitat assessment revealed three main fauna habitat types within the Study Area:

- Rocky Hills;
- Pindan Plains;
- Savannah Woodlands;

The habitats of the Study Area are described below, mapped in Figure 4.18, with area calculations of habitats within the Study Area displayed in Table 4.13

Table 4.13 – Fauna Habitat area Calculations of the Study Area.

Habitat	Area in Study Area (ha)	% of Study Area
Rocky Hills	1199.83	15.78
Pindan Plains	1610.09	21.18
Savannah Woodlands	4792.88	63.04

4.5.1 Rocky Hills

Rocky Hills within the Study Area are associated with the Reeves Land System, and are characterised by sparse *Corymbia dendromerinx* over moderately dense *Acacia drepanocarpa* subsp. *latifolia* over a ground vegetation layer of dense *Triodia caelestialis* hummock grassland and *Sorghum plumosum* tussock grassland on rocky hilltops, slopes, gullies and outcrops.

Reptile species expected to favour this habitat include the skinks *Ctenotus pantherinus*, *Ctenotus inornatus* and *Carlia munda*, the goannas *Varanus brevicauda* (Short-tailed Pygmy Monitor) and *Varanus tristis* (Black-headed Monitor), the dragon *Pogona minor* (Dwarf Bearded Dragon), the geckos *Diplodactylus conspicillatus* (Fat-tailed Gecko) and *Lucasium stenodactylum*, the snakes *Aspidites melanocephalus* (Black-headed Python), *Suta punctata* (Little Spotted Snake) and *Pseudechis australis* (Mulga Snake).

Bird diversity within the Study Area is lowest in this habitat, due to the dry, open nature of the vegetation. However, this habitat provides foraging opportunities for raptors, and during flowering periods, many honeyeaters species will be present. The Little Woodswallow is likely to nest locally on the faces of large rock outcrops. Of conservation signifance, the Australian Bustard and Rainbow Bee-eater are likely to occur in this habitat, with potential for the latter to nest along drainage lines.

Crevices and small caves in large rock outcrops may provide roosting opportunities for several bat species, including the Northern Freetail Bat. The Common Rock-rat is expected to occur in large outcrops, and major crevices and overhangs will provide shelter for the Euro.

During the Level 1 Survey, the burrowing skink *Lerista apoda* was recorded under a sandstone rock within the Rocky Hills habitat. This species was previously only known from sandy coastal habitats on the Dampier Peninsula, and may represent an inland range extension of approximately 85 km.

Figure 4.14 – The Burrowing Skink *Lerista apoda* Recorded During the Level 1 Survey in Rocky Hills.

Figure 4.15 – Representative Photo of Rocky Hills Habitat Type.

4.5.2 Pindan plains

Pindan Plains within the Study Area are associated with the Yeeda and Fraser Land Systems, and are characterised by scattered *Corymbia greeniana* over a moderately dense to dense shrub layer consisting primarily of *Acacia tumida* var *tumida*, *Acacia platycarpa* and *Grevillea refracta* on weak orange to red sandy soils. The ground vegetation layer consists of a mix of grasses including *Triodia caelestialis*, *Aristida holathera* var *holathera*, *Crysopogon* sp., *Eriachne obtusa* and *Sorghum plumosum*.

Reptile species expected to favour this habitat include the skinks *Eremiascincus isolepis*, *Ctenotus pantherinus*, *Ctenotus inornatus* and *Carlia munda*, the dragons *Diporiphora pindan* and *Pogona minor* (Dwarf Bearded Dragon), the monitor *Varanus gouldii* (Sand Goanna), the geckos *Strophurus ciliaris* and *Lucasium stenodactylum*, and the snakes *Aspidites melanocephalus* (Black-headed Python), *Brachyurophis roperi* and *Pseudechis australis* (Mulga Snake).

A diverse range of bird species are expected to occur within this habitat, including the Red-backed Fairy-wren, Long-tailed Finch, Little Friarbird, Red-winged Parrot, Budgerigar and Zebra Finch. Of conservation signifance, the Australian Bustard, Rainbow Bee-eater and Bush Stone-curlew are likely to be common within this habitat.

Due to the weak soil substrate, a number of small burrowing mammals are likely to occur. The Bilby (EPBC Act Vulnerable), Western Chestnut Mouse and Lesser Hairy-footed Dunnart may occur in this habitat. The Euro and Northern Nailtail Wallaby are both likely to occur throughout the Study Area in this habitat.

Figure 4.16 – Representative Photo of Pindan Plains Habitat Type.

4.5.3 Savannah woodlands

Savannah woodlands within the Study Area are associated with the Wanganut Land System, and are characterised by scattered *Corymbia greeniana* over a ground vegetation layer of *Eriachne obtusa* tussock grassland and *Triodia caelestialis* hummock grassland on firm clay soils, often with the presence of large termite mounds.

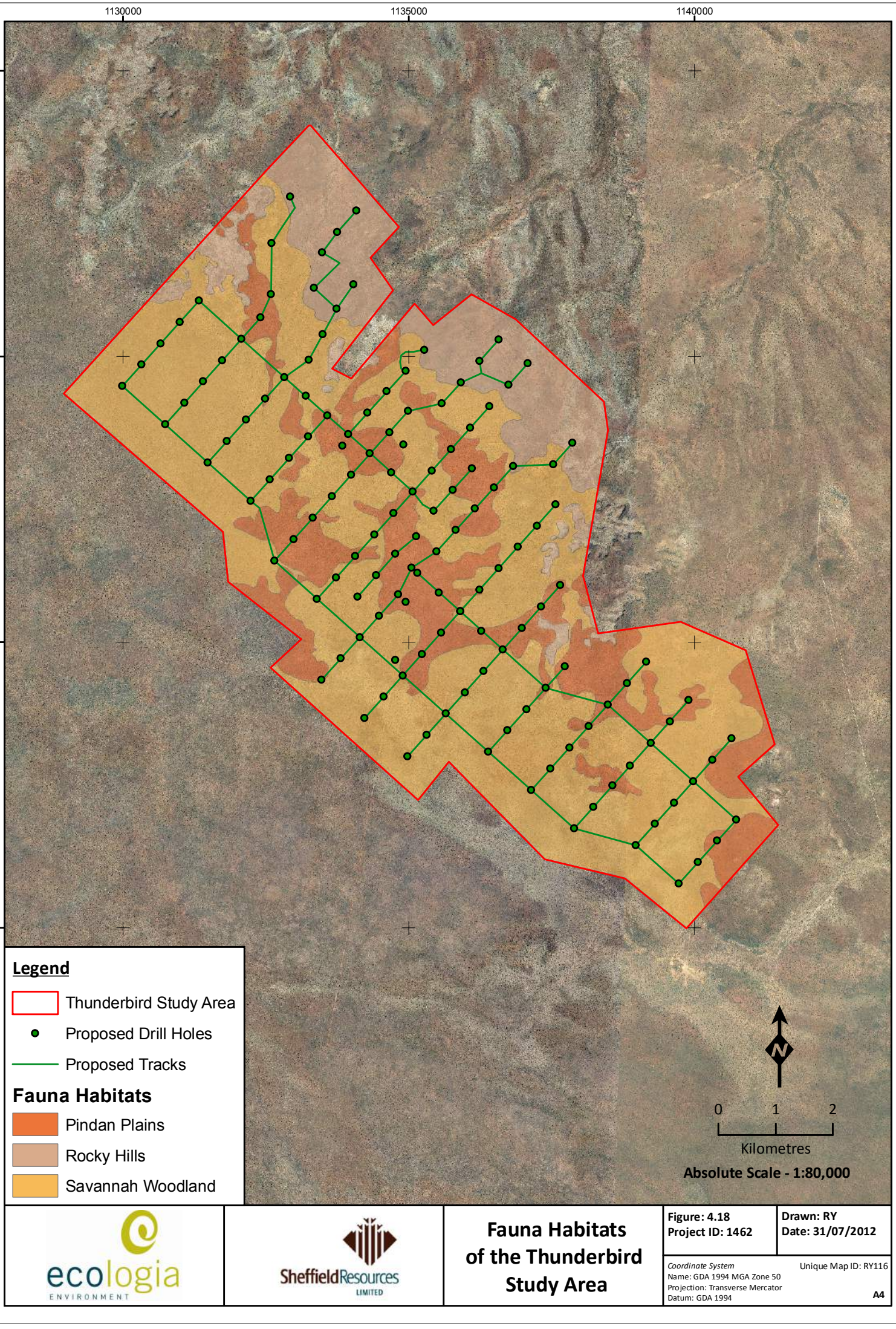
Reptile species expected to favour this habitat include the skinks *Cryptoblepharus ruber*, *Ctenotus inornatus* and *Carlia munda*, the dragons *Chlamydosaurus kingii* (Frilled Lizard) and *Pogona minor* (Dwarf Bearded Dragon), the monitor *Varanus gouldii* (Sand Goanna), the geckos *Diplodactylus conspicillatus* and *Lucasium stenodactylum*, and the snakes *Aspidites melanocephalus* (Black-headed Python), *Demansia angusticeps* and *Pseudechis australis* (Mulga Snake).

A diverse range of bird species are expected to occur within this habitat, including the Red-tailed Black-cockatoo, Red-winged Parrot, Varied Lorikeet, Rufous Songlark, Double-barred Finch, Australian Owlet-nightjar and Southern Boobook. Several species of raptor may nest and forage in

this habitat. Of conservation signifance, the Australian Bustard, Rainbow Bee-eater, and Gouldian Finch (EPBC Act Endangered) may occur in this habitat.

Mammal species expected to occur within this habitat include grassland generalists such as the Delicate Mouse, Euro, Northern Nailtail Wallaby and Dingo. Several bat species that roost in tree hollows are likely to occur, including Gould's and Hoary Wattled Bats, Little Broad-nosed Bats and Northern Freetail Bats.

Figure 4.17 – Representative Photo of Savannah woodlands Habitat Type.



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Fauna Habitats of the Thunderbird Study Area

Figure: 4.18	**Drawn: RY**
Project ID: 1462	**Date: 31/07/2012**

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

Unique Map ID: RY116

A4

Table 4.14 – Conservation Significant Fauna Occurring or Potentially Occurring in the Study Area.

Species	Conservation Significance			Habitat	Previous Records	Likelihood of Occurrence
	EPBC Act	WC Act	DEC			
Mammals						
Northern Quoll *Dasyurus hallucatus*	EN	S1	EN	Rocky areas, also eucalypt forest and woodland.	Not previously recorded on the Dampier Peninsula, but has been recorded in similar habitat to that present, 90 km east of the Study Area in 2001 (NatureMap)	**LOW** Some suitable habitat in rocky hills, but not previously recorded on Dampier Peninsula.
Bilby *Macrotis lagotis*	VU	S1	VU	Variety of habitats on soft soil, including spinifex grassland, acacia shrubland, open woodland, and cracking clays.	Numerous records within 100 km of Study Area (NatureMap), including eight records within 20 km of tenement E0402083 (DEC Rare Fauna Search), the most recent record being from 1996.	**MEDIUM** Extensive suitable habitat occurs within the Study Area. However, threats including soil degradation due to livestock combined with high fire frequency may inhibit the Bilby's occurrence.
Crest-tailed Mulgara *Dasycercus cristicauda*	VU	S1	VU	Sandy areas predominately on the top of sand dunes at the base of large Canegrass clumps or Nitre Bush hummocks.	Not previously recorded within 100 km of the Study Area (NatureMap)	**LOW** No suitable habitat. Not previously recorded within 100 km of the Study Area.
Golden Horseshoe Bat *Rhinonicteris aurantius*	VU	S1	VU	Roost in caves with high humidity (95%) and temperature (32 °C). Forage along waterbodies with fringing vegetation.	No previously recorded within 100 km of Study Area (NatureMap).	**LOW** No potential roost caves. Not previously recorded on Dampier Penisula.
Northern Leaf-nosed Bat *Hipposideros stenotis*			P2	Sandstone caves.	Recorded at Derby, 65 km east of Study Area (NatureMap)	**LOW** No potential roost caves. Not previously recorded on Dampier Penisula.
Yellow-lipped Cave Bat *Vespadelus douglasorum*			P2	Tropical woodlands of West Kimberley	Recorded near Beagle Bay, approximately 45 km north of Study Area (NatureMap).	**LOW** No potential roost caves. Rarely recorded on Dampier Peninsula.

Species	Conservation Significance			Habitat	Previous Records	Likelihood of Occurrence
	EPBC Act	WC Act	DEC			
Ghost Bat *Macroderma gigas*			P4	Caves, rockpiles and abandoned mines.	Not previously recorded on Dampier Peninsula (NatureMap)	**LOW** No potential roost caves. Not previously recorded on Dampier Penisula.
Birds						
Gouldian Finch *Erythrura gouldiae*	EN	S1	EN	Tropical savannas; breed in rocky hills with hollow-bearing eucalypts near water.	Regularly recorded near Cape Leveque, 100 km north of Study Area (NatureMap).	**MEDIUM** Suitable habitat occurs within the Study Area. However, known from very few locations on Dampier Peninsula.
Fork-tailed Swift *Apus pacificus*	M	S3		Almost entirely aerial, particularly associated with storm fronts.	Recorded 80 km west of the Study Area at James Price Point (*ecologia* internal database). Numerous records throughout Dampier Peninsula (NatureMap).	HIGH A relatively common summer migrant in the northwest of Australia that will occasionally forage in the aerial space above the Study Area.
Eastern Great Egret *Ardea modesta*	M	S3		Floodwaters, rivers, shallows of wetlands, intertidal mud-flats.	Numerous records throughout the Dampier Peninsula (NatureMap).	**LOW** Very little suitable habitat, but may occur during the wet season in flooded depressions.
Glossy Ibis *Plegadis falcinellus*	M	S3		Shallows and adjacent flats of freshwater lakes and swamps; river pool; flooded samphire; sewage ponds. Nest in freshwater/brackish wetlands with tall, dense stands of emergent vegetation and low trees or bushes.	Recorded throughout the southern Dampier Peninsula, including a record 20 km east of the Study Area (NatureMap).	**LOW** Very little suitable habitat, but may occur during the wet season in flooded depressions.
Cattle Egret *Ardea ibis*	M	S3		Grassy habitats and wetlands, particularly damp pastures.	Recorded approximately 37 km south-west, and 65 km east (Derby) of Study Area (NatureMap).	**LOW** Very little suitable habitat, but may occur during the wet season in open flooded depressions.

Species	Conservation Significance			Habitat	Previous Records	Likelihood of Occurrence
	EPBC Act	WC Act	DEC			
White-bellied Sea-Eagle *Haliaeetus leucogaster*	M	S3		Coastal and near coastal water bodies.	Numerous records approximately 37 km south-west, and 68 km south-east of Study Area (NatureMap).	**LOW** Very little suitable habitat, but may occur during the wet season in open flooded depressions.
*shorebirds	M	S3		Open plains, coastal and freshwater lakes, swamps, rivers, mudflats, flooded grasslands	Most shorebirds listed are regularly recorded in the coastal regions of the Dampier Penisula, with infrequent records from inland swamps, lakes and rivers (NatureMap).	**LOW** Little suitable habitat within the Study Area for shorebird species.
Rainbow Bee-eater *Merops ornatus*	M	S3		Open country, most vegetation types, dunes, banks.	Numerous records throughout the Dampier Penisula (NatureMap).	**RECORDED** This species was recorded throughout the Study Area during the Level 1 Survey. Some nesting habitat present along drainage lines.
Barn Swallow *Hirundo rustica*	M	S3		Open country, agricultural land, especially near water.	Recorded approximately 37 km south-west, and 65 km east (Derby) of Study Area (Birdata)	**LOW** Little suitable habitat within the Study Area.
Eastern Osprey *Pandion cristatus*	M			Mangroves, rivers, estuaries, inland seas, coastal islands.	Recorded approximately 37 km south-west, and 68 km south-east of Study Area (Birdata).	**LOW** Little suitable habitat within the Study Area.
Peregrine Falcon *Falco peregrinus*		S4		Coastal cliffs, riverine gorges and wooded watercourses.	Recorded approximately 37 km south-westof Study Area (NatureMap).	**LOW** Little suitable habitat within the Study Area.
Grey Falcon *Falco hypoleucos*			P4	Lightly wooded coastal and riverine plains.	Two records approximately 37 km south-west, and 68 km south-east of Study Area (NatureMap).	**LOW** Little suitable habitat within the Study Area.

Species	Conservation Significance			Habitat	Previous Records	Likelihood of Occurrence
	EPBC Act	WC Act	DEC			
Australian Bustard *Ardeotis australis*			P4	Open grasslands, chenopod flats and low heathland.	Numerous records in southern Dampier Peninsula, including the nearest record of 35 km east of Study Area (NatureMap).	**RECORDED** This species was recorded on three occasions during the survey. Extensive suitable habitat occurs throughout.
Masked Owl (*Tyto novaehollandiae*)			P4	Forest, woodland, caves, mature trees with hollows.	Not recorded within 100 km of Study Area (NatureMap)	**LOW** Little suitable habitat within the Study Area. Not known from Dampier Peninsula.
Bush Stone-curlew *Burhinus grallarius*			P4	Lightly wooded country next to daytime shelter of thickets or long grass.	Several records approximately 37 km south-west, and 68 km south-east of Study Area (NatureMap).	**RECORDED** This species was recorded on one occasion during the survey. Extensive suitable habitat occurs throughout.
Star Finch (western) *Neochmia ruficauda subclarescens*			P4	Vegetation around watercourses, particularly thick reed beds.	Recorded approximately 35 km east, and 82 km south-east of Study Area (NatureMap).	**LOW** Little suitable habitat within the Study Area.
Reptiles						
Salt-water Crocodile *Crocodylus porosus*		S4	Other	Tidal rivers, coastal floodplains and channels, billabongs and swamps up to 150 km inland.	Not recorded away from coast on Dampier Peninsula, with scare records in the region (NatureMap)	**LOW** No suitable habitat within the Study Area.
Lerista separanda			P2	Sandy areas.	Several records along the north-west coast of the Dampier Peninsula, all greater than 85 km from Study Area (NatureMap).	**LOW** Little suitable habitat within the Study Area.
Simoselaps minimus			P2	Coastal dunes or sandy areas between dunes and adjacent acacia shrublands.	Five records within 100 km of Study Area, all coastal between Broome and Beagle Bay (NatureMap)	**LOW** No suitable habitat within the Study Area.

* Refer to Appendix F for complete list of migratory-listed shorebird species of the families Charadriidae, Rostratulidae, Scolopacidae, Glareolidae, and Laridae.
Note: Description of conservation significant codes provided in Appendix A.

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5 DISCUSSION

5.1 VEGETATION COMMUNITIES CONSERVATION ASSESSMENT

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

5.1.1 Vegetation of National and State significance

Currently, there are no nationally listed TECs listed under the EPBC Act, nor state listed TECs or PECs listed under the WC Act that occurs within the Study Area.

5.1.2 Vegetation of Regional Significance

Regional significance addresses the representation of species and habitats at a biogeographic regional level. Species or habitat types that are endemic to the Dampierland bioregion and with limited or unknown distributions are considered regionally significant.

Regional conservation significance of the vegetation communities of the Study Area has been assessed based upon two sources of information; land systems (Van Vreeswyk *et al.* 2004) and the digitised dataset of native vegetation (Shepherd *et al.* 2001) which reinterpreted Beard's (1975) vegetation mapping. These are the only broad-scale mapping projects that have been conducted in the vicinity of the Study Area from which the regional extent of each vegetation unit mapped at this scale can be quantified.

Based on the regional distribution (as discussed in Sections 5.1.2.1 and 5.1.2.2 below), it is considered that the vegetation communities recorded in the Study Area are fairly widespread throughout the Kimberley bioregion and have low-medium conservation significance.

5.1.2.1 Land System Analysis

At a regional level, four land systems occur within the Thunderbird Study Area. The Study Area contains a very small proportion of these systems within Dampierland and development of the Thunderbird project is unlikely to affect Fraser, Waganut or Yeeda lands systems at a regional scale.

The Reeves Landsystem (sand plain with scattered hills and minor plateaux, reddish sandy soils, pindan) runs as a band along the north-eastern boundary of the Study Area. The total area of this landsystem that occurs within the Dampier Peninsula is 44,794 ha, of which 7.5% occurs within the Thunderbird Study Area.

5.1.2.2 Analysis of Shepherd *et al.* Dataset

The Study Area is comprised of Shrublands, pindan; *Acacia tumida* shrubland with grey box and cabbage gum medium woodland over ribbon grass and curly spinifex (750); Hummock grasslands, shrub steppe; *Acacia eriopoda* over soft spinifex (751) and Shrublands, pindan; *Acacia eriopoda* & *A. tumida* shrubland with scattered low *Eucalyptus confertifolia* over curly spinifex (762). While vegetation unit 750 is covers vast areas in Dampierland, almost 10 % of vegetation units 751 and 762 occur within the Study Area.

5.1.3 Vegetation of Local Significance

5.1.3.1 Assessment of the riparian vegetation

The creeklines of the Thunderbird Study Area have been identified by the Traditional Owners as areas that have environmental cultural significance and a 2 km buffer surrounding each creekline has been suggested. The multi-variate analysis of the quadrats and derived vegetation communities from the current survey did not distinguish these creeklines as vegetation units separate from the surrounding vegetation. *Eucalyptus camaldulensis* and *E. victrix* are two key phreatophytic species sometimes found along drainage lines that are dependent on ground water; these were not present on the drainage lines surveyed within the current survey.

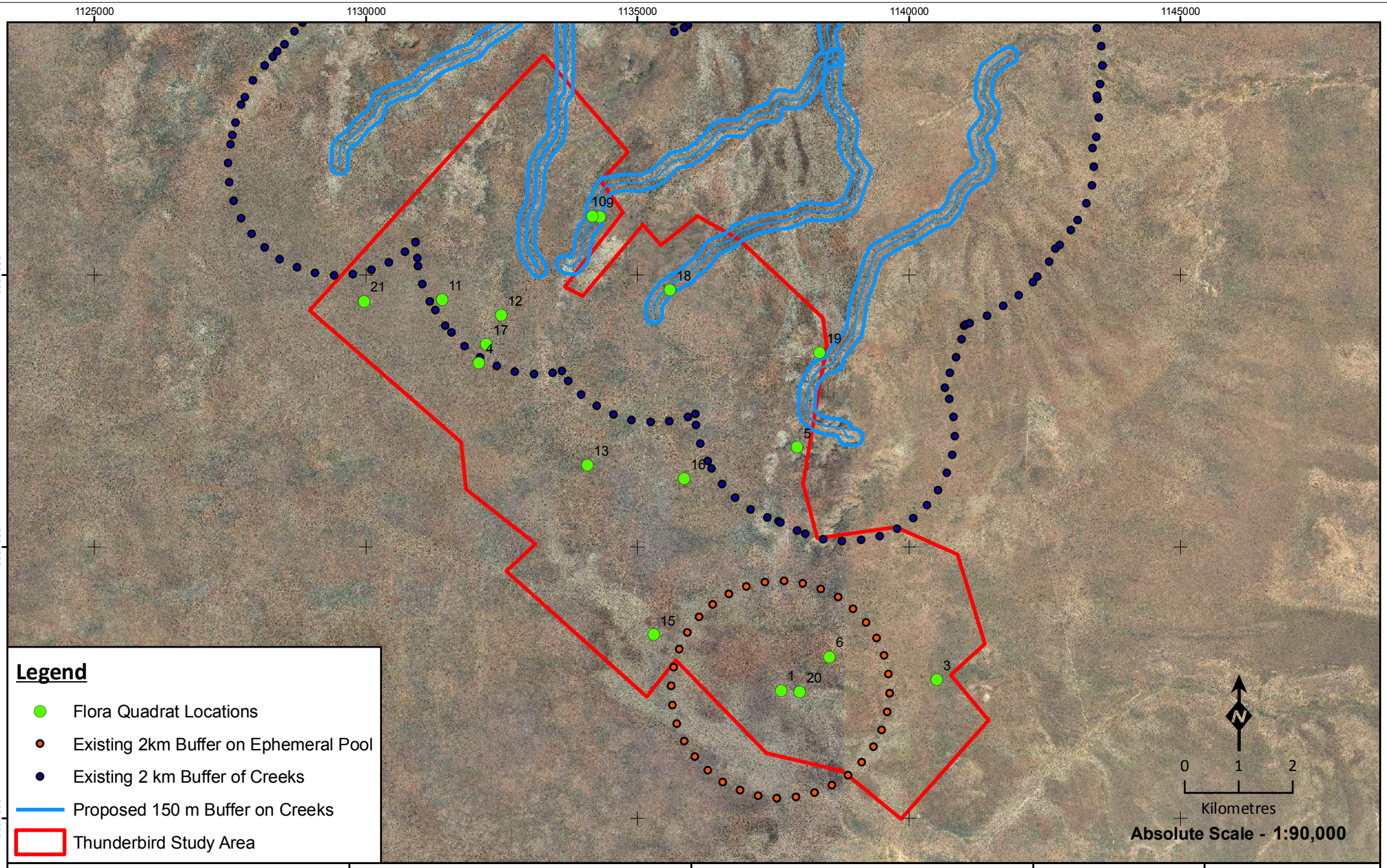
The current drilling program is non-intensive, with the drilling holes separated from each other by ca. 500-1000 m, and as the soils of the Thunderbird Study Area are sand-based soils it is anticipated that the drill holes will collapse following drilling and not affect the drainage or alter the water table. To avoid the extracted sediments from being washed into surrounding drainage lines, samples should either be replaced or collected with no extracted soil left on the surface. To avoid disturbance to the drainage lines in the current drilling program it is recommended that buffer zones of 150 m from the drainage lines would be sufficient to avoid disturbance to the creekline vegetation composition, structure and function.

5.1.3.2 Assessment of the ephemeral pool

The vegetation of the ephemeral pool was dominated by low *Melaleuca viridiflora*, over dense tussock grassland (*Sacciolepis indica*, *Sorghum plumosum*, *Fruiena ciliaris*) and herbs (*Byblis* filifolia. and *Drosera* indica) (EtMvSi). *Melaleuca*'s are known phreatophytic species that rely on the groundwater at least some of the year for survival. This temporary pool vegetation unit appears to be localised with a gradation to the vegetation unit MnMvAcEoTc, Sparse *Corymbia greeniana* over *Melaleuca nervosa* or *M. viridiflora* over *Acacia colei* var. *colei* over *Eriachne obtusa* tussock grassland and *Triodia caelestialis* hummock grassland over a distance of approximately 250 m. The current drilling program maintains a buffer zone of 2 km from the temporary pool and should be adequate to ensure that there is no adverse impact to this vegetation unit.

5.1.3.3 Assessment of the Phreatophytic vegetation units

As discussed in Section 5.1.3.2, *Melaleuca*'s are known to be phreatophytic (groundwater dependent) species. The impact to the *Melaleuca* vegetation communities (EtMvSi and MnMvAcEoTc) from the current drilling program should be minimal given that the drilling program is of low intensity and the soils appear to be mostly sandy and thought to collapse rapidly following drilling. The impact to these vegetation units from an altered water table if the Thunderbird project is developed could be assessed through a seperate hydrological survey.



ecologia ENVIRONMENT

Sheffield Resources LIMITED

Buffer Zones on Significant Locations within the Study Area

Figure:5.1
Project ID: 1462

Drawn: RY
Date: 04/07/2012

Coordinate System
Name: GDA 1994 MGA Zone 51
Projection: Transverse Mercator
Datum: GDA 1994

Unique Map ID: RT106

A4

5.2 FLORA CONSERVATION ASSESSMENT

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

5.2.1 Flora of National and State Conservation Significance

National significance refers to those features of the environment which are recognised under legislation as being of importance to the Australian community; in particular, species 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 DRF under the WC Act are of state significance.

No flora of national or state significance was recorded in the Study Area.

5.2.2 Flora of Regional and Local Conservation Significance

Regional significance addresses the representation of habitats at a biogeographic regional level. Priority Flora taxa that are endemic to the Kimberley bioregion, and whose distributions are limited or unknown, are considered regionally significant.

Flora 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.

Three Priority taxa were recorded by *ecologia* within the Study Area.

Table 5.1 summarises the known distribution and abundance of these taxa from all sources, including DEC records. As a dominant species in most of the vegetation groups, *Triodia caelestialis* was recorded throughout the Study Area in high percentage covers. Previously, this species was only known from three records in the central and western Kimberely and on the very eastern edge of Dampierland. *Triodia caelestialis* has been recently described (2008) and is thought to occur widely in the Thunderbird area. A regional survey for this species would assist in determining its extent in the eastern Dampier Peninsula.

Eriachne sp. Dampier Peninsula is restricted to the Dampierland bioregion based on current records. One taxon, *Pterocaulon intermedium,* has been recorded within the King Leopold Conservation Park

Table 5.1 – Regional Distribution of Priority Flora Recorded during the Current Survey

Species	Status	Number of locations recorded in this study	Number of other records regionally (AVH)	Bioregions in which Recorded	Records within Con. Estate	Recorded abundance elsewhere
Pterocaulon intermedium	P3	1	12	PIL, DL, NK, CK	1	n/a
Eriachne sp. Dampier Peninsula (K.F. Kennealy 5946)	P3	3	8	DL	0	Scattered on Pindan plains
Triodia caelestialis	P3	15	3	CK, DL, NK	0	n/a

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).

As detailed in Table 4.7, the collections for 11 taxa are range extensions of more than 100 km from any collection previously lodged with the Western Australian Herbarium: *Heliotropium dichotomum*, *Fimbristylis simulans*, *Acacia drepanocarpa* subsp. *latifolia*, *Tephrosia forrestiana*, *Rotala occultiflora*, *Stemodia lythrifolia*, *Cenchrus elymoides*, *Triodia caelestialis*, *Triodia intermedia*, *Polygala linariifolia* and *Trichodesma zeylanicum* var. *zeylanicum*.

5.3 CONSERVATION SIGNIFICANT FAUNA WITH A MEDIUM OR HIGH LIKELIHOOD

5.3.1 Mammals

5.3.1.1 Bilby (*Macrotis lagotis*)

Conservation Status: EPBC Act Vulnerable, WC Act Schedule 1 (Vulnerable).

Distribution and Habitat: Once common over 70% of mainland Australia's arid and semiarid regions, Bilbies are currently patchily distributed through the Tanami, Great Sandy and Gibson Deserts (Maxwell *et al.* 1996). Isolated populations also occur in south-west Queensland and to the north-east of Alice Springs. Bilbies occur in a variety of habitats, including spinifex grassland, acacia shrubland, open woodland and cracking clays (Maxwell *et al.* 1996; Johnson 2008). The species underwent a sudden and widespread collapse in population size in the early 1900s, and the distribution may still be contracting and fragmenting. Reasons for the decline include predation by feral predators on both young and adult bilbies, competition from rabbits and livestock, reduced food as a result of changed fire regimes, and drought (Maxwell *et al.* 1996; O'Malley 2006a; Johnson 2008).

Ecology: The Bilby is a nocturnal marsupial with soft, silky fur (Pavey 2006). It uses its strong forelimbs and claws to construct an extensive tunnel system of up to 3 m long and 1.8 m deep in which it shelters during the day. Its long tongue is an adaptation to its specialised diet of seeds, insects, bulbs, fruit and fungi (Johnson 2008).

Likelihood of Occurrence: MEDIUM – There is a medium likelihood of the Bilby occuring based on the number of existing records within 20 km of the Study Area, as well as the presence of extensive shrubland with soft soils suitable for burrowing. However, due to high fire frequencies, in combination with soil trampling from cattle, the Bilby may now be very rare or extirpated from the local area, as indicated by a lack of records since 1996 (DEC Rare Fauna Database).

5.3.2 Birds

5.3.2.1 Gouldian Finch (*Erythrura gouldiae*)

Conservation Status: EPBC Act Endangered, WC Act Schedule 1 (Endangered)

Distribution and Habitat: The Gouldian Finch was formally distributed throughout the tropical savannas of northern Australia. It is now restricted to isolated areas mostly within the Northern Territory and the Kimberley region of Western Australia (Woinarski and Palmer 2006). Known breeding habitat is characterised by rocky hills with hollow-bearing, smooth-barked gums that are close to small waterholes or springs that persist through the dry season (O'Malley 2006b).

Ecology: Gouldian finches forage on the ground, feeding on seeding grasses, particularly native *Sorghum* spp. (Pizzey and Knight 2003). Due to the restricted diet of Gouldian Finches, they are particularly vulnerable to seed shortages (O'Malley 2006b). The decline in populations of the Gouldian Finch is representative of the general decline of granivorous birds occurring as a result of current land management practices. Ongoing key threats to the Gouldian Finch are vegetation change through inappropriate fire regimes, and grazing impacts of stock and feral herbivores (O'Malley 2006b).

Likelihood of Occurrence: MEDIUM – The Gouldian Finch is regularly recorded at Cape Leveque on the Dampier Peninsula, approximately 100 km north of the Study Area. However, suitable habitat exists throughout the Study Area, and as this species is additionally found to the east of the Study Area, inland from Derby, it may infrequently occur.

5.3.2.2 Fork-tailed Swift *(Apus pacificus)*

Conservation Status: EPBC Act Migratory, WC Act Schedule 3

Distribution and Habitat: The Fork-tailed Swift is a small insectivorous species with a white throat and rump and a deeply forked tail (Morcombe 2000). It is distributed from central Siberia and throughout Asia, breeding in north-east and mid-east Asia, and wintering in Australia and south New Guinea. It is a relatively common trans-equatorial migrant from October to April throughout mainland Australia (Simpson and Day 2004). In Western Australia the species begins to arrive in the Kimberley in late September, the Pilbara in November and in the South-west by mid-December (Johnstone and Storr 1998). In Western Australia, the Fork-tailed Swift is considered uncommon to moderately common near the north-west, west and south-east coasts, common in the Kimberley and rare or scarce elsewhere (Johnstone and Storr 1998).

Ecology: Fork-tailed swifts are nomadic in response to broad-scale weather pattern changes. They are attracted to thunderstorms where they can be seen in flocks, occasionally up to 2,000 birds. They rarely land, living almost exclusively in the air and feeding entirely on aerial insects, especially nuptial swarms of beetles, ants, termites and native bees (Simpson and Day 2004).

Likelihood of Occurrence: HIGH – Fork-tailed Swifts have been recorded throughout the Dampier Penisula during the austral summer months. It is very likely this species will utilise the aerial space

above the Study Area for foraging, particularly in response to changing weather, from October to April.

5.3.2.3 Rainbow Bee-eater (*Merops ornatus*)

Conservation Status: EPBC Act Migratory, WC Act Schedule 3

Distribution and Habitat: The Rainbow Bee-eater is scarce to common throughout much of Western Australia, except for the arid interior, preferring lightly wooded, preferably sandy, country near water (Johnstone and Storr 1998).

Ecology: In Western Australia the Rainbow Bee-eater can occur as a resident, breeding visitor, post-nuptial nomad, passage migrant or winter visitor. It nests in burrows usually dug at a slight angle on flat ground, sandy banks or cuttings, and often at the margins of roads or tracks (Simpson and Day 2004). Eggs are laid at the end of the metre long tunnel from August to January (Boland 2004). Bee-eaters are most susceptible to predation.

Likelihood of Occurrence: RECORDED – This species was recorded throughout the Study Area during the Level 1 Survey. Nesting was not recorded, although some drainage lines within the rocky hills may provide nesting opportunities for this widespread species.

Figure 5.2 – Rainbow Bee-eater (EPBC Migratory, WC Schedule 3) Recorded During the Survey.

5.3.2.4 Australian Bustard (*Ardeotis australis*)

Conservation Status: DEC Priority 4

Distribution and Habitat: The Australian Bustard is a large ground-dwelling bird that occurs Australia-wide and utilises a number of open habitats, including open or lightly wooded grasslands, chenopod flats, plains and heathlands (Johnstone and Storr 1998).

It is a nomadic species, ranging over very large areas and its abundance varies locally and seasonally from scarce to common, largely dependent on rainfall and food availability.

Ecology: The bustard has an omnivorous diet, feeding on grasses, seeds, fruit, insects and small vertebrates. Although the population size is still substantial, there has been a large historical decline in abundance, particularly south of the tropics, but also across northern Australia (Garnett and Crowley 2000). This is a result of hunting, degradation of its grassland habitat by sheep and rabbits and predation by foxes and cats (Frith 1976; Garnett and Crowley 2000). Bustards readily desert nests in response to disturbance by humans, sheep or cattle (Garnett and Crowley 2000).

Likelihood of Occurrence: **RECORDED** – This species was recorded on three occasions during the Level 1 Survey, in each of the three fauna habitats present. The Australian Bustard is expected to be a regularly occuring, widespread species within the Study Area.

Figure 5.3 – Australian Bustard (DEC Priority 4) Recorded During the Level 1 Survey.

5.3.2.5 Bush Stone-curlew (*Burhinus grallarius*)

Conservation Status: DEC Priority 4

Distribution and Habitat: The Bush Stone-curlew occurs across much of Australia, except the arid interior and central south coast, preferring lightly wooded country near thickets or long grass that act

as daytime shelter (Johnstone and Storr 1998). Historically, this species was widely distributed throughout much of WA, but it is now considered rare, with an estimated Australian population of 15,000 individuals (Garnett and Crowley 2000).

Ecology: The species is insectivorous, preying primarily upon beetles, although they will also eat seeds and shoots, frogs, lizards and snakes (Marchant and Higgins 1993; NSW National Parks and Wildlife Service 1999). They are usually seen in pairs, although may occasionally flock together during the breeding season (August to January) and are generally nocturnal, especially on moonlight nights (NSW National Parks and Wildlife Service 1999). Since Bush Stone-curlews are a ground dwelling and non-migratory species they are quite susceptible to local disturbances by humans and to predation by cats and foxes (Frith 1976; Johnstone and Storr 1998). Additional threats are altered fire regimes, degradation of habitat due to overgrazing by domestic stock as well as poisoning by eating pollard baits laid to control rabbits (NSW National Parks and Wildlife Service 1999). They are most common where land disturbance is minimal and generally become rare or extinct around human settlements (Johnstone and Storr 1998).

Likelihood of Occurrence: RECORDED – A Bush Stone-curlew was heard calling from the quarry camp after dusk, below the hill near the densly vegetated drainage line. It is likely this species occurs in similar habitat throughout the Study Area.

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6 FURTHER INVESTIGATIONS

This study has identified that forty flora species and six vertebrate fauna species of conservation significance could potentially occur within the Study Area. Further investigations required to assess the impacts to these species are recommended in order to support future Environmental Impact Assessment of a development proposal at Thunderbird. The information provided by these investigations will support future State and Commonwealth Environmental Impact Assessment processes.

6.1 STATE ASSESSMENT PROCESS

Mining activities require approval under the Mining Act 1978, by way of assessment of a Mining proposal by the Department of Mines and Petroleum (DMP). Approval is granted following DMP environmental assessment and; the issue of a Clearing Permit by the DEC, or the granting of Ministerial approval under Part IV of the Environmental Protection Act 1986.

The Western Australian *Environmental Protection Act 1986* provides that where a proposal is likely to have a significant effect on the environment, the proposal may be referred to the EPA for a decision on whether or not it requires formal assessment. The EPA then makes a decision on the level of assessment for the proposal, whether it be Public Environmental Review (PER) or Assessment on Proponent Information (API).

Projects are subject to API levels of assessment when sufficient information has been provided in the referral documentation enabling the EPA to make judgment on the acceptability of the project without further scrutiny. The API levels are further broken down into category A for projects that are more straightforward and category B for those that have unmanageable impacts.

A PER level of assessment is applied to complex projects, particularly those that arouse high levels of public interest. For projects that are subject to Public Environmental Review, the proponent is required to conduct a full environmental assessment of the project with form, content and timing stipulated by the EPA. The PER document is then released for a public environmental review period of between four and twelve weeks, also determined by the EPA depending on the significance of the proposal and the level of public interest. The whole PER process can take between 18 and 24 months to complete, if not longer. To conclude the process the Minister for the Environment determines whether, and in what manner, the proposal may be implemented, and legally binds the proponent to a set of ministerial conditions.

6.2 COMMONWEALTH ASSESSMENT PROCESS

Where a project or development is likely to have significant impact to matters of national environmental significance protected by the *Environmental Protection and Biodiversity Conservation Act 1999*, it must be referred to the Department of Sustainability, Environment, Water, Population and the Community (DSEWPaC) for assessment. The first stage of an EPBC assessment is the referral stage, which involves the submission of all known information on the proposed action to the department who review the information and release it for a ten day public comment period. The second stage is the assessment and decision stage where the department decides on the level of assessment for the proposed action, and once the relevant documentation is provided, the minister makes a final decision on whether or not to approve, approve with conditions or disapprove of the proposed action.

6.3 SHEFFIELD RESOURCES THUNDERBIRD DAMPIER PENINSULA PROJECT

Based on our knowledge of the current scale of the project, size of the proposed impact footprint and level of expected environmental impact, *ecologia* anticipates that the Thunderbird Project will potentially be assessed at the Mining Proposal level by the DMP. This level of assessment warrants the following level of biological surveys to allow adequate assessment.

It is recommended that Sheffield undertake:

- A single phase Level 2 Vertebrate Fauna Assessment which incorporates targeted conservation significant fauna surveys;
- A Level 2 Vegetation and Flora Assessment;
- A baseline Short-Range Endemic Fauna Assessment, and
- A baseline Subterranean Fauna Assessment for Troglofauna and Stygofauna.

If the level of assessment is increased due to unforeseen circumstances, additional phases of surveys can be implemented to compliment the above surveys, and raise the level of biological assessment to a level that would be acceptable for higher EPA level assessments.

There is also the potential need for referral under the EPBC Act, as several EPBC listed species may potentially occur in the Study Area. Species such as the Bilby and Gouldian Finch require specific targeted surveys that are conducted at specific times of the year. Results from the above surveys will clarify the need for these targeted surveys and *ecologia* will provide separate advice and proposals if EPBC listed species are recorded inside the Study Area.

7 REFERENCES

AECOM. 2010. Supplementary Terrestrial Fauna and Habitat Assessment: James Price Point, WA. Unpublished report for the Department of State Development.

Prepared by AECOM for Main Roads Western Australia. 2011. Browse LNG Precinct Access Road: Targeted Fauna Survey – Greater Bilby

Atkins, K. J. 2008. Declared Rare and Priority Flora List for Western Australia. Department of Environment and Conservation.

Bamford Consulting Ecologists 2011. Assessment of Birds Utilising Habitat within the Vine Thickets and Woodlands of James Price Point, WA. Field Report, May 2011. Unpublished Report Prepared for Woodside Energy Limited.

Beard, J. S. 1975. The vegetation of the Pilbara region. Explanatory notes to map sheet 5 of vegetation survey of Western Australia: Pilbara. University of Western Australia Press, Nedlands.

Beard, J. S. 1979. *Kimberley. The vegetation of the Kimberley area*. Vegetation Survey of Western Australia 1:1,000,000 series, explanatory notes and map. University of Western Australia Press, Nedlands, WA.

Biota Environmental Sciences. 2009. James Price Point Terrestrial Fauna Survey: Wet Season. Unpublished report for the Department of State Development.

Biota Environmental Sciences. 2010. James Price Point Browse LNG Precinct Targeted Terrestrial Fauna Survey. Unpublished report for ERM on behalf of Woodside.

Boland, C. R. J. 2004. Breeding biology of Rainbow Bee-eaters (Merops ornatus): a migratory, colonial, cooperative bird. The Auk. 121:811-823.

BoM. 2011. Climate Data Online, Bureau of Meteorology. Accessed http://www.bom.gov.au/climate/data/.

Bullen, R. D. and McKenzie, N. L. 2001. Bat airframe design: Flight performance, stability and control in relation to foraging ecology. Australian Journal of Zoology. 49:235-261.

Bullen, R. D. and McKenzie, N. L. 2002. Scaling bat wingbeat frequency and amplitude. The Journal of Experimental Biology. 205:2615-2626.

Bullen, R. D. and McKenzie, N. L. 2005. Seasonal range variation of *Tadarida australis* (Chiroptera: Molossidae) in Western Australia: the impact of enthalpy. Australian Journal of Zoology. 53:145-156.

Bunge, J. and Fitzpatrick, M. 1993. Estimating the number of species: A review. Journal of the American Statistical Association. 88:364-373.

CALM. 1999. Environmental weed strategy for Western Australia. Department of Conservation and Land Management, Government of Western Australia.

Christidis, L. and Boles, W. E. 2008. Systematics and Taxonomy of Australian Birds. CSIRO Publishing, Collingwood.

Churchill, S. 1998. Australian Bats. Reed New Holland, Sydney.

Cogger, H. G. 2000. Reptiles and Amphibians of Australia. Reed New Holland, Sydney.

Colwell, R. K. 2009. EstimateS: Statistical estimation of species richness and shared species from samples. Version 8.

Colwell, R. K. and Coddington, J. A. 1994. Estimating terrestrial biodiversity through extrapolation. Philosophical Transactions of the Royal Society (Series B). 345:101-118.

Department of Sustainability, Environment, Water, Population and Communities. 2009. Interim Biogeographic Regionalisation for Australia (IBRA), Version 6.1

ecologia Environment. 2004. Beagle Bay Big Tree Country Tropical Timber Plantation Project. Fauna Assessment Survey. Unpublished report for Tropical Timber Plantations Pty Limited.

ecologia. 2011. James Price Point: Light Industrial Area, Workers' Accommodation Camp and Southern Pipeline Terrestrial Vertebrate Fauna Assessment. Unpublished Report for Woodside Energy Limited.

ENV Australia. 2008. Perpendicular Head-North Head, Packer Island, Gourdon Bay and Coulomb-Quondong Vertebrate Fauna Assessment. Unpublished report for the Department of Industry and Resources.

2011. Browse Project Greater Bilby Survey of the James Price Point Area: Summary Report.

Environmental Protection Authority. 2002. Position Statement No. 3: Terrestrial Biological Surveys as an Element of Biodiversity Protection.

Environmental Protection Authority. 2004a. Guidance Statement No. 51: Terrestrial flora and vegetation surveys for environmental impact assessment in Western Australia.

Environmental Protection Authority. 2004b. Guidance Statement No. 56: Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia.

EPA and DEC. 2010. Technical Guide - Terrestrial Vertebrate Fauna Surveys for Environmental Impact Assessment.

Fowler, J. and Cohen, L. 1990. Practical Statistics for Field Biology, Wiley, Chichester, UK.

Frith, A. J. 1976. Reader's Digest Complete Birds of Australia. Reader's Digest, Sydney.

Garnett, S. T. and Crowley, G. M. 2000. The Action Plan for Australian Birds. Environment Australia, Canberra.

Gaston, K. J. 1996. Species richness: measure and measurement. In: Biodiversity, a biology of number and difference. Blackwell Science, Cambridge.

Graham, G. 2002. Dampierland 2 (DL2 – Pindanland subregion). Department of Conservation and Land Management, Perth, Western Australia.

Johnson, K. A. 2008. Bilby, *Macrotis lagotis*. pp. 191-193 *in* van Dyck, S., and Strahan, R., eds. The Mammals of Australia. Reed New Holland, Sydney.

Johnstone, R. E. and Storr, G. M. 1998. Handbook of Western Australian Birds, Volume I - Non-Passerines (Emu to Dollarbird). Western Australian Museum, Perth.

Kenneally, K. F., Edinger, D. C., and Willing, T. 1996. Broome and Beyond: Plants and People of the Dampier Peninsula, Kimberley, Western Australia. Department of Conservation and Land Management, Western Australia.

Marchant, S. and Higgins, P. J. 1993. Handbook of Australian, New Zealand and Antarctic Birds. Oxford University Press, Melbourne.

Maxwell, S., Burbidge, A. A., and Morris, K. D., eds. 1996. The 1996 Action Plan for Australian Marsupials and Monotremes. Wildlife Australia, Canberra.

Menkhorst, P. and Knight, F. 2011. *A Field Guide to the Mammals of Australia*. Oxford University Press, Melbourne.

Morcombe, M. 2000. Field Guide to Australian Birds. Steve Parish Publishing Pty Ltd, Archerfield, Australia.

National Health and Medical Research Council. 2004. Australian code of practice for the care and use of animals for scientific purposes.

NSW National Parks and Wildlife Service. 1999. Bush Stone-curlew *Burhinus grallarius* (Latham, 1801). NSW National Parks and Wildlife Service, Hurstville, NSW www.npws.nsw.gov.au,.

O'Malley, C. 2006a. Australian Threatened Species, Greater Bilby, *Macrotis lagotis*.

O'Malley, C. 2006b. National Recovery Plan for the Gouldian Finch (*Erythrura gouldiae)*. WWF-Australia, Sydney and Parks and Wildlife NT, Department of Natural Resources, Environment and the Arts, NT Government.

Pavey, C. 2006. Threatened Species of the Northern Territory: Greater Bilby *Macrotis lagotis in* Department of Natural Resources Environment and the Arts, ed. Parks and Wildlife Commission - Northern Territory Government.

Pizzey, G. and Knight, F. 2003. A Field Guide to the Birds of Australia. Harper Collins Publishers, Sydney.

Rogers, D., Hassell, C., Oldland, J., Clemens, R., Boyle, A., and Rogers, K. 2009. Monitoring Yellow Sea Migrants in Australia (MYSMA): North-western Australian shorebird surveys and workshops.

Shepherd, D. P., Beeston, G. R., and Hopkins, A. J. M. 2001. Native vegetation in Western Australia: Extent, type and status. Technical Report 249. Department of Agriculture, South Perth.

Shepherd, D. P., Beeston, G. R., and Hopkins, A. J. M. 2002. Native Vegetation in Western Australia. Technical Report 249. Department of Agriculture, Western Australia, South Perth.

Simpson, K. and Day, N. 2004. Field Guide to the Birds of Australia. Penguin Group, Camberwell.

Storr, G. M., Smith, L. A., and Johnstone, R. E. 1983. Lizards of Western Australia II: Dragons and Monitors. Western Australian Museum, Perth.

Storr, G. M., Smith, L. A., and Johnstone, R. E. 1990. Lizards of Western Australia III: Geckos and Pygopods. Western Australian Museum, Perth.

Storr, G. M., Smith, L. A., and Johnstone, R. E. 1999. Lizards of Western Australia I: Skinks. Western Australian Museum, Perth.

Storr, G. M., Smith, L. A., and Johnstone, R. E. 2002. Snakes of Western Australia. Western Australian Museum, Perth.

van Dyck, S. and Strahan, R. 2008. *The Mammals of Australia*. Reed New Holland, Sydney.

Van Vreeswyk, A. M. E., Payne, A. L., Leighton, K. A., and Hennig, P. 2004. An inventory and condition survey of the Pilbara region, Western Australia. Department of Agriculture Technical Bulletin. 92.

WAHERB. 2010. FloraBase - The Western Australian Flora. Department of Environment and Conservation.

Western Australian Herbarium. 1998-2012. FloraBase - The Western Australian Flora. Accessed December 2011. http://florabase.dec.wa.gov.au/.

Wilson, S. and Swan, G. 2010. *A Complete Guide to Reptiles of Australia*. New Holland Publishers, Sydney.

Woinarski, J. C. Z. and Palmer, C. 2006. Threatened Species of the Northern Territory: Gouldian Finch *Erythrura gouldiae*. Parks and Wildlife Commission - Northern Territory Government.

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APPENDIX A EXPLANATION OF CONSERVATION CODES

Appendix A1 – Definitions of relevant categories under the *Environment Protection and Biodiversity Conservation Act*.

Category	Definition
Endangered (EN)	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 (VU)	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.
Migratory (M)	Species are defined as migratory if they are listed in an international agreement approved by the Commonwealth Environment Minister, including: • the Bonn Convention (Convention on the Conservation of Migratory Species of Wild Animal) for which Australia is a range state; • the agreement between the Government of Australian and the Government of the Peoples Republic of China for the Protection of Migratory Birds and their environment (CAMBA); or • the agreement between the Government of Japan and the Government of Australia for the Protection of Migratory Birds and Birds in Danger of Extinction and their Environment (JAMBA).

Appendix A2 – Definition of Schedules under the *Wildlife Conservation Act 1950*.

Schedule	Definition
Schedule 1 (S1)	Fauna which are rare of likely to become extinct, are declared to be fauna that is in need of special protection.
Schedule 2 (S2)	Fauna which are presumed to be extinct, are declared to be fauna that is in need of species protection.
Schedule 3 (S3)	Birds which are subject to an agreement between the governments of Australia and Japan relating to the protection of migratory birds and birds in danger of extinction, are declared to be fauna that is in need of species protection.
Schedule 4 (S4)	Declared to be fauna that is in need of species protection, otherwise than for the reasons mentioned above.

Appendix A3 – Definition of Department of Environment and Conservation Priority Codes.

Threatened	**Definition**
Critically Endangered (CR)	Considered to be facing an extremely high risk of extinction in the wild.
Endangered (EN)	Considered to be facing a very high risk of extinction in the wild.
Vulnerable (VU)	Considered to be facing a high risk of extinction in the wild.
Priority	**Definition**
Priority 1 (P1)	*Taxa with few, poorly known populations on threatened lands.* Taxa which are known from few specimens or sight records from one or a few localities, on lands not managed for conservation, e.g. agricultural or pastoral lands, urban areas, active mineral leases. The taxon needs urgent survey and evaluation of conservation status before consideration can be given to declaration as threatened fauna.
Priority 2 (P2)	*Taxa with few, poorly known populations on conservation lands.* Taxa which are known from few specimens or sight records from one or a few localities, on lands not under immediate threat of habitat destruction or degradation, e.g. national parks, conservation parks, nature reserves, State forest, vacant crown land, water reserves, etc. The taxon needs urgent survey and evaluation of conservation status before consideration can be given to declaration as threatened fauna.
Priority 3 (P3)	*Taxa with several, poorly known populations, some on conservation lands.* Taxa which are known from few specimens or sight records from several localities, some of which are on lands not under immediate threat of habitat destruction or degradation. The taxon needs urgent survey and evaluation of conservation status before consideration can be given to declaration as threatened fauna.
Priority 4 (P4)	*Taxa in need of monitoring.* Taxa which are considered to have been adequately surveyed, or for which sufficient knowledge is available, and which are considered not currently threatened or in need of special protection, but could if present circumstances change. These taxa are usually represented on conservation lands.
Priority 5 (P5)	*Taxa in need of monitoring.* Taxa which are not considered threatened but are subject to a specific conservation program, the cessation of which would result in the species becoming threatened within five years.

Table A4 – 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 A5 – Definition of codes for Priority Ecological Communities

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.

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APPENDIX B FLORA QUADRAT DESCRIPTIONS

Quadrat 1

Botanist	Renee Tuckett
Quadrat Size	50 x 50 m
Easting	499677
Northing	8067413
Habitat and Waterway	Floodplain (Depression)
Slope	Gentle
Surface Layer	Loose
Soil Colour	White, Grey
Soil Texture	Sandy-Clay, Clay
Rock Type	No Rocks
Rock Size and Abundance	No Rocks - None
Vegetation Condition	Poor (moderate grazing, weeds)
Disturbance Type	Animal Tracks; Faeces
Time since Fire	> 5 years
Leaf Litter Distribution and Cover	Dispersed; 2**%**

Stratum	Taxa
Trees (<10 m)	*Eucalyptus tectifica; Melaleuca viridiflora*
Shrubs (>2 m)	*Acacia colei var. colei*
Shrubs (1-2 m)	*Bauhinia cunninghamii; Sida hackettiana*
Shrubs (<1 m)	*Stylosanthes hamata*
Herbs	*Asteraceae sp.; Blumea integrifolia; Buchnera asperata; Byblis filifolia; Chamaecrista mimosoides; Drosera indica; Eleocharis geniculata; Ludwigia perennis; Melochia corchorifolia; Mimulus uvedaliae var. lutea; Oldenlandia galioides; Phyllanthus virgatus; Rotala occultiflora; Stackhousia intermedia; Stemodia lathraia; Stylosanthes scabra; Thysanotus chinensis*
Sedges	*Cyperus ? conicus; Fimbristylis dichotoma; Lipocarpha microcephala*
Tussock Grasses	*Chrysopogon sp.; Digitaria bicornis; Eragrostis cumingii; Eriachne obtusa; Fuirena ciliaris; Sacciolepis indica; Sorghum plumosum*

Quadrat 3

Botanist	Renee Tuckett
Quadrat Size	50 x 50 m
Easting	502522
Northing	8067698
Habitat and Waterway	Plain
Slope	Negligible
Surface Layer	Loose
Soil Colour	Orange
Soil Texture	Sandy-Clay
Rock Type	No Rocks
Rock Size and Abundance	No Rocks - None
Vegetation Condition	Excellent (no obvious disturbance)
Disturbance Type	No Disturbance
Time since Fire	2-5 years
Leaf Litter Distribution and Cover	Dispersed; 75**%**

Stratum	Taxa
Trees (<10 m)	*Corymbia greeniana; Erythrophleum chlorostachys; Eucalyptus tectifica*
Shrubs (>2 m)	*Acacia platycarpa; Acacia tumida var. tumida; Bauhinia cunninghamii; Grevillea pyramidalis subsp. pyramidalis*
Shrubs (1-2 m)	*Acacia hippuroides; Brachychiton diversifolius subsp. diversifolius; Dodonaea hispidula var. arida; Ehretia saligna var. saligna; Grevillea refracta subsp. refracta*
Climbers	*Galactia tenuiflora*
Herbs	*Buchnera asperata; Byblis filifolia; Corchorus sidoides subsp. vermicularis; Crotalaria crispata; Galactia tenuiflora; Gomphrena canescens subsp. canescens; Microstachys chamelea; Pterocaulon sphacelatum*
Hummock Grasses	*Triodia caelestialis*
Tussock Grasses	*Aristida holathera var. holathera; Chrysopogon sp.; Cynodon dactylon; Eriachne obtusa; Sorghum plumosum*

Quadrat 4

Botanist	Renee Tuckett
Quadrat Size	50 x 50 m
Easting	493955
Northing	8073233
Habitat and Waterway	Plain
Slope	Negligible
Surface Layer	Loose, Crust
Soil Colour	Orange, Brown
Soil Texture	Sandy-Clay
Rock Type	Limestone
Rock Size and Abundance	Boulders - Few (<10%)
Vegetation Condition	Very Good (slight disturbance)
Disturbance Type	Animal Tracks; Grazing; Faeces
Time since Fire	> 5 years
Leaf Litter Distribution and Cover	Dispersed; 15**%**

Stratum	Taxa
Trees (<10 m)	*Indetermined; Terminalia sp.*
Shrubs (>2 m)	*Acacia monticola; Brachychiton diversifolius subsp. diversifolius; Grevillea pyramidalis subsp. pyramidalis; Grevillea refracta subsp. refracta; Santalum lanceolatum; Terminalia canescens*
Shrubs (1-2 m)	*Dodonaea hispidula var. arida*
Shrubs (<1 m)	*Acacia hippuroides; Sida spinosa; Tephrosia remotiflora; Triumfetta plumigera; Ventilago viminalis*
Climbers	*Dicliptera armata*
Herbs	*Buchnera asperata; Glycine tomentella; Gomphrena canescens subsp. canescens; Gomphrena flaccida; Heliotropium dichotomum; Hybanthus aurantiacus; Microstachys chamelea; Oldenlandia mitrasacmoides subsp. mitrasacmoides; Polycarpaea corymbosa; Polycarpaea longiflora; Pterocaulon sphacelatum; Ptilotus corymbosus; Waltheria indica; Zornia prostrata var. prostrata*
Sedges	*Fimbristylis simulans*
Hummock Grasses	*Triodia caelestialis*
Tussock Grasses	*Chrysopogon sp.; Eriachne ciliata; E. melicacea; Setaria apiculata; Sorghum plumosum*

Quadrat 5

Botanist	Renee Tuckett
Quadrat Size	50 x 50 m
Easting	499829
Northing	8071874
Habitat and Waterway	Hillslope - Ridgetop
Slope	Moderate, Steep
Surface Layer	Rocky/Stony
Soil Colour	Orange, Brown
Soil Texture	Sandy-Clay
Rock Type	Sandstone
Rock Size and Abundance	Stones, Boulders, Surface Plates - Continuous (>70%)
Vegetation Condition	Very Good (slight disturbance)
Disturbance Type	Animal Tracks
Time since Fire	2-5 years
Leaf Litter Distribution and Cover	Dispersed; 30**%**

Stratum	Taxa
Trees (<10 m)	*Corymbia dendromerinx; Eucalyptus tectifica; Ficus platypoda*
Shrubs (>2 m)	*Acacia platycarpa; Dolichandrone heterophylla; Grevillea refracta subsp. refracta; Indetermined; Terminalia canescens*
Shrubs (1-2 m)	*Acacia drepanocarpa subsp. latifolia; Atalaya hemiglauca; Atalaya variifolia; Calytrix exstipulata; Dodonaea hispidula var. arida; Dolichandrone heterophylla; Ehretia saligna var. saligna; Flueggea virosa subsp. melanthesoides; Indetermined; Premna acuminata*
Shrubs (<1 m)	*Corymbia dendromerinx; Grevillea pyramidalis subsp. pyramidalis; Premna acuminata; Solanum cunninghamii; Triumfetta breviaculeata*
Climbers	*Dicliptera armata; Glycine tomentella; Tinospora smilacina; Vigna lanceolata var. filiformis*
Herbs	*Bonamia linearis; Buchnera linearis; Crotalaria medicaginea var. neglecta; Gomphrena canescens subsp. canescens; Microstachys chamelea; Pterocaulon sphacelatum; Tephrosia remotiflora; Waltheria indica*
Sedges	*Cyperus microcephalus*
Tussock Grasses	*Cenchrus elymoides; Chrysopogon sp.; Cymbopogon procerus; Eriachne obtusa; Eriachne sp. Dampier Peninsula (K.F.Kenneally 5946); Sorghum plumosum*

Quadrat 6

Botanist	Renee Tuckett
Quadrat Size	50 x 50 m
Easting	500544
Northing	8068052
Habitat and Waterway	Plain
Slope	Negligible
Surface Layer	Loose
Soil Colour	Orange, Brown, White
Soil Texture	Sandy-Clay
Rock Type	No Rocks
Rock Size and Abundance	No Rocks - None
Vegetation Condition	Excellent (no obvious disturbance)
Disturbance Type	No Disturbance
Time since Fire	2-5 years
Leaf Litter Distribution and Cover	Dispersed; 80**%**

Stratum	Taxa
Trees (<10 m)	*Corymbia dendromerinx; Corymbia greeniana; Corymbia zygophylla*
Shrubs (>2 m)	*Acacia colei var. colei; Acacia tumida var. tumida; Brachychiton diversifolius subsp. diversifolius; Grevillea pyramidalis subsp. pyramidalis; Grevillea refracta subsp. refracta; Persoonia falcata; Terminalia canescens*
Shrubs (1-2 m)	*Calytrix exstipulata; Dodonaea hispidula var. arida*
Shrubs (<1 m)	*Erythrophleum chlorostachys; Wrightia saligna*
Climbers	*Marsdenia viridiflora subsp. tropica*
Herbs	*Buchnera linearis; Chamaecrista symonii; Corchorus sidoides subsp. vermicularis; Microstachys chamelea; Pterocaulon sphacelatum; Spermacoce occidentalis*
Hummock Grasses	*Triodia caelestialis*
Tussock Grasses	*Aristida holathera var. latifolia; Eriachne obtusa; Sorghum plumosum*

Quadrat 9

Botanist	Renee Tuckett
Quadrat Size	25 x 100 m
Easting	496084
Northing	8075977
Habitat and Waterway	Gully (Minor Creek (<5m))
Slope	Gentle
Surface Layer	Loose, Rocky/Stony
Soil Colour	Orange, Brown, White
Soil Texture	Sandy-Clay
Rock Type	Ironstone, Quartz
Rock Size and Abundance	Gravel/Pebble, Stones, Boulders - Many (30-70%)
Vegetation Condition	Very Good (slight disturbance)
Disturbance Type	Animal Tracks; Faeces
Time since Fire	> 5 years
Leaf Litter Distribution and Cover	Dispersed; 5**%**

Stratum	Taxa
Trees (<10 m)	*Corymbia greeniana*
Shrubs (>2 m)	*Dolichandrone heterophylla; Grevillea pyramidalis subsp. pyramidalis; Terminalia canescens*
Shrubs (1-2 m)	*Acacia tumida var. tumida; Corymbia dendromerinx*
Shrubs (<1 m)	*Bauhinia cunninghamii; Dodonaea hispidula var. arida; Grevillea refracta subsp. refracta; Senna oligoclada; Triumfetta sp.; Wrightia saligna*
Climbers	*Dicliptera armata; Xenostegia tridentata*
Herbs	*Buchnera asperata; Corchorus sidoides subsp. vermicularis; Euphorbia ?myrtoides; Glycine tomentella; Gomphrena canescens subsp. canescens; Gomphrena flaccida; Indigofera haplophylla; Microstachys chamelea; Oldenlandia mitrasacmoides subsp. mitrasacmoides; Polycarpaea corymbosa; Pterocaulon sphacelatum; Ptilotus corymbosus; Stemodia lythrifolia; Tephrosia remotiflora; Waltheria indica*
Sedges	*Bulbostylis barbata; Fimbristylis simulans*
Hummock Grasses	*Triodia caelestialis*
Tussock Grasses	*Eragrostis cumingii; Eriachne ciliata; Eriachne obtusa; Eriachne sulcata; Heteropogon contortus; Sorghum plumosum; Sporobolus australasicus*

Quadrat 10

Botanist	Renee Tuckett
Quadrat Size	50 x 50 m
Easting	495950
Northing	8075986
Habitat and Waterway	Hillslope - Midslope
Slope	Gentle
Surface Layer	Rocky/Stony
Soil Colour	Orange, Brown
Soil Texture	Sandy-Clay
Rock Type	Ironstone
Rock Size and Abundance	Gravel/Pebble, Stones, Boulders - Continuous (>70%)
Vegetation Condition	Excellent (no obvious disturbance)
Disturbance Type	No Disturbance
Time since Fire	2-5 years
Leaf Litter Distribution and Cover	Dispersed; 2%

Stratum	Taxa
Trees (<10 m)	*Corymbia dendromerinx; Corymbia greeniana*
Shrubs (>2 m)	*Acacia tumida var. tumida; Dolichandrone heterophylla; Grevillea pyramidalis subsp. pyramidalis; Terminalia canescens*
Shrubs (1-2 m)	*Ficus aculeata var. indecora; Wrightia saligna*
Shrubs (<1 m)	*Corchorus sidoides subsp. vermicularis; Grevillea refracta subsp. refracta; Hybanthus aurantiacus; Indigofera haplophylla; Solanum cunninghamii; Tephrosia simplicifolia; Terminalia canescens*
Herbs	*Asteraceae sp.; Buchnera linearis; Euphorbia myrtoides; Gomphrena canescens subsp. canescens; Hibiscus geranioides; Indigofera haplophylla; Indigofera linifolia; Oldenlandia mitrasacmoides subsp. mitrasacmoides; Polycarpaea corymbosa; Polygala linariifolia; Pterocaulon sphacelatum; Ptilotus corymbosus; Spermacoce occidentalis; Stemodia lythrifolia*
Sedges	*Bulbostylis barbata; Fimbristylis simulans*
Hummock Grasses	*Triodia caelestialis*
Tussock Grasses	*Eriachne ciliata; Sorghum plumosum*

Quadrat 11

Botanist	Renee Tuckett
Quadrat Size	50 x 50 m
Easting	493242
Northing	8074375
Habitat and Waterway	Plain
Slope	Negligible
Surface Layer	Loose
Soil Colour	Orange
Soil Texture	Sand Sandy-Clay
Rock Type	No Rocks
Rock Size and Abundance	No Rocks - None
Vegetation Condition	Excellent (no obvious disturbance)
Disturbance Type	No Disturbance
Time since Fire	1-2 years
Leaf Litter Distribution and Cover	Dispersed; 25**%**

Stratum	Taxa
Trees (<10 m)	*Corymbia greeniana; Corymbia zygophylla; Erythrophleum chlorostachys*
Shrubs (>2 m)	*Brachychiton diversifolius subsp. diversifolius; Grevillea refracta subsp. refracta*
Shrubs (1-2 m)	*Acacia tumida var. tumida*
Shrubs (<1 m)	*Acacia platycarpa; Brachychiton diversifolius subsp. diversifolius; Dodonaea hispidula var. arida; Dolichandrone heterophylla; Terminalia canescens; Wrightia saligna*
Climbers	*Galactia tenuiflora*
Herbs	*Buchnera linearis; Chamaecrista symonii; Crotalaria brevis; Glycine tomentella; Gomphrena canescens subsp. canescens; Indetermined; Polycarpaea corymbosa; Pterocaulon sphacelatum*
Sedges	*Cyperaceae sp.*
Hummock Grasses	*Triodia caelestialis*
Tussock Grasses	*Aristida holathera var. holathera; Chrysopogon sp.; Eriachne melicacea; Sorghum plumosum*

Quadrat 12

Botanist	Renee Tuckett
Quadrat Size	50 x 50 m
Easting	494331
Northing	8074124
Habitat and Waterway	Plain
Slope	Negligible
Surface Layer	Loose
Soil Colour	Orange
Soil Texture	Sand Sandy-Clay
Rock Type	No Rocks
Rock Size and Abundance	No Rocks - None
Vegetation Condition	Excellent (no obvious disturbance)
Disturbance Type	No Disturbance
Time since Fire	No Evidence
Leaf Litter Distribution and Cover	Dispersed; 25**%**

Stratum	Taxa
Trees (<10 m)	*Corymbia greeniana; Erythrophleum chlorostachys; Hakea arborescens*
Shrubs (>2 m)	*Acacia platycarpa; Acacia tumida var. tumida; Bauhinia cunninghamii; Dolichandrone heterophylla; Ehretia saligna var. saligna; Grevillea refracta subsp. refracta; Terminalia canescens; Ventilago viminalis*
Shrubs (1-2 m)	*Brachychiton diversifolius subsp. diversifolius; Dodonaea hispidula var. arida; Grevillea pyramidalis subsp. pyramidalis*
Shrubs (<1 m)	*Brachychiton diversifolius subsp. diversifolius; Corchorus sidoides subsp. vermicularis; Premna acuminata*
Herbs	*Buchnera asperata; Calandrinia strophiolata; Chamaecrista symonii; Crotalaria brevis; Gomphrena canescens subsp. canescens; Hybanthus aurantiacus; Jasminum molle; Melhania oblongifolia; Microstachys chamelea; Polygala tepperi; Pterocaulon sphacelatum; Spermacoce occidentalis; Velleia panduriformis; Waltheria indica*
Sedges	*Scleria brownii*
Hummock Grasses	*Triodia caelestialis*
Tussock Grasses	*Aristida holathera var. latifolia; Eriachne ciliata; Eriachne obtusa; Sorghum plumosum*

Quadrat 13

Botanist	Renee Tuckett
Quadrat Size	50 x 50 m
Easting	495996
Northing	8071422
Habitat and Waterway	Plain
Slope	Negligible
Surface Layer	Loose
Soil Colour	Orange, Brown, White
Soil Texture	Sandy-Clay
Rock Type	No Rocks
Rock Size and Abundance	No Rocks - None
Vegetation Condition	Good (low grazing, few weeds)
Disturbance Type	Animal Tracks; Faeces
Time since Fire	2-5 years
Leaf Litter Distribution and Cover	Dispersed; 15**%**

Stratum	Taxa
Trees (<10 m)	*Corymbia greeniana; Eucalyptus tectifica; Indetermined*
Shrubs (>2 m)	*Acacia platycarpa; Acacia tumida var. tumida; Atalaya hemiglauca; Bauhinia cunninghamii; Brachychiton diversifolius subsp. diversifolius; Grevillea refracta subsp. refracta; Terminalia canescens*
Shrubs (1-2 m)	*Acacia tumida var. tumida; Brachychiton diversifolius subsp. diversifolius; Dodonaea hispidula var. arida; Erythrophleum chlorostachys; Gardenia pyriformis subsp. keartlandii; Wrightia saligna*
Shrubs (<1 m)	*Microstachys chamelea; Premna acuminata; Sida spinosa*
Climbers	*Galactia tenuiflora*
Herbs	*Bonamia linearis; Calandrinia strophiolata; Chamaecrista symonii; Corchorus sidoides subsp. vermicularis; Gomphrena canescens subsp. canescens; Microstachys chamelea; Pterocaulon intermedium; Pterocaulon sphacelatum; Spermacoce occidentalis; Waltheria indica*
Hummock Grasses	*Triodia caelestialis*
Tussock Grasses	*Aristida holathera var. latifolia; Chrysopogon sp.; Eragrostis ?eriopoda; Eriachne melicacea; Sorghum plumosum*

Quadrat 15

Botanist	Renee Tuckett
Quadrat Size	50 x 50 m
Easting	497313
Northing	8068356
Habitat and Waterway	Plain
Slope	Negligible
Surface Layer	Loose
Soil Colour	Yellow, White
Soil Texture	Sandy-Clay, Loam, Clay
Rock Type	No Rocks
Rock Size and Abundance	No Rocks - None
Vegetation Condition	Good (low grazing, few weeds)
Disturbance Type	Animal Tracks; Faeces
Time since Fire	2-5 years
Leaf Litter Distribution and Cover	Dispersed; 5**%**

Stratum	Taxa
Trees (<10 m)	*Corymbia greeniana; Melaleuca nervosa*
Shrubs (>2 m)	*Bauhinia cunninghamii; Ehretia saligna var. saligna; Hakea arborescens*
Shrubs (1-2 m)	*Acacia colei var. colei*
Shrubs (<1 m)	*Carissa lanceolata; Dolichandrone heterophylla*
Climbers	*Glycine tomentella*
Herbs	*?Ptilotus sp; Buchnera asperata; Crotalaria crispata; Drosera derbyensis; Gomphrena canescens subsp. canescens; Heliotropium cunninghamii; Oldenlandia mitrasacmoides subsp. mitrasacmoides; Pterocaulon serrulatum var. velutinum; Spermacoce occidentalis; Stemodia lathraia; Stemodia lythrifolia*
Hummock Grasses	*Triodia caelestialis*
Tussock Grasses	*?Eragrostis sp.; Aristida holathera var. holathera; Eriachne obtusa; Eriachne sp. Dampier Peninsula (K.F.Kenneally 5946)*

Quadrat 16

Botanist	Renee Tuckett
Quadrat Size	50 x 50 m
Easting	497776
Northing	8071234
Habitat and Waterway	Plain
Slope	Negligible
Surface Layer	Loose
Soil Colour	Orange, Brown, White
Soil Texture	Sandy-Clay
Rock Type	No Rocks
Rock Size and Abundance	No Rocks - None
Vegetation Condition	Very Good (slight disturbance)
Disturbance Type	Animal Tracks
Time since Fire	> 5 years
Leaf Litter Distribution and Cover	Dispersed; 25**%**

Stratum	Taxa
Trees (<10 m)	*Brachychiton diversifolius subsp. diversifolius; Corymbia greeniana; Corymbia zygophylla; Eucalyptus tectifica; Melaleuca nervosa*
Shrubs (>2 m)	*Acacia platycarpa; Brachychiton diversifolius subsp. diversifolius; Grevillea pyramidalis subsp. pyramidalis; Grevillea refracta subsp. refracta*
Shrubs (1-2 m)	*Bauhinia cunninghamii; Brachychiton diversifolius subsp. diversifolius; Dolichandrone heterophylla; Ehretia saligna var. saligna; Erythrophleum chlorostachys*
Shrubs (<1 m)	*Dodonaea hispidula var. arida; Solanum cunninghamii*
Climbers	*Glycine tomentella*
Herbs	*Buchnera asperata; Buchnera linearis; Chamaecrista symonii; Crotalaria crispata; Glycine tomentella; Gomphrena canescens subsp. canescens; Indetermined; Microstachys chamelea; Pterocaulon sphacelatum; Spermacoce occidentalis; Trichodesma zeylanicum var. zeylanicum*
Sedges	*Cyperaceae sp.; Scleria brownii*
Hummock Grasses	*Triodia caelestialis*
Tussock Grasses	*Aristida holathera var. latifolia; Chrysopogon sp.; Eragrostis ?eriopoda; Eriachne obtusa; Sorghum plumosum*

Quadrat 17

Botanist	Renee Tuckett
Quadrat Size	50 x 50 m
Easting	494080
Northing	8073582
Habitat and Waterway	Plain
Slope	Negligible
Surface Layer	Loose
Soil Colour	Orange
Soil Texture	Sand, Sandy-Clay
Rock Type	No Rocks
Rock Size and Abundance	No Rocks - None
Vegetation Condition	Very Good (slight disturbance)
Disturbance Type	Animal Tracks
Time since Fire	2-5 years
Leaf Litter Distribution and Cover	Dispersed; 30**%**

Stratum	Taxa
Trees (<10 m)	*Corymbia greeniana; Corymbia zygophylla; Erythrophleum chlorostachys; Gardenia pyriformis subsp. keartlandii*
Shrubs (>2 m)	*Acacia platycarpa; Bauhinia cunninghamii; Brachychiton diversifolius subsp. diversifolius; Codonocarpus cotinifolius; Dodonaea hispidula var. arida; Hakea arborescens; Terminalia canescens*
Shrubs (1-2 m)	*Acacia tumida var. tumida; Grevillea refracta subsp. refracta*
Shrubs (<1 m)	*Corchorus sidoides subsp. vermicularis; Dolichandrone heterophylla; Heliotropium cunninghamii; Solanum cunninghamii; Wrightia saligna*
Herbs	*Buchnera linearis; Byblis rorida; Crotalaria crispata; Evolvulus alsinoides var. decumbens; Gomphrena canescens subsp. canescens; Microstachys chamelea; Polycarpaea corymbosa; Pterocaulon sphacelatum; Spermacoce occidentalis; Trianthema pilosa*
Hummock Grasses	*Triodia caelestialis*
Tussock Grasses	*Aristida holathera var. holathera; Aristida inaequiglumis; Eriachne melicacea; Eriachne obtusa; Sorghum plumosum*

Quadrat 18

Botanist	Renee Tuckett
Quadrat Size	10 x 250 m
Easting	497408
Northing	8074676
Habitat and Waterway	Gully (Minor Creek (<5m))
Slope	Gentle
Surface Layer	Loose
Soil Colour	Brown
Soil Texture	Sandy-Clay
Rock Type	Ironstone
Rock Size and Abundance	Gravel/Pebble, Stones, Boulders, Surface Plates - Common (10-30%)
Vegetation Condition	Good (low grazing, few weeds)
Disturbance Type	Animal Tracks; Grazing; Faeces
Time since Fire	1-2 years
Leaf Litter Distribution and Cover	Dispersed; 5**%**

Stratum	Taxa
Trees (<10 m)	*Corymbia dendromerinx; Corymbia greeniana; Eucalyptus tectifica; Hakea arborescens; Melaleuca viridiflora*
Shrubs (>2 m)	*Acacia monticola; Acacia tumida var. tumida; Cyperus conicus; Grevillea pyramidalis subsp. pyramidalis*
Shrubs (1-2 m)	*Bauhinia cunninghamii; Ehretia saligna var. saligna; Tephrosia forrestiana; Triumfetta breviaculeata*
Climbers	*Dicliptera armata*
Herbs	*Bacopa floribunda; Blumea integrifolia; Desmodium filiforme; Euphorbia sp.; Gomphrena canescens subsp. canescens; Hybanthus aurantiacus; Indigofera linifolia; Microstachys chamelea; Oldenlandia mitrasacmoides subsp. mitrasacmoides; Pterocaulon serrulatum var. velutinum; Stemodia lathraia; Stemodia lythrifolia; Waltheria indica*
Sedges	*Fimbristylis dichotoma; Fimbristylis simulans*
Hummock Grasses	*Triodia caelestialis*
Tussock Grasses	*Aristida hygrometrica; Cymbopogon procerus; Eragrostis cumingii; Eriachne obtusa; Eriachne sp. Dampier Peninsula (K.F.Kenneally 5946); Heteropogon contortus; Sorghum plumosum*

Quadrat 19

Botanist	Renee Tuckett
Quadrat Size	50 x 50 m
Easting	500192
Northing	8073618
Habitat and Waterway	Plain
Slope	Negligible
Surface Layer	Loose, Rocky/Stony
Soil Colour	White
Soil Texture	Sandy-Clay
Rock Type	Ironstone
Rock Size and Abundance	Gravel/Pebble - Many (30-70%)
Vegetation Condition	Very Good (slight disturbance)
Disturbance Type	Animal Tracks
Time since Fire	1-2 years
Leaf Litter Distribution and Cover	Dispersed; 2%

Stratum	Taxa
Trees (<10 m)	*Bauhinia cunninghamii; Corymbia dendromerinx; Corymbia greeniana*
Shrubs (>2 m)	*Dolichandrone heterophylla; Ehretia saligna var. saligna; Grevillea pyramidalis subsp. pyramidalis*
Shrubs (1-2 m)	*Acacia stipuligera; Bridelia tomentosa*
Shrubs (<1 m)	*Acacia hippuroides; Acacia stipuligera; Atalaya hemiglauca; Corchorus sidoides subsp. vermicularis; Ehretia saligna var. saligna; Grevillea refracta subsp. refracta; Solanum cunninghamii*
Climbers	*Glycine tomentella*
Herbs	*Buchnera asperata; Buchnera linearis; Evolvulus alsinoides; Goodenia scaevolina; Goodenia sepalosa var. sepalosa; Heliotropium dichotomum; Hybanthus aurantiacus; Microstachys chamelea; Oldenlandia mitrasacmoides subsp. mitrasacmoides; Polycarpaea corymbosa; Spermacoce occidentalis; Stylosanthes scabra; Tephrosia leptoclada; Trachymene microcephala; Wrightia saligna; Zornia prostrata*
Hummock Grasses	*Triodia caelestialis*
Tussock Grasses	*Aristida hygrometrica; Chrysopogon sp.; Eriachne ciliata; Sorghum plumosum; Yakirra australiensis var. intermedia*

Quadrat 20

Botanist	Renee Tuckett
Quadrat Size	50 x 50 m
Easting	491807
Northing	8074299
Habitat and Waterway	Plain
Slope	Negligible
Surface Layer	Loose
Soil Colour	Orange
Soil Texture	Sand, Sandy-Clay
Rock Type	No Rocks
Rock Size and Abundance	No Rocks - None
Vegetation Condition	Very Good (slight disturbance)
Disturbance Type	Animal Tracks; Faeces
Time since Fire	1-2 years
Leaf Litter Distribution and Cover	Dispersed; 10**%**

Stratum	Taxa
Trees (<10 m)	*Corymbia greeniana; Corymbia zygophylla; Erythrophleum chlorostachys*
Shrubs (>2 m)	*Brachychiton diversifolius subsp. diversifolius; Hakea arborescens; Terminalia canescens*
Shrubs (1-2 m)	*Acacia tumida var. tumida; Brachychiton diversifolius subsp. diversifolius; Wrightia saligna*
Shrubs (<1 m)	*Acacia platycarpa; Dolichandrone heterophylla; Premna acuminata*
Climbers	*Galactia tenuiflora*
Herbs	*Buchnera asperata; Gomphrena canescens subsp. canescens; Microstachys chamelea; Oldenlandia mitrasacmoides subsp. mitrasacmoides; Solanum cunninghamii*
Hummock Grasses	*Triodia caelestialis*
Tussock Grasses	*Aristida holathera var. latifolia; Eriachne melicacea; Eriachne obtusa; Sorghum plumosum*

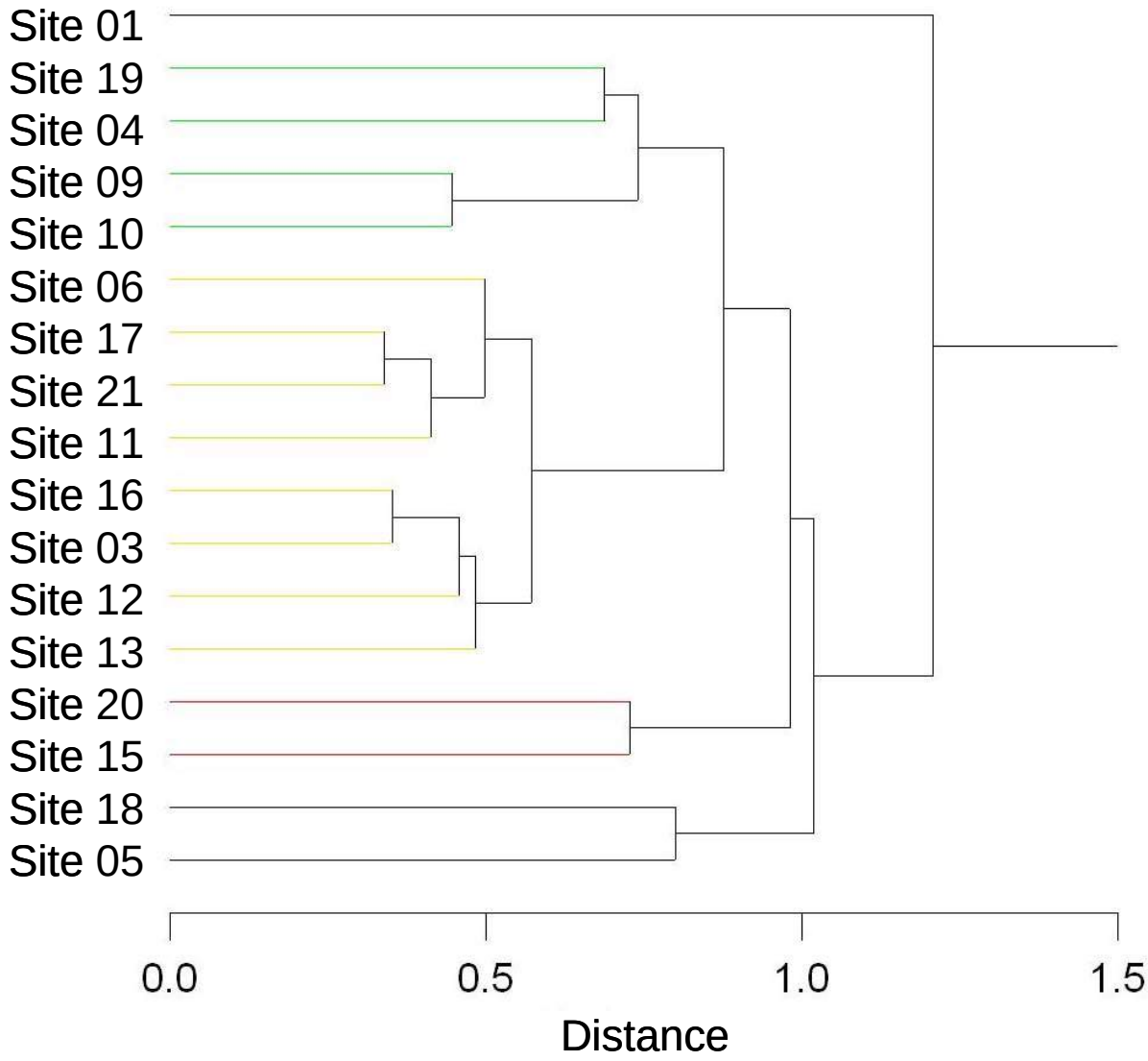
Quadrat 21

Botanist	Renee Tuckett
Quadrat Size	50 x 50 m
Easting	500022
Northing	8067395
Habitat and Waterway	Plain
Slope	Negligible
Surface Layer	Loose
Soil Colour	Orange, Yellow, White
Soil Texture	Sandy-Clay, Clay
Rock Type	No Rocks
Rock Size and Abundance	No Rocks - None
Vegetation Condition	Excellent (no obvious disturbance)
Disturbance Type	No Disturbance
Time since Fire	> 5 years
Leaf Litter Distribution and Cover	Dispersed; 5**%**

Stratum	Taxa
Trees (<10 m)	*Melaleuca viridiflora*
Shrubs (>2 m)	*Acacia colei var. colei; Terminalia canescens*
Shrubs (1-2 m)	*Brachychiton diversifolius subsp. diversifolius*
Shrubs (<1 m)	*Grevillea pyramidalis subsp. pyramidalis; Tephrosia remotiflora; Wrightia saligna*
Climbers	*Zornia prostrata*
Herbs	*Buchnera asperata; Byblis filifolia; Chamaecrista symonii; Crotalaria brevis; Crotalaria crispata; Desmodium filiforme; Drosera derbyensis; Drosera indica; Gomphrena canescens subsp. canescens; Melaleuca nervosa; Oldenlandia mitrasacmoides subsp. mitrasacmoides; Spermacoce occidentalis; Stackhousia intermedia; Stemodia lathraia; Waltheria indica; Xyris complanata*
Hummock Grasses	*Triodia caelestialis*
Tussock Grasses	*Chrysopogon sp.; Ectrosia schultzii; Eriachne melicacea; Eriachne obtusa; Paspalidium rarum; Sorghum plumosum*

APPENDIX C DENDROGRAM AND SPECIES X QUADRAT MATRIX

Dendrogram of Cluster Analysis



APPENDIX D VASCULAR FLORA WITHIN THUNDERBIRD STUDY AREA

Family	Taxon	Observation
Acanthaceae	*Dicliptera armata*	
Aizoaceae	*Trianthema pilosa*	
Amaranthaceae	*?Ptilotus sp*	
	Gomphrena canescens subsp. canescens	
	Gomphrena flaccida	
	Ptilotus corymbosus	
Apocynaceae	*Carissa lanceolata*	
	Marsdenia viridiflora subsp. tropica	
	Wrightia saligna	
Araliaceae	*Trachymene microcephala*	
Asparagaceae	*Thysanotus chinensis*	
Asteraceae	*Asteraceae sp.*	
	Blumea integrifolia	
	Pterocaulon intermedium	P3
	Pterocaulon serrulatum var. velutinum	
	Pterocaulon sphacelatum	
Bignoniaceae	*Dolichandrone heterophylla*	
Boraginaceae	*Ehretia saligna var. saligna*	
	Heliotropium cunninghamii	
	Heliotropium dichotomum	
	Trichodesma zeylanicum var. zeylanicum	
Byblidaceae	*Byblis filifolia*	
	Byblis rorida	
Caryophyllaceae	*Polycarpaea corymbosa*	
	Polycarpaea holtzei	
	Polycarpaea longiflora	
Celastraceae	*Stackhousia intermedia*	
Combretaceae	*Terminalia canescens*	
	Terminalia sp.	
Convolvulaceae	*Bonamia linearis*	

Family	Taxon	Observation
Convolvulaceae	*Evolvulus alsinoides*	
	Evolvulus alsinoides var. decumbens	
	Polymeria ambigua	
	Xenostegia tridentata	
Cyperaceae	*Bulbostylis barbata*	
	Cyperaceae sp.	
	Cyperus ? conicus	
	Cyperus conicus	
	Cyperus microcephalus	
	Eleocharis geniculata	
	Fimbristylis dichotoma	
	Fimbristylis simulans	
	Fuirena ciliaris	
	Lipocarpha microcephala	
	Scleria brownii	
Droseraceae	*Drosera derbyensis*	
	Drosera indica	
Euphorbiaceae	*Euphorbia ?myrtoides*	
	Euphorbia myrtoides	
	Euphorbia sp.	
	Microstachys chamelea	
Fabaceae	*Acacia colei var. colei*	
	Acacia drepanocarpa subsp. latifolia	
	Acacia hippuroides	
	Acacia monticola	
	Acacia platycarpa	
	Acacia stipuligera	
	Acacia tumida var. tumida	
	Bauhinia cunninghamii	
	Chamaecrista mimosoides	
	Chamaecrista symonii	

Family	Taxon	Observation
Fabaceae	*Crotalaria brevis*	
	Crotalaria crispata	
	Crotalaria medicaginea var. neglecta	
	Desmodium filiforme	
	Erythrophleum chlorostachys	
	Galactia tenuiflora	
	Glycine tomentella	
	Indigofera haplophylla	
	Indigofera linifolia	
	Senna oligoclada	
	Stylosanthes hamata	Invasive
	Stylosanthes scabra	Invasive
	Tephrosia forrestiana	
	Tephrosia leptoclada	
	Tephrosia remotiflora	
	Tephrosia simplicifolia	
	Vigna lanceolata var. filiformis	
	Zornia prostrata var. prostrata	
Goodeniaceae	*Goodenia scaevolina*	
	Goodenia sepalosa var. sepalosa	
	Velleia panduriformis	
Gyrostemonaceae	*Codonocarpus cotinifolius*	
Lamiaceae	*Premna acuminata*	
Lythraceae	*Rotala occultiflora*	
Malvaceae	*Brachychiton diversifolius subsp. diversifolius*	
	Corchorus sidoides subsp. vermicularis	
	Gossypium australe	
	Hibiscus geranioides	
	Melhania oblongifolia	
	Melochia corchorifolia	
	Sida hackettiana	

Family	Taxon	Observation
Malvaceae	*Sida spinosa*	
	Triumfetta breviaculeata	
	Triumfetta plumigera	
	Triumfetta sp.	
	Waltheria indica	
Menispermaceae	*Tinospora smilacina*	
Moraceae	*Ficus aculeata var. indecora*	
	Ficus platypoda	
Myrtaceae	*Calytrix exstipulata*	
	Corymbia dendromerinx	
	Corymbia greeniana	
	Corymbia zygophylla	
	Eucalyptus tectifica	
	Lophostemon grandiflorus	
	Melaleuca nervosa	
	Melaleuca viridiflora	
Oleaceae	*Jasminum molle*	
Onagraceae	*Ludwigia perennis*	
Orobanchaceae	*Buchnera asperata*	
	Buchnera linearis	
Phrymaceae	*Mimulus uvedaliae var. lutea*	
Phyllanthaceae	*Bridelia tomentosa*	
	Flueggea virosa subsp. melanthesoides	
	Phyllanthus virgatus	
Plantaginaceae	*Bacopa floribunda*	
	Stemodia lathraia	
	Stemodia lythrifolia	
Poaceae	*?Eragrostis sp.*	
	Aristida holathera var. holathera	
	Aristida holathera var. latifolia	
	Aristida hygrometrica	

Family	Taxon	Observation
Poaceae	*Aristida inaequiglumis*	
	Cenchrus elymoides	
	Chrysopogon sp.	
	Cymbopogon bombycinus	
	Cymbopogon procerus	
	Cynodon dactylon	Invasive
	Digitaria bicornis	
	Ectrosia schultzii	
	Eragrostis ?eriopoda	
	Eragrostis cumingii	
	Eriachne ciliata	
	Eriachne melicacea	
	Eriachne obtusa	
	Eriachne sp. Dampier Peninsula (K.F.Kenneally 5946)	P3
	Eriachne sulcata	
	Heteropogon contortus	
	Paspalidium rarum	
	Sacciolepis indica	
	Setaria apiculata	
	Sorghum plumosum	
	Sporobolus australasicus	
	Triodia caelestialis	P3
	Triodia intermedia	
	Yakirra australiensis var. intermedia	
Polygalaceae	*Polygala linariifolia*	
	Polygala tepperi	
Portulacaceae	*Calandrinia strophiolata*	
Proteaceae	*Grevillea pyramidalis subsp. pyramidalis*	
Proteaceae	*Grevillea refracta subsp. refracta*	
	Hakea arborescens	
	Persoonia falcata	

Family	Taxon	Observation
Rhamnaceae	*Ventilago viminalis*	
Rubiaceae	*Gardenia pyriformis subsp. keartlandii*	
	Oldenlandia galioides	
	Oldenlandia mitrasacmoides subsp. mitrasacmoides	
Rubiaceae	*Spermacoce occidentalis*	
Santalaceae	*Santalum lanceolatum*	
Sapindaceae	*Atalaya hemiglauca*	
	Atalaya variifolia	
	Dodonaea hispidula var. arida	
Solanaceae	*Solanum cunninghamii*	
Violaceae	*Hybanthus aurantiacus*	
Xyridaceae	*Xyris complanata*	

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APPENDIX E FAUNA SITE DESCRIPTIONS

Vegetation and Fauna Habitat Description	Site Photo
Site TB OS 1 Moderately dense *Corymbia greeniana* and *C. greeniana* woodland over moderately dense *Acacia platycarpa* and *A. tumida* shrubland over dense *Triodia caelestialis*, *Aristida holathera* and *Sorghum plumosum* tussock grassland. Soil substrate consists of weak orange sand-loam. **Habitat type:** Pindan plains	
Site TB OS 2 Moderately dense *Corymbia zygophylla* woodland over moderately dense *Acacia platycarpa* and *A. tumida* shrubland over dense *Triodia caelestialis* hummock grassland and *Sorghum plumosum* tussock grassland. Soil substrate consists of weak orange sand-loam. **Habitat type:** Pindan plains	

Site TB OS 3 Moderately dense *Corymbia greeniana* over dense *Bauhinia cunninghamii* and *Hakea* sp. shrubland over *Triodia caelestialis* hummock grassland and *Sorghum plumosum* tussock grassland. Soil substrate consists of weak orange sand-loam. **Habitat type:** Pindan plains	
Site TB OS 4 Open *Corymbia greeniana* woodland over moderately dense *Acacia tumida*, *Bauhinia cunninghamii* and *Dodonaea hispidula* shrubland over dense *Triodia caelestialis* hummock grassland and *Aristida holathera* and *Sorghum plumosum* tussock grassland. Soil substrate consists of firm reddish-brown sand-clay. **Habitat type:** Pindan plains	

Site TB OS 5 Very open *Corymbia greeniana* and *Terminalia canescens* over moderately dense *Grevillea refracta* shrubland over *Aristida holathera* tussock grassland. Soil substrate consists of firm reddish-brown sand-loam with scattered loose sandstone rocks. **Habitat type:** Pindan plains	
Site TB OS 6 Moderately dense *Corymbia zygophylla* and *C. greeniana* woodland over *Grevillea refracta*, *Dodonaea hispidula* and *Acacia tumida* shrubland over *Eriachne* sp. tussock grassland. Soil substrate consists of weak brown sand-loam with plentiful leaflitter and moderate woodlitter. **Habitat type:** Pindan plains	

Site TB OS 7 Low-lying depression within open *Corymbia greeniana* and *Melaleuca* sp. woodland over open *Acacia colei* shrubland over *Enneapogon* sp. tussock grassland. Soil substrate consists of firm grey loam-clay with numerous termite mounds. **Habitat type:** Savannah woodlands	
Site TB OS 8 Open *Corymbia greeniana* woodland over *Acacia* spp. and *Grevillea refracta* over *Aristida holathera* and *Sorghum plumosum* tussock grassland. Soil substrate consists of firm reddish-brown sand-loam. **Habitat type:** Pindan plains	

Site TB OS 9 Open *Corymbia* spp. woodland over *Grevillea refracta*, *Hakea* sp. and *Acacia tumida* over *Triodia caelestialis* hummock grassland and *Sorghum plumosum* tussock grassland in a dry creekline. Soil substrate consists of firm brown sand-loam with continuous ferruginised sandstone stones. **Habitat type:** Rocky hills	
Site TB OS 10 Moderately open *Corymbia* spp. and *Melaleuca* sp. woodland over *Acacia* spp., *Hakea* sp. and *Grevillea refracta* shrubland over *Triodia caelestialis* hummock grassland and *Sorghum plumosum* tussock grassland in a dry creekline. Soil substrate consists of firm brown loam with continuous sandstone stones. Site was burnt in April 2012. **Habitat type:** Rocky hills	

Site TB OS 11 Open *Corymbia greeniana*, *Melaleuca* sp. and *Bauhinia cunninghamii* woodland over *Acacia colei*, *Hakea* sp. and *Gardenia pyriformis* over *Triodia caelestialis* hummock grassland. Soil substrate consists of firm grey sand-loam. **Habitat type:** Savannah woodlands	
Site TB OS 12 Moderately open *Corymbia greeniana* woodland over moderately dense *Acacia tumida* and *Grevillea refracta* shrubland over *Triodia caelestialis* hummock grassland and *Sorghum plumosum* tussock grassland plain. Soil substrate consists of weak orange sand-loam. **Habitat type:** Pindan plains	

Site TB OS 13 Open *Corymbia greeniana* woodland over moderately dense *Acacia tumida*, *A. platycarpa*, *Bauhinia cunninghamii* and *Dodonaea hispidula* shrubland over *Eriachne* sp. and *Chrysopogon* sp. tussock grassland plain. Soil substrate consists of weak brown sand-loam. **Habitat type:** Pindan plains	
Site TB OS 14 Large sandstone rock outcrop. Scattered *Corymbia* sp. woodland over moderately dense *Grevillea refracta*, *Hakea* sp., *Acacia tumida* and *Calytrix extipulata* shrubland over dense *Triodia caelestialis* hummock grassland and sparse *Sorghum plumosum* tussock grassland. Soil substrate consists of strong orange sand-clay with continuous loose rocks and sandstone boulders. **Habitat type:** Rocky hills	

Site TB OS 15 Scattered *Corymbia* sp. woodland over moderately dense *Hakea* sp., *Acacia* sp. and *Calytrix extipulata* shrubland over dense *Triodia caelestialis* hummock grassland on rocky hillslope. Soil substrate consists of firm brown sand-loam with continuous loose sandstone stones. **Habitat type:** Rocky hills	
Site TB OS 16 Open *Corymbia greeniana* and *Bauhinia cunninghamii* woodland over moderately dense *Hakea* sp. shrubland over dense *Triodia caelestialis* hummock grassland on plain. Soil substrate consists of firm brown sand-clay wit h many laterite pebbles. **Habitat type:** Savannah woodlands	

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APPENDIX F REGIONAL FAUNA RECORDS

Appendix F1: Mammals

Family and Species	Common name	Conservation Status			Beagle Bay (*ecologia* 2004)	James Price Point (AECOM 2010)	James Price Point (AECOM 2010)	James Price Point (AECOM 2011)	James Price Point (Biota 2009)	James Price Point (Biota 2010)	Dampier Peninsula (ENV 2008)	James price Point (ENV 2011)	NatureMap	DEC Threatened and Priority Fauna Search	DSEWPaC Protected Matters Search
		EPBC Act	WC Act	DEC											
TACHYGLOSSIDAE															
Tachyglossus aculeatus	Echidna						S				✓				
DASYURIDAE															
Dasyurus hallucatus	Northern Quoll	EN	S1	EN											✓
Dasycercus cristicauda	Crest-tailed Mulgara	VU	S1	VU											✓
Sminthopsis youngsoni	Lesser Hairy-footed Dunnart					✓									
PERAMELIDAE															
Isoodon auratus	Golden Bandicoot	VU	S1	VU										✓	
THYLACOMYIDAE															
Macrotis lagotis	Bilby	VU	S1	VU		S	S	S			S	S	✓	✓	
PHALANGERIDAE															
Trichosurus vulpecula arnhemensis	Northern Brushtail Possum				✓						✓				
POTOROIDAE															
Bettongia lesueur	Burrowing Bettong	VU	S1	VU									✓		
MACROPODIDAE															
Macropus agilis	Agile Wallaby					S	✓		✓	✓	✓				
Macropus robustus	Euro										✓		✓		
Macropus rufus	Red Kangaroo										✓				
EMBALLONURIDAE															
Saccolaimus flaviventris	Yellow-bellied Sheathtail Bat					✓			✓		✓				
Taphozous georgianus	Common Sheathtail Bat										✓				
MOLOSSIDAE															
Chaerophon jobensis	Northern Freetail Bat					✓			✓		✓				
Mormopterus beccarii	Beccari's Freetail Bat										✓				

Family and Species	Common name	Conservation Status			Beagle Bay (*ecologia* 2004)	James Price Point (AECOM 2010)	James Price Point (AECOM 2010)	James Price Point (AECOM 2011)	James Price Point (Biota 2009)	James Price Point (Biota 2010)	Dampier Peninsula (ENV 2008)	James price Point (ENV 2011)	NatureMap	DEC Threatened and Priority Fauna Search	DSEWPaC Protected Matters Search
		EPBC Act	WC Act	DEC											
Mormopterus loriae	Little Northern Freetail Bat P1			P1							✓				
Tadarida australis	White-striped Freetail Bat										✓				
VESPERTILIONIDAE															
Chalinolobus gouldii	Gould's Wattled Bat					✓			✓		✓				
Chalinolobus nigrogriseus	Hoary Wattled Bat				✓	✓			✓		✓				
Miniopterus schreibersii orianae	Common Bentwing Bat										✓				
Nyctophilus arnhemensis	Arnhem Land Long-eared Bat								✓		✓				
Nyctophilus geoffroyi	Lesser Long-eared Bat					✓					✓				
Pipistrellus westralis	Northern Pipistrell										✓				
Scotorepens greyii	Little Broad-nosed Bat				✓	✓			✓		✓				
Scotorepens sanborni	Northern broad-nosed Bat								✓		✓				
Vespadelus caurinus	Western Cave Bat										✓				
Vespadelus douglasorum	Yellow-lipped Cave Bat			P2	✓										
Vespadelus finlaysoni	Finlayson's Cave Bat										✓				
MURIDAE															
Leggadina lakedownensis	Lakeland Downs Mouse			P4							✓				
Pseudomys delicatulus	Delicate Mouse				✓	✓	S		✓	✓	✓				
Pseudomys nanus	Western Chestnut Mouse				✓						✓		✓		
Rattus tunneyi	Pale Field Rat										✓	✓			
CANIDAE															
Canis lupus	Dog/Dingo					✓	✓		✓	✓	✓				
INTRODUCED MAMMALS															
Mus musculus	House Mouse								✓		✓				
Rattus rattus	Black Rat						✓				✓				
Vulpes vulpes	Red Fox										✓				
Felis catus	Cat				✓		✓		✓	✓	✓				

Family and Species	Common name	Conservation Status			Beagle Bay (*ecologia* 2004)	James Price Point (AECOM 2010)	James Price Point (AECOM 2010)	James Price Point (AECOM 2011)	James Price Point (Biota 2009)	James Price Point (Biota 2010)	Dampier Peninsula (ENV 2008)	James price Point (ENV 2011)	NatureMap	DEC Threatened and Priority Fauna Search	DSEWPaC Protected Matters Search
		EPBC Act	WC Act	DEC											
Equus asinus	Donkey				✓						✓				
Bos taurus	Cow						✓				✓				

S – Secondary signs found

Appendix F2: Birds

Family and Species	Common name	Conservation Status			Beagle Bay (*ecologia* 2004)	James Price Point (AECOM 2010)	James Price Point (AECOM 2010)	James Price Point (Biota 2009)	James Price Point (Bamford 2011)	Dampier Peninsula (ENV 2008)	North-West WA (Rogers *et al.* 2009)	NatureMap	DEC Threatened and Priority Fauna Search	DSEWPaC Protected Matters Search	Birdata
		EPBC Act	WC Act	DEC											
PHASIANIDAE															
Coturnix ypsilophora	Brown Quail					✓	✓	✓	✓	✓		✓			✓
ANSERANATIDAE															
Anseranas semipalmata	Magpie Goose											✓			✓
ANATIDAE															
Dendrocygna eytoni	Plumed Whistling-duck									✓	✓	✓			✓
Dendrocygna arcuata	Wandering Whistling-duck									✓	✓				✓
Chenonetta jubata	Australian Wood Duck										✓				✓
Malacorhynchus membranaceus	Pink-eared Duck										✓				✓
Nettapus pulchellus	Green Pygmy-Goose										✓				✓
Anas gracilis	Grey Teal									✓	✓	✓			✓
Anas superciliosa	Pacific Black Duck									✓	✓				✓
Aythya australis	Hardhead									✓	✓	✓			✓
PODICIPEDIDAE															
Tachybaptus novaehollandiae	Australasian Grebe									✓	✓	✓			✓
Poliocephalus poliocephalus	Hoary-headed Grebe										✓				✓
COLUMBIDAE															
Phaps histrionica	Flock Bronzewing			P4		✓				✓					✓
Ocyphaps lophotes	Crested Pigeon				✓		✓	✓	✓	✓		✓			✓
Geopelia cuneata	Diamond Dove				✓	✓		✓	✓	✓		✓			✓
Geopelia striata	Peaceful Dove				✓	✓	✓	✓	✓	✓		✓			✓
Geopelia humeralis	Bar-shouldered Dove				✓	✓	✓	✓	✓	✓					✓
PODARGIDAE															
Podargus strigoides	Tawny Frogmouth				✓	✓	✓	✓	✓	✓		✓			✓

Family and Species	Common name	Conservation Status			Beagle Bay (*ecologia* 2004)	James Price Point (AECOM 2010)	James Price Point (AECOM 2010)	James Price Point (Biota 2009)	James Price Point (Bamford 2011)	Dampier Peninsula (ENV 2008)	North-West WA (Rogers *et al.* 2009)	NatureMap	DEC Threatened and Priority Fauna Search	DSEWPaC Protected Matters Search	Birdata
		EPBC Act	WC Act	DEC											
EUROSTOPODIDAE															
Eurostopodus argus	Spotted Nightjar						✓			✓					✓
AEGOTHELIDAE															
Aegotheles cristatus	Australian Owlet-nightjar				✓	✓	✓		✓	✓		✓			✓
APODIDAE															
Apus pacificus	Fork-tailed Swift	M	S3		✓	✓	✓		✓					✓	✓
FREGATIDAE															
Fregata ariel	Lesser Frigatebird	M	S3			✓	✓	✓		✓	✓			✓	✓
SULIDAE															
Sula leucogaster	Brown Booby	M	S3			✓				✓	✓				✓
ANHINGIDAE															
Anhinga novaehollandiae	Australasian Darter									✓	✓				✓
PHALACROCORACIDAE															
Microcarbo melanoleucos	Little Pied Cormorant									✓	✓				✓
Phalacrocorax carbo	Great Cormorant														✓
Phalacrocorax sulcirostris	Little Black Cormorant									✓	✓				✓
Phalacrocorax varius	Pied Cormorant						✓			✓	✓				✓
PELECANIDAE															
Pelecanus conspicillatus	Australian Pelican					✓	✓			✓	✓	✓			✓
CICONIIDAE															
Ephippiorhynchus asiaticus	Black-necked Stork									✓	✓				✓
ARDEIDAE															
Ardea pacifica	White-necked Heron									✓	✓	✓			✓
Ardea modesta	Eastern Great Egret	M	S3							✓	✓			✓	✓
Egretta picata	Pied Heron									✓					✓
Egretta novaehollandiae	White-faced Heron						✓			✓	✓				✓

Family and Species	Common name	Conservation Status			Beagle Bay (*ecologia* 2004)	James Price Point (AECOM 2010)	James Price Point (AECOM 2010)	James Price Point (Biota 2009)	James Price Point (Bamford 2011)	Dampier Peninsula (ENV 2008)	North-West WA (Rogers *et al.* 2009)	NatureMap	DEC Threatened and Priority Fauna Search	DSEWPaC Protected Matters Search	Birdata
		EPBC Act	WC Act	DEC											
Ardea ibis	Cattle Egret	M	S3							✓				✓	✓
Butorides striatus	Striated Heron									✓	✓				✓
Egretta garzetta	Little Egret									✓	✓				✓
Egretta sacra	Eastern Reef Egret	M	S3							✓	✓				✓
Nycticorax caledonicus	Nankeen Night Heron							✓							✓
THRESKIORNITHIDAE															
Plegadis falcinellus	Glossy Ibis	M	S3							✓	✓	✓			✓
Threskiornis molucca	Australian White Ibis									✓	✓	✓			✓
Threskiornis spinicollis	Straw-necked Ibis						✓			✓	✓	✓			✓
Platalea regia	Royal Spoonbill										✓				✓
ACCIPITRIDAE															
Pandion cristatus	Eastern Osprey						✓	✓		✓					✓
Elanus axillaris	Black-shouldered Kite						✓			✓					✓
Lophoictinia isura	Square-tailed Kite					✓		✓		✓					✓
Hamirostra melanosternon	Black-breasted Buzzard											✓			✓
Haliaeetus leucogaster	White-bellied Sea-Eagle	M	S3			✓	✓	✓	✓	✓				✓	✓
Haliastur sphenurus	Whistling Kite						✓			✓		✓			✓
Haliastur indus	Brahminy Kite					✓	✓		✓	✓					✓
Milvus migrans	Black Kite				✓	✓	✓			✓		✓			✓
Accipiter fasciatus	Brown Goshawk				✓	✓	✓	✓	✓	✓		✓			✓
Accipiter cirrhocephalus	Collared Sparrowhawk				✓					✓					✓
Circus assimilis	Spotted Harrier									✓					✓
Circus approximans	Swamp Harrier									✓					✓
Aquila audax	Wedge-tailed Eagle											✓			✓
Hieraaetus morphnoides	Little Eagle					✓				✓					✓
FALCONIDAE															

Family and Species	Common name	Conservation Status			Beagle Bay (*ecologia* 2004)	James Price Point (AECOM 2010)	James Price Point (AECOM 2010)	James Price Point (Biota 2009)	James Price Point (Bamford 2011)	Dampier Peninsula (ENV 2008)	North-West WA (Rogers *et al.* 2009)	NatureMap	DEC Threatened and Priority Fauna Search	DSEWPaC Protected Matters Search	Birdata
		EPBC Act	WC Act	DEC											
Falco cenchroides	Nankeen Kestrel				✓	✓	✓	✓		✓		✓			✓
Falco berigora	Brown Falcon				✓	✓	✓	✓	✓	✓		✓			✓
Falco longipennis	Australian Hobby						✓								✓
Falco hypoleucos	Grey Falcon			P4											✓
Falco peregrinus	Peregrine Falcon		S4				✓	✓		✓			✓		✓
GRUIDAE															
Grus rubicunda	Brolga									✓	✓	✓			✓
RALLIDAE															
Porphyrio porphyrio	Purple Swamphen									✓					✓
Rallina fasciata	Red-legged Crake									✓					
Gallirallus philippensis	Buff-banded Rail									✓					✓
Fulica atra	Eurasian Coot										✓				✓
OTIDIDAE															
Ardeotis australis	Australian Bustard			P4	✓	✓				✓			✓		✓
BURHINIDAE															
Burhinus grallarius	Bush Stone-curlew			P4	✓			✓		✓			✓		✓
Esacus magnirostris	Beach Stone-curlew						✓			✓					✓
HAEMATOPODIDAE															
Haematopus longirostris	Australian Pied Oystercatcher					✓	✓	✓		✓	✓				✓
Haematopus fuliginosus	Sooty Oystercatcher					✓	✓			✓	✓				✓
RECURVIROSTRIDAE															
Himantopus himantopus	Black-winged Stilt									✓	✓	✓			✓
Recurvirostra novaehollandiae	Red-necked Avocet										✓				✓
CHARADRIIDAE															
Pluvialis fulva	Pacific Golden Plover		S3							✓	✓				✓
Pluvialis squatarola	Grey Plover		S3							✓	✓				✓

Family and Species	Common name	Conservation Status			Beagle Bay (*ecologia* 2004)	James Price Point (AECOM 2010)	James Price Point (AECOM 2010)	James Price Point (Biota 2009)	James Price Point (Bamford 2011)	Dampier Peninsula (ENV 2008)	North-West WA (Rogers *et al.* 2009)	NatureMap	DEC Threatened and Priority Fauna Search	DSEWPaC Protected Matters Search	Birdata
		EPBC Act	WC Act	DEC											
Charadrius leschenaultii	Greater Sand Plover		S3				✓			✓	✓				✓
Charadrius mongolus	Lesser Sand Plover		S3				✓				✓				✓
Charadrius ruficapillus	Red-capped Plover					✓				✓	✓				✓
Charadrius veredus	Oriental Plover		S3								✓			✓	✓
Elseyornis melanops	Black-fronted Dotterel						✓			✓	✓				✓
Erythrogonys cinctus	Red-kneed Dotterel									✓	✓				✓
Vanellus miles	Masked Lapwing						✓			✓	✓	✓			✓
JACANIDAE															
Irediparra gallinacea	Comb-crested Jacana									✓					✓
ROSTRATULIDAE															
Rostratula australis	Australian Painted Snipe	VU	S1	VU										✓	✓
SCOLOPACIDAE															
Gallinago megala	Swinhoe's Snipe	M	S3								✓				✓
Limosa limosa	Black-tailed Godwit	M	S3								✓				✓
Limosa lapponica	Bar-tailed Godwit	M	S3				✓			✓	✓				✓
Numenius minutus	Little Curlew	M	S3								✓				✓
Numenius phaeopus	Whimbrel	M	S3				✓			✓	✓				✓
Numenius madagascariensis	Eastern Curlew	M	S3	P4			✓			✓	✓				✓
Numenius arquata	Eurasian Curlew	M	S3								✓		✓		
Xenus cinereus	Terek Sandpiper	M	S3								✓				✓
Actitis hypoleucos	Common Sandpiper	M	S3					✓		✓	✓				✓
Tringa brevipes	Grey-tailed Tattler	M	S3				✓			✓	✓				✓
Tringa glareola	Wood Sandpiper	M	S3				✓				✓				✓
Tringa nebularia	Common Greenshank	M	S3				✓			✓	✓				✓
Tringa stagnatilis	Marsh Sandpiper	M	S3								✓				✓
Arenaria interpres	Ruddy Turnstone	M	S3				✓			✓	✓				✓

Family and Species	Common name	Conservation Status			Beagle Bay (*ecologia* 2004)	James Price Point (AECOM 2010)	James Price Point (AECOM 2010)	James Price Point (Biota 2009)	James Price Point (Bamford 2011)	Dampier Peninsula (ENV 2008)	North-West WA (Rogers *et al.* 2009)	NatureMap	DEC Threatened and Priority Fauna Search	DSEWPaC Protected Matters Search	Birdata
		EPBC Act	WC Act	DEC											
Limnodromus semipalmatus	Asian Dowitcher	M	S3								✓				✓
Calidris tenuirostris	Great Knot	M	S3							✓	✓				✓
Calidris canutus	Red Knot	M	S3								✓				✓
Calidris alba	Sanderling	M	S3				✓			✓	✓				✓
Calidris ruficollis	Red-necked Stint	M	S3				✓			✓	✓				✓
Calidris subminuta	Long-toed Stint	M	S3								✓				✓
Calidris melanotos	Pectoral Sandpiper	M	S3								✓				✓
Calidris acuminata	Sharp-tailed Sandpiper	M	S3				✓				✓				✓
Calidris ferruginea	Curlew Sandpiper	M	S3								✓				✓
Limicola falcinellus	Broad-billed Sandpiper	M	S3								✓				✓
Philomachus pugnax	Ruff	M	S3								✓				✓
TURNICIDAE															
Turnix maculosus	Red-backed Button-quail								✓	✓					✓
Turnix castanotus	Chestnut-backed Button-quail			P4			✓								
Turnix pyrrhothorax	Red-chested Button-quail					✓	✓								✓
Turnix velox	Little Button-quail				✓	✓				✓					✓
GLAREOLIDAE															
Glareola maldivarum	Oriental Pratincole	M	S3								✓			✓	✓
Stiltia isabella	Australian Pratincole									✓	✓	✓			✓
STERCORARIIDAE															
Stercorarius parasiticus	Arctic Jaeger	M	S3												✓
LARIDAE															
Sternula albifrons	Little Tern	M	S3				✓			✓	✓				✓
Sternula nereis	Fairy Tern									✓					✓
Gelochelidon nilotica	Gull-billed Tern						✓			✓	✓				✓

Family and Species	Common name	Conservation Status			Beagle Bay (*ecologia* 2004)	James Price Point (AECOM 2010)	James Price Point (AECOM 2010)	James Price Point (Biota 2009)	James Price Point (Bamford 2011)	Dampier Peninsula (ENV 2008)	North-West WA (Rogers *et al.* 2009)	NatureMap	DEC Threatened and Priority Fauna Search	DSEWPaC Protected Matters Search	Birdata
		EPBC Act	WC Act	DEC											
Hydroprogne caspia	Caspian Tern	M	S3								✓				✓
Chlidonias hybrida	Whiskered Tern									✓	✓				✓
Chlidonia leucopterus	White-winged Black Tern	M	S3							✓	✓				✓
Sterna dougallii	Roseate Tern	M	S3							✓	✓				✓
Sterna sumatrana	Black-naped Tern	M	S3							✓					
Sterna hirundo	Common Tern	M	S3			✓	✓				✓				✓
Thalasseus bengalensis	Lesser Crested Tern	M	S3			✓	✓			✓	✓				✓
Thalasseus bergii	Crested Tern					✓	✓			✓	✓				✓
Chroicocephalus novaehollandiae	Silver Gull						✓			✓	✓				✓
CACATUIDAE (PSITTACIDAE)															
Calyptorhynchus banksii	Red-tailed Black-Cockatoo				✓	✓	✓			✓					✓
Eolophus roseicapillus	Galah				✓					✓					✓
Cacatua sanguinea	Little Corella						✓			✓		✓			✓
Nymphicus hollandicus	Cockatiel					✓									✓
PSITTACIDAE															
Trichoglossus haematodus	Rainbow Lorikeet				✓	✓		✓	✓						✓
Trichoglossus haematodus rubritorquis	Red-collared Lorikeet						✓			✓		✓			
Psitteuteles versicolor	Varied Lorikeet				✓	✓		✓		✓					✓
Aprosmictus erythropterus	Red-winged Parrot				✓	✓	✓	✓	✓	✓					✓
Melopsittacus undulatus	Budgerigar									✓					✓
CUCULIDAE															
(Centropodidae) *Centropus phasianinus*	Pheasant Coucal				✓	✓	✓	✓	✓	✓					✓
Scythrops novaehollandiae	Channel-billed Cuckoo						✓								✓
Chalcites basalis	Horsfield's Bronze-Cuckoo				✓	✓	✓	✓		✓					✓
Chalcites osculans	Black-eared Cuckoo						✓	✓							✓

Family and Species	Common name	Conservation Status			Beagle Bay (*ecologia* 2004)	James Price Point (AECOM 2010)	James Price Point (AECOM 2010)	James Price Point (Biota 2009)	James Price Point (Bamford 2011)	Dampier Peninsula (ENV 2008)	North-West WA (Rogers *et al.* 2009)	NatureMap	DEC Threatened and Priority Fauna Search	DSEWPaC Protected Matters Search	Birdata
		EPBC Act	WC Act	DEC											
Chalcites minutillus	Little Bronze-Cuckoo				✓	✓				✓					✓
Cacomantis pallidus	Pallid Cuckoo				✓	✓	✓			✓					✓
Cacomantis variolosus	Brush Cuckoo				✓		✓	✓		✓					✓
Cuculus optatus	Oriental Cuckoo						✓								✓
STRIGIDAE															
Ninox connivens	Barking Owl									✓					✓
Ninox novaeseelandiae	Southern Boobook				✓	✓				✓					✓
TYTONIDAE															
Tyto longimembris	Eastern Grass Owl									✓					✓
Tyto novaehollandiae	Masked Owl			P4										✓	
HALCYONIDAE															
Dacelo leachii	Blue-winged Kookaburra				✓	✓	✓	✓		✓					✓
Todiramphus pyrrhopygius	Red-backed Kingfisher						✓	✓		✓					✓
Todiramphus sanctus	Sacred Kingfisher				✓	✓	✓	✓	✓	✓					✓
Todiramphus chloris	Collared Kingfisher									✓					✓
MEROPIDAE															
Merops ornatus	Rainbow Bee-eater	M	S3		✓	✓	✓	✓	✓	✓				✓	✓
CORACIIDAE															
Eurystomus orientalis	Dollarbird					✓	✓	✓							✓
CLIMACTERIDAE															
Climacteris melanura	Black-tailed Treecreeper				✓					✓		✓			✓
PTILINORHYNCHIDAE															
Ptilonorhynchus nuchalis	Great Bowerbird				✓	✓	✓	✓	✓	✓					✓
MALURIDAE															
Malurus lamberti	Variegated Fairy-wren					✓	✓	✓	✓	✓					✓
Malurus melanocephalus	Red-backed Fairy-wren				✓	✓	✓	✓		✓		✓			

Family and Species	Common name	Conservation Status			Beagle Bay (*ecologia* 2004)	James Price Point (AECOM 2010)	James Price Point (AECOM 2010)	James Price Point (Biota 2009)	James Price Point (Bamford 2011)	Dampier Peninsula (ENV 2008)	North-West WA (Rogers *et al.* 2009)	NatureMap	DEC Threatened and Priority Fauna Search	DSEWPaC Protected Matters Search	Birdata
		EPBC Act	WC Act	DEC											
ACANTHIZIDAE															
Smicrornis brevirostris	Weebill				✓	✓		✓		✓		✓			✓
Gerygone levigaster	Mangrove Gerygone						✓			✓					✓
Gerygone fusca	Western Gerygone									✓					✓
Gerygone tenebrosa	Dusky Gerygone									✓					✓
Gerygone albogularis	White-throated Gerygone				✓	✓	✓	✓	✓	✓					✓
PARDALOTIDAE															
Pardalotus rubricatus	Red-browed Pardalote						✓	✓		✓		✓			✓
Pardalotus striatus	Striated Pardalote				✓	✓		✓	✓	✓		✓			✓
MELIPHAGIDAE															
Certhionyx variegatus	Pied Honeyeater									✓					
Lichenostomus virescens	Singing Honeyeater				✓	✓	✓	✓	✓	✓		✓			✓
Lichenostomus unicolor	White-gaped Honeyeater					✓	✓	✓	✓	✓					✓
Lichenostomus plumulus	Grey-fronted Honeyeater							✓							
Lichenostomus flavescens	Yellow-tinted Honeyeater				✓	✓		✓		✓		✓			✓
Lichenostomus penicillatus	White-plumed Honeyeater						✓	✓							
Manorina flavigula	Yellow-throated Miner									✓					✓
Conopophila rufogularis	Rufous-throated Honeyeater				✓	✓	✓	✓		✓		✓			✓
Epthianura tricolor	Crimson Chat									✓					
Sugomel niger	Black Honeyeater														✓
Myzomela erythrocephala	Red-headed Honeyeater						✓			✓					✓
Cissomela pectoralis	Banded Honeyeater				✓	✓						✓			✓
Lichmera indistincta	Brown Honeyeater				✓	✓	✓	✓	✓	✓		✓			✓
Melithreptus gularis	Black-chinned Honeyeater				✓	✓	✓	✓	✓	✓					✓
Melithreptus albogularis	White-throated Honeyeater				✓	✓	✓			✓		✓			✓
Philemon argenticeps	Silver-crowned Friarbird						✓			✓					

Family and Species	Common name	Conservation Status			Beagle Bay (*ecologia* 2004)	James Price Point (AECOM 2010)	James Price Point (AECOM 2010)	James Price Point (Biota 2009)	James Price Point (Bamford 2011)	Dampier Peninsula (ENV 2008)	North-West WA (Rogers *et al.* 2009)	NatureMap	DEC Threatened and Priority Fauna Search	DSEWPaC Protected Matters Search	Birdata
		EPBC Act	WC Act	DEC											
Philemon citreogularis	Little Friarbird				✓	✓	✓	✓	✓	✓		✓			✓
POMATOSTOMIDAE															
Pomatostomus temporalis	Grey-crowned Babbler				✓	✓	✓	✓	✓	✓		✓			✓
NEOSITTIDAE															
Daphoenositta chrysoptera	Varied Sittella				✓	✓	✓	✓		✓		✓			✓
CAMPEPHAGIDAE															
Coracina novaehollandiae	Black-faced Cuckoo-shrike				✓	✓	✓	✓	✓	✓		✓			✓
Lalage sueurii	White-winged Triller				✓	✓	✓		✓	✓					✓
PACHYCEPHALIDAE															
Pachycephala melanura	Mangrove Golden Whistler									✓					✓
Pachycephala rufiventris	Rufous Whistler				✓	✓	✓	✓	✓	✓					✓
Pachycephala lanioides	White-breasted Whistler									✓					✓
Colluricincla harmonica	Grey Shrike-thrush				✓	✓	✓	✓	✓	✓					✓
Oreoica gutturalis	Crested Bellbird									✓					
ORIOLIDAE															
Oriolus sagittatus	Olive-backed Oriole				✓	✓	✓			✓					✓
ARTAMIDAE															
Artamus leucorhynchus	White-breasted Woodswallow						✓	✓	✓	✓					✓
Artamus personatus	Masked Woodswallow				✓	✓			✓	✓					✓
Artamus superciliosus	White-browed Woodswallow					✓				✓					✓
Artamus cinereus	Black-faced Woodswallow				✓	✓	✓	✓	✓	✓					✓
Artamus minor	Little Woodswallow				✓	✓	✓	✓	✓	✓					✓
Cracticus torquatus	Grey Butcherbird							✓							✓
Cracticus nigrogularis	Pied Butcherbird				✓	✓	✓	✓	✓	✓		✓			✓
RHIPIDURIDAE (DICRURIDAE)															

Family and Species	Common name	Conservation Status			Beagle Bay (*ecologia* 2004)	James Price Point (AECOM 2010)	James Price Point (AECOM 2010)	James Price Point (Biota 2009)	James Price Point (Bamford 2011)	Dampier Peninsula (ENV 2008)	North-West WA (Rogers *et al.* 2009)	NatureMap	DEC Threatened and Priority Fauna Search	DSEWPaC Protected Matters Search	Birdata
		EPBC Act	WC Act	DEC											
Rhipidura albiscapa	Grey Fantail									✓					✓
Rhipidura phasiana	Mangrove Grey Fantail									✓					✓
Rhipidura rufiventris	Northern Fantail					✓	✓	✓	✓	✓					✓
Rhipidura leucophrys	Willie Wagtail				✓	✓	✓	✓		✓		✓			✓
CORVIDAE															
Corvus bennetti	Little Crow				✓					✓					✓
Corvus orru	Torresian Crow				✓	✓	✓	✓	✓	✓		✓			✓
MONARCHIDAE (DICRURIDAE)															
Myiagra ruficollis	Broad-billed Flycatcher									✓					✓
Myiagra rubecula	Leaden Flycatcher				✓	✓	✓	✓							✓
Myiagra inquieta	Restless Flycatcher				✓	✓	✓	✓	✓	✓		✓			✓
Grallina cyanoleuca	Magpie-lark				✓		✓			✓		✓			✓
PETROICIDAE															
Microeca fascinans	Jacky Winter				✓	✓	✓	✓		✓		✓			✓
Microeca flavigaster	Lemon-bellied Flycatcher									✓					✓
Melanodryas cucullata	Hooded Robin				✓					✓					✓
ALAUDIDAE															
Mirafra javanica	Horsfield's Bushlark									✓					✓
CISTICOLIDAE (SYLVIIDAE)															
Cisticola exilis	Golden-headed Cisticola							✓							✓
ACROCEPHALIDAE (SYLVIIDAE)															
Acrocephalus australis	Australian Reed-Warbler									✓					✓
MEGALURIDAE (SYLVIIDAE)															
Megalurus timoriensis	Tawny Grassbird									✓					✓
Cincloramphus mathewsi	Rufous Songlark					✓			✓	✓					✓
Cincloramphus cruralis	Brown Songlark					✓				✓					✓

Family and Species	Common name	Conservation Status			Beagle Bay (*ecologia* 2004)	James Price Point (AECOM 2010)	James Price Point (AECOM 2010)	James Price Point (Biota 2009)	James Price Point (Bamford 2011)	Dampier Peninsula (ENV 2008)	North-West WA (Rogers *et al.* 2009)	NatureMap	DEC Threatened and Priority Fauna Search	DSEWPaC Protected Matters Search	Birdata
		EPBC Act	WC Act	DEC											
TIMALIIDAE (ZOSTEROPIDAE)															
Zosterops luteus	Yellow White-eye						✓		✓	✓					✓
HIRUNDINIDAE															
Hirundo rustica	Barn Swallow	M	S3									✓			✓
Petrochelidon ariel	Fairy Martin					✓				✓					✓
Petrochelidon nigricans	Tree Martin				✓	✓		✓	✓	✓					✓
NECTARINIIDAE (DICAEIDAE)															
Dicaeum hirundinaceum	Mistletoebird				✓	✓	✓		✓	✓					✓
ESTRILDIDAE															
Taeniopygia guttata	Zebra Finch							✓	✓	✓		✓			✓
Taeniopygia bichenovii	Double-barred Finch					✓		✓		✓		✓			✓
Poephila acuticauda	Long-tailed Finch				✓	✓	✓	✓		✓		✓			✓
Emblema pictum	Painted Finch														✓
Erythrura gouldiae	Gouldian Finch	EN	S1	EN			✓	✓	✓	✓				✓	✓
Lonchura castaneothorax	Chestnut-breasted Mannikin														✓
MOTACILLIDAE															
Motacilla flava	Yellow Wagtail									✓	✓				✓

* Introduced species

Appendix F3: Reptiles

Family and Species	Common name	Conservation Status			Beagle Bay (*ecologia* 2004)	James Price Point (AECOM 2010)	James Price Point (AECOM 2010)	James Price Point (Biota 2009)	James Price Point (Biota 2010)	Dampier Peninsula (ENV 2008)	NatureMap	DEC Threatened and Priority Fauna Search	DSEWPaC Protected Matters Search
		EPBC Act	WC Act	DEC									
CROCODYLIDAE													
Crocodylus porosus	Salt-water Crocodile		S4							✓			✓
DIPLODACTYLIDAE													
Diplodactylus conspicillatus	Fat-tailed Gecko					✓	✓	✓	✓	✓			
Lucasium stenodactylum	Sand-plain Gecko				✓	✓		✓	✓	✓			
Oedura rhombifer							✓			✓			
Rhynchoedura ornata	Beaked Gecko				✓								
Strophurus ciliaris					✓	✓	✓	✓	✓	✓			
Strophurus jeanae										✓			
Strophurus taeniatus										✓			
GEKKONIDAE													
Gehyra australis						✓							
Gehyra nana										✓			
Gehyra pilbara					✓	✓		✓		✓			
Gehyra punctata								✓		✓			
Gehyra variegata							✓			✓			
Heteronotia binoei	Bynoe's Gecko				✓	✓		✓	✓	✓			
**Hemidactylus frenatus*	Asian House Gecko									✓			
PYGOPODIDAE													
Delma borea										✓			
Delma tincta								✓		✓			
Lialis burtonis						✓	✓	✓	✓	✓			
Pygopus nigriceps					✓								
Pygopus steelescotti	Northern Hooded Scaly-foot							✓					

Family and Species	Common name	Conservation Status			Beagle Bay (*ecologia* 2004)	James Price Point (AECOM 2010)	James Price Point (AECOM 2010)	James Price Point (Biota 2009)	James Price Point (Biota 2010)	Dampier Peninsula (ENV 2008)	NatureMap	DEC Threatened and Priority Fauna Search	DSEWPaC Protected Matters Search
		EPBC Act	WC Act	DEC									
SCINCIDAE													
Carlia munda					✓	✓				✓			
Carlia rufilatus						✓		✓	✓	✓			
Carlia triacantha					✓								
Cryptoblepharus carnabyi					✓								
Cryptoblepharus metallicus										✓			
Cryptoblepharus ruber	Tawny Snake-eyed Skink					✓		✓	✓	✓			
Ctenotus colletti										✓			
Ctenotus helenae										✓			
Ctenotus inornatus					✓	✓	✓	✓	✓	✓	✓		
Ctenotus pantherinus						✓							
Ctenotus serventyi					✓	✓		✓					
Eremiascincus isolepis					✓	✓	✓	✓	✓	✓			
Eremiascincus richardsonii	Banded Skink									✓			
Lerista apoda						✓		✓	✓				
Lerista bipes						✓		✓	✓	✓			
Lerista greeri										✓			
Lerista griffini					✓	✓		✓	✓				
Lerista labialis										✓			
Lerista separanda				P2				✓		✓			
Menetia greyii									✓				
Morethia ruficauda										✓			
Morethia storri					✓	✓		✓					
Proablepharus tenuis								✓					
Tiliqua multifasciata	Central Blue-tongue							✓		✓			
Tiliqua scincoides	Common Blue-tongue				✓	✓	✓	✓	✓	✓			

Family and Species	Common name	Conservation Status			Beagle Bay (*ecologia* 2004)	James Price Point (AECOM 2010)	James Price Point (AECOM 2010)	James Price Point (Biota 2009)	James Price Point (Biota 2010)	Dampier Peninsula (ENV 2008)	NatureMap	DEC Threatened and Priority Fauna Search	DSEWPaC Protected Matters Search
		EPBC Act	WC Act	DEC									
AGAMIDAE													
Amphibolurus gilberti	Gilbert's Dragon					✓	✓	✓	✓	✓			
Chelosania brunnea	Chameleon Dragon									✓			
Chlamydosaurus kingii	Frilled Lizard				✓	✓	✓	✓	✓	✓	✓		
Ctenophorus caudicinctus	Ring-tailed Rock Dragon									✓			
Ctenophorus isolepis	Military Dragon									✓	✓		
Ctenophorus nuchalis	Central Netted Dragon									✓			
Dipophora magna					✓						✓		
Dipophora pindan					✓	✓	✓	✓	✓	✓			
Diporiphora sp.					✓								
Pogona minor	Dwarf Bearded Dragon				✓	✓	✓	✓	✓	✓			
VARANIDAE													
Varanus acanthurus	Spiny-tailed Monitor						✓			✓			
Varanus brevicauda	Short-tailed Pygmy Monitor					✓		✓					
Varanus gouldii	Gould's Monitor				✓	✓	✓	✓		✓			
Varanus panoptes	Yellow-spotted Monitor						✓	✓					
Varanus scalaris	Spotted Tree Monitor				✓								
Varanus tristis	Black-headed Monitor					✓	✓	✓	✓	✓			
TYPHLOPIDAE													
Ramphotyphlops diversus					✓	✓		✓	✓	✓			
BOIDAE													
Antaresia stimsoni	Stimson's Python				✓		✓	✓		✓			
Aspidites melanocephalus	Black-headed Python				✓	✓			✓	✓	✓		
Liasis olivaceus	Olive Python									✓			
COLUBRIDAE													
Dendrelaphis punctulata	Common Tree Snake								✓	✓			

Family and Species	Common name	Conservation Status			Beagle Bay (*ecologia* 2004)	James Price Point (AECOM 2010)	James Price Point (AECOM 2010)	James Price Point (Biota 2009)	James Price Point (Biota 2010)	Dampier Peninsula (ENV 2008)	NatureMap	DEC Threatened and Priority Fauna Search	DSEWPaC Protected Matters Search
		EPBC Act	WC Act	DEC									
ELAPIDAE													
Brachyurophis roperi	Northern Shovel-nosed Snake				✓	✓		✓	✓				
Demansia angusticeps						✓		✓	✓				
Demansia olivacea	Olive Whipsnake									✓			
Demansia psammophis	Yellow-faced Whipsnake									✓			
Ephalophis greyae	Mangrove Sea Snake												✓
Furina ornata	Moon Snake				✓	✓		✓	✓	✓			
Pseudechis australis	Mulga Snake					✓		✓	✓	✓	✓		
Pseudonaja mengdeni	Western Brown Snake				✓	✓							
Pseudonaja nuchalis	Northern Brown Snake							✓		✓			
Simoselaps anomalus	Desert Banded Snake									✓			
Simoselaps minimus	Dampierland Burrowing Snake			P2				✓		✓			
Suta punctata	Spotted Snake							✓	✓	✓	✓		

* Introduced species

Appendix F4: Amphibians

Family and Species	Common name	Conservation Status			Beagle Bay (*ecologia* 2004)	James Price Point (*ecologia* 2011)	James Price Point (Biota 2009)	James Price Point (Biota 2010)	Dampier Peninsula (ENV 2008)	NatureMap	DEC Threatened and Priority Fauna Search	DSEWPaC Protected Matters Search
		EPBC Act	WC Act	DEC								
HYLIDAE												
Cyclorana australis	Giant Frog				✓		✓		✓			
Cyclorana longipes	Long-footed Frog						✓					
Litoria caerulea	Green Tree Frog				✓	✓	✓		✓			
Litoria coplandi	Copland's Rock Frog								✓			
Litoria nasuta	Rocket Frog								✓			
Litoria rothii	Northern Laughing Tree Frog								✓			
Litoria rubella	Little Red Tree Frog				✓				✓			
LIMNODYNASTIDAE												
Platyplectrum ornatum	Ornate Burrowing Frog					✓	✓	✓	✓			
MYOBATRACHIDAE												
Uperoleia talpa	Mole Toadlet				✓				✓	✓		

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APPENDIX G RARE FLORA REPORT FORMS

Department of Environment and Conservation
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Threatened and Priority Flora Report Form

Version 1.0 January 2010

Please complete as much of the form as possible, with emphasis on those sections bordered in black.

TAXON: Eriachne sp. Dampier Peninsula (K.F.Kenneally 5946) **TPFL Pop. No:**

OBSERVATION DATE: 25/06/2012 **CONSERVATION STATUS:** P3 New population ☐

OBSERVER/S: Renee Young **PHONE:** 93221944

ROLE: Senior Botanist **ORGANISATION:** ecologia Environment

DESCRIPTION OF LOCATION (Provide at least nearest town/named locality, and the distance and direction to that place):

70km West of Derby on the Dampier Peninsula

Reserve No:

DEC DISTRICT: **LGA:** Land manager present: ☐

DATUM: GDA94 / MGA94 ☒ AGD84 / AMG84 ☐ WGS84 ☐ Unknown ☐

COORDINATES: (If UTM coords provided, **Zone** is also required) DecDegrees ☐ DegMinSec ☐ UTMs ☒

Lat / Northing: 8071874

Long / Easting: 0499829

ZONE: 50

METHOD USED: GPS ☒ Differential GPS ☐ Map ☐

No. satellites: +3 Map used:

Boundary polygon captured: ☐ Map scale:

LAND TENURE:

Nature reserve ☐ Timber reserve ☐ Private property ☐ Rail reserve ☐ Shire road reserve ☐

National park ☐ State forest ☐ Pastoral lease ☐ MRWA road reserve ☐ Other Crown reserve ☐

Conservation park ☐ Water reserve ☐ UCL ☐ SLK/Pole _____ to _____ Specify other:

AREA ASSESSMENT: Edge survey ☐ Partial survey ☐ Full survey ☒ Area observed (m²): 2500

EFFORT: Time spent surveying (minutes): 60 No. of minutes spent / 100 m²:

POP'N COUNT ACCURACY: Actual ☐ Extrapolation ☐ Estimate ☒ Count method: (Refer to field manual for list)

WHAT COUNTED: Plants ☒ Clumps ☐ Clonal stems ☐

TOTAL POP'N STRUCTURE:	**Mature:**	**Juveniles:**	**Seedlings:**	**Totals:**
Alive				60
Dead				

Area of pop (m²):

Note: PIs record count as numbers (not percentages) for database.

QUADRATS PRESENT: No. _____ Size _____ Data attached ☐ Total area of quadrats (m²):

Summary Quad. Totals: Alive				60

REPRODUCTIVE STATE: Clonal ☐ Vegetative ☐ Flowerbud ☐ Flower ☐

Immature fruit ☐ Fruit ☐ Dehisced fruit ☐ Percentage in flower: _____ %

CONDITION OF PLANTS: Healthy ☒ Moderate ☐ Poor ☐ Senescent ☐

COMMENT:

THREATS - type, agent and supporting information: Eg clearing, too frequent fire, weed, disease. Refer to field manual for list of threats & agents. **Specify agent** where relevant. Rate current and potential threat impact: N=Nil, L=Low, M=Medium, H=High, E=Extreme Estimate time to potential impact: S=Short (<12mths), M=Medium (<5yrs), L=Long (5yrs+)	**Current impact (N-E)**	**Potential Impact (L-E)**	**Potential Threat Onset (S-L)**
• Mining	N	E	L
• Grazing	L	M	M
• Invasive species	L	L	M

Please return completed form to DEC, Locked Bag 104, BENTLEY DELIVERY CENTRE WA 6983

RECORDS: Please forward to **Administrative Officer, Flora,** Species and Communities Branch.

Record entered by: _____ **Sheet No.:** _____ **Record Entered in Database** ❑

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HABITAT INFORMATION:

LANDFORM:
Crest ☐
Hill ☐
Ridge ☒
Outcrop ☐
Slope ☐
Flat ☐
Open depression ☐
Drainage line ☐
Closed depression ☐
Wetland ☐

ROCK TYPE:
Granite ☐
Dolerite ☐
Laterite ☐
Ironstone ☐
Limestone ☐
Quartz ☐
Specify other: Sanstone

LOOSE ROCK: (on soil surface; eg gravel, quartz fields)
0-10% ☐
10-30% ☐
30-50% ☐
50-100% ☐

SOIL TYPE:
Sand ☐
Sandy loam ☐
Loam ☐
Clay loam ☐
Light clay ☐
Peat ☐
Specify other: Sandy-clay

SOIL COLOUR:
Red ☐
Brown ☒
Yellow ☐
White ☐
Grey ☐
Black ☐
Specify other: Orange

DRAINAGE:
Well drained ☐
Seasonally inundated ☐
Permanently inundated ☐
Tidal ☐

Specific **Landform** Element: _____
(Refer to field manual for additional values)

CONDITION OF SOIL: Dry ☒ Moist ☐ Waterlogged ☐ Inundated ☐

VEGETATION CLASSIFICATION*:
Eg: 1. Banksia woodland (B. attenuata, B. ilicifolia); 2. Open shrubland (Hibbertia sp., Acacia spp.) ; 3. Isolated clumps of sedges (Mesomelaena tetragona)

1. _____
2. _____
3. _____
4. _____

ASSOCIATED SPECIES: _____

Other (non-dominant) spp _____

* Please record up to four of the most representative vegetation layers (with up to three dominant species in each layer). Structural Formations should follow 2009 *Australian Soil and Land Survey Field Handbook* guidelines – refer to field manual for further information and structural formation table.

CONDITION OF HABITAT: Pristine ☐ Excellent ☐ Very good ☒ Good ☐ Degraded ☐ Completely degraded ☐

COMMENT: Animal tracks

FIRE HISTORY: **Last Fire:** Season/Month: _____ Year: 4yrs **Fire Intensity:** High ☐ Medium ☐ Low ☐ No signs of fire ☐

FENCING: Not required ☐ Present ☐ Replace / repair ☐ Required ☐ Length req'd: _____

ROADSIDE MARKERS: Not required ☐ Present ☐ Replace / reposition ☐ Required ☐ Quantity req'd: _____

OTHER COMMENTS: (Please include recommended management actions and/or implemented actions - include date. Also include details of additional data available, and how to locate it.)

SPECIMEN: Collectors No: 1462RY05-06 WA Herb. ☐ Regional Herb. ☐ District Herb. ☐ Other: _____

ATTACHED: Map ☐ Mudmap ☐ Photo ☐ GIS data ☐ Field notes ☐ Other: _____

COPY SENT TO: Regional Office ☐ District Office ☐ Other:

Submitter of Record: Heather Broad Role: Botanist Signed: HBroad Date: 09/08/2012

Please return completed form to DEC, Locked Bag 104, BENTLEY DELIVERY CENTRE WA 6983

RECORDS: Please forward to **Administrative Officer, Flora,** Species and Communities Branch.

Record entered by: _____ **Sheet No.:** _____ **Record Entered in Database** ☐

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Version 1.0 January 2010

Please complete as much of the form as possible, with emphasis on those sections bordered in black.

TAXON: Eriachne sp. Dampier Peninsula (K.F.Kenneally 5946) **TPFL Pop. No:**

OBSERVATION DATE: 23/06/2012 **CONSERVATION STATUS:** P3 New population ☐

OBSERVER/S: Renee Young **PHONE:** 93221944

ROLE: Senior Botanist **ORGANISATION:** ecologia Environment

DESCRIPTION OF LOCATION (Provide at least nearest town/named locality, and the distance and direction to that place):

70km West of Derby on the Dampier Peninsula

Reserve No:

DEC DISTRICT: **LGA:** Land manager present: ☐

DATUM: GDA94 / MGA94 ☒ AGD84 / AMG84 ☐ WGS84 ☐ Unknown ☐

COORDINATES: (If UTM coords provided, Zone is also required) DecDegrees ☐ DegMinSec ☐ UTMs ☒

Lat / Northing: 8068356

Long / Easting: 0497313

ZONE: 50

METHOD USED: GPS ☒ Differential GPS ☐ Map ☐

No. satellites: +3 Map used:

Boundary polygon captured: ☐ Map scale:

LAND TENURE:

Nature reserve ☐ Timber reserve ☐ Private property ☐ Rail reserve ☐ Shire road reserve ☐

National park ☐ State forest ☐ Pastoral lease ☐ MRWA road reserve ☐ Other Crown reserve ☐

Conservation park ☐ Water reserve ☐ UCL ☐ SLK/Pole _____ to _____ Specify other:

AREA ASSESSMENT: Edge survey ☐ Partial survey ☐ Full survey ☒ Area observed (m²): 2500

EFFORT: Time spent surveying (minutes): 30 No. of minutes spent / 100 m²:

POP'N COUNT ACCURACY: Actual ☐ Extrapolation ☐ Estimate ☒ Count method: (Refer to field manual for list)

WHAT COUNTED: Plants ☐ Clumps ☐ Clonal stems ☐

TOTAL POP'N STRUCTURE:	**Mature:**	**Juveniles:**	**Seedlings:**	**Totals:**
Alive				30
Dead				

Area of pop (m²):

Note: PIs record count as numbers (not percentages) for database.

QUADRATS PRESENT: No. _____ Size _____ Data attached ☐ Total area of quadrats (m²):

Summary Quad. Totals: Alive				30

REPRODUCTIVE STATE: Clonal ☐ Vegetative ☐ Flowerbud ☐ Flower ☐

Immature fruit ☐ Fruit ☐ Dehisced fruit ☐ Percentage in flower: _____ %

CONDITION OF PLANTS: Healthy ☒ Moderate ☐ Poor ☐ Senescent ☐

COMMENT:

THREATS - type, agent and supporting information: Eg clearing, too frequent fire, weed, disease. Refer to field manual for list of threats & agents. **Specify agent** where relevant. Rate current and potential threat impact: N=Nil, L=Low, M=Medium, H=High, E=Extreme Estimate time to potential impact: S=Short (<12mths), M=Medium (<5yrs), L=Long (5yrs+)	**Current impact (N-E)**	**Potential Impact (L-E)**	**Potential Threat Onset (S-L)**
• Mining	N	E	L
• Grazing	L	M	M
• Invasive species	L	L	M

Please return completed form to DEC, Locked Bag 104, BENTLEY DELIVERY CENTRE WA 6983

RECORDS: Please forward to **Administrative Officer, Flora,** Species and Communities Branch.

Record entered by: _____ **Sheet No.:** _____ **Record Entered in Database** ☐

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Version 1.0 January 2010

HABITAT INFORMATION:

LANDFORM:
Crest ☐
Hill ☐
Ridge ☐
Outcrop ☐
Slope ☐
Flat ☒
Open depression ☐
Drainage line ☐
Closed depression ☐
Wetland ☐

ROCK TYPE:
Granite ☐
Dolerite ☐
Laterite ☐
Ironstone ☐
Limestone ☐
Quartz ☐
Specify other:
No rocks

LOOSE ROCK:
(on soil surface; eg gravel, quartz fields)
0-10% ☐
10-30% ☐
30-50% ☐
50-100% ☐

SOIL TYPE:
Sand ☐
Sandy loam ☐
Loam ☐
Clay loam ☐
Light clay ☐
Peat ☐
Specify other:
Sandy-clay

SOIL COLOUR:
Red ☐
Brown ☐
Yellow ☒
White ☒
Grey ☐
Black ☐
Specify other:

DRAINAGE:
Well drained ☐
Seasonally inundated ☐
Permanently inundated ☐
Tidal ☐

Specific **Landform** Element:
(Refer to field manual for additional values)

CONDITION OF SOIL: Dry ☒ Moist ☐ Waterlogged ☐ Inundated ☐

VEGETATION CLASSIFICATION*:
Eg: 1. Banksia woodland (B. attenuata, B. ilicifolia); 2. Open shrubland (Hibbertia sp., Acacia spp.); 3. Isolated clumps of sedges (Mesomelaena tetragona)

1.
2.
3.
4.

ASSOCIATED SPECIES:

Other (non-dominant) spp

* Please record up to four of the most representative vegetation layers (with up to three dominant species in each layer). Structural Formations should follow 2009 *Australian Soil and Land Survey Field Handbook* guidelines – refer to field manual for further information and structural formation table.

CONDITION OF HABITAT: Pristine ☐ Excellent ☐ Very good ☐ Good ☐ Degraded ☐ Completely degraded ☐

COMMENT: Animal tracks

FIRE HISTORY: **Last Fire:** Season/Month: _____ Year: 4yrs **Fire Intensity:** High ☐ Medium ☐ Low ☐ No signs of fire ☐

FENCING: Not required ☐ Present ☐ Replace / repair ☐ Required ☐ Length req'd: _____

ROADSIDE MARKERS: Not required ☐ Present ☐ Replace / reposition ☐ Required ☐ Quantity req'd: _____

OTHER COMMENTS: (Please include recommended management actions and/or implemented actions - include date. Also include details of additional data available, and how to locate it.)

SPECIMEN: Collectors No: 1462RY15-19 WA Herb. ☐ Regional Herb. ☐ District Herb. ☐ Other: _____
ATTACHED: Map ☐ Mudmap ☐ Photo ☐ GIS data ☐ Field notes ☐ Other: _____
COPY SENT TO: Regional Office ☐ District Office ☐ Other:

Submitter of Record: Heather Broad Role: Botanist Signed: HBroad Date: 09/08/2012

Please return completed form to DEC, Locked Bag 104, BENTLEY DELIVERY CENTRE WA 6983

RECORDS: Please forward to **Administrative Officer, Flora,** Species and Communities Branch.

Record entered by:_____ **Sheet No.:**_____ **Record Entered in Database** ☐

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Version 1.0 January 2010

Please complete as much of the form as possible, with emphasis on those sections bordered in black.

TAXON: Eriachne sp. Dampier Peninsula (K.F.Kenneally 5946) **TPFL Pop. No:**

OBSERVATION DATE: 23/06/2012 **CONSERVATION STATUS:** P3 New population ☐

OBSERVER/S: Renee Young **PHONE:** 93221944

ROLE: Senior Botanist **ORGANISATION:** ecologia Environment

DESCRIPTION OF LOCATION (Provide at least nearest town/named locality, and the distance and direction to that place):

70km West of Derby on the Dampier Peninsula

Reserve No:

DEC DISTRICT: **LGA:** Land manager present: ☐

DATUM: GDA94 / MGA94 ☒ AGD84 / AMG84 ☐ WGS84 ☐ Unknown ☐

COORDINATES: (If UTM coords provided, Zone is also required) DecDegrees ☐ DegMinSec ☐ UTMs ☒

Lat / Northing: 8074676

Long / Easting: 0497408

ZONE: 50

METHOD USED: GPS ☒ Differential GPS ☐ Map ☐

No. satellites: +3 Map used:

Boundary polygon captured: ☐ Map scale:

LAND TENURE:

Nature reserve ☐ Timber reserve ☐ Private property ☐ Rail reserve ☐ Shire road reserve ☐

National park ☐ State forest ☐ Pastoral lease ☐ MRWA road reserve ☐ Other Crown reserve ☐

Conservation park ☐ Water reserve ☐ UCL ☐ SLK/Pole _____ to _____ Specify other:

AREA ASSESSMENT: Edge survey ☐ Partial survey ☐ Full survey ☒ Area observed (m²): 2500

EFFORT: Time spent surveying (minutes): 60 No. of minutes spent / 100 m²:

POP'N COUNT ACCURACY: Actual ☐ Extrapolation ☐ Estimate ☒ Count method: (Refer to field manual for list)

WHAT COUNTED: Plants ☒ Clumps ☐ Clonal stems ☐

TOTAL POP'N STRUCTURE:	**Mature:**	**Juveniles:**	**Seedlings:**	**Totals:**
Alive				30
Dead				

Area of pop (m²):

Note: Pls record count as numbers (not percentages) for database.

QUADRATS PRESENT: No. _____ Size _____ Data attached ☐ Total area of quadrats (m²):

Summary Quad. Totals: Alive				30

REPRODUCTIVE STATE: Clonal ☐ Vegetative ☐ Flowerbud ☐ Flower ☐

Immature fruit ☐ Fruit ☐ Dehisced fruit ☐ Percentage in flower: _____ %

CONDITION OF PLANTS: Healthy ☒ Moderate ☐ Poor ☐ Senescent ☐

COMMENT:

THREATS - type, agent and supporting information: Eg clearing, too frequent fire, weed, disease. Refer to field manual for list of threats & agents. **Specify agent** where relevant. Rate current and potential threat impact: N=Nil, L=Low, M=Medium, H=High, E=Extreme Estimate time to potential impact: S=Short (<12mths), M=Medium (<5yrs), L=Long (5yrs+)	**Current impact (N-E)**	**Potential Impact (L-E)**	**Potential Threat Onset (S-L)**
• Mining	N	E	L
• Grazing	M	M	M
• Invasive species	L	L	M

Please return completed form to DEC, Locked Bag 104, BENTLEY DELIVERY CENTRE WA 6983

RECORDS: Please forward to **Administrative Officer, Flora,** Species and Communities Branch.

Record entered by: _____ **Sheet No.:** _____ **Record Entered in Database** ☐

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HABITAT INFORMATION:

LANDFORM:
Crest ☐
Hill ☐
Ridge ☐
Outcrop ☐
Slope ☒
Flat ☐
Open depression ☐
Drainage line ☒
Closed depression ☐
Wetland ☐

ROCK TYPE:
Granite ☐
Dolerite ☐
Laterite ☐
Ironstone ☒
Limestone ☐
Quartz ☐
Specify other: _____

LOOSE ROCK:
(on soil surface; eg gravel, quartz fields)
0-10% ☐
10-30% ☐
30-50% ☐
50-100% ☐

SOIL TYPE:
Sand ☐
Sandy loam ☐
Loam ☐
Clay loam ☐
Light clay ☐
Peat ☐
Specify other: Sandy-clay

SOIL COLOUR:
Red ☐
Brown ☒
Yellow ☐
White ☐
Grey ☐
Black ☐
Specify other: _____

DRAINAGE:
Well drained ☐
Seasonally inundated ☐
Permanently inundated ☐
Tidal ☐

Specific **Landform** Element: _____
(Refer to field manual for additional values)

CONDITION OF SOIL: Dry ☒ Moist ☐ Waterlogged ☐ Inundated ☐

VEGETATION CLASSIFICATION*:
Eg: 1. Banksia woodland (B. attenuata, B. ilicifolia); 2. Open shrubland (Hibbertia sp., Acacia spp.); 3. Isolated clumps of sedges (Mesomelaena tetragona)

1. _____
2. _____
3. _____
4. _____

ASSOCIATED SPECIES: _____

Other (non-dominant) spp _____

* Please record up to four of the most representative vegetation layers (with up to three dominant species in each layer). Structural Formations should follow 2009 *Australian Soil and Land Survey Field Handbook* guidelines – refer to field manual for further information and structural formation table.

CONDITION OF HABITAT: Pristine ☐ Excellent ☐ Very good ☐ Good ☒ Degraded ☐ Completely degraded ☐

COMMENT: Animal tracks, grazing

FIRE HISTORY: **Last Fire:** Season/Month: _____ Year: 2yrs **Fire Intensity:** High ☐ Medium ☐ Low ☐ No signs of fire ☐

FENCING: Not required ☐ Present ☐ Replace / repair ☐ Required ☐ Length req'd: _____

ROADSIDE MARKERS: Not required ☐ Present ☐ Replace / reposition ☐ Required ☐ Quantity req'd: _____

OTHER COMMENTS: (Please include recommended management actions and/or implemented actions - include date. Also include details of additional data available, and how to locate it.)

SPECIMEN: Collectors No: 1462RY18-19 WA Herb. ☐ Regional Herb. ☐ District Herb. ☐ Other: _____

ATTACHED: Map ☐ Mudmap ☐ Photo ☐ GIS data ☐ Field notes ☐ Other: _____

COPY SENT TO: Regional Office ☐ District Office ☐ Other:

Submitter of Record: Heather Broad Role: Botanist Signed: HBroad Date: 09/08/2012

Please return completed form to DEC, Locked Bag 104, BENTLEY DELIVERY CENTRE WA 6983

RECORDS: Please forward to **Administrative Officer, Flora,** Species and Communities Branch.

Record entered by: _____ **Sheet No.:** _____ **Record Entered in Database** ☐

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Please complete as much of the form as possible, with emphasis on those sections bordered in black.

TAXON: Pterocaulon intermedium **TPFL Pop. No:**

OBSERVATION DATE: 25/06/2012 **CONSERVATION STATUS:** P3 New population ☐

OBSERVER/S: Renee Young **PHONE:** 93221944

ROLE: Senior Botanist **ORGANISATION:** ecologia Environment

DESCRIPTION OF LOCATION (Provide at least nearest town/named locality, and the distance and direction to that place):

70km West of Derby on the Dampier Peninsula

Reserve No:

DEC DISTRICT: **LGA:** Land manager present: ☐

DATUM:
GDA94 / MGA94 ☒
AGD84 / AMG84 ☐
WGS84 ☐
Unknown ☐

COORDINATES: (If UTM coords provided, Zone is also required)
DecDegrees ☐ DegMinSec ☐ UTMs ☒
Lat / Northing: 8071422
Long / Easting: 0495996
ZONE: 50

METHOD USED:
GPS ☐ Differential GPS ☐ Map ☐
No. satellites: +3 Map used:
Boundary polygon captured: ☐ Map scale:

LAND TENURE:

Nature reserve ☐	Timber reserve ☐	Private property ☐	Rail reserve ☐	Shire road reserve ☐
National park ☐	State forest ☐	Pastoral lease ☐	MRWA road reserve ☐	Other Crown reserve ☐
Conservation park ☐	Water reserve ☐	UCL ☐	SLK/Pole _____ to _____	Specify other:

AREA ASSESSMENT: Edge survey ☐ Partial survey ☐ Full survey ☒ Area observed (m²): 2500

EFFORT: Time spent surveying (minutes): 60 No. of minutes spent / 100 m²:

POP'N COUNT ACCURACY: Actual ☐ Extrapolation ☐ Estimate ☒ Count method:
(Refer to field manual for list)

WHAT COUNTED: Plants ☒ Clumps ☐ Clonal stems ☐

TOTAL POP'N STRUCTURE:	**Mature:**	**Juveniles:**	**Seedlings:**	**Totals:**
Alive				5
Dead				

Area of pop (m²):

Note: Pls record count as numbers (not percentages) for database.

QUADRATS PRESENT: No. _____ Size _____ Data attached ☐ Total area of quadrats (m²):

Summary Quad. Totals: Alive				5

REPRODUCTIVE STATE: Clonal ☐ Vegetative ☐ Flowerbud ☐ Flower ☐
Immature fruit ☐ Fruit ☐ Dehisced fruit ☐ Percentage in flower: _____ %

CONDITION OF PLANTS: Healthy ☒ Moderate ☐ Poor ☐ Senescent ☐

COMMENT:

THREATS - type, agent and supporting information: Eg clearing, too frequent fire, weed, disease. Refer to field manual for list of threats & agents. **Specify agent** where relevant. Rate current and potential threat impact: N=Nil, L=Low, M=Medium, H=High, E=Extreme Estimate time to potential impact: S=Short (<12mths), M=Medium (<5yrs), L=Long (5yrs+)	**Current impact (N-E)**	**Potential Impact (L-E)**	**Potential Threat Onset (S-L)**
• Mining	N	E	L
• Grazing	L	M	M
• Invasive species	L	L	M

Please return completed form to DEC, Locked Bag 104, BENTLEY DELIVERY CENTRE WA 6983

RECORDS: Please forward to **Administrative Officer, Flora,** Species and Communities Branch.

Record entered by: _____ **Sheet No.:** _____ **Record Entered in Database** ❑

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HABITAT INFORMATION:

LANDFORM:
Crest ☐
Hill ☐
Ridge ☐
Outcrop ☐
Slope ☐
Flat ☒
Open depression ☐
Drainage line ☐
Closed depression ☐
Wetland ☐

ROCK TYPE:
Granite ☐
Dolerite ☐
Laterite ☐
Ironstone ☐
Limestone ☐
Quartz ☐
Specify other: No rocks

LOOSE ROCK: (on soil surface; eg gravel, quartz fields)
0-10% ☐
10-30% ☐
30-50% ☐
50-100% ☐

SOIL TYPE:
Sand ☐
Sandy loam ☐
Loam ☐
Clay loam ☐
Light clay ☐
Peat ☐
Specify other: Sandy-clay

SOIL COLOUR:
Red ☐
Brown ☒
Yellow ☐
White ☐
Grey ☐
Black ☐
Specify other: Orange

DRAINAGE:
Well drained ☐
Seasonally inundated ☐
Permanently inundated ☐
Tidal ☐

Specific **Landform** Element: _____
(Refer to field manual for additional values)

CONDITION OF SOIL: Dry ☒ Moist ☐ Waterlogged ☐ Inundated ☐

VEGETATION CLASSIFICATION*:
Eg: 1. Banksia woodland (B. attenuata, B. ilicifolia); 2. Open shrubland (Hibbertia sp., Acacia spp.) ; 3. Isolated clumps of sedges (Mesomelaena tetragona)

1. _____
2. _____
3. _____
4. _____

ASSOCIATED SPECIES: _____

Other (non-dominant) spp _____

* Please record up to four of the most representative vegetation layers (with up to three dominant species in each layer). Structural Formations should follow 2009 *Australian Soil and Land Survey Field Handbook* guidelines – refer to field manual for further information and structural formation table.

CONDITION OF HABITAT: Pristine ☐ Excellent ☐ Very good ☐ Good ☒ Degraded ☐ Completely degraded ☐

COMMENT: Animal tracks

FIRE HISTORY: **Last Fire:** Season/Month: _____ Year: 4yrs **Fire Intensity:** High ☐ Medium ☐ Low ☐ No signs of fire ☐

FENCING: Not required ☐ Present ☐ Replace / repair ☐ Required ☐ Length req'd: _____

ROADSIDE MARKERS: Not required ☐ Present ☐ Replace / reposition ☐ Required ☐ Quantity req'd: _____

OTHER COMMENTS: (Please include recommended management actions and/or implemented actions - include date. Also include details of additional data available, and how to locate it.)

Small range extension - 70 km E of known record (note: few GPS locations)

SPECIMEN: Collectors No: 1462RY13-28 WA Herb. ☐ Regional Herb. ☐ District Herb. ☐ Other: _____

ATTACHED: Map ☐ Mudmap ☐ Photo ☐ GIS data ☐ Field notes ☐ Other: _____

COPY SENT TO: Regional Office ☐ District Office ☐ Other:

Submitter of Record: Heather Broad Role: Botanist Signed: H Broad Date: 09/08/2012

Please return completed form to DEC, Locked Bag 104, BENTLEY DELIVERY CENTRE WA 6983

RECORDS: Please forward to **Administrative Officer, Flora,** Species and Communities Branch.

Record entered by: _____ **Sheet No.:** _____ **Record Entered in Database** ☐

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Please complete as much of the form as possible, with emphasis on those sections bordered in black.

TAXON: Triodia caelestialis **TPFL Pop. No:**

OBSERVATION DATE: 22-25/06/2012 **CONSERVATION STATUS:** P3 New population ☐

OBSERVER/S: Renee Young **PHONE:** 93221944

ROLE: Senior Botanist **ORGANISATION:** ecologia Environment

DESCRIPTION OF LOCATION (Provide at least nearest town/named locality, and the distance and direction to that place):

70km West of Derby on the Dampier Peninsula

Reserve No:

DEC DISTRICT: **LGA:** Land manager present: ☐

DATUM:
GDA94 / MGA94 ☒
AGD84 / AMG84 ☐
WGS84 ☐
Unknown ☐

COORDINATES: (If UTM coords provided, Zone is also required)
DecDegrees ☐ DegMinSec ☐ UTMs ☒
Lat / Northing: See attached sheet
Long / Easting: See attached sheet
ZONE: 50

METHOD USED:
GPS ☐ Differential GPS ☐ Map ☐
No. satellites: +3 Map used:
Boundary polygon captured: ☐ Map scale:

LAND TENURE:

Nature reserve ☐	Timber reserve ☐	Private property ☐	Rail reserve ☐	Shire road reserve ☐
National park ☐	State forest ☐	Pastoral lease ☐	MRWA road reserve ☐	Other Crown reserve ☐
Conservation park ☐	Water reserve ☐	UCL ☐	SLK/Pole _____ to _____	Specify other:

AREA ASSESSMENT: Edge survey ☐ Partial survey ☐ Full survey ☒ Area observed (m²): 2500

EFFORT: Time spent surveying (minutes): 60 No. of minutes spent / 100 m²:

POP'N COUNT ACCURACY: Actual ☐ Extrapolation ☐ Estimate ☒ Count method:
(Refer to field manual for list)

WHAT COUNTED: Plants ☒ Clumps ☐ Clonal stems ☐

TOTAL POP'N STRUCTURE:	Mature:	Juveniles:	Seedlings:	Totals:
Alive				1100
Dead				

Area of pop (m²):

Note: Pls record count as numbers (not percentages) for database.

QUADRATS PRESENT: No. Size Data attached ☐ Total area of quadrats (m²):

Summary Quad. Totals: Alive				1100

REPRODUCTIVE STATE: Clonal ☐ Vegetative ☐ Flowerbud ☐ Flower ☐
Immature fruit ☐ Fruit ☐ Dehisced fruit ☐ Percentage in flower: %

CONDITION OF PLANTS: Healthy ☒ Moderate ☐ Poor ☐ Senescent ☐

COMMENT:

THREATS - type, agent and supporting information: Eg clearing, too frequent fire, weed, disease. Refer to field manual for list of threats & agents. **Specify agent** where relevant. Rate current and potential threat impact: N=Nil, L=Low, M=Medium, H=High, E=Extreme Estimate time to potential impact: S=Short (<12mths), M=Medium (<5yrs), L=Long (5yrs+)	**Current impact (N-E)**	**Potential Impact (L-E)**	**Potential Threat Onset (S-L)**
• Mining	N	E	L
• Grazing		M	M
• Invasive species	L	L	M

Please return completed form to DEC, Locked Bag 104, BENTLEY DELIVERY CENTRE WA 6983

RECORDS: Please forward to **Administrative Officer, Flora,** Species and Communities Branch.

Record entered by: **Sheet No.:** **Record Entered in Database** ☐

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HABITAT INFORMATION:

LANDFORM:
Crest ☐ Hill ☐ Ridge ☐ Outcrop ☐ Slope ☐ Flat ☐ Open depression ☐ Drainage line ☐ Closed depression ☐ Wetland ☐

ROCK TYPE:
Granite ☐ Dolerite ☐ Laterite ☐ Ironstone ☐ Limestone ☐ Quartz ☐
Specify other: _____

LOOSE ROCK:
(on soil surface; eg gravel, quartz fields)
0-10% ☐ 10-30% ☐ 30-50% ☐ 50-100% ☐

SOIL TYPE:
Sand ☐ Sandy loam ☐ Loam ☐ Clay loam ☐ Light clay ☐ Peat ☐
Specify other: _____

SOIL COLOUR:
Red ☐ Brown ☐ Yellow ☐ White ☐ Grey ☐ Black ☐
Specify other: _____

DRAINAGE:
Well drained ☐ Seasonally inundated ☐ Permanently inundated ☐ Tidal ☐

Specific **Landform** Element: _____
(Refer to field manual for additional values)

CONDITION OF SOIL: Dry ☒ Moist ☐ Waterlogged ☐ Inundated ☐

VEGETATION CLASSIFICATION*:
Eg: 1. Banksia woodland (B. attenuata, B. ilicifolia); 2. Open shrubland (Hibbertia sp., Acacia spp.) ; 3. Isolated clumps of sedges (Mesomelaena tetragona)

1. _____
2. _____
3. _____
4. _____

ASSOCIATED SPECIES: _____

Other (non-dominant) spp _____

* Please record up to four of the most representative vegetation layers (with up to three dominant species in each layer). Structural Formations should follow 2009 *Australian Soil and Land Survey Field Handbook* guidelines – refer to field manual for further information and structural formation table.

CONDITION OF HABITAT: Pristine ☐ Excellent ☐ Very good ☐ Good ☐ Degraded ☐ Completely degraded ☐

COMMENT: _____

FIRE HISTORY: **Last Fire:** Season/Month: _____ Year: _____ **Fire Intensity:** High ☐ Medium ☐ Low ☐ No signs of fire ☐

FENCING: Not required ☐ Present ☐ Replace / repair ☐ Required ☐ Length req'd: _____

ROADSIDE MARKERS: Not required ☐ Present ☐ Replace / reposition ☐ Required ☐ Quantity req'd: _____

OTHER COMMENTS: (Please include recommended management actions and/or implemented actions - include date. Also include details of additional data available, and how to locate it.)

Range extension - 152 km W of eastern population and 220 km NE of southwerstern record

SPECIMEN: Collectors No: See attached sheet WA Herb. ☐ Regional Herb. ☐ District Herb. ☐ Other: _____

ATTACHED: Map ☐ Mudmap ☐ Photo ☐ GIS data ☐ Field notes ☐ Other: locations

COPY SENT TO: Regional Office ☐ District Office ☐ Other:

Submitter of Record: Heather Broad Role: Botanist Signed: HBroad Date: 09/08/2012

Please return completed form to DEC, Locked Bag 104, BENTLEY DELIVERY CENTRE WA 6983

RECORDS: Please forward to **Administrative Officer, Flora,** Species and Communities Branch.

Record entered by: _____ **Sheet No.:** _____ **Record Entered in Database** ☐

Triodia caelestialis Locations

Location	Number of Plants	Northing	Easting	Landform	Rock type	Soil type
03-21	40	8067698	502522	Flat	No rocks	Sandy-clay
04-06	100	8067686	501984	Flat	Limestone	Sandy-clay
06-09	40	8068230	499830	Flat	No rocks	Sandy-clay
09-11	100	8075977	496084	Slope, drainage	Ironstone,	Sandy-clay
10-01	150	8075986	495950	Slope	Ironstone	Sandy-clay
11-10	20	8074375	493242	Flat	No rocks	Sandy-clay
12-02	40	8074124	494331	Flat	No rocks	Sandy-clay
13-01	100	8071422	495996	Flat	No rocks	Sandy-clay
15-02	150	8068356	497313	Flat	No rocks	Sandy-clay, Loam
15-28	20	8068356	497313	Flat	No rocks	Sandy-clay, Loam
16-01	40	8071234	497776	Flat	No rocks	Sandy-clay
16-29	20	8071234	497776	Flat	No rocks	Sandy-clay
17-16	40	8072735	494449	Flat	No rocks	Sandy-clay, sand
18-13	40	8074676	497408	Slope, drainage	Ironstone	Sandy-clay
19-01	100	8073618	500192	Flat	Ironstone	Sandy-clay
20A-10	40	8074299	491807	Flat	No rocks	Sand, sandy-clay
20A-22	20	8074299	491807	Flat	No rocks	Sand, sandy-clay
20B-07	40	8067457	500071	Flat	No rocks	Sandy-clay, clay