FLORA AND VEGETATION OF THE

THUNDERBIRD MINERAL SANDS PROJECT AREA

Prepared for

Sheffield Resources Limited

Prepared by

Mattiske Consulting Pty Ltd

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Mattiske Consulting Pty Ltd

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ABBREVIATIONS

The following abbreviations are used throughout this document:

BAM Act	*Biosecurity and Agriculture Management Act 2007*
BOM	Commonwealth Bureau of Meteorology
DAFWA	Department of Agriculture and Food, Western Australia
DER	Department of Environment Regulation
DMP	Department of Mines and Petroleum
DotE	Department of the Environment

ABBREVIATIONS

DPaW	Department of Parks and Wildlife
Ecologia	Ecologia Environment
EPA	Environment Protection Authority
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
ESCAVI	Executive Steering Committee for Australian Vegetation Information
Mattiske	Mattiske Consulting Pty Ltd
NVIS	National Vegetation Information System
PEC	Priority Ecological Community
Sheffield	Sheffield Resources Limited
TEC	Threatened Ecological Community
TSSC	Western Australian Threatened Species Scientific Committee
WAH	Western Australian Herbarium
WAOL	Western Australian Organism List

1. SUMMARY

Mattiske Consulting Pty Ltd was commissioned by Sheffield Resources Limited to undertake a Level 2 flora and vegetation survey of the Thunderbird Project Area. The Thunderbird Project Area occupies an area of 18,886 ha and is situated on the Dampier Peninsula, between Broome and Derby, across the Mt Jowlaenga and Yeeda Stations.

The Thunderbird Project Area has been the subject of three flora and vegetation surveys completed between 2012 and 2015. Prior to undertaking the field survey in June 2016, Mattiske Consulting Pty Ltd reviewed the historical literature relating to the flora and vegetation of the region, as well as undertaking a gap analysis of the three surveys which had previously been completed in the Thunderbird Project Area. The gap analysis identified four principle areas which warranted additional survey work in the Thunderbird Project Area. These were:

1. A change in the boundary of the Thunderbird Project Area, as compared to the areas surveyed between 2012 and 2015, necessitating the establishment of survey quadrats in areas which previously did not fall within the present Thunderbird Project Area boundary;
2. The lower than desirable density of quadrats surveyed in the previous surveys to ensure adequate coverage for a Level 2 vegetation survey;
3. Mapping of the vegetation within the Thunderbird Project Area which did not reflect the landforms present; and
4. A review of an area within the Thunderbird Project Area which had been described as having similarities with the Lolly Well Springs wetland complex Priority 3 PEC.

A total of 255 vascular plant taxa which are representative of 129 genera and 44 families were recorded in the Thunderbird Project Area during the 2016 survey. The majority of taxa recorded were representative of the Poaceae (46 taxa), Fabaceae (45 taxa), Malvaceae (18 taxa), Cyperaceae (14 taxa), Myrtaceae (14 taxa), Amaranthaceae (12 taxa) and Convolvulaceae (10 taxa) families. Overall, when data from the three previous flora surveys of the Thunderbird Project Area are assessed together with the data from the present survey, approximately 81% of the species potentially present within the Thunderbird Project Area have been recorded. This, together with the fact that four surveys have been completed over a four-year period, demonstrates that the area has been thoroughly assessed floristically, and that the conditions for a Level 2 survey have been satisfied.

A total of 14 vegetation communities were defined and mapped, based on a statistical analysis of the combined data from the present and three past surveys of the Thunderbird Project Area. Two of these vegetation communities, W6 and W8, which constitute pindan vegetation (low sparse eucalypt woodlands over *Acacia tumida* shrubland over *Triodial Chrysopogon* grasslands), accounted for approximately 86% of the surveyed area. The other main communities mapped were associated with the drainage channels (*Melaleuca viridifloral Melaleuca alsophila* woodland) and rocky hills within the Thunderbird Project Area. Overall, the vegetation communities mapped and species recorded in the Thunderbird Project Area are consistent with the historical mapping of John Beard (1976) and the more recent land systems mapping of Kimberley by Schoknecht and Payne (2010). The majority of the

Thunderbird Project Area comprised red sandy flats supporting pindan vegetation. Indicative impact areas show that impacts associated with planned mining operations may impact the W6 and W8 communities. These communities are essentially the common pindan vegetation of the region, and hence likely impacts are considered to be low.

The priority taxon *Triodia caelestialis* (P3) was recorded widely across the survey area. A second priority taxon, *Pterocaulon intermedium* (P3), was recorded infrequently, and was not associated with any specific vegetation community delineated. Both taxa are expected to be recorded outside the Thunderbird Project Area boundary, and hence overall impacts are considered likely to be low.

An area within the Thunderbird Project Area, which statistically groups with community W1, a drainage channel community consisting of *Melaleuca viridifloral Melaleuca alsophila*, was claimed by Ecologia (2014) to have some resemblance to the Lolly Wells Spring PEC. This claim was not supported by any statistical analysis or reasonable argument. A review by Mattiske indicates that the claimed area is simply an internal drainage area set in a low lying area amongst gentle slopes.

2. INTRODUCTION

Sheffield Resources Limited (Sheffield) proposes to develop a mineral sands (zircon and ilmenite) mining operation at its Thunderbird Mineral Sands Project Area, hereinafter referred to as the Thunderbird Project Area, in the West Kimberley region of Western Australia. The Thunderbird Project Area has been the subject of three flora and vegetation surveys completed by Ecologia Environment (Ecologia) between 2012 and 20152. These surveys were a Level 1 flora and fauna assessment (Ecologia 2012), a Level 2 flora and vegetation survey (Ecologia 2014) and a Haul Road and Accommodation Camp flora and fauna assessment (Ecologia 2015).

Mattiske Consulting Pty Ltd (Mattiske) was commissioned in May 2016 by Sheffield, to undertake a further flora and vegetation assessment of the Thunderbird Project Area. The reasons for undertaking an additional survey included a change to the Thunderbird Project Area boundary, with previously unsurveyed areas now forming part of the project area, and the identification of gaps in the original surveys which warranted additional survey work being undertaken.

2.1 Location and Scope of Proposal

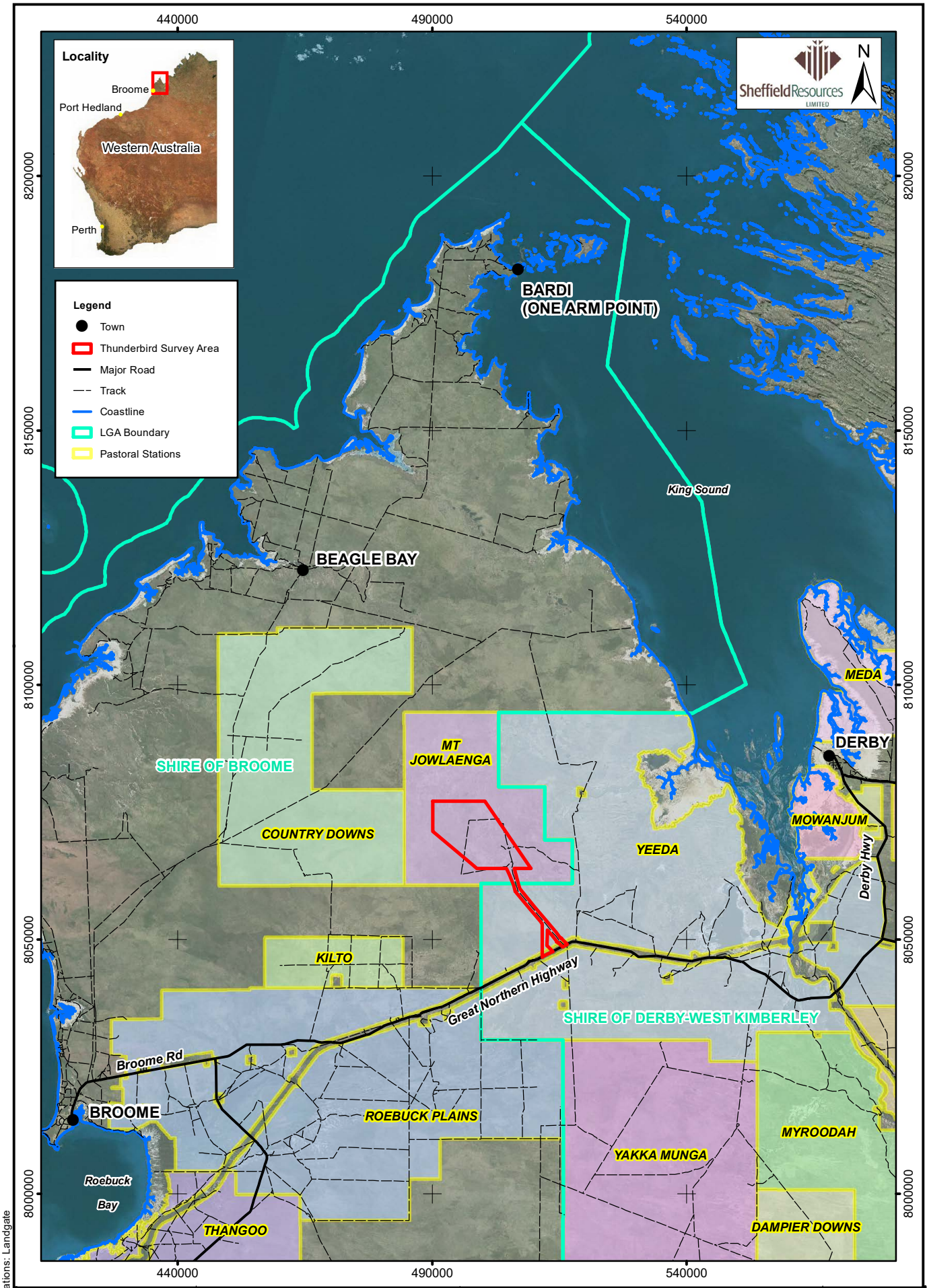
The Thunderbird Project Area is located approximately 98 km northeast of Broome and 72 km west of Derby in the West Kimberley region of Western Australia (Figure 1). The Thunderbird Project Area is situated on the Mt Jowlaenga and Yeeda Stations, and occupies an area of approximately 18,886 ha.

The Thunderbird Project Area is located within granted mining leases M04/311, M04/313, M04/357, M04/454, granted exploration tenements E04/2083, E04/2159, E04/2171, E04/2084, granted miscellaneous licences L04/85, L04/93, L04/86, L04/92, L04/84, L04/81, pending mining lease M04/459, and pending miscellaneous licences L04/82 and L04/83 (Figure 2).

The scope of the survey was to complete a Level 2 flora and vegetation assessment of the Thunderbird Project Area, whose boundary had been modified relative to previously completed flora surveys. New vegetation survey quadrats were established in areas previously not surveyed. In addition, after completing a gap analysis of the previous survey work, additional survey work within the original survey areas was undertaken to provide a more comprehensive survey of the Thunderbird Project Area.

2.2 Western Australia's Flora – A Legislative Perspective

Western Australia has a unique and diverse flora, and is recognised as one of the world's 34 biodiversity hotspots (Myers *et al*. 2000). In this context, Western Australia possesses a high degree of species richness and endemism. This is particularly pronounced in the south-west region of the state. The Department of Parks and Wildlife (DPaW) flora statistics indicate that there are currently over 12,000 native plant species known to occur within Western Australia (DPaW 2016a). Scientific knowledge of many of these species is limited.



Source: Pastoral Stations: Landgate

0 5 10 15 20 km

Scale: 1:1,000,000
MGA94 (Zone 51)

CAD Ref: a2409_f50_01

Date: Jul 2016 | Rev: A | A4

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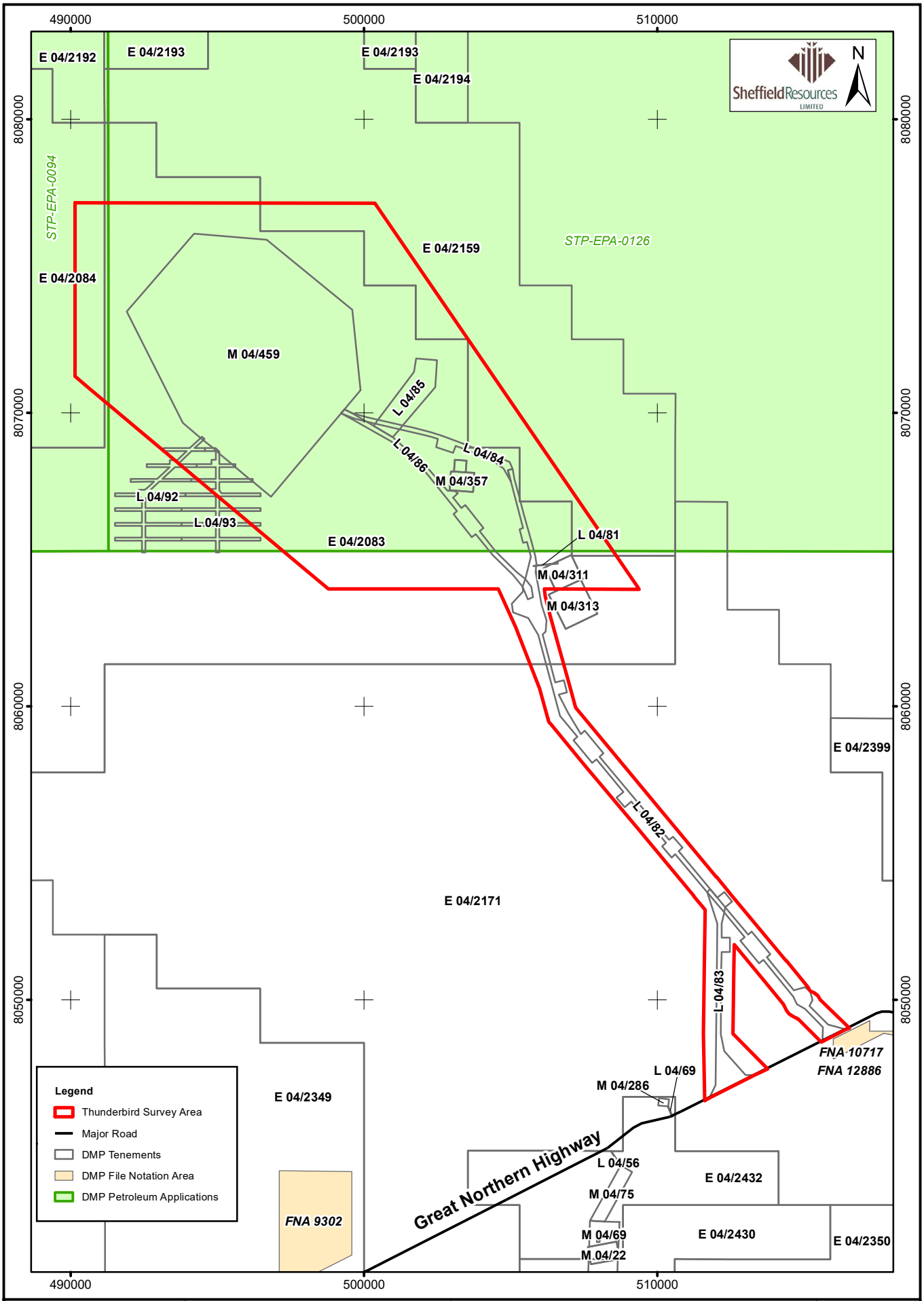
Thunderbird Mineral Sands Project
Locality
Showing Pastoral Stations

Figure: **1**



Source: Tenements: DMP, Catchments: DoW

0 1 2 3 km

Scale: 1:175,000
MGA94 (Zone 51)

CAD Ref: a2409_f50_02

Date: Jul 2016 | Rev: A | A4

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Thunderbird Mineral Sands Project
Tenements
as at 11/07/2016

Figure: **2**

The legislative protection of flora within Western Australia is principally governed by three Acts. These are:

- The *Wildlife Conservation Act 1950*;
- The *Environmental Protection Act 1986*; and
- Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*.

The unique flora of Western Australia is potentially under threat due to historical clearing practices associated with agricultural, mining and human habitation activities. As a consequence of these historical clearing practices a number of flora species have become threatened or have the potential to become threatened as their habitat is impacted by human activity. In addition, some areas of the State have been affected by past clearing practices such that entire ecological communities are under threat. The following sections describe these threatened and priority flora and ecological communities, and outline the legislative protection afforded to them.

At the State level, the *Wildlife Conservation Act 1950* provides for taxa of native flora (and fauna) to be specially protected because they are subject to identifiable threats. Protection of these taxa has been identified as being warranted because they may become extinct, are threatened, or are otherwise in need of special protection. Ecological communities that are deemed to be threatened are afforded protection under the *Environmental Protection Act 1986*. Listings of threatened species and communities are reviewed annually by the Western Australian Threatened Species Scientific Committee (TSSC), which is a body appointed by the Minister for the Environment and supported by the DPaW. The TSSC reviews threatened and specially protected flora (and fauna) listings on an annual basis. Recommendation for additions or deletions to the listings of specially protected flora (and fauna) is made to the Minister for the Environment by the TSSC, via the Director General of the DPaW, and the WA Conservation Commission. Under Schedule 1 of the *Wildlife Conservation Act 1950*, the Minister for the Environment may declare a class or description of flora to be threatened flora throughout the State, by notice published in the *Government Gazette* (DPaW 2016b).

At the Commonwealth level, under the *Environment Protection and Biodiversity Conservation Act 1999*, a nomination process exists, to list a threatened species or ecological community. Additions or deletions to the lists of Threatened species and communities are made by the Minister for the Environment, on advice from the Federal Threatened Species Scientific Committee. *Environment Protection and Biodiversity Conservation Act 1999* lists of Threatened flora and ecological communities are published on the Department of the Environment (DotE) website (2016a, 2016b).

2.2.1 Threatened and Priority Flora

Flora within Western Australia that is considered to be under threat may be classed as either threatened flora or priority flora. Where flora has been gazetted as threatened flora under the *Wildlife Conservation Act 1950*, it is an offence "to take" such flora without the written consent of the Minister. The *Wildlife Conservation Act 1950* states that "to take" flora includes to gather, pluck, cut, pull up, destroy, dig up, remove or injure the flora or to cause or permit the same to be done by any means.

Priority flora constitute species which are considered to be under threat, but for which there is insufficient information available concerning their distribution and/or populations to make a proper evaluation of their conservation status. Such species are considered to potentially be under threat, but do not have legislative protection afforded under the *Wildlife Conservation Act 1950*. The DPaW categorises priority flora according to their conservation priority, using five categories, P1 to P4, to denote the conservation priority status of such species, with P1 listed species being the most threatened, and P4 the least. Priority flora species are regularly reviewed, and may have their priority status changed when more information on the species becomes available. Appendix A1 sets out definitions of both threatened and priority flora (DPaW 2016c).

At the Commonwealth level, under the *Environment Protection and Biodiversity Conservation Act 1999*, threatened species can be listed as extinct, extinct in the wild, critically endangered, endangered, vulnerable, or conservation dependent, by the Commonwealth Minister for the Environment. Refer to Appendix A2 for a description of each of these categories of threatened species. Under the *Environment Protection and Biodiversity Conservation Act 1999*, a person must not take an action that has or will have a significant impact on a listed threatened species without approval from the Commonwealth Minister for the Environment, unless those actions are not prohibited under the Act.

The current *Environment Protection and Biodiversity Conservation Act 1999* list of Threatened flora may be found on the Department of the Environment (2016a) website.

2.2.2 Threatened and Priority Ecological Communities

An ecological community is defined as a naturally occurring biological assemblage that occurs in a particular type of habitat composed of specific abiotic and biotic factors. At the State level, ecological communities may be considered as threatened once they have been identified as such by the Western Australian Threatened Ecological Communities Scientific Advisory Committee. A threatened ecological community is defined, under the *Environmental Protection Act 1986*, as an ecological community listed, designated or declared under a written law or a law of the Commonwealth as threatened, endangered or vulnerable. There are four State categories of threatened ecological communities, or TECs: presumed totally destroyed (PD); critically endangered (CR); endangered (EN); and vulnerable (VU) (DPaW 2015d). A description of each of these categories of TECs is presented in Appendix A3. Threatened ecological communities are gazetted as such (DPaW 2016e).

At the Commonwealth level, some Western Australian TECs are listed as threatened, under the *Environment Protection and Biodiversity Conservation Act 1999*. Under the *Environment Protection and Biodiversity Conservation Act 1999*, a person must not take an action that has or will have a significant impact on a listed threatened ecological community without approval from the Commonwealth Minister for the Environment, unless those actions are not prohibited under the Act. A description of each of these categories of TECs is presented in Appendix A4. The current *Environment Protection and Biodiversity Conservation Act 1999* list of threatened ecological communities can be located on the DotE (2016b) website.

Ecological communities identified as threatened, but not listed as threatened ecological communities, can be classified as priority ecological communities (PECs). These communities are under threat, but there is insufficient information available concerning their distribution to make a proper evaluation of their conservation status. The DPaW categorises priority ecological communities according to their conservation priority, using five categories, P1 to P5, to denote the conservation priority status of such ecological communities, with P1 communities being the most threatened and P5 the least. Appendix A5 sets out definitions of priority ecological communities (DPaW 2016d). A list of current priority ecological communities can be viewed at the DPaW (2016f) website.

2.2.3 Clearing of Native Vegetation

Under the *Environmental Protection Act 1986*, the clearing of native vegetation requires a permit to do so, from the Department of Environment Regulation or the Department of Mines and Petroleum, unless that clearing is exempted under specific provisions listed in Schedule 6 of the Act, or are prescribed in the *Environmental Protection (Clearing of Native Vegetation) Regulations 2004*. Under the *Environmental Protection Act 1986*, "native vegetation" means indigenous aquatic or terrestrial vegetation, and includes dead vegetation unless that dead vegetation is of a class declared by regulation to be excluded from this definition but does not include vegetation in a plantation. Under the *Environmental Protection Act 1986*, Section 51A, "clearing" means the killing or destruction of, the removal of, the severing or ringbarking of trunks or stems of, or the doing of any other substantial damage to, some or all of the native vegetation in an area, and includes the draining or flooding of land, the burning of vegetation, the grazing of stock, or any other act or activity, that causes any of the aforementioned consequences or results.

Under the *Environmental Protection Act 1986*, ten principles are set out, under which native vegetation should not be cleared. These principles state that native vegetation should not be cleared, if:

a. it comprises a high level of biological diversity;
b. it comprises the whole or a part of, or is necessary for the maintenance of, a significant habitat for fauna indigenous to Western Australia;
c. it includes, or is necessary for the continued existence of, threatened flora;
d. it comprises the whole or a part of, or is necessary for the maintenance of, a threatened ecological community;
e. it is significant as a remnant of native vegetation in an area that has been extensively cleared;
f. it is growing in, or in association with, an environment associated with a watercourse or wetland;
g. the clearing of the vegetation is likely to cause appreciable land degradation;
h. the clearing of the vegetation is likely to have an impact on the environmental values of any adjacent or nearby conservation area;
i. the clearing of the vegetation is likely to cause deterioration in the quality of surface or underground water; or
j. the clearing of the vegetation is likely to cause, or exacerbate, the incidence or intensity of flooding.

The *Environmental Protection (Clearing of Native Vegetation) Regulations 2004*, under Regulation 5, sets out prescribed clearing actions that do not require a clearing permit, as defined in Section 51C of the *Environmental Protection Act 1986*. However, exemptions under these Regulations do not apply in Environmentally Sensitive Areas (ESA's).

Under the *Environmental Protection (Clearing of Native Vegetation) Regulations 2004*, under Regulation 6 – "Environmentally sensitive areas" include "the area covered by vegetation within 50 m of threatened flora, to the extent to which the vegetation is continuous with the vegetation in which the threatened flora is located". Similarly, "the area covered by a threatened ecological community" is listed as an environmentally sensitive area under Regulation 6.

2.3 Declared (Plant) Pest Organisms

The *Biosecurity and Agriculture Management Act 2007* (BAM Act), Section 22, makes provision for a plant taxon to be listed as a declared pest organism in respect to parts of, or the entire State. According to the BAM Act, a declared pest is defined as a prohibited organism (Section 12), or an organism for which a declaration under section 22 (2) of the Act is in force.

Under section 26 (1) of the BAM Act, a person who finds a declared plant pest must report, in accordance with subsection (2), the presence or suspected presence of the declared pest to the Director General or an inspector of the Department of Agriculture and Food Western Australia.

Under the *Biosecurity and Agriculture Management Regulations 2013*, declared plant pests are placed in one of three control categories, C1 (exclusion), C2 (eradication) or C3 (management), which determines the measures of control which apply to the declared pest (Appendix A6). According to section 30 (3) of the BAM Act, the owner or occupier of land, or a person who is conducting an activity on the land, must take the prescribed control measures to control the declared pest if it is present on the land.

The current listing of declared pest organisms and their control category is available on the Western Australian Organism List (WAOL), at the Biosecurity and Agriculture Management website of the Department of Agriculture and Food Western Australia (DAFWA 2016).

2.4 Local and Regional Significance

Flora or vegetation may be locally or regionally significant in addition to statutory listings by the State or Federal Government.

In regards to flora; species, subspecies, varieties, hybrids and ecotypes may be significant other than as threatened flora or priority flora, for a variety of reasons, including:

- a keystone role in a particular habitat for threatened species, or supporting large populations representing a significant proportion of the local regional population of a species;
- relic status;

- anomalous features that indicate a potential new discovery;
- being representative of the range of a species (particularly, at the extremes of range, recently discovered range extensions, or isolated outliers of the main range);
- the presence of restricted subspecies, varieties, or naturally occurring hybrids;
- local endemism/a restricted distribution; and
- being poorly reserved (Environmental Protection Authority 2004).

Vegetation may be significant because the extent is below a threshold level and a range of other reasons, including:

- scarcity;
- unusual species;
- novel combinations of species;
- a role as a refuge;
- a role as a key habitat for threatened species or large populations representing a significant proportion of the local to regional total population of a species;
- being representative of the range of a unit (particularly, a good local and/or regional example of a unit in "prime" habitat, at the extremes of range, recently discovered range extensions, or isolated outliers of the main range);
- a restricted distribution (Environmental Protection Authority 2004).

Vegetation communities are locally significant if they contain Priority Flora species or contain a range extension of a particular taxon outside of the normal distribution. They may also be locally significant if they are very restricted to one or two locations or occur as small isolated communities. In addition, vegetation communities that exhibit unusually high structural and species diversity are also locally significant.

Vegetation communities are regionally significant where they are limited to specific landform types, are uncommon or restricted plant community types within the regional context, or support populations of threatened Flora.

Determining the significance of flora and vegetation may be applied at various scales, for example, a vegetation community may be nationally significant and governed by statutory protection as well as being locally and regionally significant.

3. OBJECTIVES

The aim of this survey was to complete a Level 2 flora and vegetation survey of the Thunderbird Project Area. Specifically, the objectives of the survey of the Thunderbird Project Area included:

- Undertake a desktop assessment to evaluate the botanical values of the local and broader area associated with the Thunderbird Project Area to identify any matters of botanical or conservation significance;
- Review previous literature and data, including undertaking a gap analysis with respect to previous flora and vegetation surveys of the Thunderbird Project Area;
- On the basis of the reviews, provide summaries to assist in the assessment of the potential range of values and the potential for conservation significant species and communities;
- Undertake botanical data collection in quadrats that are representative of all potential vegetation communities within the survey area of sufficient detail to permit appropriate statistical analyses;
- Collect and identify the vascular plant species present in vegetation survey quadrats, as well as opportunistically, within the Thunderbird Project Area;
- Record visual observations on the fire regimes, grazing pressures and overall health of the vegetation to allow for an assessment of the overall condition of the flora and vegetation within the Thunderbird Project Area;
- Identify and record the locations of any Declared Organisms within the Thunderbird Project Area;
- Review the conservation status of the vascular plant species recorded by reference to current literature and current listings by the DPaW (2016g) and plant collections held at the Western Australian State Herbarium, and listed by the Department of the Environment (DotE 2016a) under the *Environment Protection and Biodiversity Conservation Act 1999*;
- Define and prepare a vegetation map of the vegetation communities within the Thunderbird Project Area;
- Assess the condition of the vegetation communities within the Thunderbird Project Area;
- Provide descriptions of the vegetation communities present within the Thunderbird Project Area and evaluate their regional significance; and
- Prepare a report summarising the findings.

4. METHODS

The Thunderbird Project Area is approximately 18,886 ha in area. The coordinates delineating the boundaries of the Thunderbird Project Area are set out in Appendix B.

The survey was completed to the standards set out in *Guidance Statement 51 - Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia* (EPA 2004), *Position Statement No.3 – Terrestrial Biological Surveys as an Element of Biodiversity Protection* (EPA 2002), and *Technical Guide – Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment* (EPA 2015).

4.1 Desktop Survey

The desktop assessment for the Thunderbird Project Area was undertaken using the DPaW (2007-, 2016b, 2016e, 2016f) and DotE (2016a, 2016b, 2016c) databases. A 40 km search radius about the approximate centre point of the Thunderbird Project Area (499587 mE, 8070710 mN, MGA94 zone 51) was used as a search reference point. These databases were utilised to identify the possible occurrence of threatened and priority flora, threatened and priority ecological communities and any other matters protected under the EPBC Act within the vicinity of the Thunderbird Project Area.

4.2 Data from Flora and Vegetation Surveys of the Thunderbird Project Area Completed between 2012 and 2015

The Thunderbird Project Area has been the subject of three flora and vegetation surveys, completed by Ecologia Environment, between 2012 and 2015 (Ecologia 2012, 2014, 2015). Quadrat based survey data was made available by Sheffield from these surveys, in a range of formats. Species height and projected foliage cover was not made available for all three surveys. The data was transformed into a presence-absence format. Several of the survey quadrats established between 2012 and 2015 by Ecologia were re-assessed in June 2016 to verify species identifications and increase confidence in the supplied data for use in statistical analysis in 2016. The data from the 2012 to 2015 surveys was reviewed and the names and status of all species was updated to ensure currency with present taxonomic listings (DPaW 2016g).

4.3 Field Survey

The assessment of the flora and vegetation of the Thunderbird Project Area (Figures 1 and 2) was undertaken by four experienced botanists from Mattiske, from the 20th to 28th June 2016. All botanists held valid collection licences to collect flora for scientific purposes, issued under the *Wildlife Conservation Act 1950*. Additionally, at least one botanist held a valid permit to take Declared Rare Flora, issued under the *Wildlife Conservation Act 1950*.

The coordinates defining the boundaries of the Thunderbird Project Area were supplied by Sheffield (Appendix B). Aerial photographic maps at a 1:10,000 scale of the Thunderbird Project Area, based on

high resolution aerial imagery taken between October 2014 and September 2015 (0.15 m resolution overall, 0.05 m resolution in part), were prepared by CAD Resources of Carine, Western Australia. To sample all the apparent vegetation types across Thunderbird Project Area, the location of vegetation survey quadrats was made primarily on the basis of aerial photographic maps. Additional sites were selected *in situ*, based on observations of vegetation communities during the field survey. Wherever possible, replicate vegetation survey quadrats were established in the same but discontinuous vegetation community types. In addition to data recorded from vegetation survey quadrats, a more comprehensive species inventory of the Thunderbird Project Area was achieved using supplementary survey techniques - opportunistic collections, relevés and traverses - within the Thunderbird Project Area. This also enabled the visual confirmation of community boundaries during the field survey work.

All vegetation survey quadrats measured 50 m x 50 m in size. In situations where vegetation community shape (e.g. drainage channels) precluded establishing quadrats of the standard dimension, an area of equivalent size (i.e. 2,500 m^2) was surveyed. The flora and vegetation was described and sampled systematically at each vegetation survey quadrat, and additional opportunistic collecting was undertaken wherever previously unrecorded plants were observed. At each vegetation survey quadrat, the following floristic and environmental parameters were recorded:

- GPS location (GDA94 datum);
- soil type, colour and any additional observations;
- local site topography;
- presence of any outcropping rocks and their type;
- aspect of the hill-slopes;
- percentage of litter cover (logs, twigs and/or leaves);
- percentage of bare ground;
- time since fire;
- condition of the vegetation, based on Trudgeon's (1988) condition ratings; and
- alive and dead percentage of foliage cover and average height of each species recorded.

Searches for priority flora were undertaken concurrently with vegetation quadrat assessments. Preferred habitats of previously recorded priority species were traversed when encountered by botanists. When any suspected priority flora was encountered, counts were made in an appropriate area and field notes were made in relation to soil, topography and associated species. Some of the locations of priority flora recorded by Ecologia (2012, 21014, 2015) were re-visited and specimens collected to ensure the accuracy and consistency of identifications.

In addition to survey quadrats, targeted threatened and priority flora surveys were conducted concurrently. Preferred habitats of previously recorded priority species were traversed when encountered by botanists. When any suspected threatened or priority flora was encountered, counts were made in an appropriate area and anecdotal field notes were made in relation to soil, topography and associated

species. A selection of previous locations of species recorded by Ecologia were re-visited and specimens collected to ensure the accuracy and consistency of identifications between surveys and personnel.

All plant specimens collected during the field survey were dried and processed in accordance with the requirements of the Western Australian Herbarium (WAH). All plant specimens were identified through comparisons with pressed specimens housed at the Mattiske herbarium and WAH. Where appropriate, plant taxonomists with specialist skills were consulted. Nomenclature of the species recorded is in accordance with the WAH (DPaW 2016g).

4.4 Statistical Analysis of Data and Vegetation Mapping

A species accumulation curve, based on accumulated species versus number of quadrats surveyed was prepared, to evaluate the level of adequacy of the survey effort. The species accumulation curve was based on the species accumulation analysis of Colwell (2013).

Plymouth Routines in Multivariate Ecological Research version 6 (PRIMER v6) statistical analysis software was used to analyse species-by-site data and discriminate sites on the basis of their species composition (Clarke and Gorley 2006). To down-weight the relative contributions of quantitatively dominant species a presence/absence transformation of the data was used for statistical analysis. Introduced species, singletons (species recorded at only one site) and specimens that were not identified down to the species level were excluded from the analysis. Annuals were removed from the data in the analysis due to the likelihood of substantial differences between years based on seasonality of local rainfall events. Computation of similarity matrices was based on the Bray-Curtis similarity measure. Transformed data were analysed using a series of multivariate analysis routines including Hierarchical Clustering (CLUSTER), Similarity Profile (SIMPROF) and Similarity Percentages (SIMPER). Results were used to inform and support interpretation of aerial photography and delineation of individual vegetation communities.

4.5 Vegetation Descriptions

The description of the vegetation communities was based on Alpin's (1979) modification of the vegetation classification system of Specht (1970), to align with the NVIS. Vegetation communities were described at the association level of the NVIS classification framework, as defined by the Executive Steering Committee for Australian Vegetation Information (ESCAVI 2003).

5. DESKTOP SURVEY RESULTS

5.1 Climate

Beard (1990) described the climate of the West Kimberley, where the Thunderbird Project Area is situated, as having a semi-arid to dry hot tropical climate, with summer rainfall and annual precipitation of 250-800 mm. Much of the rain comes from thunderstorms. The heaviest and most widespread falls are associated with cyclonic disturbances. Derby Aero, which is located approximately 72 km to the east of the Thunderbird Project Area, has an average annual rainfall of 691 mm (Bureau of Meteorology, BOM 2016). Rainfall and temperature data for Derby Aero is illustrated in Figure 3. The rainfall and temperature data displayed covers the period January 2012 to June 2016, to span both the current survey being reported, as well as the three previous surveys (Ecologia 2012, 2014, 2015) of the Thunderbird Project Area. Rainfall in the four months preceding the June 2016 field survey was 190 mm, which is 51% of the long term average for the corresponding period. Table 1 lists the rainfall for the four months preceding each survey completed in the Thunderbird Project Area. Two of the surveys were completed after above average rainfall periods. The present survey was completed after the driest period preceding all four surveys.

Table 1: Rainfall at Derby Aero in the four months preceding flora and vegetation surveys in the Thunderbird Project Area.

Flora Survey Period	Surveying Company	Four-Month Rainfall[1]		Percent of Long Term Average Rainfall for CorrespondingMonths[1]
		Interval	Rainfall Total (mm)	
21st – 26th June 2012	Ecologia	Feb-May 2012	439.2	118
4th – 15th April 2013	Ecologia	Dec 2012 – Mar 2013	742.4	124
11th – 15th May 2015	Ecologia	Jan-Apr 2015	384.6	70
20th - 28th June 2016	Mattiske	Feb-May 2016	190.0	51

1. BOM 2016

5.2 IBRA7 Biogeographical Sub-regions

The Interim Biogeographic Regionalisation for Australia (IBRA) delineated 85 bioregions across Australia, based on a range of biotic and abiotic factors, including climate, vegetation, fauna, geology and landform (Thackway and Cresswell 1995; DotE 2016d). IBRA Version 7 refined the original 85 bioregions and 403 sub-regions described in IBRA 6.1, by expanding the number of regions to 89 and the number of sub-regions to 419. The sub-regions represent more localised and homogenous geomorphological units in each bioregion. IBRA7 includes four new oceanic bioregions, and seven new sub-regions in the oceanic bioregions and six new sub-regions in South Australia (DotE 2016d)

The Thunderbird Project Area is situated within the Dampierland 2 (DL2 – Pindanland) sub-region of the Dampierland (DAL) region. (Figure 4). Graham (2001) describes the Dampierland 2 (DLS – Pindanland) subregion as having a climate which is dry hot tropical and semi-arid with summer rainfall.

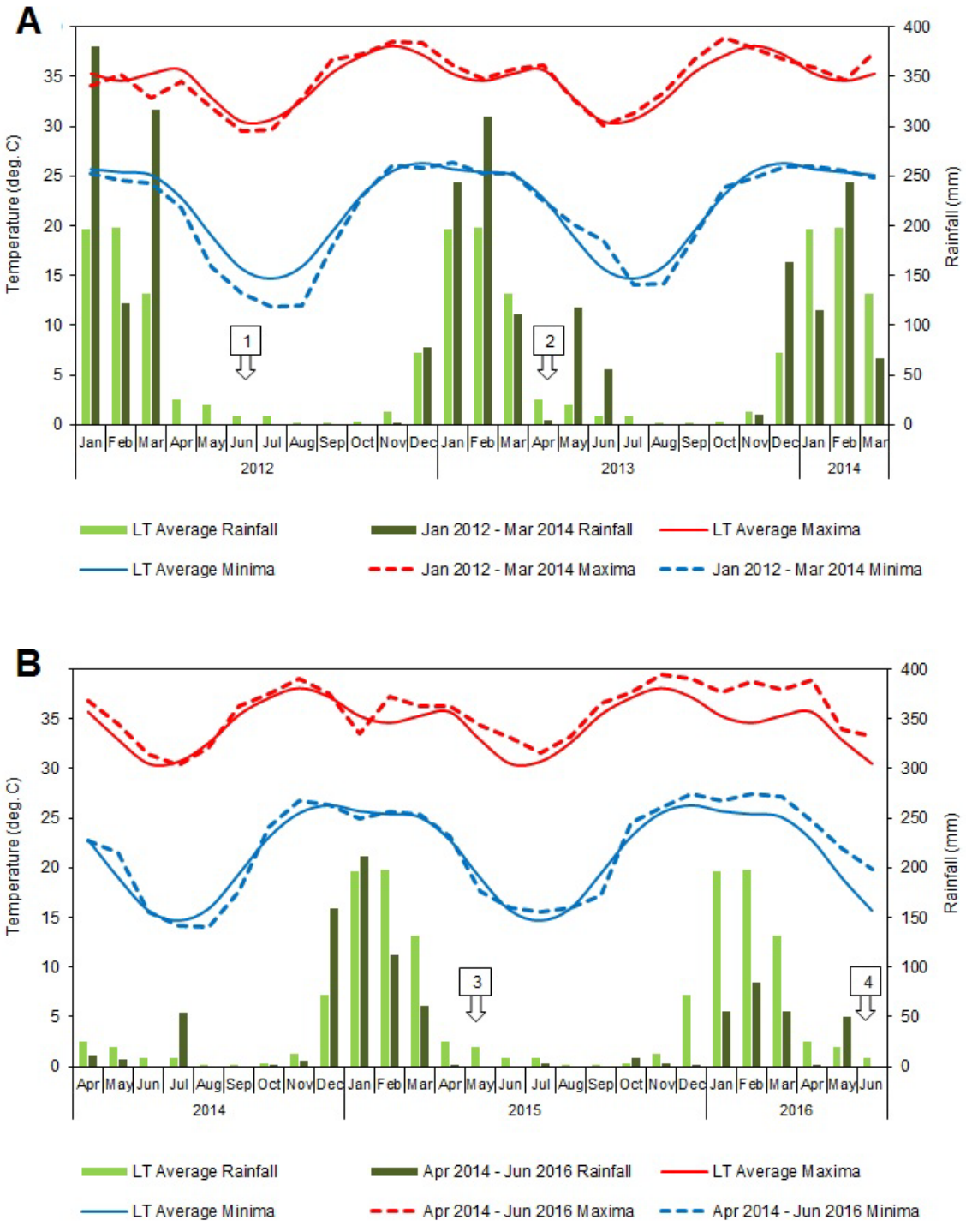


Figure 3: Rainfall and temperature data for Derby Aero
Long term average (LTA) rainfall and temperature data, together with monthly rainfall data for the period January 2012 to March 2014 (Fig. 2A) and April 2014 to June 2016 (Fig 2B) are shown (BOM 2016). The numbered markers indicate the timing of flora and vegetation surveys within the Thunderbird Project Area: 1 – June 2012 (Ecologia 2012); 2 – April 2013 (Ecologia 2014); 3 – May 2015 (Ecologia 2015); 4 - June 2016 (Mattiske, this report).

The Pindanland subregion comprises sandplains of the Dampier Peninsula and western part of Dampierland. Geologically, the subregion is dominated by:

- Quaternary sandplains overlying Jurassic and Mesozoic sandstones with pindan;
- Quaternary marine deposits on coastal plains; and
- Quaternary alluvial plains associated with Permian and Mesozoic sediments of the Fitzroy Trough.

The vegetation is described as primarily pindan (Graham 2001, Kenneally *et al*. 1996). The term pindan refers to both the soil type and its associated vegetation. The pindan soils comprise red earthy clayish sands, which form extensive undulating plains with little organised surface drainage. Pindan vegetation consists of a grassland with an upper layer composed of eucalypts, and a dense middle layer composed of *Acacia* species (Kenneally *et al*. 1996). Typical trees species include *Eucalyptus tectifica, Eucalyptus flavescens, Corymbia polycarpa, Corymbia greeniana* and *Corymbia zygophylla* (Graham 2001, Kenneally *et al*. 1996). Other common tree and large shrub species present include *Bauhinia cunninghamii, Ehretia saligna, Hakea macrocarpa, Hakea arborescens, Grevillea pyramidalis, Ventilago viminalis* and *Brachychiton diversifolius*. The grasses present are typically a mix of *Triodia*, *Chrysopogon* and *Sorghum* species (Graham 2001, Kenneally *et al*. 1996).

Table 2: Extent of IBRA sub-regions intersecting the Thunderbird Project Area.

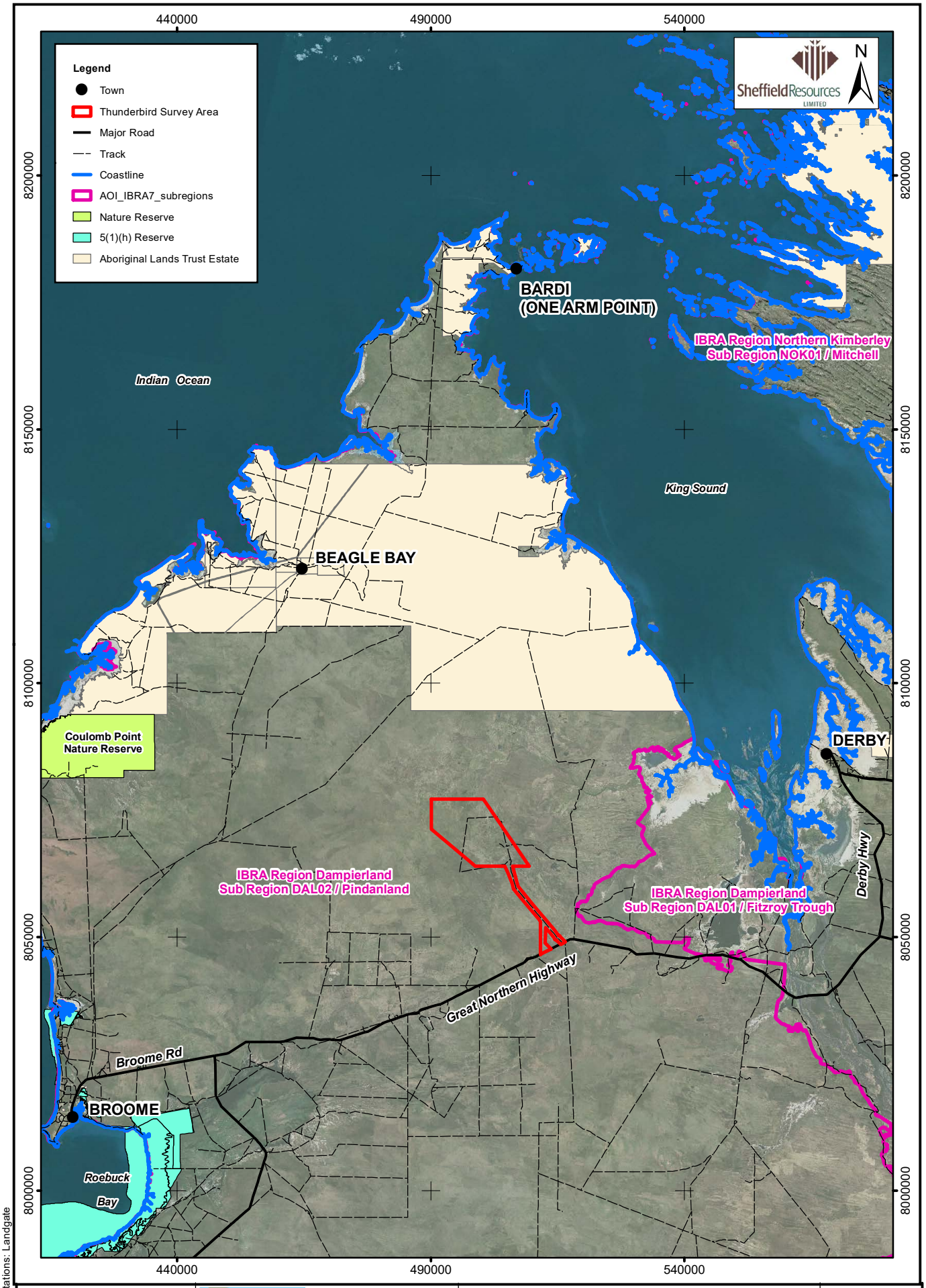
IBRA Sub-region	State-wide	Thunderbird Project Area	
	Current Extent (ha)	Area of Intersection (ha)	Proportion of Current Extent (%)
DL2 (Pindanland)	4,926,230	18,885.9195	0.38

5.3 Beard's Vegetation Mapping

Beard (1979, 1990) divided the northern province (Kimberley area) into four botanical districts, based on a combination of climate, landforms, geology, soils and vegetation patterns. The four botanical districts delineated in the northern province are the North Kimberley Region (Gardner Botanical District), Central Kimberley Region (Fitzgerald Botanical District), East Kimberley Region (Hall Botanical District) and the Dampierland Region (Dampier Botanical District) (Beard 1979, 1990). The Thunderbird Project Area falls within the Dampierland Region (Dampier Botanical District).

Geologically, Beard (1979) described the Dampier Region as being composed of quaternary sandplains and alluvia with outcrops of Phanerozoic sandstone and reef limestone. The country is low lying with little relief, except for local rugged sections on outcrops of either limestone or sandstone. The plains consist of sandy red earths, some yellow earths and lateritic podzolic soils. The region experiences summer (wet season) rainfall of 400-800 mm, with a dry season 8 months long. Much of the rain comes from thunderstorms. The heaviest and most widespread falls are associated with cyclonic disturbances.

The vegetation of the area is described as pindan, a term which incorporates the red sandy soils and the associated vegetation. The pindan is a grassland wooded by a sparse upper layer of trees and a dense thicket-forming layer of *Acacia*. Fires are a common occurrence, which periodically destroys the ground



Source: Pastoral Stations: Landgate

0 5 10 15 20 km

Scale: 1:1,000,000
MGA94 (Zone 51)

CAD Ref: a2409_f50_04

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Thunderbird Mineral Sands Project
IBRA Regions
Showing Managed Lands and Waters

Figure: **4**

layer and middle *Acacia* layer, leaving the trees intact. The grasses regenerate from seeds and rhizomes, the *Acacia* from seed. Over the succeeding years the *Acacias* grow taller, developing into a tall thicket or low forest, suppressing the grasses and herbs. Eventually a fire puts the succession back to the beginning, and the cycle repeats (Beard 1990). The common trees in the area are *Eucalyptus tectifica* and *Corymbia grandifolia*, typically 10-25 m in height. The pindan layer consists of *Acacia tumida*, with some *Acacia holosericea*, *Dolichandrone heterophylla*, *Gardenia pyriformis* subsp. *keartlandii* (formerly *Gardenia keartlandii*), *Grevillea refracta*, *Grevillea heliosperma*, *Hakea arborescens*, *Hakea macrocarpa*, *Petalostigma pubescens* and *Terminalia circumalata*. The grass layer is mainly *Triodia bitextura* (formerly *Plectrachne pungens*) with some *Chrysopogon* (Beard 1979). Within the Dampier Botanical District, the Thunderbird Project Area is situated within Beard's (1979) Dampier Peninsula sub-province, adjacent to Beard's (1979) Fitzroy Plains sub-province. Given the proximity of the latter to the Thunderbird Project Area, there is a likelihood that elements of both sub-provinces may be present. A summary of each of these sub-provinces is set out below.

Dampier Peninsula Sub-province

Gently undulating sandplain with red earthy sands. The sandplain is entirely covered by pindan-woodland vegetation type, which is comprised of an open layer of trees, 12-15 m in height, over a pindan layer of dense *Acacia*, up to 5 m, and a sparse grassy ground layer. Beard (1979) states that approximately 25 km north of Broome there is a gradual change in the vegetation, compared to that which is present in the more southern portion of the peninsula. The dominant tree species consist of *Eucalyptus tectifica* and *Corymbia grandiflora*, whilst *Acacia tumida* replaces *Acacia eriopoda* as the dominant pindan shrub. Other plant taxa commonly present include *Erythrophleum chlorostachys*, *Gyrocarpus americanus* and *Bauhinia cunninghamii*, mostly as smaller trees. The pindan layer consists of *Acacia tumida* with some *Acacia holosericea*, *Dolichandrone heterophylla*, *Gardenia pyriformis* subsp. *keartlandii*, Grevillea refract, *Grevillea heliosperma*, *Hakea arborescens*, *Hakea macrocarpa*, *Petalostigma pubescens* and *Terminalia circumalata*. The grass layer is mainly *Triodia pungens*. and *Chrysopogon* spp.

Fitzroy Plains Sub-province

Extensive sandplains, often with longitudinal sand ridges, usually without surface drainage. Broad saline mud-flats are present in bays and estuaries in coastal parts. The spoils consist of red earthy sands, sometimes with ironstone gravel. The vegetation is largely pindan. *Eucalyptus miniata*, *Eucalyptus tectifica* and *Corymbia confertifolia*, reaching 12-15 m in height. A smaller tree layer at 4-8 m is characterized by *Corymbia confertifolia*, with *Adansonia gregorii*, *Buchanania obovata*, *Erythrophleum chlorostachys*, *Grevillea* spp., *Bauhinia cunninghamii*, *Persoonia falcata* and *Terminalia canescens*. Acacia tumida is the principal Acacia dominating the pindan. The grassy ground layer is composed of *Triodia pungens.*, *Chrysopogon* spp. and annual *Sorghum*. In the middle section of the sandplains, numerous other shrubs, including *Acacia holosericea*, *Acacia monticola*, *Atalaya hemiglauca*, *Dolichandrone heterophylla*, *Grevillea* spp. and *Hakea* spp. are present. The grassy ground layer is composed of *Triodia pungens*, *Chrysopogon pallidus*, *Sorghum timorense*, *Sorghum stipoideum*, *Aristida holathera*, *Aristida hygrometrica*, *Eriachne ciliata*, *Eriachne obtusa*, *Eriachne eriopoda* and *Panicum* spp.

5.4 Land Systems

A land system is an area, or areas, through which there is a recurring pattern of topography, soils and vegetation (Christian and Stewart, 1953). The land systems approach to mapping has been used to map the arid rangelands in Western Australia since 1969. The regional land system mapping of the Kimberley by Schoknecht and Payne (2010) delineated a series of mapping units in the Kimberley region. The Thunderbird Project Area intersects four land systems (Figure 5). The four land systems that intersect the Thunderbird Project Area are the Fraser, Reeves, Wanganut and Yeeda land systems. The areas of each of these land systems together with their extent of intersection with the Thunderbird Project Area is set out in Table 3. A description of each of these land systems, summarised from Schoknecht and Payne (2010), is set following Table 3.

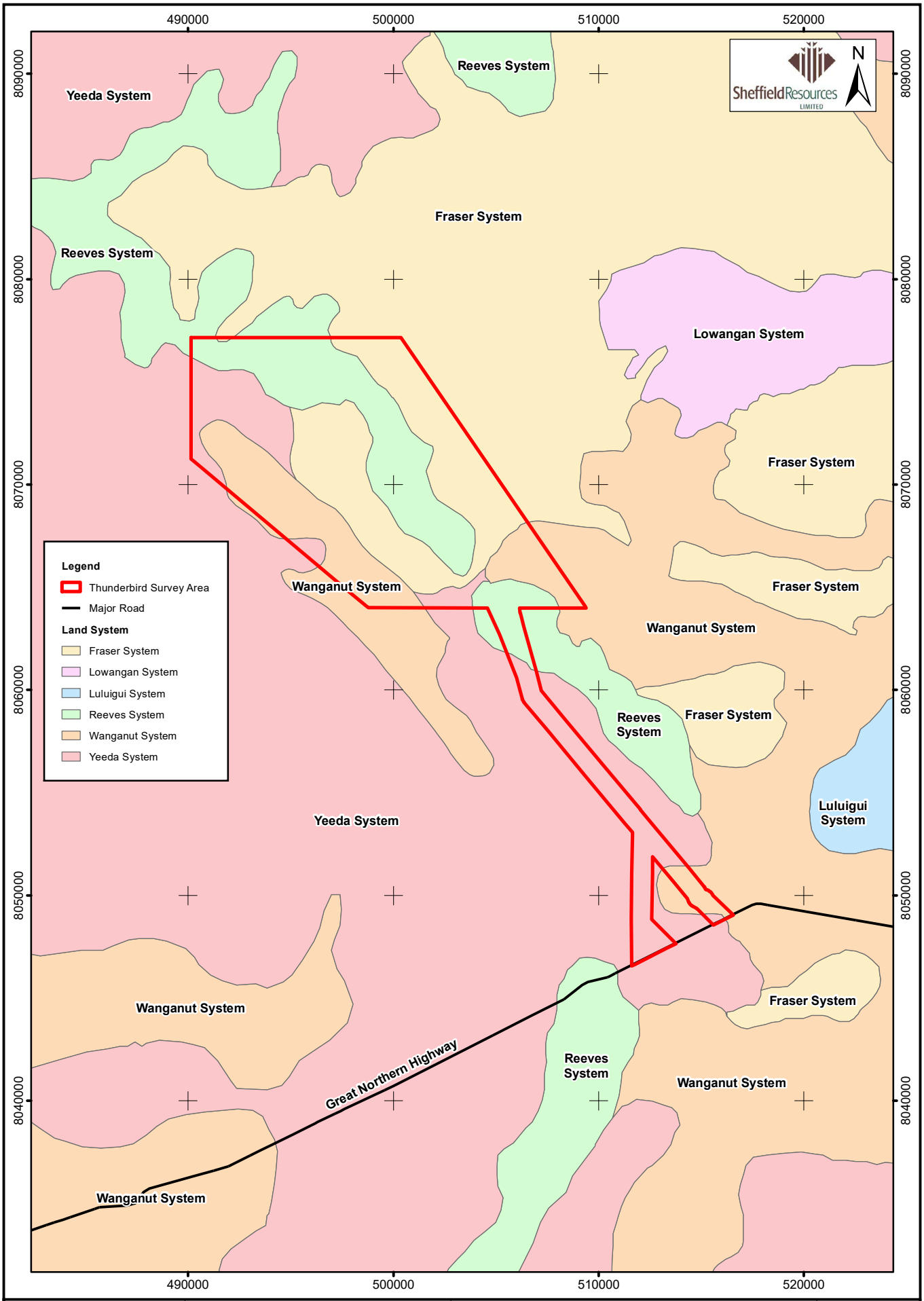
Table 3: Extent of Land Systems intersecting the Thunderbird Project Area.

Land System	State-wide	Thunderbird Project Area	
	Current Extent (ha)	Area of Intersection (ha)	Proportion of Current Extent (%)
Fraser	73,563.9768	5832.3473	7.928
Reeves	45,714.0627	5063.5019	11.076
Wanganut	706,433.7548	3967.8905	0.562
Yeeda	2,625,930.2681	4022.1528	0.153

Fraser Land System (Fra)

The Fraser land System consists of sandplains with irregular dunes and local stony surfaces, pindan and spinifex/tussock grasslands. The Fraser land system comprises six land units:

1. Sandplains up to 4.8 km in extent, of reddish sandy soils with brownish massive heavy clays in pans, supporting low woodland (pindan) with prominent *Acacia* shrub layer and *Triodia bitextura – Chrysopogon* spp. ground storey. *Corymbia dichromophloia - Corymbia zygophylla - Acacia* spp. community.
2. Sand dunes up to 6.4 km long and 9 m high, of deep red sands, supporting variable vegetation of low woodland (pindan) with prominent *Acacia* shrub layer and *Triodia bitextura – Chrysopogon* spp. ground storey, and more open woodlands with *Triodia pungens* and *Aristida browniana*. *Bauhinia cunninghamii* alliance.
3. Sandplains, up to 3,2 km in extent, with outcrops, on shallow, gravelly, reddish skeletal soil and some reddish sand soil, supporting open woodlands and patches of pindan with *Triodia bitextura - Chrysopogon* spp. ground storey. *Adansonia gregorii* and *Corymbia dichromophloia* alliances.
4. Low lying sandplains up to 1.6 km wide, with yellowish mottled sandy soils supporting a complex of grassy woodlands and pindan vegetation with *Chrysopogon* spp., and *Triodia bitextura*. *Bauhinia cunninghamii* and *Corymbia dichromophloia* alliances.
5. Drainage floors, up to 275 m wide, with sealed scalded surfaces and sand hummocks, on yellowish mottled loamy soils, supporting low grassy woodland with *Chrysopogon* spp. *Grevillea striata* and *Bauhinia cunninghamii* alliances.



Source: Land Systems: DoAF

0 1 2 3 4 5 km

Scale: 1:250,000
MGA94 (Zone 51)

CAD Ref: a2409_f50_05

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Thunderbird Mineral Sands Project
Land Systems

Figure: **5**

6. Drainage floors, up to 275 m wide, with sealed scalded surfaces and sand hummocks, on yellowish mottled loamy soils, supporting low grassy woodland with *Chrysopogon* spp. *Grevillea striata* and *Bauhinia cunninghamii* alliances.
7. Channels, up to 30 m wide and 3 m deep, on bed loads of deep sand with banks of brownish loamy alluvial soils, supporting fringing woodlands and forests. *Eucalyptus camaldulensis* - *Terminalia platyphylla* fringing communities.

The Fraser land system is generally stable with low susceptibility to erosion except for sand dunes (unit 2) which have moderate susceptibility immediately after fire but stabilise rapidly after rain. Fire history affects composition and density of pindan vegetation which is resilient under controlled grazing.

Reeves Land System (Rev)

The Reeves land system consists of sandplains with scattered hills and minor plateaux on reddish sandy soils, supporting pindan woodlands and spinifex/tussock grasslands. The Reeves land system comprises five land units:

1. Hills, up to 60 m high; flat or gently sloping rocky crests up to 800 m wide, with marginal escarpments, locally vertical, and basal scree slopes, supporting a depauperate woodland and spinifex grassland with scattered trees (*Corymbia confertifolia*) and scrubs.
2. Reddish sandy soil sandy surfaces with local outcropping, up to 1.6 km in extent, supporting a low woodland (pindan) with prominent *Acacia* tall shrub layer and *Triodia bitextura*, *Chrysopogon* spp. ground storey. *Corymbia dichromophloia*, *Corymbia zygophylla*, *Acacia* spp. community.
3. Sandplains up to 2.4 km wide, of reddish sandy soils, supporting a low woodland (pindan) with *Triodia bitextura*, *Chrysopogon* spp. ground storey; *Adansonia gregorii* and *Corymbia dichromophloia* alliances.
4. Pans and depressions, up to 800 m wide, with mottled sandy soils and greyish massive silty to heavy clays in pans, which are mostly bare, with paperbark fringing communities. *Melaleuca* spp. communities.
5. Channels, up to 9 m wide and 1.5 m deep, with bed loads ranging from deep sand to cobbles, and banks of brownish loamy alluvial soils, supporting fringing woodlands. *Eucalyptus camaldulensis* and *Melaleuca* spp. communities.

Pindan vegetation subject to fairly frequent fires which induce short term changes in botanical composition, density and structure; low to moderate pastoral value for a few years after fire. Sandplains (unit 3) have minor susceptibility to wind erosion immediately after fire but stabilise rapidly after rain; control of grazing pressure and frequency of burning is desirable.

Wanganut Land System (Wan)

The Wanganut land system consists of sandplains and dunes with pindan woodlands and spinifex/tussock grasslands. The Wanganut land System comprises six land units:

1. Sandplains, up to 4.8 km in extent, of deep red sands, supporting woodlands (pindan) with prominent *Acacia* shrub layer and *Triodia bitextura* – *Chrysopogon* spp. *Corymbia dichromophloia* alliance.

2. Linear dunes, up to 9 m high and 19 km long, of mainly deep red sands, supporting low woodlands (pindan) with patches of dense *Acacia* shrubs and *Triodia bitextura – Chrysopogon* spp. and *Aristida* spp. ground storeys. *Corymbia dichromophloia* and *Bauhinia cunninghamii* alliances.
3. Dune swales, up to 1.6 km wide, and low-lying sandplain of mainly yellowish sandy soils with minor amounts of reddish sandy soils, supporting grassy woodlands with patchy *Acacia* shrub layer. *Triodia bitextura* and *Triodia bitextura – Chrysopogon* spp. ground storeys. *Corymbia dichromophloia*, *Eucalyptus tectifica* and *Eucalyptus microtheca* alliances. The introduced **Cenchrus ciliaris* (buffel grass) was common in parts.
4. Pans and depressions, linear, up to 800 m wide and 4.8 km long, consisting of yellowish, strongly mottles loamy soils; brownish, massive intractable heavy clay in pans, supporting ribbon grass grasslands with patches of *Triodia bitextura* and fringing paperbark and bloodwood woodlands. *Corymbia polycarpa*, *Eucalyptus microtheca*, and *Melaleuca* spp. alliances.
5. Drainage floors composed of a complex of yellowish sandy soils and scalded greyish and brownish sands and loams over tough clay, supporting a complex of ribbon grass and paperbark trees. *Melaleuca* spp. community and *Chrysopogon* spp. community.
6. Channels, up to 30 m wide and 4.5 m deep, bed loads of deep sand, banks of brownish sandy and loamy alluvial soils, supporting fringing forests and woodlands. *Eucalyptus camaldulensis – Terminalia platyphylla* fringing community.

The Wanganut land system supports dense wattle scrub with pindan pastures and is subject to fairly frequent fires which induce short term changes in botanical composition, density and structure. Pindan pastures, depending on time since last fire, are poorly to moderately attractive and useful to cattle. Generally, not prone to degradation or erosion but control of grazing pressure and frequency of burning is desirable.

Yeeda Land System (Yed)

The Yeeda land system consists of sandplains and occasional dunes, with deep red and yellow sands, with shrubby spinifex grasslands or pindan woodlands. The Yeeda land system comprises four land units:

1. Sandplains of deep red sands, up to 16 km in extent, supporting woodlands (pindan) prominent *Acacia* shrub layer and *Triodia bitextura*, *Chrysopogon* spp. ground storey. *Corymbia dichromophloia* alliance.
2. Shallow valleys, up to 4.8 km wide, with reddish sandy soils or deep yellow sands, supporting grassy woodlands with patchy *Acacia* shrub layer and *Chrysopogon* spp., with *Eucalyptus tectifica* and *Eucalyptus argillacea*.
3. Plains with thin sand cover, of predominantly yellowish sandy soils, with scalded areas of greyish sands over tough loamy subsoils. The vegetation is composed of open patchy woodlands with *Chrysopogon* spp. and *Triodia bitextura*, patches of paperbark trees. *Grevillea striata*, *Bauhinia cunninghamii* and *Melaleuca* spp. alliances.
4. Pans, less than 800 m wide, of brownish, massive, intractable, silty to heavy clays, supporting various tall grasses with fringes of bloodwood and paperbark woodlands. *Corymbia polycarpa* and *Melaleuca* spp. alliances.

5.5 Geology, Soils and Topography

The Thunderbird Project Area is situated within Beard's (1990) Dampier Botanical District. Beard (1990) described the geology, soils and topography of the Dampier Botanical District as consisting of extensive sandplains on red earthy sands, low uplands of sandstone and limestone with shallow stony soils. Geologically, the area comprises Quaternary sandplain overlying Jurassic sandstones, with Quaternary marine deposits on the coastal plains, and Devonian reef limestones and extensive alluvial river plains.

In more recent times mapping of soils and landscapes has become available at a greater level of detail. The Department of Agriculture, in its "Soil-landscapes of Western Australia's Rangelands and Arid Interior" (Tille 2006), describes a range of soil-landscape mapping units. Tille (2006) describes the geology of the southern Kimberley, where the Thunderbird Project Area is situated, as comprising Devonian to Triassic sandstone, shale, siltstone and limestone of the Lennard Shelf and Fitzroy Trough (northern Canning Basin). The landforms present are sandplains and alluvial plains (with some hills) overlying the sedimentary rocks of the Canning Basin. The soils are red deep sands, with some yellow sandy earth and red sandy earths on sandplains.

Tille (2006) divided the Kimberley Region into three soil-landscape provinces (Figure 6A), with the Thunderbird Project Area being situated within the Fitzroy Province. Tille (2006) subdivides the Fitzroy Province into five soil-landscape zones (Figure 6B), with the Thunderbird Project Area being situated within Zone 335 – Dampier Sandplain Zone (Figure 7). The landform and soil data illustrated in Figure 7 was extracted from the soil datasets managed by the Department of Agriculture and Food (2012). The Dampier Sandplain Zone occupies an area of 27,000 km^2 and is located in the south-western Kimberley between Broome, Derby, Kimberley Downs Station and the Yampi Peninsula. It is composed of sandplains and dunes (with some sandy plateaux and coastal mud flats) on sedimentary rocks of the Canning Basin. The soils consist of red deep sands with some yellow sandy earths and some red and yellow sandy earths. The vegetation is described as consisting of pindan shrublands with spinifex/tussock grasslands (and some eucalypts).

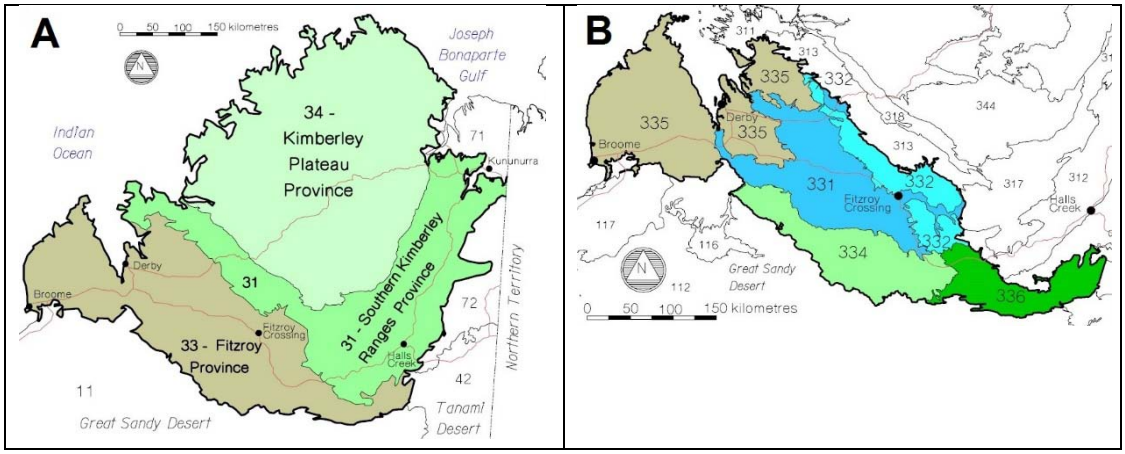


Figure 6: Soil-landscape provinces and zones of the Kimberley
Soil landscape-provinces of the Kimberley (Figure 6A) and soil-landscape zones of the Fitzroy Province (Figure 6B). Figures extracted from Tille (2006).

5.6 Pre-European Vegetation

The pre-European vegetation dataset, prepared through the National Land and Water Resources Audit, describes vegetation in relation to natural resource boundaries commonly used for environmental reporting (Shepherd *et al.* 2001). The pre-European vegetation dataset builds on the vegetation map database developed by G R Beeston and A J M Hopkins, based on 1: 250,000 scale mapping. A total of 819 vegetation types were recognised in Western Australia, ranging from tall forests, through to a wide variety of forests and woodlands, shrublands and grasslands, mostly with an overstorey of trees. The identification of the original pre-European and current extent of each of the vegetation types assist in providing baselines for managing issues such as land clearing. Although the extent of native vegetation remains largely intact within the inland areas of Western Australia, the structure and floristic composition have been altered since European settlement through grazing by introduced animals such as sheep, cattle, goats and rabbits, mining activities and by altered fire regimes (Shepherd *et al*. 2001).

In more recent years Hopkins, Beeston and Shepherd (2001) delineated a series of vegetation maps based primarily in this region on the previous work of Beard (1979). The pre-European vegetation associations occurring within the vicinity of the Thunderbird Project Area are illustrated in Figure 8. The Thunderbird Project Area intersects the six vegetation associations. These are:

Vegetation association 60.2: Grasslands, tall bunch grass savanna woodland. grey box and cabbage gum over ribbon grass;

Vegetation association 750.1: Shrublands, pindan; *Acacia tumida* shrubland with grey box and cabbage gum medium woodland over ribbon grass and curly spinifex;

Vegetation association 751: Shrublands, pindan; *Acacia eriopoda* and *Acacia tumida* shrubland with scattered low *Corymbia confertifolia* (formerly *Eucalyptus confertifolia*) over curly spinifex;

Vegetation association 752: Hummock grasslands, shrub steppe; *Acacia tumida* over *Acacia intermedia*

Vegetation association 755: Shrublands, pindan; *Acacia tumida* and *Acacia monticola* (formerly *Acacia impressa*) shrubland with scattered low bloodwood and *Eucalyptus setosa* over ribbon grass and curly spinifex; and

Vegetation association 762: Hummock grasslands, shrub steppe; *Acacia eriopoda* over soft spinifex.

Vegetation associations 60.2, 751, 752, 755 and 762 are restricted to the Dampierland system. Vegetation Association 762 occurs in the Dampierland and adjacent Fitzroy and North Fitzroy systems. The area of pre-European vegetation associations intersecting the Thunderbird Project Area are set out in Table 4.

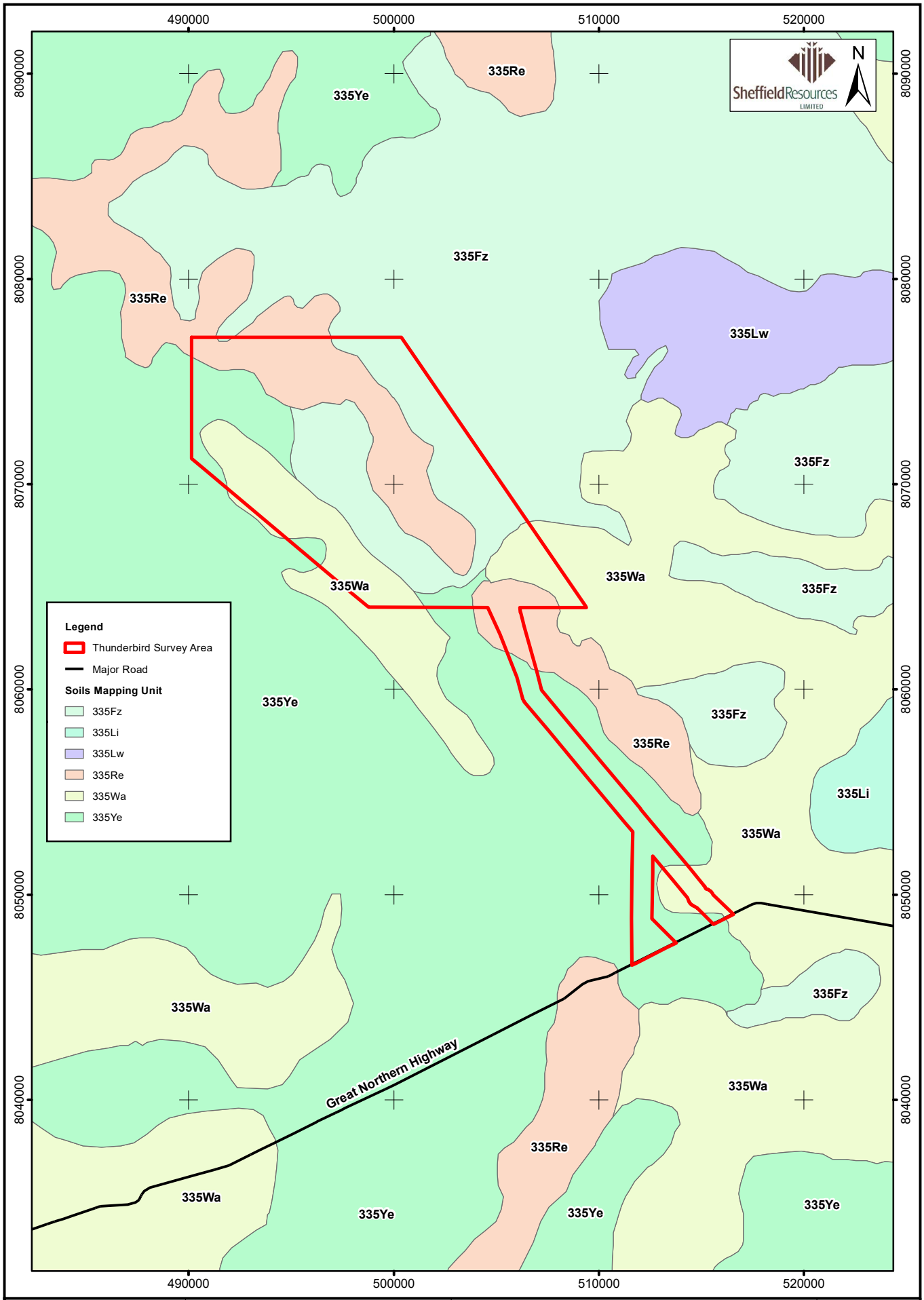
Table 4: Extent of pre-European vegetation associations intersecting the Thunderbird Project Area

Vegetation Association	State-wide[1]			Thunderbird Project Area	
	Pre-European Extent (ha)	Current Extent Impacted (ha)	Percent Remaining (%)	Area of Intersection (ha)	Proportion of Current Extent (%)
Dampierland_60.2	7748.85	7748.85	100.00	189.94	2.45
Dampierland_750.1	1,223,884.58	1,218,427.52	99.55	13,921.6866	1.14
Dampierland_751	16,045.28	15,994.73	99.68	1,332.2378	8.30
Dampierland_752	6,808.69	6,759.22	99.27	8.6597	0.13
Dampierland_755	183,168.83	183,058.23	99.94	738.7564	0.40
Dampierland_762 Fitzroy Sandplain_762 North Fitzroy Plains_762	6,811.39	6,807.35	99.94	2,694.6381	39.56

1. Government of Western Australia 2015

5.7 Current Land Use

The Dampierland bioregion is utilised for a range of purposes, including pastoralism, exploration / mining activities, native title and heritage areas, tourism and nature reserves. A large proportion of the Dampier Peninsula consists of pastoral leases, with the Thunderbird Project Area being situated across lands of the Mt Jowlaenga and Yeeda stations (Figure 1), which are currently grazed by cattle. Native title areas cover the majority of the Dampier Peninsula (Figure 9). The Dampier Peninsula has one area set aside as a nature reserve – the Coulomb Point Nature Reserve (Figure 4), which occupies an area of 28,676 ha (DotE 2016e).



Source: Land Systems: DoAF

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Scale: 1:250,000
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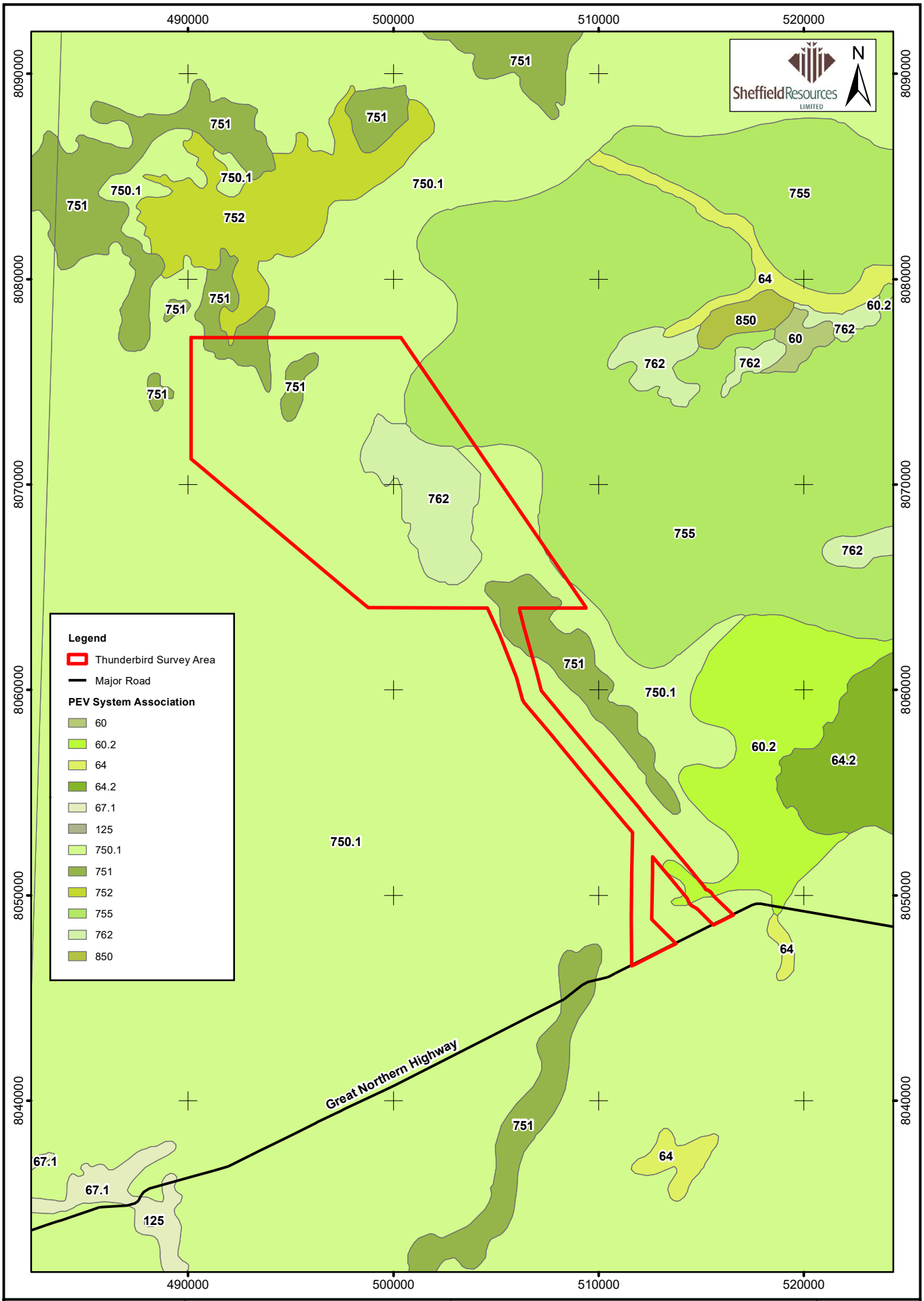
Thunderbird Mineral Sands Project
Soils

Figure: **7**



Source: Land Systems: DoAF

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Scale: 1:250,000
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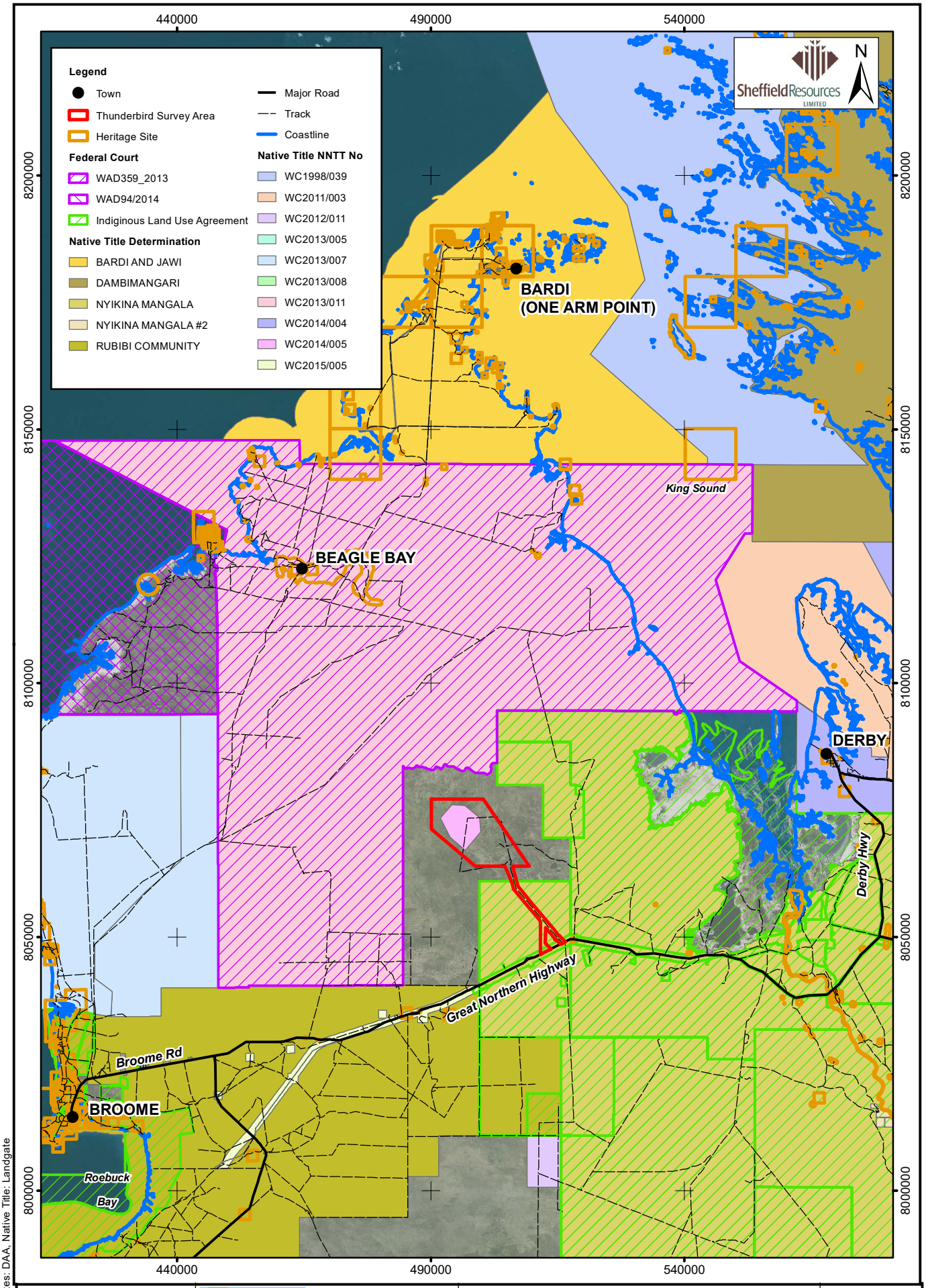
Thunderbird Mineral Sands Project
Pre-European Vegetation

Figure: **8**



Source:Heritage sites: DAA, Native Title: Landgate

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Scale: 1:1,000,000
MGA94 (Zone 51)

CAD Ref: a2409_f50_09

Date: Jul 2016 | Rev: A | A4

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Thunderbird Mineral Sands Project
Heritage

Figure: **9**

5.8 Previous Surveys in the Thunderbird Project Area

Ecologia completed three surveys of the Thunderbird Project Area between 2012 and 2015 (Ecologia 2012, 2014, 2015). These surveys comprised a Level 1 flora survey (Ecologia 2012), a level 2 flora survey (Ecologia 2014) and a flora survey for a proposed haul road alignment (Ecologia 2015). The combined surveys recorded a total of 329 flora species (Appendix C). The majority of taxa recorded were representative of the Poaceae (54 taxa), Fabaceae (53 taxa), Cyperaceae (34 taxa), Malvaceae (22 taxa) and Asteraceae (11 taxa) families.

No threatened flora were recorded from the three surveys. Five priority flora taxa were recorded from the three surveys. These taxa are *Fuirena nodiflora* (P1), *Fuirena incrassata* (P3), *Pterocaulon intermedium* (P3), *Tephrosia valleculata* (P3) and *Triodia caelestialis* (P3). One taxon, *Eriachne* sp. Dampier Peninsula (K.F. Kennealy 5946), was a Priority 3 taxon at the time of the surveys, but has since been delisted as a priority taxon (DPaW 2016g). The locations of the priority flora recorded during the three surveys (Ecologia 2012, 2014, 2015) are set out in Appendix G and shown in Figure 11B.

Eight introduced flora tax were recorded from the three surveys. These taxa were *Cynodon dactylon*, *Digitaria ciliaris*, *Echinochloa colona*, *Malvastrum americanum*, *Sida acuta*, *Stylosanthes hamata*, Stylosanthes scabra and *Tridax procumbens*. *Sida acuta* is listed as a Declared Pest species pursuant to Section 22(2) of the *Biosecurity and Agriculture Management Act 2007*.

Eleven vegetation units were mapped in the Thunderbird Project Area by Ecologia across the three surveys (Ecologia 2012, 2014, 2015). These vegetation units are summarised in Table 5 and illustrated in Figure 10, and are based on data provided to Sheffield by Ecologia. The most commonly represented vegetation unit was EcAtSt (*Erythrophleum chlorostachys* low, open woodland, over *Acacia tumida* var. *tumida* mid, sparse shrubland, over *Sorghum timorense* open tussock grassland) which comprised 25.88% of the area surveyed. Four other vegetation units (BdEcAtSt, CgDhSt, EtApStCpEo and GpAmStTc) accounted for a further 48.05% of the mapped vegetation (Table 5). Within the surveyed area, there was considerable similarity between the species associated with these major vegetation units (Ecologia 2012, 2014, 2015), with the upper storey being dominated by a restricted range of species (*Corymbia greeniana*, *Eucalyptus tectifica*, *Corymbia dendromerinx*, *Brachychiton diversifolius* subsp. *diversifolius* and *Erythrophleum chlorostachys*). The mid storey was dominated by *Acacia* species, principally *Acacia tumida* var. *tumida*. The lower stratum was a mixed grassland comprising a mixture of *Triodia caelestialis* (P3), *Sorghum timorense* and *Chrysopogon pallidus*.

A 14.46 ha area of vegetation unit MaMvEtCPCc (*Melaleuca alsophila* or *Melaleuca viridiflora* and *Eucalyptus tectifica* low, open woodland, over *Chrysopogon pallidus* sparse tussock grassland and *Cyperus conicus* sparse sedgeland) was described as having similarities with the Lolly Well Springs wetland complex Priority 3 PEC assemblage (Ecologia 2014). The claimed similarity was based on the landform on which this portion of the vegetation unit is present being described as a low, large organic mound spring with moats. The presence of *Melaleuca viridiflora* and Cyperaceae species, also present in the Lolly Well Springs wetland complex are suggested to indicate that this vegetation unit may constitute

a potential PEC. No statistical analysis comparing the vegetation within the Thunderbird Project Area with comparative quadrats established at the Lolly Wells Springs is presented by Ecologia (2014).

Table 5: Vegetation units delineated by Ecologia within the Thunderbird Project Area

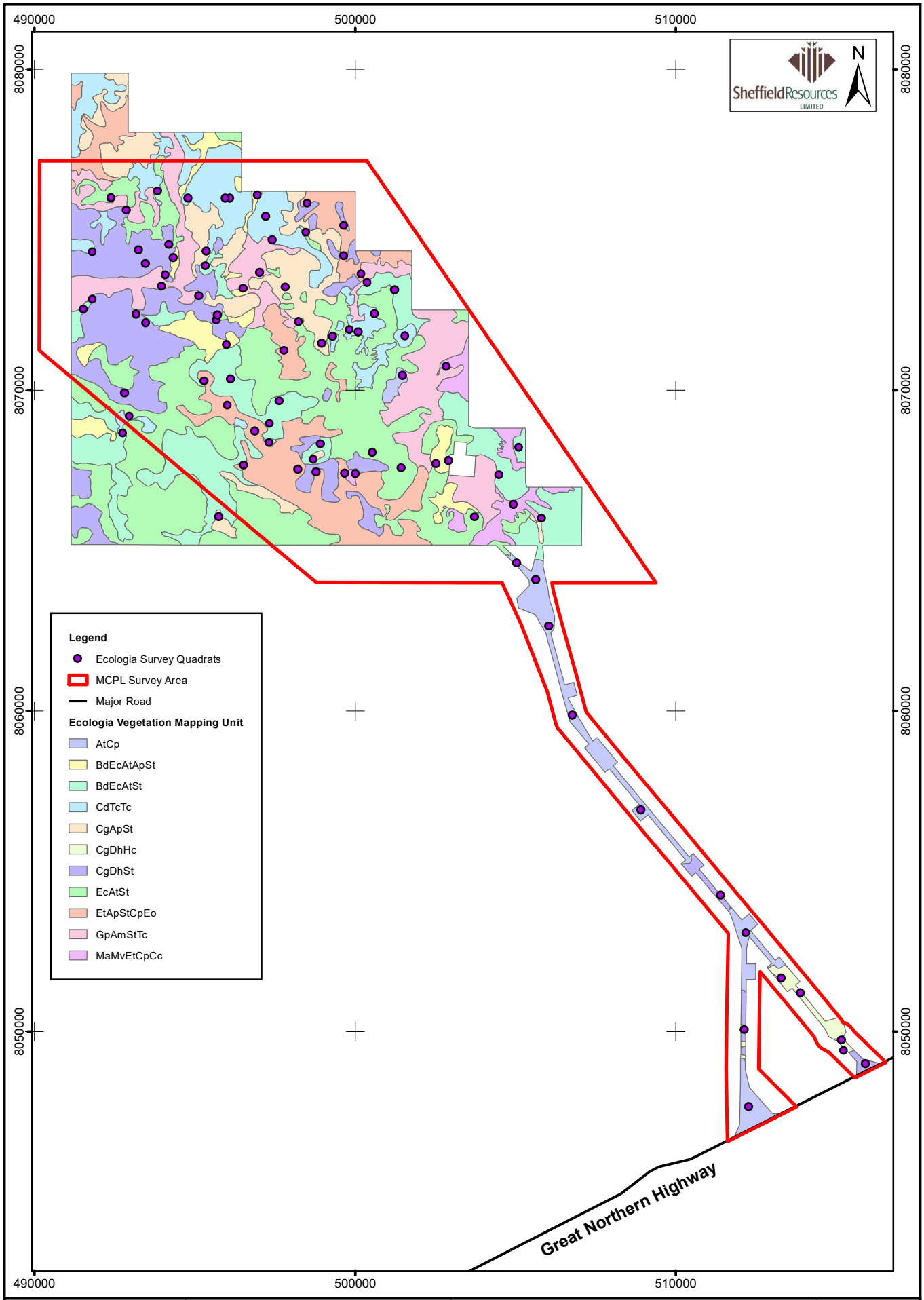
Ecologia Vegetation Unit	Description	Total Area Mapped (ha)	Proportion of Total Area Surveyed (%)
AtStCpHc	*Acacia tumida* var. *tumida* tall shrubland, over *Sorghum timorense*, *Chrysopogon pallidus* and *Heteropogon contortus* tussock grassland. Landform: Sandy plain	625.0644	3.98
BdEcAtApSt	*Brachychiton diversifolius* subsp. *diversifolius* and *Erythrophleum chlorostachys* low open woodland over *Acacia tumida* var. *tumida* and *Acacia platycarpa* tall, sparse shrubland over *Sorghum timorense* sparse tussock grassland. Landform: Sandy plain	541.1858	3.45
BdEcAtSt	*Brachychiton diversifolius* subsp. *diversifolius* and *Erythrophleum chlorostachys* low open woodland over *Acacia tumida* var. *tumida* sparse shrubland over *Sorghum timorense* sparse tussock grassland. Landform: Sandy plain	2,111.1677	13.44
CdTcTc	*Corymbia dendromerinx* and *Terminalia canescens* low, open woodland, over *Triodia caelestialis* (P3) open hummock grassland. Landform: Hillslope - midslope or ridgetop	1,307.6766	8.33
CgApSt	*Corymbia greeniana* mid, open woodland, over *Acacia platycarpa* tall, sparse shrubland, over *Sorghum timorense* open tussock grassland. Landform: Sandy plain	1,155.4066	7.36
CgDhHc	*Corymbia greeniana* low open forest over *Dolichandrone heterophylla* sparse shrubland, over *Heteropogon contortus* sparse tussock grassland. Landform: Floodplains adjacent to ephemeral waterways	110.6998	0.70
CgDhSt	*Corymbia greeniana* low open woodland over *Dolichandrone heterophylla* sparse shrubland over *Sorghum timorense* tussock grassland. Landform: Sandy plain	2,041.3534	13.00

Table 5: Vegetation units delineated by Ecologia within the Thunderbird Project Area

Ecologia Vegetation Unit	Description	Total Area Mapped (ha)	Proportion of Total Area Surveyed (%)
EcAtSt	*Erythrophleum chlorostachys* low, open woodland, over *Acacia tumida* var. *tumida* mid, sparse shrubland, over *Sorghum timorense* open tussock grassland. Landform: Sandy plain	4,064.4403	25.88
EtApStCpEo	*Eucalyptus tectifica* low, open woodland, over *Acacia platycarpa* tall, over *Sorghum timorense*, *Chrysopogon pallidus* and *Eriachne obtusa* open tussock grassland. Landform: Sandy floodplain	1,759.5221	11.21
GpAmStTc	*Grevillea pyramidalis* subsp. *pyramidalis* low, open woodland, over *Acacia monticola* mid, sparse shrubland, over *Sorghum timorense* sparse tussock grassland and *Triodia caelestialis* (P3) sparse hummock grassland. Landform: Gravelly plains	1,633.4877	10.40
MaMvEtCpCc	*Melaleuca alsophila* or *Melaleuca viridiflora* and *Eucalyptus tectifica* low open woodland, over *Chrysopogon pallidus* sparse tussock grassland and *Cyperus conicus* sparse sedgeland. Landform: Sandy floodplan	352.6004	2.25

5.9 Fire History

Parts of the Dampier peninsula had been burnt, both prior to, and over the period in which surveys of the Thunderbird Project Area have taken place (Landgate 2016). Specifically, various sections of the Thunderbird Project Area have been burnt between 2011 and 2016 (Landgate 2016). This has been confirmed through field observations and recordings by both Ecologia and Mattiske during the field surveys.



Source: Vegetation: ecologia environment

0 1 2 3 4 km

Scale: 1:160,000
MGA94 (Zone 51)

CAD Ref: a2409_f50_10

Date: Jul 2016 | Rev: A | A4

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Thunderbird Mineral Sands Project
Ecologia Mapped Vegetation

Figure: **10**

5.10 Threatened Ecological Communities

No TECs, pursuant to Schedule 1 of the *Wildlife Conservation Act 1950* and as listed by the DPaW (2016e) occur within the vicinity of the Thunderbird Project Area. No TECs, pursuant to the *EPBC Act* and as listed by the DotE (2016b) occur within the vicinity of the Thunderbird Project Area.

Two TECs, pursuant to Schedule 1 of the *Wildlife Conservation Act 1950* and as listed by the DPaW (2016e, DPaW Reference 01-0816EC) occur on the Dampier Peninsula. These are the Monsoon (vine) thickets on coastal sand dunes of the Dampier Peninsula (community identifier 67), and the Assemblages of Bunda Bunda organic mound spring (community identifier 85). Both TECs are classed as vulnerable (DPaW 2016d). Of the two TECs, the Monsoon (vine) thickets on coastal sand dunes of the Dampier Peninsula is listed as an endangered TEC according to the *EPBC Act* and as listed by the DotE (2016b). Both TECs are located on or close to coastal areas of the Dampier Peninsula, more than 50 km from the Thunderbird Project Area. Consequently, because of their restricted coastal location, none would be expected to occur within the Thunderbird Project Area.

5.11 Priority Ecological Communities

No PECs as listed by DPaW (2016f) currently intersect the Thunderbird Project Area. There are currently three Priority 1 and five Priority 3 PECs, as listed by DPaW (2016f, DPaW Reference 01-0816EC), which occur within 50 km of the Thunderbird Project Area (Figure 11A). These PECs are:

Dwarf pindan heath community of Broome coast (Priority 1)
Occurs between the racecourse and Gantheame Point lighthouse. Insufficient survey outside of Broome townsite area to determine full extent.
Threats: clearing, trampling, weed invasion, inappropriate fire regimes.

***Corymbia paractia* dominated community on dunes (Priority 1)**
Corymbia paractia behind dunes, Broome township area, Dampier Peninsula. Transition zone where coastal dunes (with vine thickets) merge with pindan (desert) vegetation. Also, port north of Broome.
Threats: clearing, trampling, weed invasion, inappropriate fire regimes.

Relict dune system dominated by extensive stands of Minyjuru (Mangarr - Sersalisia sericea) (Priority 1)
Contains frequent mature (100 years +) Sersalisia sericea or otherwise known as Minyjuru. Minyjurur is a culturally important and renowned local bush tucker species and does not occur in such frequency and longevity in other locations. The community is recorded as a Eucalyptus, Sersalisia low woodland unit that occurs on parallel dunes in the area south east of Gantheaume Point. The community also contains numerous woodland species such as: *Erythrophleum chlorostachys* (ironwood), *Eucalyptus* (*Corymbia*) *zygophylla* (Broome bloodwood), *Hakea macrocarpa* and *Corynotheca micrantha* (zig-zag Lilly). Some species are more reminiscent of desert and aridlands country including: *Solanum cunninghamii* (bush tomato), *Scaevola parvifolia*, *Goodenia sepalosa*, *Senna costata*, *Gyrostemon tepperi* and *Triodia* sp.

(spinifex). The extensive stands of Minyjuru occur in association with species more often found within the nearby threatened ecological community- Monsoon vine thicket.
Threats: weed invasion, grazing, inappropriate fire regime, proposed developments.

Assemblages of Disaster Bay organic mound springs (Priority 3)
Organic mounds springs on tidal flats with *Melaleuca acacioides*, *Timonius timon*, *Pandanus spiralis*, *Melaleuca viridiflora*, *Acacia neurocarpa* and *Lumnitzera racemosa* (mangrove) woodland with *Typha domingensis* and sedges, including *Schoenoplectus litoralis*.
Threats: soil compaction by cattle; potential changes in sea level due to climate change.

Assemblages of Lolly Well Springs wetland complex (Priority 3)
Wetland complex containing numerous low organic mound springs with moats.
Threats: recreational use, potential tourism developments, weed invasion, rubbish.

Kenneally *et al*. (1996) state that areas of permanent fresh water are rare on the Dampier Peninsula, but where they occur they support groves of *Melaleuca cajuputi* and *Melaleuca viridiflora*, together with aquatic species such as *Nymphaea violacea*, *Nymphoides indica* and *Nymphoides beaglensis*. Mound springs, sometimes raised two metres above the surrounding plain are situated near the Beagle Bay community, and support large fern colonies of *Cyclosorus interruptus* and *Lygodium microphyllum* (Kenneally *et al*. 1996). This is likely to represent vegetation which may be encountered at the Lolly Wells Spring wetland complex.

Kimberley vegetation Association 67 as defined by Beard (1979) (Priority 3)
Grasslands, tall bunch grass savanna, sparse low tree; ribbon grass & paperbarks.
Threats: extensive threatening processes acting at landscape scales, namely altered fire regimes, over grazing, and weed invasion.

Kimberley vegetation Association 73 as defined by Beard (1979) (Priority 3)
Grasslands, short bunch grass savanna, grass; salt water grassland (Sporobolus virginicus)
Threats: extensive threatening processes acting at landscape scales, namely altered fire regimes, over grazing, and weed invasion.

Kimberley Vegetation Association 759 as defined by Beard (1979) (Priority 3)
Grasslands, tall bunch grass savanna woodland, coolabah over ribbon/blue grass (*Bothriochloa* spp.)
Threats: extensive threatening processes acting at landscape scales, namely altered fire regimes, over grazing, and weed invasion.

Based on the desktop assessment, vegetation associations 67, 73, and 759 do not intersect the Thunderbird Project Area (Figure 8). The Dwarf pindan heath community of Broome coast, *Corymbia paractia* dominated community on dunes, Relict dune system dominated by extensive stands of Minyjuru, and Assemblages of Disaster Bay organic mound springs are associated with coastal areas of the Dampier Peninsula, and hence would not be expected to be recorded within the Thunderbird Project

Area. The Thunderbird Project Area, based on high resolution aerial imagery recorded in 2014 and 2015, does not contain obvious areas of vegetation consistent with permanent water associated with springs. Kenneally *et al*. (1996) state that areas of permanent fresh water are rare on the Dampier Peninsula, but where they occur they support groves of *Melaleuca cajuputi* and *Melaleuca viridiflora*, together with aquatic species such as *Nymphaea violacea*, *Nymphoides indica* and *Nymphoides beaglensis*. Mound springs, sometimes raised two metres above the surrounding plain are situated near the Beagle Bay community, and support large fern colonies of *Cyclosorus interruptus* and *Lygodium microphyllum* (Kenneally et al. 1996). This is likely to represent vegetation which may be encountered at the Lolly Wells Spring wetland complex. This type of vegetation is unlikely to be present within the Thunderbird project Area.

5.12 Threatened and Priority Flora

The desktop survey for threatened and priority flora which may potentially occur within the Thunderbird Project Area was undertaken using the resources of NatureMap (DPaW 2007-), the WAH (DPaW 2016g) and the DotE (2016a; 2016b), and included an application to the DPaW for a listing of threatened and priority flora known to occur on the broader Dampier Peninsula. In addition, the results of recent surveys of the Thunderbird Project Area (Ecologia 2012, 2014, 2015) were reviewed to provide a more complete inventory of species which may occur within the Thunderbird Project Area. Within the 40 km search radius about the vicinity of the Thunderbird Project Area there are no known threatened flora taxa and nine priority flora taxa. The nine priority flora taxa are comprised of two Priority 1 and seven Priority 3 (DPaW 2016g) taxa. These priority flora taxa are listed in Table 6 and their present distributions in the vicinity of the Thunderbird Project Area illustrated in Figure 11A and 11B.

Previous surveys of the Thunderbird Project Area, completed between 2012 and 2015 (Ecologia 2012, 2014, 2015) recorded five priority flora taxa. Four of the five taxa: *Fuirena nudiflora* (P1), *Fuirena incrassata* (P3), *Tephrosia valleculata* (P3), and *Pterocaulon intermedium* (P3) were recorded infrequently. The fifth taxon, *Triodia caelestialis* (P3) was recorded at 48 of the 65 quadrats surveyed, indicating that it was relatively common within the surveyed area.

Across the broader Dampier peninsula, one threatened and 30 priority flora taxa, which are in addition to those recorded within the 40 km search buffer previously described, have been recorded. The threatened taxon, *Seringia exastia*, is listed under its former name of *Keraudrenia exastia*, as critically endangered according to the EPBC Act (DotE 2016a). The 30 additional priority taxa are comprised of 13 Priority 1, 16 Priority 3 taxa, and one Priority 4 taxon (Table 6).

An assessment of the likelihood of recording any of the listed priority taxa within the Thunderbird Project Area, based on factors including known soil type, topography and distribution, is set out in Appendix D. Based on this assessment, five taxa have a high likelihood of being recorded within the Thunderbird Project Area. These taxa are *Fuirena incrassata* (P1), Pterocaulon intermedium (P3), *Stylidium pindanicum* (P3), *Tephrosia valleculata* (P3), and *Triodia caelestialis* (P3). With the exception of *Stylidium pindanicum* (P3), the other taxa have previously been recorded within the Thunderbird Project

Area. *Fuirena nudiflora* (P1) has previously been reported as being recorded within the Thunderbird Project Area (Ecologia 2014). A review of this taxon's distribution indicates that its presence within the Thunderbird Project Area would represent a range extension of more than 600 km west of its current known locations (DPaW 2016g). For this reason, and the fact that Ecologia (2014) do not state whether the identification was confirmed by a specialist taxonomist at the Western Australian Herbarium, it has been excluded from being considered likely to be present in the Thunderbird Project Area. A further 11 taxa are considered to have a medium probability of occurring within the Thunderbird Project Area (Table 6).

Table 6: Threatened and Priority flora taxa in the vicinity of the Thunderbird Project Area

Species	SCC[1]	Family	40 km buffer	Broader Dampier Peninsula	Likelihood to Record
Seringia exastia	T	Malvaceae		x	low
Aphyllodium parvifolium	P1	Fabaceae	x		medium
Bonamia oblongifolia	P1	Convolvulaceae		x	low
Byblis guehoi	P1	Byblidaceae		x	low
Corymbia paractia	P1	Myrtaceae		x	low
Cullen candidum	P1	Fabaceae		x	low
Cyperus haspan subsp. *haspan*	P1	Cyperaceae		x	low
Fuirena nudiflora[3]	P1	Cyperaceae	x		low
Haemodorum capitatum	P1	Haemodoraceae		x	medium
Ipomoea tolmerana subsp. occidentalis	P1	Convolvulaceae		x	low
Jacquemontia sp. Broome (A.A. Mitchell 3028)	P1	Convolvulaceae		x	low
Parsonsia kimberleyensis	P1	Apocynaceae		x	low
Polymeria sp. Broome (K.F. Kenneally 9759)	P1	Convolvulaceae		x	low
Thespidium basiflorum	P1	Asteraceae		x	low
Utricularia stellaris	P1	Lentibulariaceae		x	low
Utricularia tubulata	P1	Lentibulariaceae		x	low
Acacia monticola x *tumida* var. *kulparn*	P3	Fabaceae		x	medium
Aphyllodium glossocarpum	P3	Fabaceae		x	medium
Colocasia esculenta var. *aquatilis*	P3	Araceae		x	low
Dendrophthoe odontocalyx	P3	Loranthaceae		x	medium
Eriochloa fatmensis	P3	Poaceae		x	low
Fuirena incrassata	P3	Cyperaceae	x		high
Goodenia byrnesii	P3	Goodeniaceae		x	low
Goodenia sepalosa var. *glandulosa*	P3	Goodeniaceae	x		medium
Glycine pindanica	P3	Fabaceae		x	medium
Hibiscus panduriformis	P3	Malvaceae	x		low

Table 6: Threatened and Priority flora taxa in the vicinity of the Thunderbird Project Area

Species	SCC[1]	Family	40 km buffer	Broader Dampier Peninsula	Likelihood to Record
Lophostemon grandiflorus subsp. *grandiflorus*	P3	Myrtaceae		x	low
Nicotiana heterantha	P3	Solanaceae		x	low
Nymphoides beaglensis	P3	Menyanthaceae	x		low
Phyllanthus eremicus	P3	Phyllanthaceae		x	low
Pterocaulon intermedium[2, 3, 4]	P3	Asteraceae	x		high
Schoenus punctatus	P3	Cyperaceae		x	medium
Seringia katatona	P3	Malvaceae		x	medium
Stylidium costulatum	P3	Stylidiaceae		x	medium
Stylidium pindanicum	P3	Stylidiaceae		x	high
Tephrosia valleculata[3]	P3	Fabaceae	x		high
Terminalia kumpaja	P3	Combretaceae		x	low
Triodia acutispicula	P3	Poaceae		x	medium
Triodia caelestialis[2, 3, 4]	P3	Poaceae	x		high
Pittosporum moluccanum	P4	Pittosporaceae		x	low

1 - State Conservation Code (refer Appendix A); 2 - recorded by Ecologia within the Thunderbird Project Area (Ecologia 2012); 3 - recorded by Ecologia within the Thunderbird Project Area (Ecologia 2014); 4 - recorded by Ecologia within the Thunderbird Project Area (Ecologia 2015)

5.13 Introduced (Exotic) Plant Species

A total of eleven introduced (exotic) plant species were recorded from the desktop assessment utilising a 40 km search buffer about the Thunderbird Project Area. The introduced taxa are listed in Table 7. None of the species are listed as a Prohibited Organism pursuant to Section 12 of the *Biosecurity and Agriculture Management Act 2007* or listed as a Weed of National Significance (DotE 2016f).

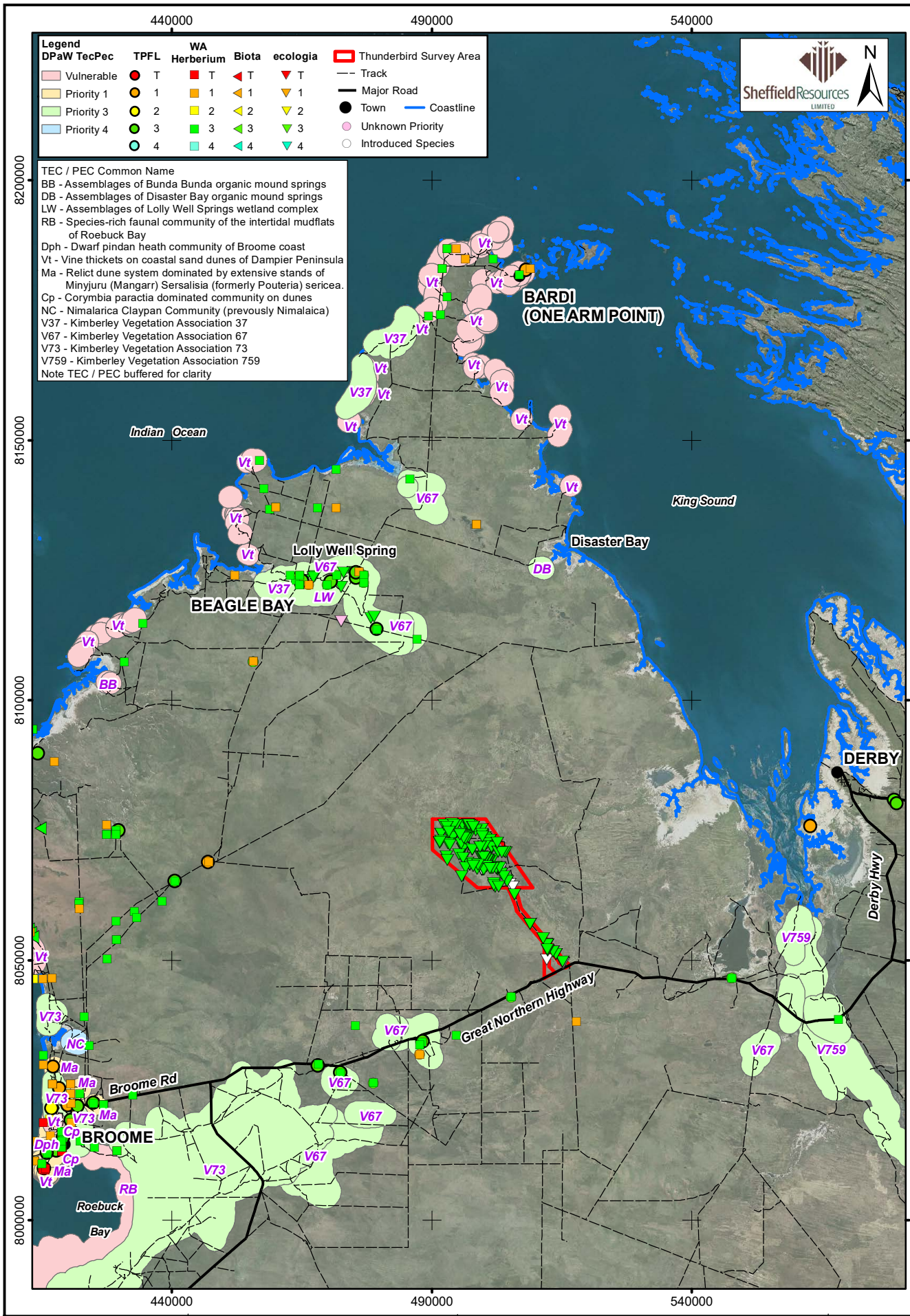
Table 7: Introduced plant species in the vicinity of the Thunderbird Project Area

Introduced Species	Common Name	Family	Potential /Recorded[6]
Cyanthillium cinereum [2]	-	Asteraceae	R
Cynodon dactylon [1, 2, 4]	couch grass	Poaceae	R
Digitaria ciliaris [3, 4]	summer grass	Poaceae	R
Echinochloa colona [3, 4]	awnless barnyard grass	Poaceae	R
Eragrostis minor [1, 4]	smaller stinkgrass	Poaceae	P
Flaveria trinervia [1]	speedy weed	Asteraceae	P
Moringa oleifera [1, 4]	-	Moringaceae	P
Sida acuta [3, 5]	spiny head sida	Malvaceae	R
Stylosanthes hamata [1, 2, 3, 4]	verano stylo	Fabaceae	R
Stylosanthes scabra [2, 3, 4]	-	Fabaceae	R
Tridax procumbens [3, 4]	tridax	Asteraceae	R

1 - recorded from NatureMap (DPaW 2007-); 2 - recorded by Ecologia (2012); 3 - Recorded by Ecologia (2014); 4 – Permitted (s11) under the BAM Act 2007; 5 – Declared Pest (s22(2) under the BAM Act 2007; 6 - P = Potential to occur, R = Recorded previously by Mattiske (2010, 2014).

One of the species is listed as a Declared Pest species pursuant to Section 22(2) of the *Biosecurity and Agriculture Management Act 2007*. The listed taxon is *Sida acuta* (Plate 1). *Sida acuta* is a common weed of the Kimberley, occurring in wasteland, creeks and riverine vine thickets (Hussey *et al*. 2007). *Sida acuta* is a densely branched perennial herb or small shrub to 1 m, with yellow flowers which are produced between March and September (DPaW 2016g). *Sida acuta* is subject to control/keeping category C3 (Management), under which such organisms should have some form of management applied that will alleviate the harmful impact of the organism, reduce the numbers or distribution of the organism or prevent or contain the spread of the organism (BAM Act 2007).

Plate 1: *Sida acuta* (DPaW 2016g)



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Scale: 1:1,000,000
MGA94 (Zone 51)

CAD Ref: a2409_f50_08a

Date: Oct 2016 | Rev: E | A4

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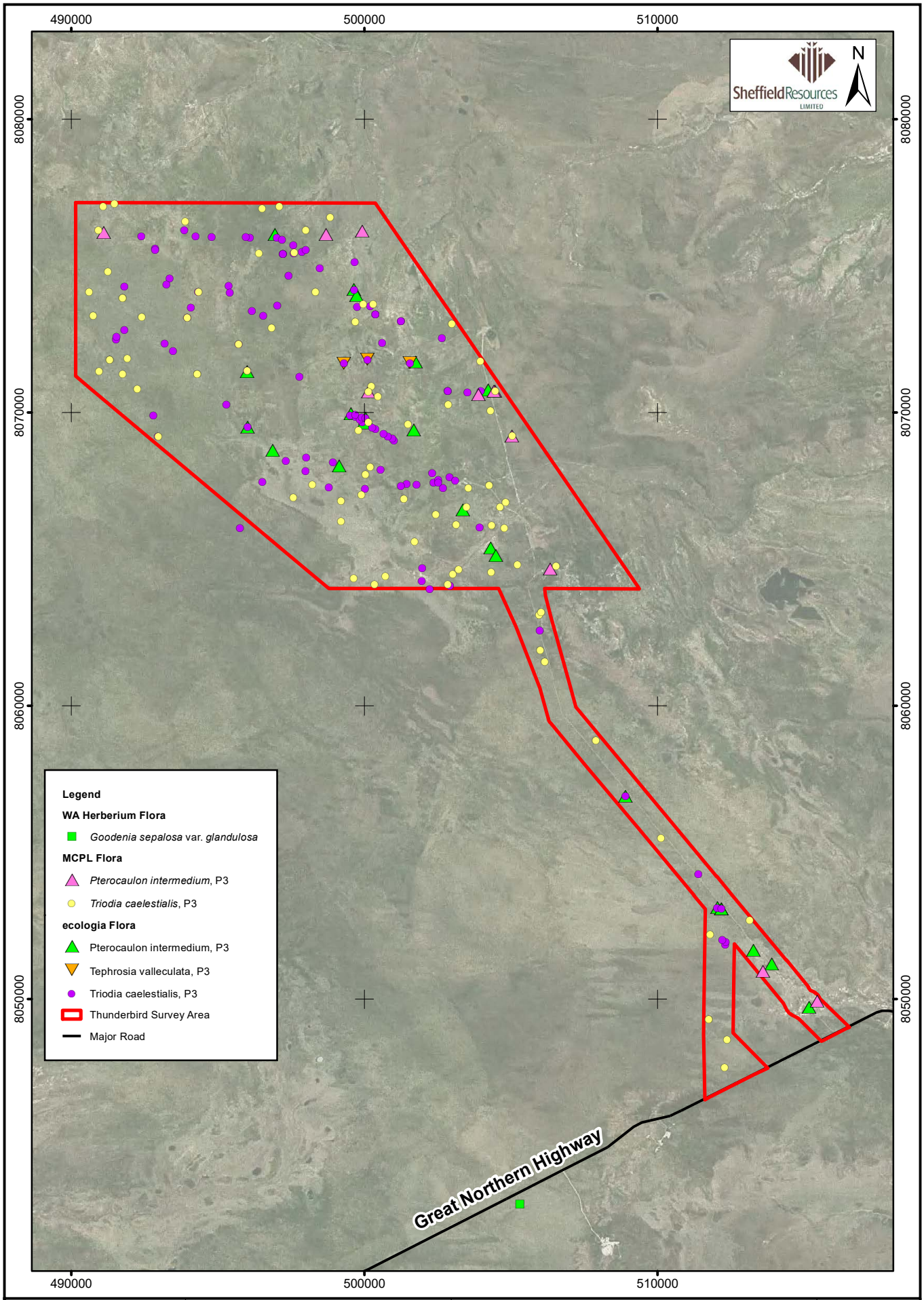
Thunderbird Mineral Sands Project
Priority Ecological Communities and Flora

Figure: **11A**



Source: Flora: ecologia, DPaW (14-0716)

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Scale: 1:175,000
MGA94 (Zone 51)

CAD Ref: a2409_f50_08d

Date: Oct 2016 | Rev: D | A4

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Thunderbird Mineral Sands Project
Conservation Significant Flora

Figure:

11B

6. FIELD SURVEY RESULTS

A total of 155 survey quadrats were established by Mattiske in June 2016 to assess the flora and vegetation of the Thunderbird Project Area (Figure 12). Refer to Appendix E for a list of the geographic locations of the survey quadrats.

6.1 Field Survey Coverage, Limitations and Constraints

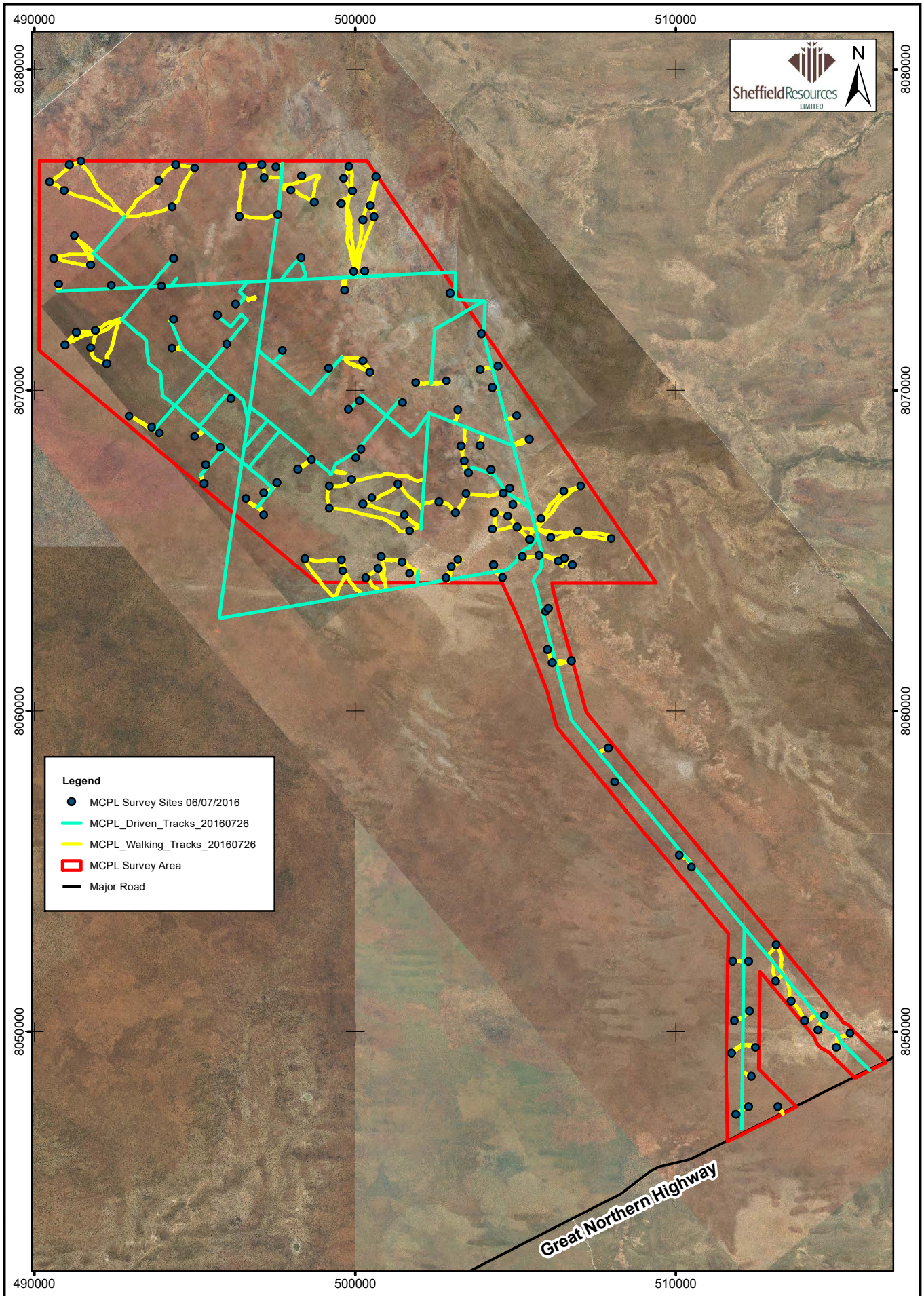
The coverage of the Thunderbird Project Area, based on survey quadrat locations, tracks and foot traverses is illustrated in Figure 12. An assessment of the survey against a range of factors which may have had an impact on the outcomes of the present survey was made (Table 8). Based on this assessment, the survey of the Thunderbird Project Area has not been subject to constraints which would affect the thoroughness of the survey and the conclusions which have been formed.

Table 8: Potential flora and vegetation survey limitations for the Thunderbird Project Area

Potential Survey Limitation	Impact on Survey
Sources of information and availability of contextual information (i.e. pre-existing background versus new material).	**Not a constraint.** Reference resources such as Beard's mapping, Land Systems mapping, online flora and vegetation information, provided an appropriate level of information for the current survey. In addition, the Thunderbird Project Area had been the subject of three previous surveys between 2012 and 2015 (Ecologia 2012, 2014, 2015). This material provided directly relevant information for the present survey.
Scope (i.e. what life forms, etc., were sampled).	**Not a constraint.** Vascular flora, which were the focus of the present survey, were thoroughly sampled.
Proportion of flora collected and identified (based on sampling, timing and intensity).	**Not a constraint.** The proportion of flora collected and identified was considered adequate. An analysis of the survey data demonstrated that approximately 80.13% of the potential flora species that may occur were recorded. This is based on both the present survey and surveys completed between 2012 and 2015 (Ecologia 2012, 2014, 2015). Of the 255 plant tax recorded in the current survey, approximately 16% were annual species. Additionally, a further approximately 16% of recorded taxa were classified as being annuals/short lived perennials. Any flora which could not be identified in the field was collected for subsequent identification. Of the 775 plants specimens collected, 60 could not be identified to the species level or could only be done so with some level of qualification. The reasons for this included the absence of fertile material required for accurate identification, the poor quality of the plant material available (senescent specimens) or the juvenile nature of the specimens available.
Completeness and further work which might be needed (i.e. was the relevant survey area fully surveyed).	**Not a constraint**. Survey quadrat locations were pre-selected using high resolution aerial photography to ensure all apparent vegetation communities identified were sampled, with multiple replications where possible. Quadrat locations, were in part, selected to complement past surveys (Ecologia 2012, 2014, 2015) and provide a greater degree of survey area coverage. Where necessary, additional sites were chosen in the field. Site selection and replication was considered adequate to accurately analyse and discriminate sites based on species composition and subsequently delineate vegetation community boundaries. The original haul road survey (Ecologia 2015) restricted vegetation community mapping strictly to the haul road width. In the present survey a 300 m buffer either side of the proposed haul road was surveyed.

Table 8: Potential flora and vegetation survey limitations for the Thunderbird Project Area

Potential Survey Limitation	Impact on Survey
Mapping reliability.	**Not a constraint**. Coverage of the survey area is considered to be good. High quality aerial maps (Scale: 1:10,000) were used for both the survey work and subsequent vegetation community mapping. Vegetation community boundaries were often discontinuous with interfaces resembling admixtures of one or more communities. This is a recognised and unavoidable limitation of vegetation mapping, particularly across mosaic Eucalyptus / Melaleuca and other shrubs associations and open woodland associations.
Timing, weather, season, cycle.	**Minor constraint**. The EPA (2004) recommends that flora and vegetation surveys in the Kimberley region (Northern Province) should be undertaken after the main rainfall period in the summer months. Rainfall in the four months preceding the June 2016 survey was well below average, with the area experiencing 51% of the long term average rainfall (Table 1, Figure 3). Compared to the three previous surveys of the Thunderbird Project Area (Table 1), the present survey was completed after one of the driest summer rainfall periods. This is likely to have affected the proportion of annual species likely to be recorded. In addition, identification of some taxa is likely to have been compromised due to the lack of, or poor quality of fertile material for plant identification.
Disturbances (fire, flood, accidental human intervention, etc.).	**Minor constraint**. Portions of the Thunderbird Project Area have been the subject of fires over the course of the surveys of the area undertaken since 2012 (refer to Section 5.9). Based on field observations, the vegetation has recovered rapidly, with the main species likely to be vegetation community defining, being readily identifiable from regrowth, even in areas which had been burnt within the 12 months preceding the present survey.
Intensity (in retrospect, was the intensity adequate).	N**ot a constraint**. The survey intensity was considered to have been thorough throughout the survey area with more than adequate replication being achieved via pre-planned quadrat locations, opportunistic field selection and relevé sites. The survey area was easily accessible by car and on foot.
Resources (i.e. were there adequate resources to complete the survey to the required standard).	**Not a constraint**. Resources, in terms of equipment, support and personnel were adequate.
Access problems (i.e. ability to access survey area).	**Not a constraint**. Vehicle access across the Thunderbird Project Area was via both existing Mt Jowlaenga station tracks and exploration tracks. These provided good access to the majority of the survey area. Some lengthy foot traverses were required to access parts of the survey area on the northern and eastern portions of the Thunderbird project Area (Figure 12).
Experience levels (e.g. degree of expertise in plant identification to taxon level).	**Not a constraint**. All botanists had extensive experience working in a range of botanical districts across the state. Two of the botanists on the present survey had previous experience working in the Kimberley region.



Source: Tracks: MCPL, Aerial Photography: Landgate and Sheffield Resources

0 1 2 3 4 km

Scale: 1:160,000
MGA94 (Zone 51)

CAD Ref: a2409_f50_11

Date: Jul 2016 | Rev: A | A4

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Thunderbird Mineral Sands Project
Tracks and Foot traverses

Figure: **12**

6.2 Flora

A total of 255 vascular plant taxa which are representative of 129 genera and 44 families were recorded in the Thunderbird Project Area during the 2016 survey. The majority of taxa recorded were representative of the Poaceae (46 taxa), Fabaceae (45 taxa), Malvaceae (18 taxa), Cyperaceae (14 taxa), Myrtaceae (14 taxa), Amaranthaceae (12 taxa) and Convolvulaceae (10 taxa) families. The taxa recorded during the survey are set out in Appendix C. A list of plant taxa recorded at each survey quadrat within the Thunderbird Project Area is set out in Appendix F.

Annual species represented 16.47% % of all recorded plant species within the Thunderbird Project Area during the 2016 survey. A further 16.08% of all recorded plant species recorded during the 2016 survey represented annual/short-lived perennial species The average species richness for the 155 quadrats surveyed during the 2016 survey was 20.51 ± 0.44 (mean ± s.e.m.), with a range of eight to 36 species per quadrat.

6.2.1 Proportion of Flora Surveyed

A species accumulation plot, based on accumulated species recorded versus sites surveyed within the Thunderbird Project Area was used to provide an indication as to the level of adequacy of the survey effort. As the number of survey sites increases, and correspondingly the size of the area surveyed increases, there should be a diminishing number of new species recorded. At some point, the number of new species recorded becomes essentially asymptotic. When the number of new species being recorded for survey effort expended approaches this asymptotic value, the survey effort can be considered to be adequate.

The species accumulation curve (Figure 13), based on the species accumulation analysis of Colwell (2013) was used to evaluate the adequacy of sampling. The asymptotic value was determined using Michaelis-Menten modelling. Using this analysis, the incidence based coverage estimator of species richness (ICE, Chao 2004) was calculated to be 534.11, based on data from the combination of surveys between 2012 and 2015 (Ecologia 2012, 2014, 2015) and the present survey. Based on this value, and the total of 419 species recorded across the 242 survey quadrats, approximately 80.13% of the flora species potentially present within the survey area were recorded.

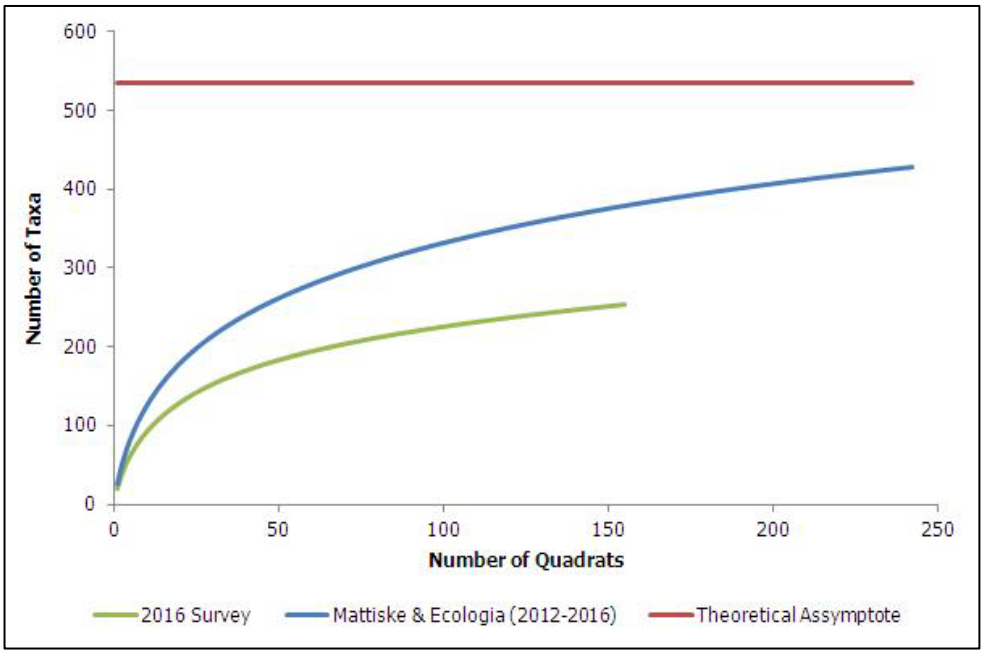


Figure 13: Average randomised species accumulation curve

6.2.2 Threatened and Priority Flora

No threatened flora pursuant to Schedule 1 of the *Wildlife Conservation Act 1950* and as listed by the DPaW (2016b) were recorded within the Thunderbird Project Area. No threatened flora pursuant to the *Environment Protection and Biodiversity Conservation Act 1999* and as listed by the DotE (2016a) were recorded within Thunderbird Project Area.

Two priority flora taxa, as listed by DPaW (2016g), were recorded within the Thunderbird Project Area during the present survey. The two priority flora recorded were *Pterocaulon intermedium* (P3) and Triodia *caelestialis* (P3) (Table 9). The geographical locations of priority flora recorded within the Thunderbird Project Area, together with their populations, are listed in Appendix G. The population of *Triodia caelestialis* (P3) within quadrats was highly variable, with a range of 1 to 13,000 plants in a 50 m x 50 m quadrat. The former indicates the presence of the taxon where a population count was not necessarily recorded. The larger population numbers were determined by counting plants in a 5 m x 5 m quadrat and then extrapolating this to the 50 m x 50 m quadrat area. This method was used where large numbers of plants were present and evenly distributed within the quadrat. Completed DPaW TPFL forms for the recorded priority taxa are presented as Appendix H.

In addition to the priority taxa recorded during the present survey, Ecologia (2012, 2014, 2015) recorded a range of priority taxa. These have been described in Section 5.8 of this report. The priority taxa recorded during previous surveys, together with their locations, are listed in Appendix G.

Table 9: Priority flora taxa recorded in the Thunderbird Project Area, June 2016

Species	SCC	Family	No. Of Survey Quadrats
Pterocaulon intermedium	P3	Asteraceae	11[1]
Triodia caelestialis	P3	Poaceae	81[2]

1 - Seven quadrats and four opportunistic records; 2 - 78 quadrats and three opportunistic records

6.2.3 Taxa with Extensions to their Range

One taxon recorded during the survey of the Thunderbird Project Area represented an extension to its currently known distribution. This taxon was *Aristida contorta.* The recording of *Aristida contorta* in the Thunderbird Project Area represents an approximately 300 km range extension from known records to either the east or south-west of the survey area (DPaW 2016g). This taxon is not considered to be of conservation significance. In this report, 150 km has been used as a basis to determine an extension to the currently known range for a taxon.

6.2.4 Introduced (Exotic) Plant Species

Five introduced (exotic) plant taxa were recorded during the survey of the Thunderbird Project Area. The introduced taxon recorded were **Cenchrus ciliaris,* **Portulaca pilosa,* **Stylosanthes hamata, Stylosanthes humilis and* **Stylosanthes scabra*. None of the recorded introduced species are Declared Pests pursuant to the *BAM Act 2007.*

**Cenchrus ciliaris* (buffel grass) is a tufted perennial grass to 1 m tall. It is a widespread weed of the pastoral regions (DPaW 2016g, Hussey *et al*. 2007). **Cenchrus ciliaris* is listed as Permitted (s11) pursuant to the *BAM Act 2007* according to the DAFWA (2016). **Cenchrus ciliaris* was recorded at four quadrats in the survey area, all situated on the upper slopes and ridges of hills.

**Portulaca pilosa* is a prostrate succulent annual to 20 cm high, producing pink or yellow flowers between January and July (DPaW 2016g, Hussey *et al*. 2007). **Portulaca pilosa* is listed as Permitted (s11) pursuant to the *BAM Act 2007* according to the DAFWA (2016). **Portulaca pilosa* was recorded at a single quadrat in the survey area.

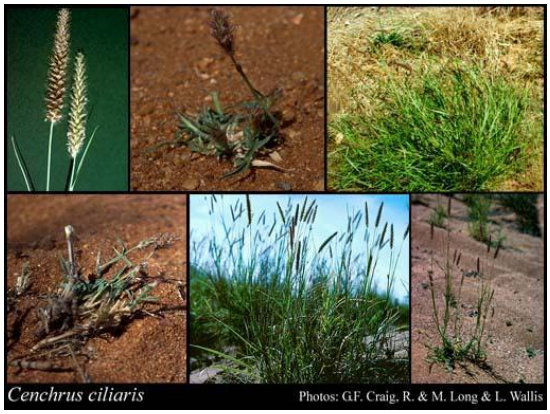


Plate 2: *_Cenchrus ciliaris_ (DPaW 2016g)

Plate 3: *_Portulaca pilosa_ (DPaW 2016g)

**Stylosanthes hamata* is a softly hairy sprawling perennial herb to30 cm. The stems have hairs on one side only. Yellow flowers are produced from April to August, and the pods are hairy only on the lower half (DPaW 2016g, Hussey *et al*. 2007). **Stylosanthes hamata* is listed as Permitted (s11) pursuant to the *BAM Act 2007* according to the DAFWA (2016). **Stylosanthes hamata* was recorded at 12 quadrats in the survey area, across a range of different landforms.

**Stylosanthes humilis* is a hairy (a mix of soft and bristly hairs) sprawling perennial herb to30 cm. Yellow-orange flowers are produced from April to August, and the pods are sparsely hairy (DPaW 2016g, Hussey *et al*. 2007). **Stylosanthes humilis* is listed as Permitted (s11) pursuant to the *BAM Act 2007* according to the DAFWA (2016). **Stylosanthes humilis* was recorded at a single quadrat within the survey area, in a drainage channel. An identified image of **Stylosanthes humilis* is not available.

Plate 4: *Stylosanthes hamata* (DPaW 2016g)

**Stylosanthes scabra* is a sub-shurub to 1 m tall. The stems are hairy all over, giving the plant a rusty appearance. Yellow flowers are produced from February to June, and the pods are densely hairy (DPaW 2016g, Hussey *et al*. 2007). * *Stylosanthes scabra* is listed as Permitted (s11) pursuant to the *BAM Act 2007* according to the DAFWA (2016). **Stylosanthes scabra* was recorded at nine quadrats in the survey area, across a range of different landforms. An identified image of **Stylosanthes scabra* is not available.

The locations at which each of the introduced taxa were recorded within the Thunderbird Project Area are set out in Table 10. Population numbers at each location were not recorded.

Table 10: Locations of introduced species recorded within the Thunderbird Project Area

Survey Quadrat	GDA94_ZONE 51		Survey Quadrat	GDA94_ZONE 51	
	Easting (mE)	Northing (mN)		Easting (mE)	Northing (mN)
* *Cenchrus ciliaris*					
TB036	499684	8073106	TB071	403310	8068243
TB055	500466	8070546	TB114	506534	8064755
* *Portulaca pilosa*					
TB059	496133	8069735			
* *Stylosanthes hamata*					
TB008	495007	8076918	TB076	503414	8067780
TB010	500650	8076645	TB085	507050	8067000
TB011	497174	8076619	TB119	501468	8064631
TB044	503951	8071750	TB142	513606	8050948
TB059	496133	8069735	TB144	514650	8050502
TB071	503310	8068243	TB150	515012	8049496

Table 10: Locations of introduced species recorded within the Thunderbird Project Area

Survey Quadrat	GDA94_ZONE 51		Survey Quadrat	GDA94_ZONE 51	
* *Stylosanthes humilis*					
TB116	503218	8064713			
* *Stylosanthes scabra*					
TB017	499923	8076197	TB056	502860	8070275
TB018	498730	8075842	TB064	505040	8069200
TB038	496823	8072877	TB079	504247	8067511
TB052	504458	8070740	TB087	504821	8066933
TB054	503905	8070626			

6.3 Statistical Analysis of Data

Cluster analyses derived from a species-by-site resemblance matrix (Bray-Curtis similarity) grouped survey sites into discrete clusters based on species composition (dissimilarity/distance increased) (Clarke and Gorley 2006). Only taxa which could be identified to species level were included in the analysis. Classification and ordination analyses were conducted on a data matrix of perennial taxa, with singularly occurring species and annual taxa omitted prior to analysis. This was justified in that singleton taxa add little additional information, and annuals (desert ephemerals) exhibit high inter-annual variation in distribution and abundance (Mott 1972, 1973). In addition, the omission of annual species from the statistical analysis allows for comparison of data from surveys undertaken in different seasons or survey years (2012 to 2016 in the case of the present analysis). Hierarchical Clustering was used in conjunction with Analysis of Similarities (ANOSIM), Similarity Profile (SIMPROF), Similarity Percentages (SIMPER), site descriptions, site photos and aerial photographs; combining these methods increased the understanding of site inter-relations and thus the ability to accurately delineate those sites based on species composition.

Similarity Profile Analysis (SIMPROF) of the 242 vegetation quadrats - 155 Mattiske quadrats from the present survey and 87 quadrats assessed between 2012 and 2015 (Ecologia 2012, 2014, 2015) - identified significantly associated groups of quadrats. Based on this analysis, 14 significantly dissimilar vegetation communities were delineated within the Thunderbird Project Area (Global R = 0.759 p = <0.001). Where appropriate, outliers and small groupings were assigned to broader comparative vegetation units based on factors including species composition and site descriptions; this is particularly relevant where survey quadrats were established on ecotones. For the purposes of vegetation mapping, i.e. extrapolating quadrat data to generalised vegetation communities over broad areas, an inclusive rather than exclusive approach was adopted for outliers. The dendrogram representing the results of the cluster analysis, and the corresponding 14 statistically dissimilar vegetation types is illustrated in Figure 14.

6.4 Vegetation Mapping

Based on the statistical analysis (Section 6.3), 14 vegetation communities were defined and mapped within the Thunderbird Project Area. An overview of the mapped vegetation is presented in Figure 15. A detailed vegetation map is presented in Appendix I. In addition to the statistical analysis, survey quadrat physical data and aerial photographic maps were used to delineate the boundaries of the vegetation communities in the Thunderbird Project Area. The delineated vegetation communities are summarised below. A listing of species recorded within each vegetation community is set out in Appendix J. Detailed descriptions of each vegetation community together with representative photographs are presented in Appendix K.

Woodlands

W1 *Melaleuca viridiflora*, *Melaleuca alsophila* and *Eucalyptus tectifica* low sparse woodland over *Bauhinia cunninghamii*, *Carissa lanceolata* and *Atalaya hemiglauca* tall sparse shrubland over *Ectrosia schultzii*, *Eriachne sulcata* and *Cyperus conicus* low sparse grassland on grey-white to light brown sandy soils in drainage channels and low lying drainage areas.

W2 *Eucalyptus tectifica* mid open woodland over *Acacia plectocarpa* subsp. *plectocarpa* and *Grevillea pyramidalis* subsp. *pyramidalis* tall sparse shrubland over *Aristida holathera* subsp. *latifolia*, *Eriachne obtusa* and *Xerochloa laniflora* mid sparse grassland on light brown clayey sands in low lying drainage areas.

W3 *Corymbia dendromerinx*, *Eucalyptus tectifica* and *Corymbia greeniana* mid open woodland over *Dolichandrone heterophylla*, *Dodonaea hispidula* var. *arida* and *Grevillea pyramidalis* subsp. *pyramidalis* mid sparse shrubland over *Triodia caelestialis* (P3), *Triodia schinzii* and *Eriachne obtusa* mid sparse hummock grassland on orange-brown clayey sands on flats and drainage areas.

W4 *Corymbia dendromerinx* mid open woodland over *Terminalia canescens*, *Calytrix exstipulata* and *Wrightia saligna* tall sparse shrubland over *Triodia caelestialis* (P3), *Triumfetta albida* and *Polycarpaea longiflora* mid open tussock grassland on brown sandy clay soils on mid-slopes to ridges of hills with sandstone outcropping.

W5 *Corymbia dendromerinx* mid open woodland over *Grevillea pyramidalis* subsp. *pyramidalis*, *Terminalia canescens* and *Waltheria indica* mid sparse shrubland over *Triodia caelestialis* (P3), *Sorghum plumosum* and *Hybanthus enneaspermus* subsp. *enneaspermus* low sparse tussock grassland on pale brown to orange-brown sandy clay loam soils on slopes and broad flat hill tops with sandstone outcropping.

W6 *Eucalyptus tectifica*, *Bauhinia cunninghamii* and *Brachychiton diversifolius* subsp. *diversifolius* mid open woodland over *Carissa lanceolata* and *Dolichandrone heterophylla* mid sparse shrubland

over *Triodia caelestialis* (P3), *Triodia schinzii* and *Eriachne obtusa* mid sparse tussock grassland on pale brown to grey brown sandy clay loams on flats.

W7 *Brachychiton diversifolius* subsp. *diversifolius* and *Eucalyptus tectifica* low open woodland over *Bauhinia cunninghamii*, *Acacia plectocarpa* subsp. *plectocarpa* and *Melaleuca viridiflora* tall sparse shrubland over *Triodia caelestialis* (P3), *Triodia schinzii* and *Aristida holathera* var. *holathera* mid sparse hummock grassland on pale orange-grey clayey sands on flats.

W8 *Erythrophleum chlorostachys*, *Brachychiton diversifolius* subsp. *diversifolius* and *Corymbia greeniana* mid open woodland over *Acacia tumida* var. *tumida*, *Bauhinia cunninghamii* and *Dodonaea hispidula* var. *arida* tall sparse shrubland over *Triodia caelestialis* (P3), *Triodia schinzii* and *Eriachne obtusa* mid sparse tussock grassland on orange brown to red fine sandy soils on flats.

W9 *Corymbia dendromerinx* low open woodland over *Grevillea pyramidalis* subsp. *pyramidalis*, *Microstachys chamaelea* and *Terminalia canescens* mid sparse shrubland over *Chrysopogon* sp. (*C. fallax* or *C. pallidus*), *Glycine tomentella* and *Sorghum plumosum* mid sparse grassland on orange-brown sandy clay with sandstone rocks and outcropping on hills.

W10 *Corymbia greeniana*, *Corymbia dendromerinx* and *Brachychiton diversifolius* subsp. *diversifolius* low open woodland over *Grevillea pyramidalis* subsp. *pyramidalis*, *Grevillea refracta* subsp. *refracta* and *Terminalia canescens* tall sparse shrubland over *Triodia caelestialis* (P3), *Solanum cunninghamii* and *Aristida hygrometrica* mid open tussock grassland on orange-brown clayey sands with occasional sandstone or ironstone rocks on flats and slopes associated with drainage areas.

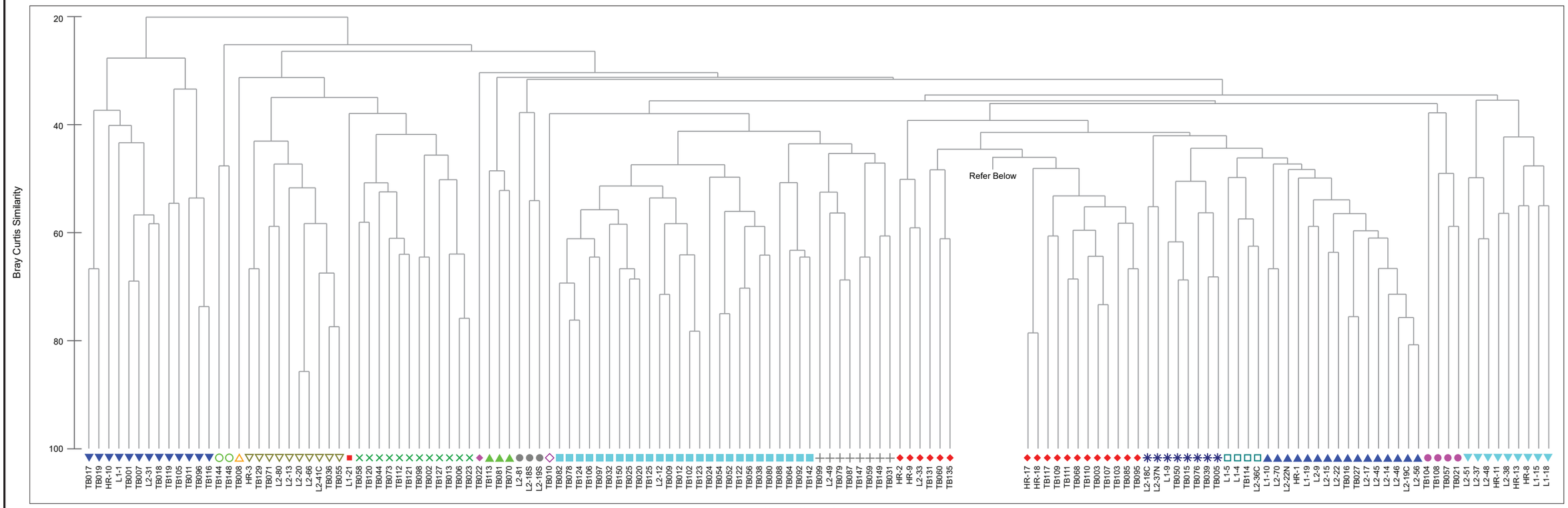
W11 *Corymbia zygophylla* low open woodland over *Acacia tumida* var. *tumida* and *Erythrophleum chlorostachys* tall sparse shrubland over *Triodia schinzii* and *Microstachys chamaelea* low sparse grassland on orange-brown clayey sands on flats and slopes.

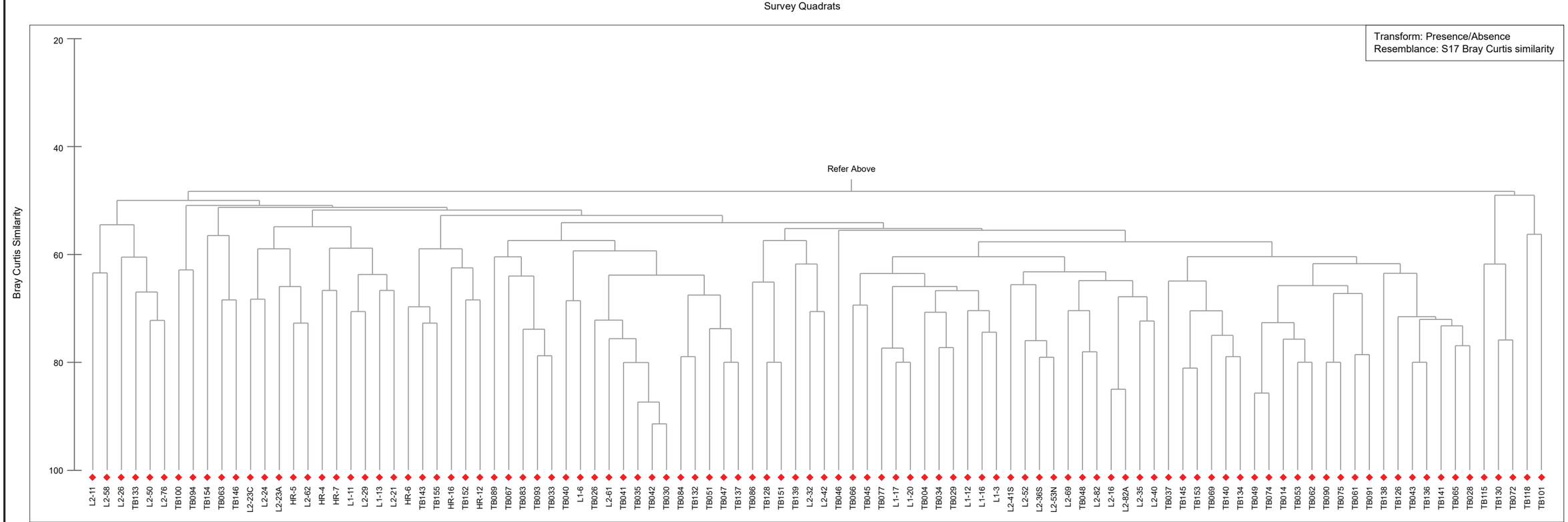
W12 *Corymbia greeniana*, *Eucalyptus tectifica* and *Corymbia dendromerinx* mid open woodland over *Dolichandrone heterophylla*, *Bauhinia cunninghamii* and *Acacia tumida* var. *tumida* tall sparse shrubland over *Triodia caelestialis* (P3), *Triodia schinzii* and *Eriachne obtusa* mid sparse tussock grassland, on brown clayey sands on flats and drainage channels.

W13 *Brachychiton diversifolius* subsp. *diversifolius, Erythrophleum chlorostachys* and *Corymbia dendromerinx* mid open woodland over *Grevillea refract* subsp. *refracta*, *Acacia monticola* and *Microstachys chamaelea* tall sparse shrubland over *Corchorus sidoides*, *Goodenia sepalosa* subsp. *sepalosa* and *Pterocaulon paradoxum* low sparse forbland on orange-brown clayey sands on flats.

Shrubland

S1 *Acacia tumida* var. *tumida* low sparse shrubland over *Waltheria indica* and *Bauhinia cunninghamii* low isolated shrubs over *Ectrosia schultzii*, *Eriachne obtusa* and *Corchorus pumilio* low sparse grassland on pale grey sandy clay loam soils on flats and slopes.





W1 W2 W3 W4 W5 W6 W7 W8 W9 W10 W11 W12 W13 S1

Client: Sheffield Resources Limited
CAD Ref: g2409_Dend_F01
Date: Sept 2016 | Rev: B | A3

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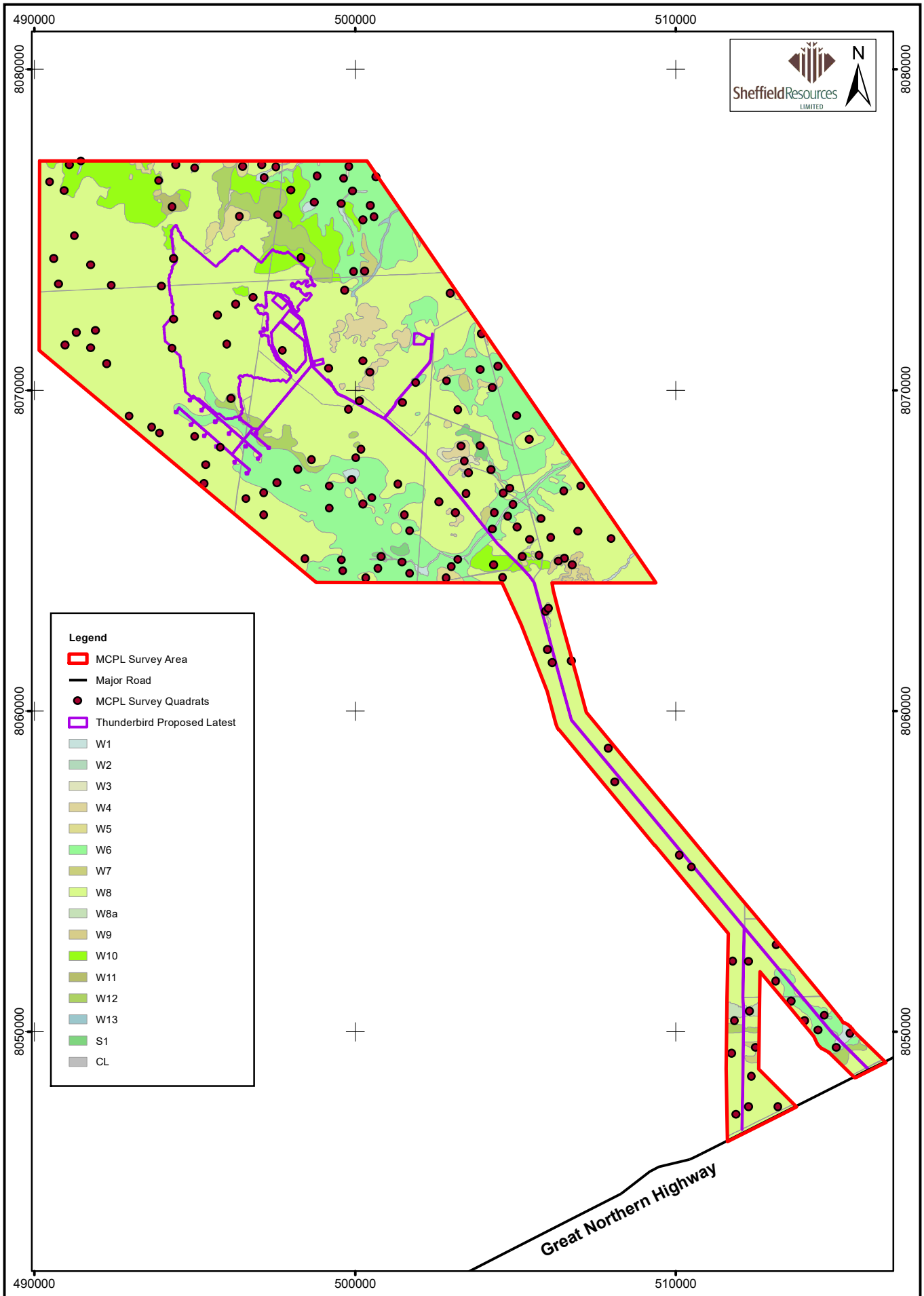
Thunderbird Mineral Sands Project
Hierarchical Cluster of Floristic Community Types
Group Average

Figure **14**



Source: Vegetation: MCPL, Site Layout: MBS

0 1 2 3 4 km

Scale: 1:160,000
MGA94 (Zone 51)

CAD Ref: a2409_f50_14

Date: Sep 2016 | Rev: B | A4

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Thunderbird Mineral Sands Project
Vegetation

Figure: **15**

6.5 Area Coverage of Vegetation Communities

The total areas mapped and percentage cover for each vegetation community delineated in the Thunderbird Project Area is set out in Table 11. In terms of area coverage, the woodland communities were the most commonly represented, accounting for 99.07% of the Thunderbird Project Area. In particular, two woodland communities - W6 and W8 (and W8a) - accounted for 86.32% of the Thunderbird Project Area. Vegetation community W8a is the same as vegetation community W8, but has been mapped as a sub-community based on its position in the landscape, being an area which is likely to be subject to seasonal inundation. Vegetation communities W2, W3 and W13 were the most restricted in terms of area coverage, occupying 0.02%, 0.19% and 0.13% respectively of the total area surveyed.

Average species richness across all 242 quadrats used for vegetation mapping (155 Mattiske quadrats and 87 Ecologia quadrats) was 25.40 ± 0.59 (mean ± s.e.m.). The W10 vegetation community exhibited the highest species richness (39.81 ± 2.85). The most species poor community delineated was the S1 community, with a mean species richness of 13.00 ± 0.74.

Table 11: Area coverage of each vegetation community in the Thunderbird Project Area.

Vegetation Community	Area (ha)	Percentage of Survey Area
S1	58.9207	0.31
W1	141.0203	0.75
W2	3.0769	0.02
W3	35.7049	0.19
W4	271.9573	1.44
W5	234.5105	1.24
W6	3,432.0202	18.17
W7	101.6397	0.54
W8	12,834.5447	67.95
W8a	36.9145	0.20
W9	67.8791	0.36
W10	964.2910	5.11
W11	40.9165	0.22
W12	519.7978	2.75
W13	25.1385	0.13
Cleared Land	117.5475	0.62
Totals	**18,885.8801**	**100.00**

6.6 Threatened Ecological Communities

No TECs, pursuant to Schedule 1 of the *Wildlife Conservation Act 1950* and as listed by the DPaW (2016e) were recorded within the Thunderbird Project Area. No TECs, pursuant to the *EPBC Act* and as listed by the DotE (2016b) were recorded within the Thunderbird Project Area.

6.7 Priority Ecological Communities

No PECs as listed by DPaW (2016f) were recorded within the Thunderbird Project Area.

6.8 Condition of the Vegetation

The condition of the vegetation within the Thunderbird Project Area ranged from good to excellent, according to Trudgeon (1988; Appendix A; Table A7). Some low level disturbance, associated with cattle was observed, predominantly in areas associated with drainage channels. Portions of the Thunderbird Project Area had been subjected to fires. The age since fire disturbance varied across the Thunderbird Project Area, with some areas having been burnt within the 12 months preceding the survey.

7. DISCUSSION

Mattiske was commissioned by Sheffield to undertake a Level 2 flora and vegetation survey of the Thunderbird Project Area. The Thunderbird Project Area occupies an area of 18,886 ha and is situated on the Dampier Peninsula, between Broome and Derby, across the Mt Jowlaenga and Yeeda Stations.

The Thunderbird Project Area has been the subject of three flora and vegetation surveys completed by Ecologia since 2012. These surveys were a Level 1 flora and fauna assessment (Ecologia 2012), a Level 2 flora and vegetation survey (Ecologia 2014) and a Haul Road and Accommodation Camp flora and fauna assessment (Ecologia 2015). These surveys recorded a range of flora species and vegetation communities which were broadly reflective of the pindan vegetation typical of the region, as described by Beard (1979), as well as the land systems described by Schoknecht & Payne (2010).

Prior to undertaking the field survey in June 2016, Mattiske reviewed the historical literature relating to the flora and vegetation of the region, as well as undertaking a gap analysis of the three surveys which had previously been completed in the Thunderbird Project Area (Ecologia 2012, 2014, 2015). The result of the gap analysis identified four principle areas which warranted additional survey work in the Thunderbird Project Area. These were:

1. A change in the boundary of the Thunderbird Project Area, as compared to the areas surveyed between 2012 and 2015 (Ecologia 2012, 2014, 2015), necessitating the establishment of survey quadrats in areas which previously did not fall within the present Thunderbird Project Area boundary (Figure 10);
2. The lower than desirable density of quadrats surveyed in the previous surveys to ensure adequate coverage for a Level 2 vegetation survey;
3. Mapping of the vegetation within the Thunderbird Project Area which did not reflect the landforms present; and
4. A review of the area within the 14.46 ha area of vegetation unit MaMvEtCPCc (*Melaleuca alsophila* or *Melaleuca viridiflora* and *Eucalyptus tectifica* low, open woodland, over *Chrysopogon pallidus* sparse tussock grassland and *Cyperus conicus* sparse sedgeland) which was described as having similarities with the Lolly Well Springs wetland complex Priority 3 PEC assemblage (Ecologia 2014).

In June 2016 Mattiske established 155 vegetation survey quadrats within the Thunderbird Project Area. Some of these quadrats were established in the sections of the Thunderbird Project Area which did not form part of the areas surveyed by Ecologia (2012, 2014, 2015). Other survey quadrats were established to provide higher survey quadrat density in areas previously surveyed (Ecologia 2012, 2014, 2015), to enable a higher level of confidence in the vegetation mapping. Several of the survey quadrats established by Ecologia between 2012 and 2015 were re-surveyed in 2016 to establish if there were any discrepancies between the species recorded between the different survey companies which would have an impact on utilising the data from previous surveys as part of the present data analysis. Quadrat based species data from the three previous surveys within the Thunderbird Project Area was made available by Sheffield. However, because of the variety of forms in which this data was provided, data from the previous surveys was reduced to a species presence-absence format to enable its incorporation

with data from the present survey. The data from 87 survey quadrats established between 2012 and 2015 (Ecologia 201, 2014, 2015) was merged with the data from the present survey (155 quadrats) for the purposes of statistical analysis and vegetation community delineation.

Flora

A total of 255 vascular plant taxa which are representative of 129 genera and 44 families were recorded in the Thunderbird Project Area during the 2016 survey. The majority of taxa recorded were representative of the Poaceae (46 taxa), Fabaceae (45 taxa), Malvaceae (18 taxa), Cyperaceae (14 taxa), Myrtaceae (14 taxa), Amaranthaceae (12 taxa) and Convolvulaceae (10 taxa) families (Appendix C). Species which were classified as strictly annual represented 16.47% of all taxa recorded. Overall, when data from the three previous flora surveys of the Thunderbird Project Area (Ecologia 2012, 2014, 2015) are assessed together with the data from the present survey, approximately 81% of the species potentially present within the Thunderbird Project Area have been recorded (Figure 13). This, together with the fact that four surveys have been completed over a four-year period, demonstrates that the area has been thoroughly assessed floristically, and that the conditions for a Level 2 survey have been satisfied.

Of the 775 plants specimens collected during the June 2016 survey, 60 could not be identified to the species level or could only be done so with some level of qualification. The reasons for this included the absence of fertile material required for accurate identification, the poor quality of the plant material available (senescent specimens) or the juvenile nature of the specimens available. Only five of the plant specimens collected (<1% of all plants collected) could only be identified to the family level. There were two reasons for the presence of relatively poor specimens. Firstly, the timing of the survey. The June 2016 survey was completed following the poorest rainfall season of all four surveys completed in the Thunderbird Project Area (Figure 3, Table 1). Rainfall in the four months preceding the 2016 survey was only 51% of the long term average. Consequently, it is unremarkable that there were a number of poor quality specimens available, many of which were annual species. Overall this is not considered to have constrained the survey of the Thunderbird Project Area because there have been four surveys in total, the first two of which (Ecologia 2012, 2014) were completed after very good rainfall seasons (Figure 3, Table 2). Secondly, some specimens which were collected from areas which had recently been the subject of bushfires (within 12 months of the survey), were of a juvenile nature and could not be positively identified to the species level.

The flora recorded during the June 2016 survey was consistent with species reported as being typical of the area (Appendix C, Beard 1979). Additionally, the species recorded were consistent with those previously reported within the Thunderbird Project Area (Ecologia 2012, 2014, 2015). The latter is particularly important, as it afforded a high level of confidence that the data from previous surveys could be merged with the present survey data for statistical analysis and vegetation community delineation.

No threatened flora were recorded within the Thunderbird Project Area during the June 2016 survey. This was also the case with the previous three surveys of the area (Ecologia 2012, 2014, 2015). Two priority flora taxa were recorded during the June 2016 survey of the Thunderbird Project Area. These

were *Triodia caelestialis* (P3) and *Pterocaulon intermedium* (P3). Specimens of both taxa collected by Mattiske in June 2016 – multiple specimens in the case of *Triodia caelestialis* (P3) – were submitted to the Western Australian Herbarium for re-identification. *Triodia caelestialis* (P3) was recorded at 78 of the 155 quadrats surveyed in June 2015. It was present in large numbers where it was recorded (Appendix G), and was recorded at locations spread across the entirety of the Thunderbird Project Area (Figure 11B, Appendix I).

Pterocaulon intermedium (P3) was recorded at 7 of the 155 quadrats surveyed in June 2016. It was recorded infrequently (Appendix G). The locations of both priority taxa within the Thunderbird Project Area does not, on the basis of all four surveys of the Thunderbird Project Area, appear to be associated with any specific landforms or soil types (Appendix I). Given the widespread distribution of both taxa, and the low level of surveys in the less accessible parts of the Dampier Peninsula, there is a reasonable expectation that they would be located beyond the Thunderbird Project Area boundary, and that impacts to these taxa from mine development would likely be low.

In addition to the aforementioned priority taxa, three other priority flora taxa have previously been recorded in the Thunderbird Project Area (Ecologia 2012, 2014, 2015). These taxa were *Fuirena incrassata* (P3), *Fuirena nudiflora* (P1), and *Tephrosia valleculata* (P3). An additional taxon, *Eriachne* sp. Dampier Peninsula (K.F. Kenneally 5946) was previously reported as a Priority 3 taxon in the Thunderbird Project Area (Ecologia 2014). This taxon is no longer listed as a priority taxon (DPaW 2016g). None of these three taxa were recorded by Mattiske during the June 2016 survey of the Thunderbird Project Area. All three taxa were recorded infrequently (Ecologia 2014). *Fuirena incrassata* (P3), which has been recorded in the region (DPaW 2016g), is an annual species. Given the poor rainfall conditions which preceded the present survey, the fact that it was not recorded during the June 2016 survey is not unsurprising. According to DPaW (2016g), the distribution of *Fuirena nudiflora* (P1) is restricted to the Victoria Bonaparte and Central Range IBRA regions, near to the borders of the Northern Territory and South Australia respectively. Its presence in the Thunderbird Project Area would represent a range extension of approximately 1,000 km to the west of its present known locations (DPaW 2016g). Unfortunately, Ecologia (2014) did not provide information as to whether or not the specimen of this taxon collected was confirmed by a specialist taxonomist, given the significance of it being recorded in the Thunderbird Project Area. However, given that it is an annual species, there would have been a low likelihood of recording this taxon given the poor rainfall season preceding the June 2016 survey. *Tephrosia valleculata* (P3) is known to occur within approximately 200 km of the Thunderbird Project Area (DPaW 2016g). Whether this species is annual or perennial is not indicated (DPaW 2016g). Its preferred habitat is on rock outcrops and soil around sandstone (DPaW 2016g), which occur within the Thunderbird Project Area. That it was not recorded during the June 2016 survey may be due to either it not being present due to the poor seasonal conditions, or given its infrequent recording by Ecologia (2014), such occurrences may be opportunistic. Again, no indication was provided as to verification of the identity of this taxon (Ecologia 2014). Notwithstanding this, given its preference for rocky outcrops (DPaW 2016g), it is unlikely to be impacted by mine development within the Thunderbird Project Area.

One taxon recorded during the June 2016 survey of the Thunderbird Project Area survey represented an extension to its currently known distribution. This taxon was *Aristida contorta.* The recording of *Aristida contorta* in the Thunderbird Project Area represents an approximately 300 km range extension from known records to either the east or south-west of the survey area (DPaW 2016g). This taxon is not considered to be of conservation significance, as it widespread throughout the State (DPaW 2016g). Ecologia (2014) reported that 26 of the taxa recorded during the Level 2 survey of the Thunderbird Project Area represented range extensions of more than 100 km from there then known range. As is the case with *Aristida contorta*, this is likely to be associated with the low level of survey of the less accessible areas of the Dampier Peninsula.

Five introduced (exotic) plant taxa were recorded during the survey of the Thunderbird Project Area (Table 10). The introduced taxon recorded were **Cenchrus ciliaris, *Portulaca pilosa, *Stylosanthes hamata and *Stylosanthes scabra*. None of the recorded introduced species are Declared Pests pursuant to the *BAM Act 2007.* All taxa were recorded infrequently, and were also reported by Ecologia during their three surveys of the Thunderbird Project Area (Ecologia 2012, 2014, 2015). Ecologia (2014) reported that the Declared Pest, **Sida aculeata*, was recorded during the then survey of the Thunderbird Project Area. Although this taxon was not recorded during the June 2016 survey, and given that it has previously been recorded within the Thunderbird Project Area, there may be a need to monitor the presence of this species.

Vegetation

Quadrat based species data was made available from the three preceding surveys of the Thunderbird Project Area (Ecologia 2012, 2014, 2015). Due to the different formats in which this data was made available, it was all converted into a species presence-absence matrix. A major concern when utilising data from previous surveys completed by different survey companies is the potential for there to be discrepancies between the data from the different surveys. A review of the previous data with that recorded during the present survey revealed that this would not pose a problem. Mattiske specifically re-surveyed several of the quadrats established by Ecologia (2012, 2014, 2015) to verify species identification. The results of this provided a high level of confidence in terms of merging the data from all four surveys.

Mattiske initially undertook a statistical analysis of the 2016 survey data in isolation. Plymouth Routines in Multivariate Ecological Research version 6 (PRIMER v6) statistical analysis software was used to analyse species-by-site data and discriminate sites on the basis of their species composition (Clarke and Gorley 2006). To down-weight the relative contributions of quantitatively dominant species a presence/absence transformation of the data was used for statistical analysis. Introduced species, singletons (species recorded at only one site) and specimens that were not identified down to the species level were excluded from the analysis. Annuals were removed from the data in analysis due to the differences between years based on seasonality of local rainfall events. Computation of similarity matrices was based on the Bray-Curtis similarity measure. Subsequently, data from 87 quadrats assessed during the previous surveys (Ecologia 2012, 2014, 2015) was merged with the data from the 155 quadrats surveyed during the June 2016 survey and the statistical analyses performed on the

merged data from 242 survey quadrats. The results of the statistical analysis are presented in the form of a dendrogram (Figure 14). With two exceptions (communities W12 and W13) there was no tendency for survey data from the four surveys to group, based on either survey type or survey company. Because of this, the aforementioned two communities were maintained as distinct communities rather than merging them into larger groupings.

Fourteen vegetation communities were defined and mapped across the Thunderbird Project Area based on the statistical analysis of the species data recorded across the combined 242 survey quadrats established in the Thunderbird Project Area between 2012 and 2016. The vegetation communities are summarised in Appendix K.

In broad terms, the vegetation of the Thunderbird Project Area consists of vegetation, where there is a sparse overstorey of *Eucalyptusl Corymbia* species – typically *Corymbia greenianal Eucalyptus tectifica* – over a mid-storey of *Acacia* species, dominated by *Acacia tumida* var. *tumida*, and a ground storey of mixed grasses, with *Triodia caelestialis* (P3), *Triodia schinzii*, and *Chrysopogon species* (*C. pallidus, C. timorense*) being dominant. Other common species in the upper storey included *Brachychiton diversifolius Corymbia zygophylla*, *Erythrophleum chlorostachys*, and *Eucalyptus flavescens*. *Atalaya hemiglauca*, *Bauhinia cunninghamii*, *Dolichandrone heterophylla*, *Ehretia saligna*, *Gardenia pyriformis* subsp. *keartlandii*, *Grevillea pyramidalis*, *Hakea arborescens*, and *Hakea macrocarpa* were common mid-storey species. Some of these, such as *Bauhinia cunninghamii*, were often of sufficient size as to form a component of the upper storey. The vegetation described here, based on the statistical analysis of the survey data, is essentially pindan. This is typical of the pindan vegetation and species described by Graham (2001), Kenneally *et al*. 1996, Beard (1979) and Schoknecht and Payne (2010) in their treatments of the IBRA region, vegetation mapping and land systems respectively. A more detailed review of these areas is presented in Section 5 of this report. In this respect, the vegetation of the Thunderbird Project Area is common and widespread through the broader Kimberley region.

Two of the 14 defined vegetation communities accounted for more than 86% of the Thunderbird Project Area (Table 11, Figure 15, Appendix I). The defined woodland communities accounted for more than 99% of the Thunderbird Project Area. Statistically, the average dissimilarity between the woodland communities was high, being typically greater than 70%. These differences were reflected in the relative presence/absence of the common range of species described in the preceding paragraph. Whilst the same species could be present at two communities (e.g. *Corymbia greenianal Eucalyptus tectifica*), one tended to be dominant at one community and not at the other, and vice versa. This tended to be reflected across the range of common species in all strata. The single defined shrubland (S1) represented 0.31% of the Thunderbird Project Area and was characterised by the absence of tree species.

From a vegetation mapping perspective, Mattiske has taken into account landform elements when allocating boundaries to vegetation communities. These include drainage channels and hills/breakaways. This was not a practice adopted in previous reports of surveys in the Thunderbird Project Area (Ecologia 2012, 2014, 2014). The high resolution aerial imagery taken since 2015 and

made available by Sheffield enabled a more accurate delineation of communities. The resulting vegetation map (Figure 15, Appendix I) is consequently more reflective of both the vegetation communities defined and the landforms present. Vegetation associated with the hills and drainage channels within the Thunderbird Project Area were statistically different from the vegetation communities defined on the flats (Appendices I and K). This also justified the decision to incorporate landform elements into the mapping.

The drainage channels (community W1) were dominated by *Melaleuca viridiflora* and *Melaleuca alsophila* (equivalent to Ecologia vegetation unit MaMvEtCpCc – refer to Table 5). The major drainage channel which traverses the southern portion of the Thunderbird Project Area polygon, just to the north of the proposed haul road junction with the main polygon, had *Eucalyptus camaldulensis* growing on its eastern section, where the drainage channel became wider and deeper. The Reeves land system (Schoknecht and Payne 2010) traverses this portion of the Thunderbird Project Area (Figure 5). One of its land units consists of channels supporting fringing woodlands of *Eucalyptus camaldulensis* and *Melaleuca* spp. communities. The major portion of the Thunderbird Project Area falls within the Fraser and Wanganut land systems (Figure 5). The vegetation recorded during both the present and previous three surveys (Ecologia 2012, 2014, 2015) recorded vegetation on soils consistent with these land systems. That is, sandplains composed of red sandy soils supporting low pindan woodland with a prominent *Acacia* shrub layer and *Triodia-Chrysopogon* ground layer (Schoknecht and Payne 2010). These were principally vegetation communities W6 and W8, which together accounted for approximately 86% of the Thunderbird Project Area. The hills and ridge communities (W4 and W5) tended to be very sparsely wooded and *Erythrophleum chlorostachys* was not present, unlike the flats where it was a common species. A section of vegetation community W8, located on one arm of the proposed access road near the great Northern Highway (Appendix I), has been delineated as a sub-community (W8a) because, unlike the remainder of the W8 community, this section is low lying in the landscape and is likely to become inundated during the wet season.

Two of the vegetation communities, W12 and W13, which comprised 2.75% and 0.13% respectively of the Thunderbird Project Area, comprised quadrats exclusively from previous surveys (Ecologia 2012, 2014, 2015). Both communities W12 and W13 did not contain any unusual species, compared to other communities of the flats. Statistically, *Triodia* spp. did not feature as defining elements of these two communities, although they were present in some quadrats. They did however statistically group together, and as such we have chosen to delineate them rather than merge them into broader groups. Community W12 was principally defined toward the Great Northern Highway end of the proposed haul road alignment and in the northern section of the Thunderbird Project Area. Community W13 was situated in areas in the north of the Thunderbird Project Area. Vegetation communities W12 and W13 are not regarded as comprising unusual vegetation or species assemblages (Appendix K), and the species present in both communities are components of the general pindan vegetation which is the dominant vegetation type in the Thunderbird Project Area. Neither community is situated in the indicative impact areas (Figure 15), and as such are unlikely to be affected by mine development.

Several of the defined vegetation communities (Table 11), represent 5% or less of the Thunderbird Project Area. However, they do not constitute communities which support either unusual species or species assemblages which would warrant special attention. As has been previously stated, the vegetation communities present, particularly on the flats, represent variations of the pindan vegetation which is the dominant vegetation of the region. Statistically, the differences between communities is related to the relative dominance in some areas of one or more of the commonly occurring species. At the time of compiling this report, Mattiske had access to indicative impact areas (Figure 15). Impacts associated with planned mining operations may impact the W6 and W8 communities, which constitute approximately 86% of the Thunderbird Survey Area. These communities are essentially the common pindan vegetation of the region, and hence impacts are likely considered to be low.

Ecologia (2014, 2014, 2015) mapped a range of vegetation communities, which show a higher level of community fragmentation than those mapped in the current report. It is likely that this, in part, is a function of the lower density of survey quadrats established – 87 from three Ecologia surveys. The communities defined and mapped in the present report are based on a total of 242 survey quadrats. In addition, the mapping presented in the present report takes into account landform elements present within the Thunderbird Project Area – for example, hills and drainage channels – which was not the case with previous mapping (Ecologia 2012, 2014, 2015). Notwithstanding this, the major communities defined by Ecologia (Figure 10, Table 5), and which are situated within the indicative impact areas (Figure 15), namely EtApStCpEo, BDEcAtSt, CdTcTc and CgDhSt, are comprised essentially of the species mix which form the broad pindan vegetation of the area. These species are the same as those used by Mattiske and which form the basis of the communities defined and mapped in the present report.

Ecologia (2014) reported that 'a 14.46 ha section of vegetation unit MaMvEtCpCc (*Melaleuca alsophila* or *Melaleuca viridiflora* and *Eucalyptus tectifica* low, open woodland, over *Chrysopogon pallidus* sparse tussock grassland and *Cyperus conicus* sparse sedgeland) closely resembles vegetation associated with a Priority Ecological Community (PEC) at Lolly Well Springs, 40 km to the north-west'. At no point in the document (Ecologia 2014) is any statistical analysis with the vegetation of Lolly Well Springs provided to support this claim. Furthermore, the author states, correctly, that 'Assemblages of Lolly Well Springs wetland complex (P3) contain numerous low organic mound springs with moats. *Melaleuca cajuputi* and/or *Timonius timon*, and *Eleocharis dulcis* are indicative of these types of wetlands'. The latter statement is uncited, but would appear to be a direct quote from Kenneally *et al*. (1996). Based on the discussion in the report (Ecologia 2014), another similarity claimed is that the area constitutes an ephemeral pool or spring which is not associated with the main drainage channel which occurs in the associated vegetation community.

During the June 2016 field survey, Mattiske revisited the area claimed to potentially constitute a PEC. The area at the time of the June 2016 survey was dry (Plates 5 & 6). The vegetation consisted of *Melaleuca viridiflora* and *Eucalyptus tectifica* low, open woodland, over *Chrysopogon pallidus* sparse tussock grassland and *Cyperus conicus* sparse sedgeland, as originally stated by Ecologia (2014). This area is not connected to the nearby main drainage channel (community W1), but statistically groups

with the W1 vegetation community described in this report. There was no evidence of a low organic mound spring. Given that Ecologia (2014) state that *Melaleuca cajuputi* and/or *Timonius timon*, and *Eleocharis dulcis* are indicative of these types of wetlands (low organic mound springs), and that none of these species was recorded during the 2014 survey by Ecologia, any claim that this portion of the Thunderbird Project Area may constitute a potential PEC is not scientifically valid, especially given the lack of statistical analysis with the Lolly Well Springs PEC. A review of the topography of the area demonstrates that the *Melaleuca viridiflora* community area is low lying relative to the surrounding land. Irrespective of whether or not this isolated *Melaleuca viridifloral Eucalyptus tectifical Cyperus conicus* community was connected to the main drainage channel nearby at some time in the past, it is nothing more than a low lying section of land which acts as a drainage area during periods of rainfall, thus maintaining conditions which continue to provide suitable habitat for the species present.

8. CONCLUSIONS

Overall, the vegetation communities mapped and species recorded in the Thunderbird Project Area are consistent with the historical mapping of Beard (1976, 1990) and more recent land systems mapping of Schoknecht and Payne (2010). The majority of the Thunderbird Project Area comprised red sandy flats supporting pindan vegetation. The priority taxon *Triodia caelestialis* (P3) was recorded widely across the survey area. A second priority taxon, *Pterocaulon intermedium* (P3), was recorded infrequently, and was not associated with any specific vegetation community delineated. Both taxa are expected to be recorded external to the Thunderbird Project Area boundary, and hence impacts within the project area are considered to be low.

With respect to the vegetation communities defined, the W6 and W8 communities comprised approximately 86% of the survey area. Indicative impact areas show that impacts associated with planned mining operations may impact these two communities. These communities are essentially the common pindan vegetation of the region, and hence impacts are considered to be low.

An area within the Thunderbird Project Area, which statistically groups with community W1, a drainage channel community consisting of *Melaleuca viridifloral Melaleuca alsophila*, was claimed by Ecologia (2014) to have some resemblance to the Lolly Wells Spring PEC. This claim was not supported by any statistical analysis or reasonable argument. A review by Mattiske indicates that the claimed area is simply an internal drainage area set in a low lying area amongst low slopes.

Plate 5: Photograph of *Melaleuca alsophila* or *Melaleuca viridiflora* and *Eucalyptus tectifica* low, open woodland, over *Chrysopogon pallidus* sparse tussock grassland and *Cyperus conicus* sparse sedgeland, facing south-east from quadrat north-west corner.

Plate 6: Photograph of *Melaleuca alsophila* or *Melaleuca viridiflora* and *Eucalyptus tectifica* low, open woodland, over *Chrysopogon pallidus* sparse tussock grassland and *Cyperus conicus* sparse sedgeland, facing north-west from quadrat north-west corner.

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10. LIST OF PERSONNEL

The following Mattiske Consulting Pty Ltd personnel were involved in this project:

Name	Position	Survey Involvement	Flora Collection Permit
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Mr D. Angus	Senior Botanist	fieldwork, plant identification, data analysis, mapping, report preparation	SL011706, 12-1516
Dr J. Cargill	Senior Ecologist	fieldwork, mapping, report review	SL011719
Ms. N. Murdock	Senior Botanist	planning, fieldwork	SL011715, 11-1516
Mr A. Barrett	Botanist	planning, fieldwork	SL011707
Mr B. Ellery	Botanist / Taxonomist	plant identification	N/A
Ms. F. Hart	Botanist	plant identification	N/A

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APPENDIX A1: STATE DEFINITION OF THREATENED AND PRIORITY FLORA SPECIES

Note: Adapted from DPaW (2016c).

Category	Definition
T – Threatened	Taxa that have been adequately searched for and are deemed to be in the wild either rare, in danger of extinction, or otherwise in need of special protection, and have been gazetted as such (Schedules 1 to 4 of the *Wildlife Conservation (Rare Flora) Notice* under the WC Act). Threatened flora are further ranked by the DPaW to align with IUCN Red List categories and criteria: • **CR:** Critically Endangered – considered to be facing an extremely high risk of extinction in the wild (Schedule 1); • **EN:** Endangered – considered to be facing a very high risk of extinction in the wild (Schedule 2); or • **VU:** Vulnerable – considered to be facing a high risk of extinction in the wild (Schedule 3). • **EX:** Presumed Extinct – taxa that have been adequately searched for and there is no reasonable doubt that the last individual has died (Schedule 4)
P1 – Priority 1 (Poorly known taxa)	Taxa that are known from one or a few collections or sight records (generally less than five), all on lands not managed for conservation, e.g. agricultural or pastoral lands, urban areas, Shire, Westrail and Main Roads WA road, gravel and soil reserves, and active mineral leases and under threat of habitat destruction or degradation. Taxa may be included if they are comparatively well known from one or more localities but do not meet adequacy of survey requirements and appear to be under immediate threat from known threatening processes.
P2 – Priority 2 (Poorly known taxa)	Taxa that are known from one or a few collections or sight records, some of which are on lands not under imminent threat of habitat destruction or degradation, e.g. national parks, conservation parks, nature reserves, State forest, vacant Crown land, water reserves, etc. Taxa may be included if they are comparatively well known from one or more localities but do not meet adequacy of survey requirements and appear to be under threat from known threatening processes.
P3 – Priority 3 (Poorly known taxa)	Taxa that are known from collections or sight records from several localities not under imminent threat, or from few but widespread localities with either large population size or significant remaining areas of apparently suitable habitat, much of it not under imminent threat. Taxa may be included if they are comparatively well known from several localities but do not meet adequacy of survey requirements and known threatening processes exist that could affect them.
P4 – Priority 4 (Rare, Near Threatened and other taxa in need of monitoring)	**1. Rare** - Taxa that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection, but could be if present circumstances change. These species are usually represented on conservation lands. **2. Near Threatened** - Taxa that are considered to have been adequately surveyed and that do not qualify for Conservation Dependent, but that are close to qualifying for Vulnerable. **3.** Taxa that have been removed from the list of threatened species during the past five years for reasons other than taxonomy.

APPENDIX A2: DEFINITION OF THREATENED FLORA SPECIES (*Environment Protection and Biodiversity Conservation Act 1999*)

Category Code	Category
Ex	**Extinct** Taxa which at a particular time if, at that time, there is no reasonable doubt that the last member of the species has died.
ExW	**Extinct in the Wild** Taxa which is known only to survive in cultivation, in captivity or as a naturalised population well outside its past range; or it has not been recorded in its known and/or expected habitat, at appropriate seasons, anywhere in its past range, despite exhaustive surveys over a time frame appropriate to its life cycle and form.
CE	**Critically Endangered** Taxa which at a particular time if, at that time, it is facing an extremely high risk of extinction in the wild in the immediate future, as determined in accordance with the prescribed criteria.
E	**Endangered** Taxa which is not critically endangered and it is facing a very high risk of extinction in the wild in the immediate or near future, as determined in accordance with the prescribed criteria.
V	**Vulnerable** Taxa which is not critically endangered or endangered and is facing a high risk of extinction in the wild in the medium-term future, as determined in accordance with the prescribed criteria.
CD	**Conservation Dependent** Taxa which at a particular time if, at that time, the species is the focus of a specific conservation program, the cessation of which would result in the species becoming vulnerable, endangered or critically endangered within a period of 5 years.

APPENDIX A3: DEFINITION OF THREATENED ECOLOGICAL COMMUNITIES (DPaW 2016d)

Category Code	Category
PTD	**Presumed Totally Destroyed** An ecological community will be listed as Presumed Totally Destroyed if there are no recent records of the community being extant and either of the following applies: (i) records within the last 50 years have not been confirmed despite thorough searches or known likely habitats or; (ii) all occurrences recorded within the last 50 years have since been destroyed.
CE	**Critically Endangered** 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, meeting any one of the following criteria: (i) The estimated geographic range and distribution has been reduced by at least 90% and is either continuing to decline with total destruction imminent, or is unlikely to be substantially rehabilitated in the immediate future due to modification; (ii) The current distribution is limited ie. highly restricted, having very few small or isolated occurrences, or covering a small area; (iii) The ecological community is highly modified with potential of being rehabilitated in the immediate future.
E	**Endangered** 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. The ecological community must meet any one of the following criteria: (i) The estimated geographic range and distribution has been reduced by at least 70% and is either continuing to decline with total destruction imminent in the short term future, or is unlikely to be substantially rehabilitated in the short term future due to modification; (ii) The current distribution is limited ie. highly restricted, having very few small or isolated occurrences, or covering a small area; (iii) The ecological community is highly modified with potential of being rehabilitated in the short term future.
V	**Vulnerable** An ecological community will be listed as Vulnerable when it has been adequately surveyed and is not Critically Endangered or Endangered but is facing high risk of total destruction in the medium to long term future. The ecological community must meet any one of the following criteria: (i) The ecological community exists largely as modified occurrences that are likely to be able to be substantially restored or rehabilitated; (ii) The ecological community may already be modified and would be vulnerable to threatening process, and restricted in range or distribution; (iii) The ecological community may be widespread but has potential to move to a higher threat category due to existing or impending threatening processes.

APPENDIX A4: DEFINITION OF THREATENED ECOLOGICAL COMMUNITIES (Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*)

Three categories exist for listing threatened ecological communities under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999.*

Listing Category	Explanation of Category
Critically endangered	If, at that time, it is facing an extremely high risk of extinction in the wild in the immediate future.
Endangered	If, at that time, it is not critically endangered and is facing a very high risk of extinction in the wild in the near future.
Vulnerable	If, at that time, it is not critically endangered or endangered, and is facing a high risk of extinction in the wild in the medium-term future.

APPENDIX A5: DEFINITION OF PRIORITY ECOLOGICAL COMMUNITIES (DPaW 2016d)

Category Code	Category
P1	**Poorly-known ecological communities** 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.
P2	**Poorly-known ecological communities** 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, un-allocated Crown land, water reserves, etc.) and not under imminent threat of destruction or degradation.
P3	**Poorly known ecological communities** (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 and inappropriate fire regimes.
P4	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.
P5	**Conservation Dependent ecological communities** 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.

APPENDIX A6: CATEGORIES AND CONTROL OF DECLARED (PLANT) PESTS IN WESTERN AUSTRALIA (DAFWA 2016, *Biosecurity and Agriculture Management Regulations 2013*)

Control Category	Control Measures
C1 (Exclusion) '(a) Category 1 (C1) — Exclusion: if in the opinion of the Minister introduction of the declared pest into an area or part of an area for which it is declared should be prevented' Pests will be assigned to this category if they are not established in Western Australia and control measures are to be taken, including border checks, in order to prevent them entering and establishing in the State.	In relation to a category 1 declared pest, the owner or occupier of land in an area for which an organism is a declared pest or a person who is conducting an activity on the land must take such of the control measures specified in subregulation (1) as are reasonable and necessary to destroy, prevent or eradicate the declared pest.
C2 (Eradication) '(b) Category 2 (C2) — Eradication: if in the opinion of the Minister eradication of the declared pest from an area or part of an area for which it is declared is feasible' Pests will be assigned to this category if they are present in Western Australia in low enough numbers or in sufficiently limited areas that their eradication is still a possibility.	In relation to a category 2 declared pest, the owner or occupier of land in an area for which an organism is a declared pest or a person who is conducting an activity on the land must take such of the control measures specified in subregulation (1) as are reasonable and necessary to destroy, prevent or eradicate the declared pest.
C3 (Management) '(c) Category 3 (C3) — Management: if in the opinion of the Minister eradication of the declared pest from an area or part of an area for which it is declared is not feasible but that it is necessary to — (i) alleviate the harmful impact of the declared pest in the area; or (ii) reduce the number or distribution of the declared pest in the area; or (iii) prevent or contain the spread of the declared pest in the area.' Pests will be assigned to this category if they are established in Western Australia but it is feasible, or desirable, to manage them in order to limit their damage. Control measures can prevent a C3 pest from increasing in population size or density or moving from an area in which it is established into an area which currently is free of that pest.	In relation to a category 3 declared pest, the owner or occupier of land in an area for which an organism is a declared pest or a person who is conducting an activity on the land must take such of the control measures specified in subregulation (1) as are reasonable and necessary to — (a) alleviate the harmful impact of the declared pest in the area for which it is declared; or (b) reduce the number or distribution of the declared pest in the area for which it is declared; or (c) prevent or contain the spread of the declared pest in the area for which it is declared.

APPENDIX A7: DEFINITION OF VEGETATION CONDITION SCALE (adapted from Trudgen 1988)

Condition Rating	Description
Excellent (1)	Pristine or nearly so, no obvious signs of damage caused by human activities since European settlement.
Very Good (2)	Some relatively slight signs of damage caused by human activities since European settlement. For example, some signs of damage to tree trunks caused by repeated fire, the presence of some relatively non-aggressive weeds, or occasional vehicle tracks.
Good (3)	More obvious signs of damage caused by human activity since European settlement, including some obvious impact on the vegetation structure such as that caused by low levels of grazing or slightly aggressive weeds.
Poor (4)	Still retains basic vegetation structure or ability to regenerate it after very obvious impacts of human activities since European settlement, such as grazing, partial clearing, frequent fires or aggressive weeds.
Very Poor (5)	Severely impacted by grazing, very frequent fires, clearing or a combination of these activities. Scope for some regeneration but not to a state approaching good condition without intensive management. Usually with a number of weed species present including very aggressive species.
Completely Degraded (6)	Areas that are completely or almost completely without native species in the structure of their vegetation; i.e. areas that are cleared or 'parkland cleared' with their flora comprising weed or crop species with isolated native trees or shrubs.

APPENDIX B: COORDINATES DELINEATING THE BOUNDARY OF THE THUNDERBIRD PROJECT AREA

Waypoint	Location (MGA94, Zone 51)	
	Easting (mE)	Northing (mN)
1	490146	8071242
2	490646	8070822
3	497979	8064671
4	498696	8064070
5	498779	8064000
6	504580	8063995
7	505172	8062694
8	505989	8060605
9	505989	8060604
10	506266	8059586
11	506273	8059567
12	506277	8059552
13	506277	8059551
14	506287	8059526
15	506305	8059486
16	506306	8059486
17	506334	8059439
18	506334	8059438
19	506343	8059425
20	506343	8059425
21	506349	8059417
22	506365	8059396
23	507534	8057989
24	507535	8057989
25	507535	8057989
26	509344	8055814
27	509345	8055813
28	509345	8055813
29	511248	8053532
30	511250	8053530
31	511638	8053059
32	511607	8051069
33	511607	8051068
34	511577	8048848
35	511577	8048846
36	511612	8046563
37	511798	8046658
38	513324	8047427
39	513770	8047648
40	512585	8048835
41	512585	8048837
42	512614	8051053
43	512614	8051055
44	512627	8051872
45	513619	8050685

Waypoint	Location (MGA94, Zone 51)	
	Easting (mE)	Northing (mN)
46	514306	8049846
47	514385	8049677
48	514392	8049664
49	514403	8049644
50	514403	8049643
51	514422	8049612
52	514445	8049580
53	514446	8049579
54	514485	8049536
55	514497	8049523
56	514498	8049523
57	514546	8049485
58	514557	8049475
59	514558	8049475
60	514561	8049473
61	514561	8049473
62	514591	8049454
63	514739	8049370
64	514756	8049361
65	514770	8049353
66	514771	8049353
67	514796	8049342
68	514800	8049340
69	514800	8049340
70	514801	8049339
71	514815	8049324
72	514815	8049324
73	514816	8049323
74	515587	8048555
75	515638	8048581
76	516441	8048988
77	516552	8049039
78	515564	8050001
79	515516	8050074
80	515514	8050077
81	515494	8050104
82	515494	8050105
83	515452	8050153
84	515451	8050153
85	515445	8050160
86	515444	8050160
87	515421	8050179
88	515387	8050207
89	515387	8050208
90	515375	8050215

APPENDIX B: COORDINATES DELINEATING THE BOUNDARY OF THE THUNDERBIRD PROJECT AREA

Waypoint	Location (MGA94, Zone 51)	
	Easting (mE)	Northing (mN)
91	515375	8050216
92	515323	8050246
93	515323	8050246
94	515288	8050262
95	515255	8050275
96	515254	8050275
97	515213	8050286
98	515191	8050331
99	515188	8050337
100	515182	8050350
101	515182	8050350
102	515154	8050397
103	515154	8050397
104	515150	8050403
105	515150	8050404
106	515146	8050408
107	515125	8050436
108	514398	8051325
109	514396	8051327
110	514394	8051329
111	512532	8053559

Waypoint	Location (MGA94, Zone 51)	
	Easting (mE)	Northing (mN)
112	512026	8054173
113	512025	8054174
114	512024	8054176
115	510119	8056458
116	510119	8056459
117	508310	8058633
118	508310	8058633
119	507210	8059957
120	506961	8060870
121	506961	8060870
122	506961	8060870
123	506363	8063056
124	506176	8063742
125	506175	8063744
126	506175	8063747
127	506145	8063993
128	509381	8063991
129	509333	8064061
130	500371	8077144
131	490147	8077155
132	490146	8071242

APPENDIX C: VASCULAR PLANTS SPECIES RECORDED FROM THE DESKTOP SURVEY AND FROM SURVEYS WITHIN THE THUNDERBIRD PROJECT AREA BETWEEN 2012 AND 2016

Notes: NM denotes species recorded from desktop assessement (DPaW 2007-); L1 (Ecologia 2012); L2 (Ecologia 2014); HR (Ecologia 2015); Mattiske (present survey); * denotes introduced species; P1 - P5 denotes priority taxon (DPaW 2016g)

Family	Species	Survey				
			Ecologia			Mattiske
		NM	L1	L2	HR	2016
PTERIDACEAE	*Cheilanthes brownii*	x		x	x	
	Cheilanthes caudata	x				
	Cheilanthes ?*nudiuscula*			x		
MARSILEACEAE	*Marsilea* sp.	x				
ALISMATACEAE	*Caldesia oligococca*	x				
HYDROCHARITACEAE	*Vallisneria annua*	x				
POACEAE	*Aristida contorta*					x
	Aristida holathera			x		
	Aristida holathera var. *holathera*	x	x	x	x	x
	Aristida holathera var. *latifolia*		x	x		x
	Aristida hygrometrica	x	x	x	x	x
	Aristida inaequiglumis		x		x	x
	Aristida aff. nitidula				x	
	Aristida sp.				x	x
	Bothriochloa bladhii	x				
	Bothriochloa sp.				x	
	* *Cenchrus ciliaris*					x
	Cenchrus elymoides		x	x		
	Cenchrus elymoides var. *elymoides*			x		
	Chloris lobata			x	x	
	Chrysopogon fallax				x	x
	Chrysopogon pallidus			x	x	x
	Chrysopogon sp.		x			x
	Cymbopogon ambiguus					x
	Cymbopogon bombycinus					x
	Cymbopogon procerus	x	x	x		x
	* *Cynodon dactylon*	x	x			
	Dactyloctenium radulans			x		x
	Digitaria bicornis		x			
	Digitaria brownii			x	x	x
	Ectrosia danesii	x				
	Ectrosia schultzii		x			x

APPENDIX C: VASCULAR PLANTS SPECIES RECORDED FROM THE DESKTOP SURVEY AND FROM SURVEYS WITHIN THE THUNDERBIRD PROJECT AREA BETWEEN 2012 AND 2016

Notes: NM denotes species recorded from desktop assessement (DPaW 2007-); L1 (Ecologia 2012); L2 (Ecologia 2014); HR (Ecologia 2015); Mattiske (present survey); * denotes introduced species; P1 - P5 denotes priority taxon (DPaW 2016g)

Family	Species	Survey				
			Ecologia			Mattiske
		NM	L1	L2	HR	2016
POACEAE (continued)	*Ectrosia schultzii* var. *schultzii*			x	x	
	Eragrostis cumingii		x	x	x	x
	Eragrostis eriopoda	x	x	x	x	x
	Eragrostis exigua	x		x		
	* *Eragrostis minor*	x				
	Eragrostis speciosa	x				
	Eragrostis tenellula					x
	Eragrostis sp.		x		x	x
	Eriachne ciliata		x	x	x	x
	Eriachne melicacea		x	x	x	x
	Eriachne obtusa		x	x	x	x
	Eriachne pulchella subsp. *dominii*	x				
	Eriachne sp. Dampier Peninsula (K. F. Kenneally 5946)		x	x	x	x
	Eriachne sulcata		x	x		x
	Eriachne sp.					x
	Eulalia aurea					x
	Heteropogon contortus		x	x	x	x
	Iseilema ?fragile					x
	Mnesithea formosa			x		
	Panicum decompositum					x
	Paspalidium rarum		x	x		
	Perotis rara			x		
	Sacciolepis indica		x			
	Schizachyrium fragile			x	x	
	Sehima nervosum			x		x
	Setaria apiculata		x	x		
	Setaria surgens			x	x	x
	Sorghum plumosum		x	x	x	x
	Sorghum timorense			x	x	x
	Sporobolus actinocladus					x
	Sporobolus australasicus		x		x	
	Thaumastochloa major			x		
	Thaumastochloa pubescens			x		
	Triodia ?bynoei					x
	Triodia ?intermedia					x
	Triodia caelestialis (P3)		x	x	x	x

APPENDIX C: VASCULAR PLANTS SPECIES RECORDED FROM THE DESKTOP SURVEY AND FROM SURVEYS WITHIN THE THUNDERBIRD PROJECT AREA BETWEEN 2012 AND 2016

Notes: NM denotes species recorded from desktop assessement (DPaW 2007-); L1 (Ecologia 2012); L2 (Ecologia 2014); HR (Ecologia 2015); Mattiske (present survey); * denotes introduced species; P1 - P5 denotes priority taxon (DPaW 2016g)

Family	Species	Survey				
			Ecologia			Mattiske
		NM	L1	L2	HR	2016
POACEAE	*Triodia schinzii*			x	x	x
(continued)	*Triodia* "schinzii group"					x
	Triodia sp.			x		x
	Urochloa piligera					x
	Urochloa praetervisa				x	
	Xerochloa barbata	x				x
	Xerochloa imberbis				x	
	Xerochloa laniflora			x		x
	Yakirra australiensis			x		x
	Yakirra australiensis var. *australiensis*			x	x	
	Yakirra australiensis var. *intermedia*		x	x	x	
	Yakirra pauciflora			x	x	
	Poaceae sp.					x
CYPERACEAE	*Abildgaardia schoenoides*			x	x	x
	Bulbostylis barbata		x	x	x	
	Crosslandia setifolia			x		
	Cyperus carinatus					x
	Cyperus concinnus	x				
	Cyperus conicus	x	x	x	x	x
	Cyperus latzii			x		
	Cyperus microcephalus		x			
	Cyperus ?*microcephalus*					x
	Cyperus microcephalus subsp. *microcephalus*			x	x	x
	Cyperus nervulosus			x		x
	Cyperus pulchellus			x		
	Cyperus tenuispica			x		x
	Cyperus sp.			x		
	Cyperus sp. A					x
	Cyperus sp. B					x
	Eleocharis geniculata		x			
	Fimbristylis ammobia			x	x	
	Fimbristylis caespitosa			x	x	
	Fimbristylis dichotoma		x			x
	Fimbristylis littoralis	x		x		x
	Fimbristylis macrantha			x		

APPENDIX C: VASCULAR PLANTS SPECIES RECORDED FROM THE DESKTOP SURVEY AND FROM SURVEYS WITHIN THE THUNDERBIRD PROJECT AREA BETWEEN 2012 AND 2016

Notes: NM denotes species recorded from desktop assessement (DPaW 2007-); L1 (Ecologia 2012); L2 (Ecologia 2014); HR (Ecologia 2015); Mattiske (present survey); * denotes introduced species; P1 - P5 denotes priority taxon (DPaW 2016g)

Family	Species	Survey				
			Ecologia			Mattiske
		NM	L1	L2	HR	2016
CYPERACEAE	*Fimbristylis microcarya*			x		
(continued)	*Fimbristylis neilsonii*			x	x	
	Fimbristylis nuda			x		
	Fimbristylis oxystachya				x	x
	Fimbristylis punctata	x		x		
	Fimbristylis rara			x		
	Fimbristylis schultzii				x	
	Fimbristylis simulans		x	x		
	Fimbristylis tetragona			x		x
	Fimbristylis trigastrocarya			x		
	Fimbristylis sp.	x			x	
	Fuirena ciliaris		x	x		
	Fuirena incrassata (P3)			x		
	Fuirena nudiflora (P1)			x		
	Lipocarpha microcephala	x	x			
	Rhynchospora affinis	x				
	Scleria brownii		x	x		
	Cyperaceae sp.		x			x
RESTIONACEAE	*Leptocarpus crassipes* (P3)	x				
XYRIDACEAE	*Xyris complanata*		x	x		x
ERIOCAULACEAE	*Eriocaulon cinereum*	x				
	Eriocaulon sp. G Kimberley Flora (K.F. Kenneally 11374E	x				
COMMELINACEAE	*Murdannia graminea*			x		
ASPARAGACEAE	*Thysanotus chinensis*		x	x		
HEMEROCALLIDACEAE	*Corynotheca micrantha*					x
MORACEAE	*Ficus aculeata*					x
	Ficus aculeata var. *indecora*		x		x	
	Ficus platypoda		x	x		x

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Family	Species	Survey				
			Ecologia			Mattiske
		NM	L1	L2	HR	2016
PROTEACEAE	*Grevillea pyramidalis*			x		
	Grevillea pyramidalis subsp. *pyramidalis*	x	x	x	x	x
	Grevillea refracta subsp. *refracta*	x	x	x	x	x
	Grevillea striata	x		x	x	x
	Grevillea sp.					x
	Hakea arborescens	x	x	x	x	x
	Hakea macrocarpa			x	x	x
	Hakea sp.					x
	Persoonia falcata		x	x	x	x
	Proteaceae sp.					x
SANTALACEAE	*Santalum lanceolatum*		x	x		x
OPILIACEAE	*Opilia amentacea*			x		
LORANTHACEAE	*Amyema sanguinea* var. *sanguinea*	x			x	
	Amyema sp.					x
	Dendrophthoe acacioides subsp. *acacioides*	x				
	Lysiana spathulata subsp. *spathulata*	x				
AMARANTHACEAE	*Achyranthes aspera*			x		
	Alternanthera angustifolia					x
	Gomphrena affinis					x
	Gomphrena brachystylis subsp. *pindanensis*	x				x
	Gomphrena canescens			x		
	Gomphrena canescens subsp. *canescens*	x	x	x	x	x
	Gomphrena flaccida	x	x	x	x	x
	Gomphrena lanata			x		
	Gomphrena leptoclada				x	
	Gomphrena leptoclada subsp. *leptoclada*			x		
	Gomphrena tenella	x				
	Gomphrena sp.					x
	Ptilotus corymbosus	x	x	x	x	x
	Ptilotus fusiformis			x		x
	Ptilotus lanatus			x		x
	Ptilotus murrayi	x				

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Family	Species	Survey				
			Ecologia			Mattiske
		NM	L1	L2	HR	2016
AMARANTHACEAE	*Ptilotus nobilis* subsp. *nobilis*	x				x
(continued)	*Ptilotus polystachyus*	x		x	x	x
	Ptilotus sp.		x			x
NYCTAGINACEAE	*Boerhavia gardneri*			x		
GYROSTEMONACEAE	*Codonocarpus cotinifolius*		x			
AIZOACEAE	*Trianthema oxycalyptrum* var. *oxycalyptrum*	x		x		
	Trianthema pilosum		x	x	x	x
PORTULACACEAE	*Calandrinia quadrivalvis*	x			x	x
	Calandrinia strophiolata	x	x	x	x	x
	Calandrinia translucens				x	
	Calandrinia sp.	x				
	Portulaca bicolor			x		
	Portulaca aff. filifolia			x		
	* *Portulaca pilosa*					x
CARYOPHYLLACEAE	*Polycarpaea corymbosa*		x	x	x	
	Polycarpaea holtzei	x				
	Polycarpaea longiflora		x	x	x	x
	Polycarpaea spirostylis	x				
MENISPERMACEAE	*Tinospora smilacina*	x	x	x	x	x
LAURACEAE	*Cassytha capillaris*			x	x	
	Cassytha sp.					x
HERNANDIACEAE	*Gyrocarpus americanus*					x
	Gyrocarpus americanus subsp. *pachyphyllus*					x
CAPPARACEAE	*Capparis lasiantha*					x

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Family	Species	Survey				
			Ecologia			Mattiske
		NM	L1	L2	HR	2016
CLEOMACEAE	*Cleome oxalidea*	x				
	Cleome tetrandra	x				
	Cleome tetrandra var. *tetrandra*	x		x		x
	Cleome viscosa			x	x	x
MORINGACEAE	* *Moringa oleifera*	x				
DROSERACEAE	*Drosera broomensis*	x		x		
	Drosera derbyensis		x	x	x	
	Drosera hartmeyerorum	x				
	Drosera indica	x	x	x		
	Drosera serpens	x				
BYBLIDACEAE	*Byblis filifolia*	x	x	x	x	x
	Byblis rorida	x				
	Byblis sp.	x				
FABACEAE	*Acacia acradenia*	x				
	Acacia adoxa	x				
	Acacia adoxa var. *adoxa*	x				
	Acacia ampliceps	x				
	Acacia bivenosa	x				
	Acacia colei	x				x
	Acacia colei var. *colei*	x	x	x	x	
	Acacia colei var. *ileocarpa*				x	
	Acacia drepanocarpa subsp. *drepanocarpa*				x	
	Acacia drepanocarpa subsp. *latifolia*		x			
	Acacia eriopoda	x		x		
	Acacia hippuroides	x	x	x		x
	Acacia monticola		x	x	x	x
	Acacia neurocarpa	x				
	Acacia platycarpa	x	x	x	x	x
	Acacia plectocarpa subsp. *plectocarpa*					x
	Acacia stigmatophylla	x		x		x
	Acacia stipuligera		x			
	Acacia synchronicia	x		x		

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Family	Species	Survey				
			Ecologia			Mattiske
		NM	L1	L2	HR	2016
FABACEAE (continued)	*Acacia tumida*	x		x		x
	Acacia tumida var. *tumida*	x	x	x	x	x
	Acacia victoriae	x				
	Acacia sp.			x		x
	Aeschynomene indica					x
	Alysicarpus muelleri			x		
	Aphyllodium parvifolium (P1)	x				
	Bauhinia cunninghamii	x	x	x	x	x
	Cajanus cinereus			x		
	Cajanus marmoratus			x		x
	Cajanus reticulatus	x				
	Canavalia papuana	x				
	Canavalia rosea	x				
	Chamaecrista mimosoides		x			
	Chamaecrista moorei				x	
	Chamaecrista symonii	x	x	x		x
	Crotalaria brevis	x	x	x		x
	Crotalaria crispata		x	x	x	
	Crotalaria cunninghamii	x				
	Crotalaria ?*medicaginea*					x
	Crotalaria medicaginea var. *neglecta*	x	x	x	x	
	Crotalaria ramosissima	x				x
	Crotalaria sp.				x	x
	Cullen balsamicum					x
	Cullen corallum	x				
	Cullen leucanthum	x				
	Cullen pustulatum				x	
	Cullen sp.					x
	Desmodium brownii	x				x
	Desmodium filiforme		x	x	x	
	Erythrophleum chlorostachys	x	x	x	x	x
	Galactia tenuiflora		x	x	x	x
	Glycine tomentella	x	x	x	x	x
	Indigofera colutea			x		
	Indigofera haplophylla		x	x		x
	Indigofera hirsuta			x		

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Family	Species	Survey				
			Ecologia			Mattiske
		NM	L1	L2	HR	2016
FABACEAE (continued)	*Indigofera linifolia*	x	x	x	x	x
	Indigofera linnaei					x
	Indigofera sp.					x
	Jacksonia aculeata	x				
	Neptunia dimorphantha	x				
	Neptunia sp.					x
	Rhynchosia minima					x
	Senna costata			x	x	x
	Senna notabilis	x				x
	Senna oligoclada		x		x	
	Sesbania erubescens	x				
	* *Stylosanthes hamata*	x	x	x	x	x
	* *Stylosanthes humilis*					x
	* *Stylosanthes scabra*		x		x	x
	Tephrosia brachyodon var. *longifolia*			x		
	Tephrosia crocea			x	x	
	Tephrosia aff. *croccea*					x
	Tephrosia forrestiana		x			
	Tephrosia leptoclada	x	x	x	x	x
	Tephrosia remotiflora		x	x	x	x
	Tephrosia simplicifolia		x	x		
	Tephrosia sp. B Kimberley Flora (C.A. Gardner 7300)					x
	Tephrosia sp. C Kimberley Flora (K.F. Kenneally 5599)				x	
	Tephrosia sp. D Kimberley Flora (R.D. Royce 1848)			x	x	x
	Tephrosia sp. F Kimberley Flora (B.R. Maslin 5139)					x
	Tephrosia valleculata (P3)			x		
	Tephrosia sp.					x
	Uraria lagopodioides			x		x
	Vachellia pachyphloia subsp. *brevipinnula*					x
	Vachellia suberosa	x				
	Vigna lanceolata			x		
	Vigna lanceolata var. *filiformis*		x	x		
	Zornia chaetophora				x	x
	Zornia prostrata		x	x	x	
	Zornia prostrata var. *prostrata*		x	x	x	x

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Family	Species	Survey				
			Ecologia			Mattiske
		NM	L1	L2	HR	2016
ZYGOPHYLLACEAE	*Tribulopis angustifolia*	x		x		x
	Tribulopis pentandra			x		
	Tribulus ranunculiflorus			x		
POLYGALACEAE	*Polygala galeocephala*			x		
	Polygala tepperi		x	x	x	x
EUPHORBIACEAE	*Euphorbia hassallii*			x	x	x
	Euphorbia mitchelliana	x		x		
	Euphorbia myrtoides		x			
	Euphorbia psilosperma			x		
	Euphorbia schultzii			x		
	Euphorbia schultzii var. *comans*			x		
	Euphorbia trigonosperma			x	x	x
	Euphorbia ?*vaccaria*					x
	Euphorbia vicina			x		
	Euphorbia sp.		x			x
	Microstachys chamaelea		x	x	x	x
PHYLLANTHACEAE	*Breynia cernua*			x		x
	Bridelia tomentosa		x			
	Flueggea virosa subsp. *melanthesoides*		x	x		x
	?*Phyllanthus baccatus*					x
	Phyllanthus exilis			x		
	Phyllanthus maderaspatensis			x		
	Phyllanthus rhytidospermus			x	x	x
	Phyllanthus virgatus		x	x		
	Phyllanthus sp.					x
CELASTRACEAE	*Denhamia cunninghamii*				x	x
	Stackhousia intermedia	x	x	x		
SAPINDACEAE	*Atalaya hemiglauca*	x	x	x	x	x
	Atalaya variifolia		x	x		x
	Atalaya sp.					x
	Dodonaea barklyana	x				

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Family	Species	Survey				
			Ecologia			Mattiske
		NM	L1	L2	HR	2016
SAPINDACEAE	*Dodonaea hispidula*	x		x		
(continued)	*Dodonaea hispidula* var. *arida*	x	x	x	x	x
RHAMNACEAE	*Ventilago viminalis*		x	x		x
MALVACEAE	*Abutilon hannii*			x		x
	Abutilon otocarpum			x		
	Adansonia gregorii					x
	Brachychiton diversifolius			x		
	Brachychiton diversifolius subsp. *diversifolius*	x	x	x	x	x
	Corchorus aestuans			x		x
	Corchorus ?*incanus*					x
	Corchorus pumilio					x
	Corchorus sidoides				x	
	Corchorus sidoides subsp. *vermicularis*		x	x		x
	Corchorus tridens			x	x	
	Corchorus sp.					x
	Gossypium australe			x	x	x
	Grewia retusifolia	x				
	Hibiscus apodus	x				
	Hibiscus geranioides	x	x	x		x
	Hibiscus leptocladus					x
	Hibiscus panduriformis (P3)	x				
	Hibiscus sp.			x		x
	* *Malvastrum americanum*				x	
	Melhania oblongifolia		x	x		x
	Melochia corchorifolia		x			
	Seringia nephrosperma	x				
	Sida hackettiana		x	x		
	Sida rohlenae subsp. *occidentalis*			x		x
	Sida spinosa		x			
	Triumfetta albida	x		x	x	x
	Triumfetta breviaculeata		x			
	Triumfetta plumigera	x	x	x		x
	Triumfetta sp.		x			
	Waltheria indica		x	x	x	x

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Family	Species	Survey				
			Ecologia			Mattiske
		NM	L1	L2	HR	2016
MALVACEAE (continued)	Malvaceae sp.					x
ELATINACEAE	*Bergia ammannioides*	x				
VIOLACEAE	*Hybanthus aurantiacus*	x	x	x	x	x
	Hybanthus enneaspermus subsp. *enneaspermus*	x		x		x
	?*Hybanthus* sp.					x
THYMELAEACEAE	*Thecanthes punicea*	x				x
LYTHRACEAE	*Ammannia muelleri*	x				
	Ammannia multiflora	x				
	Rotala occultiflora		x			
LECYTHIDACEAE	*Planchonia careya*					x
COMBRETACEAE	*Terminalia canescens*	x	x	x	x	x
	Terminalia ferdinandiana			x		
	Terminalia volucris	x				x
	Terminalia sp.		x	x		x
MYRTACEAE	*Calytrix exstipulata*		x	x	x	x
	Corymbia confertiflora	x				
	Corymbia dendromerinx	x	x	x		x
	Corymbia flavescens	x		x	x	x
	Corymbia greeniana	x	x	x	x	x
	Corymbia ?polycarpa					x
	Corymbia zygophylla	x	x	x	x	x
	Corymbia sp.	x				x
	Eucalyptus camaldulensis					x
	Eucalyptus tectifica	x	x	x		x
	Eucalyptus sp.					x
	Lophostemon grandiflorus	x				
	Melaleuca alsophila	x		x	x	x
	Melaleuca nervosa		x	x		x
	Melaleuca viridiflora		x	x		x

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Family	Species	Survey				
			Ecologia			Mattiske
		NM	L1	L2	HR	2016
MYRTACEAE (continued)	*Melaleuca* sp.					x
ONAGRACEAE	*Ludwigia perennis*		x	x		
HALORAGACEAE	*Myriophyllum callitrichoides*	x				
ARALIACEAE	*Trachymene didiscoides*					x
	Trachymene microcephala		x	x		
	Trachymene oleracea subsp. *oleracea*				x	
OLEACEAE	*Jasminum molle*		x	x		
LOGANIACEAE	*Mitrasacme connata*			x		
	Mitrasacme exserta	x		x	x	
	Mitrasacme hispida			x		
	Mitrasacme lutea			x	x	
	Mitrasacme sp.			x		
MENYANTHACEAE	*Liparophyllum violifolium*	x				
	Nymphoides beaglensis (P3)	x				
	Nymphoides indica	x				
APOCYNACEAE	Apocynaceae sp.			x		
	Carissa lanceolata		x	x	x	x
	Cynanchum carnosum					x
	Ichnocarpus frutescens			x		
	Marsdenia angustata			x		
	?*Marsdenia viridiflora*					x
	Marsdenia viridiflora subsp. *tropica*		x	x		
	Wrightia saligna	x	x	x	x	x
CONVOLVULACEAE	*Bonamia linearis*		x	x	x	x
	Bonamia sp.					x
	Evolvulus alsinoides		x	x		x
	Evolvulus alsinoides var. *decumbens*		x	x	x	x
	Evolvulus alsinoides var. *villosicalyx*					x

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Family	Species	Survey				
			Ecologia			Mattiske
		NM	L1	L2	HR	2016
CONVOLVULACEAE	*Evolvulus* sp.					x
(continued)	*Ipomoea coptica*			x	x	x
	Ipomoea muelleri	x				x
	Ipomoea pes-caprae	x				
	Ipomoea sp.					x
	Jacquemontia paniculata			x		
	Operculina brownii	x				
	Polymeria ambigua			x	x	
	Xenostegia tridentata		x	x		x
BORAGINACEAE	*Ehretia saligna*			x		x
	Ehretia saligna var. *saligna*		x	x	x	x
	Heliotropium cunninghamii		x		x	
	Heliotropium dichotomum		x			
	Heliotropium diversifolium	x				x
	Heliotropium foliatum	x		x		
	Heliotropium glabellum			x		x
	Heliotropium leptaleum			x	x	x
	Heliotropium sp. A					x
	Heliotropium sp. B					x
	Heliotropium sp. C					x
	Heliotropium sp.				x	
	Trichodesma zeylanicum	x		x		x
	Trichodesma zeylanicum var. *latisepalum*				x	
	Trichodesma zeylanicum var. *zeylanicum*	x	x	x		
LAMIACEAE	?*Clerodendrum floribundum*					x
	Clerodendrum floribundum var. *ovatum*			x		
	Clerodendrum tomentosum var. *tomentosum*				x	
	Premna acuminata		x	x		
SOLANACEAE	*Solanum beaugleholei*	x				
	Solanum cleistogamum				x	
	Solanum cunninghamii	x	x	x	x	x
	Solanum dioicum	x			x	x

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Family	Species	Survey				
			Ecologia			Mattiske
		NM	L1	L2	HR	2016
SOLANACEAE	*Solanum diversiflorum*	x				
(continued)	*Solanum lucani*	x				x
	Solanum sp. A					x
	Solanum sp. B					x
SCROPHULARIACEAE	*Eremophila bignoniiflora*	x				
	Myoporum montanum	x				
BIGNONIACEAE	*Dolichandrone heterophylla*	x	x	x	x	x
OROBANCHACEAE	*Buchnera asperata*	x	x	x	x	x
	Buchnera linearis		x		x	
	Buchnera ramosissima	x			x	x
	Buchnera urticifolia				x	x
	Striga curviflora	x		x	x	
	Striga squamigera				x	
LENTIBULARIACEAE	*Utricularia gibba*	x				
	Utricularia sp.	x				
ACANTHACEAE	*Dicliptera armata*		x	x	x	x
PHRYMACEAE	*Glossostigma diandrum*	x				
	Glossostigma drummondii	x				
	Mimulus uvedaliae var. *lutea*	x	x			
	Peplidium muelleri	x				
PLANTAGINACEAE	*Bacopa floribunda*		x			
	Stemodia lathraia	x	x	x		x
	Stemodia lythrifolia		x	x		x
	?*Stemodia* sp.					x
LINDERNIACEAE	*Lindernia aplectra*	x				
	Lindernia chrysoplectra	x				
	Lindernia sp.	x				

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Family	Species	Survey				
			Ecologia			Mattiske
		NM	L1	L2	HR	2016
RUBIACEAE	*Dentella asperata*	x				
	Dentella misera	x		x		
	Gardenia pyriformis subsp. *keartlandii*	x	x	x		x
	Oldenlandia galioides		x	x		
	Oldenlandia mitrasacmoides			x		
	Oldenlandia mitrasacmoides subsp. *mitrasacmoides*		x			
	Oldenlandia sp.	x				
	Spermacoce laevigata					x
	Spermacoce occidentalis	x	x	x	x	x
	Spermacoce sp.					x
	Synaptantha scleranthoides			x		
GOODENIACEAE	*Goodenia armitiana*	x		x	x	
	Goodenia bicolor	x				
	Goodenia lamprosperma	x				
	Goodenia scaevolina	x	x	x		x
	Goodenia sepalosa			x		
	Goodenia sepalosa var. *glandulosa* (P3)	x				
	Goodenia sepalosa var. *sepalosa*	x	x	x	x	x
	Goodenia sp. Dampier Peninsula (B.J. Carter 675)	x				
	Goodenia sp.	x				
	Velleia panduriformis	x		x		x
STYLIDIACEAE	*Stylidium adenophorum*	x				
	Stylidium desertorum	x				
	Stylidium leptorrhizum	x				
	Stylidium pindanicum (P3)	x				
ASTERACEAE	*Blumea integrifolia*	x	x			
	Calotis sp.	x				
	Centipeda minima subsp. *macrocephala*	x				
	Centipeda minima subsp. *minima*	x				
	Centipeda nidiformis	x				
	Cyanthillium cinereum					
	* *Flaveria trinervia*	x				
	Pluchea rubelliflora				x	

APPENDIX C: VASCULAR PLANTS SPECIES RECORDED FROM THE DESKTOP SURVEY AND FROM SURVEYS WITHIN THE THUNDERBIRD PROJECT AREA BETWEEN 2012 AND 2016

Notes: NM denotes species recorded from desktop assessement (DPaW 2007-); L1 (Ecologia 2012); L2 (Ecologia 2014); HR (Ecologia 2015); Mattiske (present survey); * denotes introduced species; P1 - P5 denotes priority taxon (DPaW 2016g)

Family	Species	Survey				
			Ecologia			Mattiske
		NM	L1	L2	HR	2016
ASTERACEAE (continued)	*Pluchea tetranthera*	x				x
	Pterocaulon intermedium (P3)		x	x	x	x
	Pterocaulon paradoxum	x		x	x	x
	Pterocaulon serrulatum			x		
	Pterocaulon serrulatum var. *velutinum*	x	x	x	x	x
	Pterocaulon sphacelatum		x	x	x	
	Pterocaulon tricholobum			x		
	Pterocaulon sp.				x	x
	Sphaeranthus indicus	x				
	Streptoglossa adscendens	x				
	Streptoglossa macrocephala	x				
	Streptoglossa odora	x				
	Streptoglossa ?odora					x
	* *Tridax procumbens*				x	
	Asteraceae sp.		x			x

APPENDIX D: ASSESSMENT OF THREATENED AND PRIORITY FLORA POTENTIALLY PRESENT IN THE THUNDERBIRD PROJECT AREA

Refer to Appendix A for State (SCC) and Federal (FCC; EPBC Act) conservation code definitions. IBRA Distribution: CK – Central Kimberley; CR – Central Ranges; DL – Dampierland; GSD – Great Sandy Desert; NK – North Kimberley; OVP – Ord Victoria Plain; PIL – Pilbara; VB – Victoria Bonaparte.

Taxon / Common Name	Family	SCC	FCC	Description and Habitat	Potential to Occur in Survey Area
Seringia exastia	Malvaceae	T	CE	Habit: erect shrub, to 0.6 m high Flowers: mauve-purple Flowering period: May-August (unconfirmed) Soils: sands IBRA Distribution: DL, GSD Florabase records: 18	Low Current known distribution is to the west and south of the survey area.
Aphyllodium parvifolium	Fabaceae	P1		Habit: trailing shrub to 0.3 m high Flowers: purple-pink Flowering period: April or June Soils: sands; sand hills IBRA Distribution: DL Florabase records: 5	Medium Preferred soil type & terrain likely to be present in survey area. Species has been recorded within 40 km of survey area.
Bonamia oblongifolia	Convolvulaceae	P1		Habit: perennial herb or shrub Flowers: blue Flowering period: February Soils: sandy or gravelly soils IBRA Distribution: DL, GSD Florabase records:	Low Preferred soil type & terrain likely to be present in survey area, but species has been recorded further to the west and south west of the survey area.
Byblis guehoi	Byblidaceae	P1		Habit: glandular herb Flowers: lilac-violet Flowering period: September (unconfirmed) Soils: sandy loam, waterlogged in wet season IBRA Distribution: DL Florabase records: 2	Low Preferred soil type & terrain unlikely likely to be present in survey area. Species has only been recorded near Beagle Bay Mission, more than 40 km from survey area.

APPENDIX D: ASSESSMENT OF THREATENED AND PRIORITY FLORA POTENTIALLY PRESENT IN THE THUNDERBIRD PROJECT AREA

Refer to Appendix A for State (SCC) and Federal (FCC; EPBC Act) conservation code definitions. IBRA Distribution: CK – Central Kimberley; CR – Central Ranges; DL – Dampierland; GSD – Great Sandy Desert; NK – North Kimberley; OVP – Ord Victoria Plain; PIL – Pilbara; VB – Victoria Bonaparte.

Taxon / Common Name	Family	SCC	FCC	Description and Habitat	Potential to Occur in Survey Area
Corymbia paractia	Myrtaceae	P1		Habit: tree, 4-12 m high Flowers: white Flowering period: April to May or October to December Soils: skeletal soils in transition zone between coastal beach dunes and red pindan soils IBRA Distribution: DL Florabase records: 16	Low Preferred soil type & terrain unlikely likely to be present in survey area. Species has been recorded near Broome on the coast, more than 40 km from survey area.
Cullen candidum	Fabaceae	P1		Habit: shrub to 3 m high Flowers: white Flowering period: September to October Soils: clayey sand IBRA Distribution: CK, DL Florabase records: 5	Low Preferred soil type & terrain potentially present in survey area. Nearest recorded specimen is 100 km north of survey area. Species has been recorded more frequently in the central Kimberley area.
Cyperus haspan subsp. *haspan*	Cyperaceae	P1		Habit: sedge Flowers: unknown Flowering period: unknown Soils: peat, wet areas IBRA Distribution: DL Florabase records: 1	Low Preferred soil type & terrain not known in survey area. Only recorded specimen is near Beagle Bay Mission.
Fuirena nudiflora	Cyperaceae	P1		Habit: tufted annual, grass-like sedge, 0.05-0.2 m high Flowers: brown Flowering period: April to May or July Soils: sand; swamps, creek beds IBRA Distribution: CR, VB Florabase records: 2	Low Preferred soil type & terrain known to occur with survey area. Species previously recorded within survey area, but represents a large (>500 km) range extension from its currently known distribution.

APPENDIX D: ASSESSMENT OF THREATENED AND PRIORITY FLORA POTENTIALLY PRESENT IN THE THUNDERBIRD PROJECT AREA

Refer to Appendix A for State (SCC) and Federal (FCC; EPBC Act) conservation code definitions. IBRA Distribution: CK – Central Kimberley; CR – Central Ranges; DL – Dampierland; GSD – Great Sandy Desert; NK – North Kimberley; OVP – Ord Victoria Plain; PIL – Pilbara; VB – Victoria Bonaparte.

Taxon / Common Name	Family	SCC	FCC	Description and Habitat	Potential to Occur in Survey Area
Haemodorum capitatum	Haemodoraceae	P1		Habit: herb (to 0.5 m - unconfirmed) Flowers: red-maroon Flowering period: August, November (unconfirmed) Soils: sand, sandy clay IBRA Distribution: DL Florabase records: 4	Medium Preferred soil type & terrain likely to be present in survey area. Species has been recorded within 50 km of survey area.
Ipomoea tolmerana subsp*. occidentalis*	Convolvulaceae	P1		Habit: herb Flowers: mauve Flowering period: unknown (March) Soils: unknown IBRA Distribution: DL, NK Florabase records: 4	Low Preferred soil type & terrain unknown. Species has been recorded principally near Beagle Bay Mission, more than 40 km from survey area.
Jacquemontia sp. Broome (A.A. Mitchell 3028)	Convolvulaceae	P1		Habit: herb to 0.4 m Flowers: mauve (likely) Flowering period: unknown (April) Soils: pindan sands IBRA Distribution: DL Florabase records: 3	Low Preferred soil type & terrain present in survey area. Species has been recorded principally near Broome, more than 50 km from survey area.
Parsonsia kimberleyensis	Apocynaceae	P1		Habit: climber, to 3 m high Flowers: yellow/green Flowering period: May to June Soils: vine thickets IBRA Distribution: DL Florabase records: 2	Low Preferred habitat not known in survey area. Species associated with coastal vine thickets.

APPENDIX D: ASSESSMENT OF THREATENED AND PRIORITY FLORA POTENTIALLY PRESENT IN THE THUNDERBIRD PROJECT AREA

Refer to Appendix A for State (SCC) and Federal (FCC; EPBC Act) conservation code definitions. IBRA Distribution: CK – Central Kimberley; CR – Central Ranges; DL – Dampierland; GSD – Great Sandy Desert; NK – North Kimberley; OVP – Ord Victoria Plain; PIL – Pilbara; VB – Victoria Bonaparte.

Taxon / Common Name	Family	SCC	FCC	Description and Habitat	Potential to Occur in Survey Area
Polymeria sp. Broome (K.F. Kenneally 9759)	Convolvulaceae	P1		Habit: herb Flowers: unknown Flowering period: unknown Soils: sand, coastal plain IBRA Distribution: DL Florabase records: 3	Low Preferred soil type & terrain not known in survey area. Species has been recorded principally near Broome, more than 50 km from survey area.
Thespidium basiflorum	Asteraceae	P1		Habit: tufted, multi stemmed perennial herb, to 0.2 m high Flowers: green Flowering period: May to August Soils: sandy soils, creeks IBRA Distribution: DL Florabase records: 4	Low Preferred soil type & terrain present in survey area. Species has been recorded principally near Broome and Beagle Bay Settlement, more than 50 km from survey area.
Utricularia stellaris	Lentibulariaceae	P1		Habit: floating aquatic perennial herb Flowers: yellow Flowering period: June to July Soils: swamps, lagoons IBRA Distribution: DL, NK, VB Florabase records: 4	Low Preferred soil type & terrain not known in survey area. Species has a more coastal distribution.
Utricularia tubulata	Lentibulariaceae	P1		Habit: submerged aquatic perennial herb Flowers: purple-blue Flowering period: February to March or June Soils: ephemeral swamps IBRA Distribution: DL, NK, VB Florabase records: 4	Low Preferred soil type & terrain not known in survey area. Species has been recorded more than 50 km from survey area.

APPENDIX D: ASSESSMENT OF THREATENED AND PRIORITY FLORA POTENTIALLY PRESENT IN THE THUNDERBIRD PROJECT AREA

Refer to Appendix A for State (SCC) and Federal (FCC; EPBC Act) conservation code definitions. IBRA Distribution: CK – Central Kimberley; CR – Central Ranges; DL – Dampierland; GSD – Great Sandy Desert; NK – North Kimberley; OVP – Ord Victoria Plain; PIL – Pilbara; VB – Victoria Bonaparte.

Taxon / Common Name	Family	SCC	FCC	Description and Habitat	Potential to Occur in Survey Area
Acacia monticola × *tumida* var. *kulparn*	Fabaceae	P3		Habit: large shrub to 4 m tall Flowers: yellow Flowering period: May to August (unconfirmed) Soils: sand IBRA Distribution: DL Florabase records: 15	Medium Preferred soil type & terrain likely to be present in survey area. Species has been recorded within 50 km of survey area.
Aphyllodium glossocarpum	Fabaceae	P3		Habit: spreading or erect shrub, to 1.2 m high Flowers: pink-purple Flowering period: April to October Soils: sand, Pindan IBRA Distribution: DL Florabase records: 6	Medium Preferred soil type & terrain likely to be present in survey area. Species has been recorded within 50 km of survey area.
Colocasia esculenta var. *aquatilis*	Araceae	P3		Habit: aquatic herb (lily) Flowers: yellow Flowering period: March, April (unconfirmed) Soils: swamps, springs, creeks IBRA Distribution: CK, DL, NK, OVP Florabase records: 20	Low Preferred soil type & terrain may be in survey area. Species has a more north western distribution.
Dendrophthoe odontocalyx	Loranthaceae	P3		Habit: aerial shrub, hemiparasitic on stems Flowers: orange Flowering period: June to August Soils: parasitic on *Melaleuca* spp. IBRA Distribution: DL, NK Florabase records: 4	Medium Preferred host species present in survey area. Species has been recorded within 60 km of survey area.

APPENDIX D: ASSESSMENT OF THREATENED AND PRIORITY FLORA POTENTIALLY PRESENT IN THE THUNDERBIRD PROJECT AREA

Refer to Appendix A for State (SCC) and Federal (FCC; EPBC Act) conservation code definitions. IBRA Distribution: CK – Central Kimberley; CR – Central Ranges; DL – Dampierland; GSD – Great Sandy Desert; NK – North Kimberley; OVP – Ord Victoria Plain; PIL – Pilbara; VB – Victoria Bonaparte.

Taxon / Common Name	Family	SCC	FCC	Description and Habitat	Potential to Occur in Survey Area
Eriochloa fatmensis	Poaceae	P3		Habit: grass to 0.3 m high (unconfirmed) Flowers: unknown Flowering period: unknown Soils: unknown IBRA Distribution: DL, PIL Florabase records: 3	Low Current Kimberley distribution is near Derby area.
Fuirena incrassata	Cyperaceae	P3		Habit: annual, grass-like sedge, 0.1-0.3 m high Flowers: brown Flowering period: May to August Soils: sand, sandy clay; swamps, creek beds, claypans, semi-saline lakes IBRA Distribution: CK, DL, GSD, OVP, PIL Florabase records: 7	High Preferred habitat known to occur with survey area. Species previously recorded within survey area
Goodenia byrnesii	Goodeniaceae	P3		Habit: prostrate to decumbent herb to 0.3 m high Flowers: yellow Flowering period: January to February Soils: sand; creek edges IBRA Distribution: DL, NK, OVP, VB Florabase records: 16	Low Preferred soil type & terrain may be in survey area. Species has been recorded more than 50 km form survey area.
Goodenia sepalosa var. *glandulosa*	Goodeniaceae	P3		Habit: prostrate to sprawling shrub, 0.03-0.3 m high Flowers: yellow Flowering period: January – December (mainly April – July) Soils: red sand or loam IBRA Distribution: DL, NK, VB Florabase records: 8	Medium Preferred soil type & terrain likely to be present in survey area. Species has been recorded within 50 km of survey area.

APPENDIX D: ASSESSMENT OF THREATENED AND PRIORITY FLORA POTENTIALLY PRESENT IN THE THUNDERBIRD PROJECT AREA

Refer to Appendix A for State (SCC) and Federal (FCC; EPBC Act) conservation code definitions. IBRA Distribution: CK – Central Kimberley; CR – Central Ranges; DL – Dampierland; GSD – Great Sandy Desert; NK – North Kimberley; OVP – Ord Victoria Plain; PIL – Pilbara; VB – Victoria Bonaparte.

Taxon / Common Name	Family	SCC	FCC	Description and Habitat	Potential to Occur in Survey Area
Glycine pindanica	Fabaceae	P3		Habit: scrambling perennial herb or climber Flowers: pink, blue-purple Flowering period: February to March or June Soils: Pindan soils IBRA Distribution: DL Florabase records: 16	Medium Preferred soil type & terrain likely to be present in survey area. Species has been recorded within 50 km of survey area.
Hibiscus panduriformis	Malvaceae	P3		Habit: shrub to 2 m high Flowers: yellow Flowering period: unknown Soils: clay, sandy clay (unconfirmed) IBRA Distribution: VB Florabase records: 2	Low Preferred soil type & terrain may be in survey area. Species has been recorded more than 100 km form survey area, to the north west of the survey area.
Lophostemon grandiflorus subsp. *grandiflorus*	Myrtaceae	P3		Habit: tree to 8 m high Flowers: cream-white Flowering period: January to December Soils: damp habitats (swamps, seepages) IBRA Distribution: DL, VB Florabase records: 8	Low Preferred soil type & terrain not known in survey area. Species has been recorded more than 50 km from survey area.
Nicotiana heterantha	Solanaceae	P3		Habit: short lived annual herb to 0.5 high Flowers: white-cream Flowering period: March to June or September Soils: black clay; seasonally wet flats IBRA Distribution: DL, GSD, PIL Florabase records:	Low Preferred soil type & terrain not known in survey area. Species has been recorded more than 100 km to the south west of the survey area.

APPENDIX D: ASSESSMENT OF THREATENED AND PRIORITY FLORA POTENTIALLY PRESENT IN THE THUNDERBIRD PROJECT AREA

Refer to Appendix A for State (SCC) and Federal (FCC; EPBC Act) conservation code definitions. IBRA Distribution: CK – Central Kimberley; CR – Central Ranges; DL – Dampierland; GSD – Great Sandy Desert; NK – North Kimberley; OVP – Ord Victoria Plain; PIL – Pilbara; VB – Victoria Bonaparte.

Taxon / Common Name	Family	SCC	FCC	Description and Habitat	Potential to Occur in Survey Area
Nymphoides beaglensis	Menyanthaceae	P3		Habit: annual aquatic herb Flowers: white, white-pink-purple Flowering period: March - June Soils: edges of permanent waterholes IBRA Distribution: DL, NK Florabase records: 11	Low Preferred soil type & terrain may be in survey area. Species has been recorded more than 50 km form survey area.
Phyllanthus eremicus	Phyllanthaceae	P3		Habit: perennial herb to 1 m high Flowers: pale green Flowering period: June, July (unconfirmed) Soils: red Pindan sands IBRA Distribution: DL, GSD Florabase records: 8	Low Preferred soil type & terrain known in survey area. Species has been recorded more than 50 km to the south west of the survey area.
Pterocaulon intermedium	Asteraceae	P3		Habit: aromatic perennial herb, 0.2-0.6 m high Flowers: pink-violet Flowering period: March – November (likely) Soils: red sand, sandy clay IBRA Distribution: CK, DL, NK, PIL Florabase records: 24	High Preferred habitat known to occur with survey area. Species previously recorded within survey area
Schoenus punctatus	Cyperaceae	P3		Habit: tufted sedge to 0.6 m high Flowers: brown Flowering period: August Soils: watercourses IBRA Distribution: CK, DL, PIL, VB Florabase records: 6	Medium Preferred soil type & terrain likely to be present in survey area. Species has been recorded within 60 km of survey area.

APPENDIX D: ASSESSMENT OF THREATENED AND PRIORITY FLORA POTENTIALLY PRESENT IN THE THUNDERBIRD PROJECT AREA

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Taxon / Common Name	Family	SCC	FCC	Description and Habitat	Potential to Occur in Survey Area
Seringia katatona	Malvaceae	P3		Habit: shrub, to 1 m high (unconfirmed) Flowers: mauve, purple Flowering period: April to August (unconfirmed) Soils: red sand IBRA Distribution: DL, GSD Florabase records: 21	Medium Preferred soil type & terrain likely to be present in survey area. Species has been recorded within 100 km of survey area.
Stylidium costulatum	Stylidiaceae	P3		Habit: tufted annual herb to 0.2 m tall Flowers: yellow, orange & red Flowering period: April to August Soils: sandy or clayey soils; creeks or seasonally wet areas IBRA Distribution: CK, DL, NK Florabase records: 10	Medium Preferred soil type & terrain likely to be present in survey area. Species has been recorded within 60 km of survey area.
Stylidium pindanicum	Stylidiaceae	P3		Habit: annual herb to 0.25 m tall Flowers: pink Flowering period: May to September (unconfirmed) Soils: sand, clayey soils; creeks, damp areas IBRA Distribution: DL, NK, OVP Florabase records: 16	High Preferred habitat known to occur with survey area. Species previously recorded within 40 km of survey area.
Tephrosia valleculata	Fabaceae	P3		Habit: erect shrub, to 2m high Flowers: orange and green Flowering period: April to September Soils: sandy, often shallow soils around sandstone; rock outcrops IBRA Distribution: DL, NK Florabase records: 9	High Preferred habitat known to occur with survey area. Species previously recorded within survey area

APPENDIX D: ASSESSMENT OF THREATENED AND PRIORITY FLORA POTENTIALLY PRESENT IN THE THUNDERBIRD PROJECT AREA

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Taxon / Common Name	Family	SCC	FCC	Description and Habitat	Potential to Occur in Survey Area
Terminalia kumpaja	Combretaceae	P3		Habit: tree, to 6 m high Flowers: cream Flowering period: May, October (unconfirmed) Soils: sand, Pindan sand IBRA Distribution: DL, GSD Florabase records: 17	Low Preferred soil type & terrain known in survey area. Species has been recorded more than 50 km to the south west of the survey area.
Triodia acutispicula	Poaceae	P3		Habit: tussock-forming resinous perennial grass to 1.5 m high Flowers: cream-brown Flowering period: January to April Soils: sandy soils; Pindan plains, rocky hillslopes and outcrops IBRA Distribution: DL, NK Florabase records: 18	Medium Preferred soil type & terrain likely to be present in survey area. Species has been recorded within 100 km of survey area.
Triodia caelestialis	Poaceae	P3		Habit: tussock-forming non-resinous, non-caespitose perennial grass, to 0.4 m high Flowers: straw & purple Flowering period: January to March Soils: sands IBRA Distribution: CK, DL, NK Florabase records: 18	Highly likely Preferred habitat known to occur with survey area. Species previously recorded extensively within survey area
Pittosporum moluccanum	Pittosporaceae	P4		Habit: tree to 6 m high Flowers: white Flowering period: February to August Soils: white sand; sand dunes IBRA Distribution: DL, NK Florabase records: 18	Low Preferred soil type & terrain may be in survey area. Species has been recorded more than 50 km form survey area.

APPENDIX E: LOCATIONS OF VEGETATION SURVEY QUADRATS ESTABLISHED BY MATTISKE IN THE THUNDERBIRD PROJECT AREA, JUNE 2016

Quadrat	Location (GDA94, Zone 51)	
	Easting (mE)	Northing (mN)
TB001	491459	8077134
TB002	491087	8077033
TB003	497092	8077031
TB004	494402	8077029
TB005	499814	8076979
TB006	496500	8076972
TB007	497536	8076954
TB008	495007	8076918
TB009	498331	8076669
TB010	500650	8076645
TB011	497174	8076619
TB012	499652	8076597
TB013	493878	8076519
TB014	490482	8076490
TB015	497993	8076226
TB016	490921	8076219
TB017	499923	8076197
TB018	498730	8075842
TB019	499566	8075808
TB020	500480	8075752
TB021	494294	8075712
TB022	497596	8075454
TB023	496400	8075420
TB024	500599	8075405
TB025	500250	8075300
TB026	491250	8074800
TB027	498319	8074128
TB028	490600	8074100
TB029	494343	8074100
TB030	491751	8073892
TB031	500297	8073706
TB032	499959	8073689
TB033	490746	8073301
TB034	492397	8073255
TB035	493956	8073228
TB036	499684	8073106
TB037	502973	8073018
TB038	496823	8072877
TB039	496273	8072681
TB040	495709	8072344
TB041	494344	8072199
TB042	491903	8071849
TB043	491300	8071800

Quadrat	Location (GDA94, Zone 51)	
	Easting (mE)	Northing (mN)
TB044	503951	8071750
TB045	496000	8071428
TB046	490950	8071403
TB047	491751	8071303
TB048	494300	8071300
TB049	497737	8071232
TB050	500241	8070901
TB051	492250	8070824
TB052	504458	8070740
TB053	499183	8070676
TB054	503905	8070626
TB055	500466	8070546
TB056	502860	8070275
TB057	501902	8070222
TB058	504291	8070070
TB059	496133	8069735
TB060	500136	8069658
TB061	501478	8069607
TB062	499800	8069400
TB063	503211	8069390
TB064	505040	8069200
TB065	492955	8069182
TB066	493656	8068849
TB067	493900	8068651
TB068	495002	8068549
TB069	505430	8068468
TB070	503904	8068254
TB071	503310	8068243
TB072	495803	8068203
TB073	500190	8068149
TB074	500030	8067880
TB075	498645	8067832
TB076	503414	8067780
TB077	495340	8067668
TB078	498219	8067535
TB079	504247	8067511
TB080	503542	8067420
TB081	499893	8067199
TB082	497569	8067109
TB083	495291	8067077
TB084	501349	8067066
TB085	507050	8067000
TB086	499200	8066998

APPENDIX E: LOCATIONS OF VEGETATION SURVEY QUADRATS ESTABLISHED BY MATTISKE IN THE THUNDERBIRD PROJECT AREA, JUNE 2016

Quadrat	Location (GDA94, Zone 51)	
	Easting (mE)	Northing (mN)
TB087	504821	8066933
TB088	506516	8066853
TB089	497156	8066800
TB090	504626	8066787
TB091	503478	8066764
TB092	500532	8066633
TB093	496602	8066602
TB094	502618	8066509
TB095	500252	8066446
TB096	504941	8066426
TB097	499202	8066303
TB098	503134	8066177
TB099	504349	8066171
TB100	497156	8066100
TB101	501550	8066100
TB102	504774	8066063
TB103	505804	8065988
TB104	505060	8065728
TB105	504282	8065662
TB106	501710	8065607
TB107	506948	8065596
TB108	506112	8065404
TB109	507996	8065362
TB110	505455	8065333
TB111	505741	8064851
TB112	505222	8064801
TB113	500822	8064800
TB114	506534	8064755
TB115	498450	8064740
TB116	503218	8064713
TB117	499587	8064704
TB118	506340	8064660
TB119	501468	8064631
TB120	504323	8064554
TB121	506779	8064550

Quadrat	Location (GDA94, Zone 51)	
	Easting (mE)	Northing (mN)
TB122	503009	8064490
TB123	500719	8064436
TB124	499626	8064352
TB125	501715	8064284
TB126	504603	8064155
TB127	502842	8064142
TB128	500342	8064136
TB129	506031	8063200
TB130	505951	8063100
TB131	506000	8061900
TB132	506748	8061554
TB133	506152	8061498
TB134	507898	8058832
TB135	508100	8057780
TB136	510122	8055501
TB137	510508	8055113
TB138	513148	8052699
TB139	511789	8052190
TB140	512281	8052180
TB141	513128	8051564
TB142	513606	8050948
TB143	512310	8050630
TB144	514650	8050502
TB145	511851	8050340
TB146	514021	8050337
TB147	514444	8050042
TB148	515453	8049943
TB149	512500	8049500
TB150	515012	8049496
TB151	511756	8049321
TB152	512370	8048600
TB153	512281	8047660
TB154	513196	8047660
TB155	511889	8047411

APPENDIX F: VASCULAR PLANT SPECIES RECORDED AT EACH SURVEY QUADRAT WITHIN THE THUNDERBIRD PROJECT AREA, JUNE 2016

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Abildgaardia schoenoides			x																												
Abutilon hannii																															
Acacia colei										x	x																				
Acacia hippuroides																								x	x					x	
Acacia monticola								x																x							
Acacia platycarpa				x			x				x			x												x		x	x		
Acacia plectocarpa subsp. *plectocarpa*					x					x																				x	x
Acacia stigmatophylla																															
Acacia tumida			x			x								x	x	x							x				x				
Acacia tumida var. *tumida*				x																x	x							x	x	x	
Acacia sp.																															
Aeschynomene indica																															
Alternanthera angustifolia																															
Amyema sp.																							x								
Aristida contorta				x					x					x	x	x														x	
Aristida holathera var. *holathera*							x			x				x						x					x				x		
Aristida holathera var. *latifolia*										x																x		x	x		
Aristida hygrometrica														x	x	x											x			x	
Aristida inaequiglumis					x							x					x		x							x			x		
Aristida sp.																															
Asteraceae sp.																							x					x			
Atalaya hemiglauca										x					x					x					x				x		x
Atalaya variifolia																x															
Atalaya sp.			x																												
Bauhinia cunninghamii	x			x	x	x	x		x	x	x	x		x	x		x			x					x	x	x	x	x	x	x	x
Bonamia linearis			x		x																					x					
Bonamia sp.									x																					x	
Brachychiton diversifolius subsp. *diversifolius*						x			x		x			x		x								x		x	x	x	x	x		x
Breynia cernua																															
Buchnera asperata																															
Buchnera ramosissima																															
Buchnera urticifolia								x																							
Byblis filifolia																															
Cajanus marmoratus																															
Calandrinia quadrivalvis																			x												
Calandrinia strophiolata																															
Calytrix exstipulata								x																							
Capparis lasiantha																															
Carissa lanceolata					x				x	x		x					x		x	x		x		x	x						x
Cassytha sp.																															
**Cenchrus ciliaris*																															
Chamaecrista symonii																															
Chrysopogon fallax						x		x												x			x	x	x			x	x		

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Chrysopogon pallidus	x	x					x		x					x		x		x												x	
Chrysopogon sp.				x						x			x																		
Cleome tetrandra var. *tetrandra*																															
Cleome viscosa		x																													
?*Clerodendrum floribundum*																															
Corchorus aestuans																															
Corchorus ?*incanus*																															
Corchorus pumilio		x	x	x										x	x	x						x	x				x			x	
Corchorus sidoides subsp. *vermicularis*					x												x									x					
Corchorus sp.																															
Corymbia dendromerinx		x				x		x			x		x		x					x			x				x			x	
Corymbia flavescens																															
Corymbia greeniana			x	x	x		x	x						x		x						x				x	x	x	x	x	
Corymbia ?*polycarpa*																															
Corymbia sp.																														x	
Corymbia zygophylla																					x					x				x	
Crotalaria brevis																															
Crotalaria ?*medicaginea*																															
Crotalaria ramosissima																												x			
Crotalaria sp.	x						x																								
Cullen balsamicum																															
Cullen sp.																															
Cymbopogon ambiguus																															
Cymbopogon bombycinus																															
Cymbopogon procerus								x																							
Cynanchum carnosum										x																					
Cyperaceae sp.																															
Cyperus carinatus																															
Cyperus conicus	x				x		x					x					x	x	x												
Cyperus ?*microcephalus*																															
Cyperus microcephalus subsp. *microcephalus*		x																													
Cyperus nervulosus																															
Cyperus tenuispica																															
Cyperus sp. A												x					x														
Cyperus sp. B										x																					
Dactyloctenium radulans																															
Denhamia cunninghamii					x																					x					
Desmodium brownii																		x													
Dicliptera armata						x							x																		
Digitaria brownii																															
Digitaria ctenantha											x							x													
Dodonaea hispidula var. *arida*				x	x									x	x	x						x				x	x		x	x	
Dolichandrone heterophylla				x	x	x			x			x		x	x	x	x		x						x	x	x	x	x	x		x

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Ectrosia schultzii	x						x				x							x														
Ehretia saligna																																
Ehretia saligna var. *saligna*										x																			x			
Eragrostis cumingii																			x													
Eragrostis eriopoda			x																													
Eragrostis tenellula																																
Eragrostis sp.																																
Eriachne ciliata																																
Eriachne melicacea														x		x															x	
Eriachne obtusa	x	x	x		x		x		x	x		x		x	x			x		x				x	x	x		x	x	x	x	x
Eriachne sulcata	x						x			x							x	x	x													
Eriachne sp. Dampier Peninsula (K. F. Kenneally 5946)		x				x								x									x				x				
Eriachne sp.																																
Erythrophleum chlorostachys			x	x										x	x	x					x					x		x	x	x		
Eucalyptus camaldulensis																																
Eucalyptus tectifica	x		x		x		x		x	x		x				x	x		x	x		x		x	x	x		x	x	x		x
Eucalyptus sp.		x																														
Eulalia aurea																																
Euphorbia hassallii																																
Euphorbia trigonosperma		x						x																			x					
Euphorbia ?*vaccaria*																																
Euphorbia sp.																																
Evolvulus alsinoides																																
Evolvulus alsinoides var. *decumbens*																											x					
Evolvulus alsinoides var. *villosicalyx*															x	x																
Evolvulus sp.																												x				
Ficus aculeata																																
Ficus platypoda																																
Fimbristylis dichotoma											x																					
Fimbristylis littoralis											x																					
Fimbristylis oxystachya																																
Fimbristylis tetragona																																
Flueggea virosa subsp. *melanthesoides*						x				x						x							x				x	x			
Galactia tenuiflora																																
Gardenia pyriformis subsp. *keartlandii*																												x				
Glycine tomentella		x											x				x					x	x						x		
Gomphrena affinis			x														x									x				x		
Gomphrena brachystylis subsp. *pindanensis*		x						x															x	x								
Gomphrena canescens subsp. *canescens*						x																	x					x	x			
Gomphrena flaccida		x						x						x																		
Gomphrena sp.													x																			
Goodenia scaevolina		x																				x			x		x				x	
Goodenia sepalosa var. *sepalosa*																																

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Gossypium australe																								x	x						x	
Grevillea pyramidalis subsp. *pyramidalis*		x		x	x	x							x		x	x				x		x	x	x	x	x	x		x	x	x
Grevillea refracta subsp. *refracta*		x		x												x					x						x					
Grevillea striata																																
Grevillea sp.																																
Gyrocarpus americanus																																x
Gyrocarpus americanus subsp. *pachyphyllus*																																
Hakea arborescens						x				x										x				x								
Hakea macrocarpa																										x				x		
Hakea sp.																															x	
Heliotropium diversifolium								x																			x					
Heliotropium glabellum																																
Heliotropium leptaleum																								x	x			x				
Heliotropium sp. A																																
Heliotropium sp. B																																
Heliotropium sp. C																																
Heteropogon contortus	x						x	x		x																						
Hibiscus geranioides																																
Hibiscus leptocladus																																
Hibiscus sp.																	x															
Hybanthus aurantiacus										x												x		x	x					x		
Hybanthus enneaspermus subsp. *enneaspermus*		x				x				x			x	x		x						x	x				x			x		
?*Hybanthus* sp.																																
Indigofera haplophylla																																
Indigofera linifolia								x																								
Indigofera linnaei																																
Indigofera sp.														x																		
Ipomoea coptica																																
Ipomoea muelleri			x																													
Ipomoea sp.																																
Iseilema ?*fragile*																																
Malvaceae sp.	x	x	x				x											x				x									x	
?*Marsdenia viridiflora*																																x
Melaleuca alsophila								x			x							x														
Melaleuca nervosa																																
Melaleuca viridiflora	x						x	x	x		x	x					x	x	x													
Melaleuca sp.																																
Melhania oblongifolia																																
Microstachys chamaelea			x	x	x									x	x	x					x	x					x	x	x		x	
Neptunia sp.																																
Panicum decompositum																																
Persoonia falcata				x						x															x					x		
?*Phyllanthus baccatus*					x																											

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Phyllanthus rhytidospermus																															
Phyllanthus sp.								x																							
Planchonia careya				x																											
Pluchea ?tetranthera												x																			
Poaceae sp.			x											x																x	x
Polycarpaea longiflora		x											x																		
Polygala tepperi																															
**Portulaca pilosa*																															
Proteaceae sp.									x					x																	
Pterocaulon intermedium (P3)																	x														
Pterocaulon paradoxum																															
Pterocaulon serrulatum var. *velutinum*																															
Pterocaulon sp.															x																
Ptilotus corymbosus		x											x									x									
Ptilotus fusiformis																															
Ptilotus lanatus					x												x														
Ptilotus nobilis subsp. *nobilis*										x																					
Ptilotus polystachyus																															
Ptilotus sp.																						x									
Rhynchosia minima																						x									
Santalum lanceolatum				x																											
Sehima nervosum										x																				x	
Senna costata																												x			
Senna notabilis																															
Setaria surgens											x																				
Sida rohlenae subsp. *occidentalis*										x				x		x				x				x	x			x			
Solanum cunninghamii																x						x						x			
Solanum dioicum																															
Solanum lucani																													x		
Solanum sp. A																															
Solanum sp. B																										x					
Sorghum ?plumosum												x																			
Sorghum plumosum			x	x		x			x				x							x	x		x	x					x		x
Sorghum timorense	x				x				x					x	x	x	x		x			x			x		x		x	x	
Spermacoce laevigata																															
Spermacoce occidentalis																						x						x			
Spermacoce sp.																															
Sporobolus actinocladus																															
Stemodia lathraia																	x														
Stemodia lythrifolia																															
?*Stemodia* sp.																x															
Streptoglossa ?odora																			x												
**Stylosanthes hamata*								x		x	x																				

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**Stylosanthes humilis*																																
**Stylosanthes scabra*																	x	x														
Tephrosia aff. croccea			x											x		x																
Tephrosia leptoclada																																
Tephrosia remotiflora	x							x							x							x										
Tephrosia sp. B Kimberley Flora (C.A. Gardner 7300)																																
Tephrosia sp. D Kimberley Flora (R.D. Royce 1848)																																
Tephrosia sp. F Kimberley Flora (B.R. Maslin 5139)																										x						
Tephrosia sp.		x																x										x				
Terminalia canescens	x	x		x		x	x	x	x	x			x	x	x	x	x		x	x			x		x		x		x	x	x	x
Terminalia volucris										x																						
Terminalia sp.																																
Tinospora smilacina											x																					
Trachymene didiscoides																						x										
Trianthema pilosum												x		x	x															x		
Tribulopis angustifolia																																
Trichodesma zeylanicum																																
Triodia ?bynoei																																
Triodia caelestialis (P3)	x	x	x			x			x				x		x	x						x	x			x	x	x	x	x	x	x
Triodia ?intermedia																																
Triodia schinzii				x	x							x		x					x		x											
Triodia "schinzii group"																				x					x							
Triodia sp.																																
Triumfetta albida		x						x																								
Triumfetta plumigera		x						x																								
Uraria lagopodioides							x										x			x					x							x
Urochloa piligera																																
Vachellia pachyphloia subsp. *brevipinnula*										x							x															
Velleia panduriformis																																
Ventilago viminalis												x	x			x													x			
Waltheria indica	x		x	x	x			x							x			x				x		x				x				
Wrightia saligna		x				x			x					x		x						x	x				x	x	x			
Xenostegia tridentata								x																								
Xerochloa barbata																																
Xerochloa laniflora																																
Xyris complanata	x																															
Yakirra australiensis					x																											
Zornia chaetophora																																
Zornia prostrata var. *prostrata*																																

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Abildgaardia schoenoides					x																				x							
Abutilon hannii																																
Acacia ?colei																																
Acacia hippuroides						x	x					x								x		x		x		x						x
Acacia monticola							x					x														x						
Acacia platycarpa		x	x							x	x		x	x	x	x	x		x		x					x			x	x	x	
Acacia plectocarpa subsp. *plectocarpa*			x				x													x		x					x					x
Acacia stigmatophylla				x														x					x									
Acacia ?tumida					x												x			x	x	x						x		x		
Acacia tumida var. *tumida*	x	x	x				x	x	x	x	x		x	x	x	x		x	x						x				x		x	x
Acacia sp.						x																		x								
Aeschynomene indica																																
Alternanthera angustifolia																																
Amyema sp.																																
Aristida contorta					x																x									x		x
Aristida holathera var. *holathera*						x					x		x			x	x			x												
Aristida holathera var. *latifolia*		x									x		x	x		x													x			
Aristida hygrometrica																											x					
Aristida ?inaequiglumis	x		x				x	x	x	x					x				x								x			x		
Aristida sp.																											x					
Asteraceae sp.							x				x																					
Atalaya hemiglauca				x		x							x					x					x	x								
Atalaya variifolia																				x	x	x								x		
Atalaya sp.																																
Bauhinia cunninghamii	x	x	x		x	x	x	x	x	x	x		x	x	x	x	x		x	x	x	x		x		x	x		x	x	x	
Bonamia linearis	x				x										x				x												x	x
Bonamia sp.														x																		
Brachychiton diversifolius subsp. *diversifolius*	x	x	x		x	x		x	x	x	x		x	x	x	x	x		x	x	x			x		x	x		x	x	x	x
Breynia cernua																																
Buchnera asperata																																
Buchnera ?ramosissima																																
Buchnera urticifolia																																
Byblis filifolia																																
Cajanus marmoratus																											x					
Calandrinia quadrivalvis																											x					
Calandrinia strophiolata																																
Calytrix exstipulata												x											x									
Capparis lasiantha																				x												
Carissa lanceolata	x					x	x					x		x						x		x		x					x			
Cassytha sp.																																
**Cenchrus ciliaris*				x																			x									
Chamaecrista symonii																															x	
Chrysopogon fallax		x				x					x			x		x													x	x		

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Chrysopogon pallidus																	x				x											
Chrysopogon sp.																																
Cleome tetrandra var. *tetrandra*																																
Cleome viscosa																																
?*Clerodendrum floribundum*						x								x		x																
Corchorus aestuans																																
Corchorus ?*incanus*																																
Corchorus pumilio					x								x	x			x			x		x						x		x		
Corchorus sidoides subsp. *vermicularis*	x						x			x		x			x			x	x						x	x						
Corchorus sp.																															x	
Corymbia dendromerinx				x			x	x										x	x	x			x			x		x				
Corymbia flavescens																											x					
Corymbia greeniana		x	x			x	x		x	x	x		x	x	x			x			x							x		x	x	
Corymbia ?*polycarpa*						x																										
Corymbia sp.																				x									x			
Corymbia zygophylla	x		x					x	x	x						x			x						x						x	
Crotalaria brevis																																
Crotalaria ?*medicaginea*																																
Crotalaria ramosissima																																
Crotalaria sp.																																
Cullen balsamicum																																
Cullen sp.																																
Cymbopogon ambiguus						x													x													
Cymbopogon bombycinus																				x												
Cymbopogon procerus				x																			x									
Cynanchum carnosum														x																		
Cyperaceae sp.																																
Cyperus carinatus																																
Cyperus ?*conicus*																																
Cyperus ?*microcephalus*																																
Cyperus microcephalus subsp. *microcephalus*																							x									
Cyperus nervulosus																																
Cyperus tenuispica																											x					
Cyperus sp. A																																
Cyperus sp. B																																
Dactyloctenium radulans		x																														
Denhamia cunninghamii							x																									
Desmodium brownii																															x	
Dicliptera armata																																
Digitaria brownii					x	x														x	x											
Digitaria ctenantha																											x					
Dodonaea hispidula var. *arida*	x	x	x				x	x	x	x	x	x		x	x	x	x	x	x		x					x		x	x	x	x	
Dolichandrone heterophylla		x	x				x			x			x			x	x	x			x	x		x				x		x		

APPENDIX F: VASCULAR PLANT SPECIES RECORDED AT EACH SURVEY QUADRAT WITHIN THE THUNDERBIRD PROJECT AREA, JUNE 2016

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Species	Quadrat Reference																															
	TB033	TB034	TB035	TB036	TB037	TB038	TB039	TB040	TB041	TB042	TB043	TB044	TB045	TB046	TB047	TB048	TB049	TB050	TB051	TB052	TB053	TB054	TB055	TB056	TB057	TB058	TB059	TB060	TB061	TB062	TB063	TB064
Ectrosia schultzii																																
?*Ehretia saligna*				x								x																				
Ehretia saligna var. *saligna*						x							x			x																
Eragrostis cumingii																											x					
Eragrostis eriopoda					x								x		x				x												x	
Eragrostis tenellula																																
Eragrostis sp.																												x				
Eriachne ciliata					x																											
Eriachne melicacea																																
Eriachne obtusa		x	x		x		x	x	x	x	x		x	x	x	x	x	x	x	x	x	x		x	x	x	x	x	x	x		x
Eriachne sulcata																																
Eriachne sp. Dampier Peninsula (K. F. Kenneally 5946)				x																			x									
Eriachne sp.																									x							
Erythrophleum chlorostachys	x		x		x		x	x	x	x	x		x	x	x	x	x		x		x				x			x	x	x	x	
Eucalyptus camaldulensis																																
Eucalyptus tectifica		x	x	x		x	x		x	x	x	x		x	x		x		x	x		x	x	x		x	x	x		x		x
Eucalyptus sp.																																
Eulalia aurea																																
Euphorbia hassallii																																
Euphorbia trigonosperma																																
Euphorbia ?*vaccaria*																															x	
Euphorbia sp.																		x												x		
Evolvulus alsinoides																																
Evolvulus alsinoides var. *decumbens*											x										x	x					x			x		
Evolvulus alsinoides var. *villosicalyx*																					x									x	x	
Evolvulus sp.																																
Ficus aculeata																																
Ficus platypoda																																
Fimbristylis dichotoma																																
Fimbristylis littoralis																																
Fimbristylis oxystachya																																
Fimbristylis tetragona																																
Flueggea virosa subsp. *melanthesoides*				x		x								x						x		x	x	x								
Galactia tenuiflora																																
Gardenia pyriformis subsp. *keartlandii*			x				x						x																	x		
Glycine tomentella	x			x	x		x		x	x					x				x													
Gomphrena affinis	x		x						x										x													
Gomphrena brachystylis subsp. *pindanensis*																							x									
Gomphrena canescens subsp. *canescens*		x		x							x			x																		
Gomphrena flaccida																							x									
Gomphrena sp.																																
Goodenia scaevolina												x																				
Goodenia sepalosa var. *sepalosa*																															x	

APPENDIX F: VASCULAR PLANT SPECIES RECORDED AT EACH SURVEY QUADRAT WITHIN THE THUNDERBIRD PROJECT AREA, JUNE 2016

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Gossypium australe																				x		x		x		x						
Grevillea pyramidalis subsp. *pyramidalis*	x	x		x		x	x	x		x	x	x	x	x	x	x		x		x	x	x	x	x		x				x		
Grevillea refracta subsp. *refracta*	x					x	x	x					x				x											x				
Grevillea striata																																
Grevillea sp.										x																						
Gyrocarpus americanus																				x												
Gyrocarpus americanus subsp. *pachyphyllus*																																
Hakea arborescens		x				x	x							x						x		x		x						x		x
Hakea macrocarpa	x		x							x												x										
Hakea sp.																																
Heliotropium diversifolium																																
Heliotropium glabellum																							x									
Heliotropium leptaleum		x				x															x								x			
Heliotropium sp. A																																
Heliotropium sp. B																																
Heliotropium sp. C												x																				
Heteropogon contortus																																
Hibiscus geranioides																																
Hibiscus leptocladus						x														x		x										
Hibiscus sp.																																
Hybanthus aurantiacus						x							x										x									
Hybanthus enneaspermus subsp. *enneaspermus*																				x												
?*Hybanthus* sp.												x						x								x						
Indigofera haplophylla												x																				
Indigofera linifolia																												x				
Indigofera linnaei																																
Indigofera sp.																																
Ipomoea coptica																																
Ipomoea muelleri																																
Ipomoea sp.																																
Iseilema ?*fragile*																																
Malvaceae sp.																	x									x						
?*Marsdenia viridiflora*																						x								x		
Melaleuca alsophila					x																											
Melaleuca nervosa																																x
Melaleuca viridiflora								x																x				x				
Melaleuca sp.																				x	x											
Melhania oblongifolia												x		x																		
Microstachys chamaelea	x	x			x	x	x						x		x						x				x					x		
Neptunia sp.																																
Panicum decompositum																																
Persoonia falcata		x							x		x				x				x									x	x			
?*Phyllanthus baccatus*							x																									

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Phyllanthus rhytidospermus							x		x		x																				
Phyllanthus sp.													x	x														x				
Planchonia careya																																
Pluchea ?tetranthera																						x			x							
Poaceae sp.																							x				x					
Polycarpaea longiflora																																
Polygala tepperi																																
**Portulaca pilosa*																																
Proteaceae sp.																																
Pterocaulon intermedium (P3)																				x		x										x
Pterocaulon paradoxum												x																				
Pterocaulon serrulatum var. *velutinum*																		x														
Pterocaulon sp.																																
Ptilotus corymbosus																																
Ptilotus fusiformis																																
Ptilotus lanatus																																
Ptilotus nobilis subsp. *nobilis*																																
Ptilotus polystachyus	x								x										x													
Ptilotus sp.																																
Rhynchosia minima																																
?*Santalum lanceolatum*																																
Sehima nervosum																				x		x									x	
Senna costata																			x													
Senna notabilis																																
Setaria surgens																																
Sida rohlenae subsp. *occidentalis*											x																x					
Solanum cunninghamii		x			x						x		x			x											x					
Solanum dioicum																																
Solanum lucani																																
Solanum sp. A																															x	
Solanum sp. B	x														x																	
Sorghum ?plumosum				x																												
Sorghum plumosum		x				x						x		x									x									
Sorghum timorense	x		x		x				x	x	x		x		x	x	x		x		x			x			x	x	x	x		x
Spermacoce laevigata																																
Spermacoce occidentalis																																
Spermacoce sp.																																
Sporobolus actinocladus																																
Stemodia lathraia		x											x	x																		
Stemodia lythrifolia																																
?*Stemodia* sp.																																
Streptoglossa ?odora																																
**Stylosanthes hamata*												x															x					

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**Stylosanthes humilis*																																
**Stylosanthes scabra*						x														x		x		x								x
Tephrosia aff. croccea					x		x																		x			x		x	x	
Tephrosia leptoclada						x	x																							x		
Tephrosia remotiflora						x					x							x							x							
Tephrosia sp. B Kimberley Flora (C.A. Gardner 7300)				x																												
Tephrosia sp. D Kimberley Flora (R.D. Royce 1848)																																
Tephrosia sp. F Kimberley Flora (B.R. Maslin 5139)																																
Tephrosia sp.		x				x																										
Terminalia canescens		x	x			x	x	x	x			x	x					x		x		x	x	x						x		
Terminalia volucris																																
Terminalia sp.																																
Tinospora smilacina		x												x																		
Trachymene didiscoides																																
Trianthema pilosum																																
Tribulopis angustifolia																											x					
?*Trichodesma zeylanicum*																																
Triodia ?*bynoei*																													x			
Triodia caelestialis (P3)	x	x	x	x	x	x		x		x	x	x	x	x	x	x		x	x	x			x	x		x		x	x	x		x
Triodia ?*intermedia*																																
Triodia schinzii							x		x	x					x	x	x				x										x	
Triodia "schinzii group"																									x							
Triodia sp.											x					x						x										
Triumfetta albida				x																			x									
Triumfetta plumigera																							x									
Uraria lagopodioides																	x				x							x				
Urochloa piligera																																
Vachellia pachyphloia subsp. *brevipinnula*																																
Velleia panduriformis																																
Ventilago viminalis						x												x			x									x		
Waltheria indica	x	x			x	x	x			x	x	x		x	x		x	x		x	x			x		x	x					
Wrightia saligna		x		x		x					x		x	x		x	x				x	x	x					x	x	x		
Xenostegia tridentata																																
Xerochloa barbata																																
Xerochloa laniflora																																
Xyris complanata																																
Yakirra australiensis																																
Zornia chaetophora																															x	
Zornia prostrata var. *prostrata*																											x					

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Abildgaardia schoenoides																																
Abutilon hannii							x																									
Acacia ?colei																																
Acacia hippuroides						x						x			x	x							x								
Acacia monticola							x		x			x				x							x								
Acacia platycarpa	x	x		x		x				x	x		x	x	x											x	x			x	
Acacia plectocarpa subsp. *plectocarpa*															x						x		x	x		x		x			
Acacia stigmatophylla																																
Acacia ?tumida	x	x			x					x	x		x	x												x	x			x	
Acacia tumida var. *tumida*						x						x				x	x	x	x	x	x	x		x	x			x	x		x	
Acacia sp.																																
Aeschynomene indica																																
Alternanthera angustifolia																																
Amyema sp.																																
Aristida contorta					x				x		x				x											x						
Aristida holathera var. *holathera*				x	x			x		x						x							x				x			x		
Aristida holathera var. *latifolia*		x		x				x					x						x	x					x			x			x	
Aristida hygrometrica	x																	x														
Aristida ?inaequiglumis																					x											
Aristida sp.																																
Asteraceae sp.	x							x					x																			
Atalaya hemiglauca									x							x		x									x					x
Atalaya variifolia																																
Atalaya sp.														x																		
Bauhinia cunninghamii	x	x	x		x	x		x				x	x	x	x	x	x	x	x		x	x	x				x	x	x		x	x
Bonamia linearis												x			x					x	x										x	
Bonamia sp.																																
Brachychiton diversifolius subsp. *diversifolius*			x	x	x	x		x		x	x		x	x	x	x		x	x	x	x	x	x	x	x	x	x	x	x		x	
Breynia cernua																																
Buchnera asperata							x																									
Buchnera ?ramosissima																																
Buchnera urticifolia			x																													
Byblis filifolia																																
Cajanus marmoratus																																
Calandrinia quadrivalvis																			x													x
Calandrinia strophiolata				x																												
Calytrix exstipulata							x					x																				
Capparis lasiantha																																
Carissa lanceolata			x						x			x				x			x						x				x			
Cassytha sp.																							x									
**Cenchrus ciliaris*							x																									
Chamaecrista symonii																																
Chrysopogon fallax	x	x		x				x		x				x		x		x												x		

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Chrysopogon pallidus																																
Chrysopogon sp.																						x					x					
Cleome tetrandra var. *tetrandra*																																
Cleome viscosa																																
?*Clerodendrum floribundum*																x																
Corchorus aestuans																																
Corchorus ?*incanus*																																
Corchorus pumilio		x		x	x	x		x		x	x		x		x	x		x											x		
Corchorus sidoides subsp. *vermicularis*																			x	x	x			x	x				x		x	
Corchorus sp.			x			x													x						x				x			
Corymbia dendromerinx			x				x	x	x			x				x				x		x		x								
Corymbia flavescens																																
Corymbia greeniana	x	x		x							x		x				x		x		x	x			x	x	x	x	x	x	x	
Corymbia ?*polycarpa*																																
Corymbia sp.																										x						
Corymbia zygophylla	x	x	x		x															x										x		
Crotalaria brevis						x																										
Crotalaria ?*medicaginea*																																
Crotalaria ramosissima																																
Crotalaria sp.																																
Cullen balsamicum																																
Cullen sp.																																
Cymbopogon ambiguus																x																
Cymbopogon bombycinus																																
Cymbopogon procerus							x					x																				
Cynanchum carnosum																										x						
Cyperaceae sp.																																
Cyperus carinatus																																
Cyperus ?*conicus*																																
Cyperus ?*microcephalus*							x																									
Cyperus microcephalus subsp. *microcephalus*																																
Cyperus nervulosus																																
Cyperus tenuispica																																
Cyperus sp. A																																
Cyperus sp. B																																
Dactyloctenium radulans																																
Denhamia cunninghamii																																
Desmodium brownii						x																										
Dicliptera armata																																
Digitaria brownii																x																
Digitaria ctenantha																																
Dodonaea hispidula var. *arida*		x	x					x	x	x	x	x	x			x			x	x						x	x		x	x	x	
Dolichandrone heterophylla		x			x		x			x		x	x	x		x						x										

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Ectrosia schultzii						x											x															x
?*Ehretia saligna*																																
Ehretia saligna var. *saligna*							x	x														x										
Eragrostis cumingii																																x
Eragrostis eriopoda				x	x																x					x				x		
Eragrostis tenellula																																
Eragrostis sp.																																
Eriachne ciliata																																x
Eriachne melicacea															x								x									
Eriachne obtusa	x	x	x	x		x	x	x	x	x	x	x	x	x	x	x	x	x		x	x	x	x	x	x	x	x	x		x		
Eriachne sulcata															x								x									x
Eriachne sp. Dampier Peninsula (K. F. Kenneally 5946)																																
Eriachne sp.																																
Erythrophleum chlorostachys	x	x	x	x	x			x			x		x						x	x		x			x	x	x		x	x		
Eucalyptus camaldulensis																																x
Eucalyptus tectifica							x			x		x		x	x	x	x	x	x					x				x				
Eucalyptus sp.																																
Eulalia aurea																																
Euphorbia hassallii																																
Euphorbia trigonosperma																																
Euphorbia ?*vaccaria*																																
Euphorbia sp.							x																									
Evolvulus alsinoides																																
Evolvulus alsinoides var. *decumbens*											x				x	x									x	x			x			
Evolvulus alsinoides var. *villosicalyx*					x																											
Evolvulus sp.																																
Ficus aculeata		x	x																										x			
Ficus platypoda							x																									
Fimbristylis dichotoma																																
Fimbristylis littoralis																																x
Fimbristylis oxystachya															x																	
Fimbristylis tetragona																																x
Flueggea virosa subsp. *melanthesoides*							x					x																				
Galactia tenuiflora							x																									
Gardenia pyriformis subsp. *keartlandii*	x	x																		x				x	x			x				
Glycine tomentella			x																x						x							
Gomphrena affinis																			x													
Gomphrena brachystylis subsp. *pindanensis*																																
Gomphrena canescens subsp. *canescens*																																
Gomphrena flaccida							x																									
Gomphrena sp.																																
Goodenia scaevolina																							x									
Goodenia sepalosa var. *sepalosa*																																

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Gossypium australe			x												x	x																
Grevillea pyramidalis subsp. *pyramidalis*	x	x	x						x					x		x		x		x				x					x	x		
Grevillea refracta subsp. *refracta*		x	x	x	x			x			x		x			x			x	x	x			x	x				x	x		
Grevillea striata								x																								
Grevillea sp.								x					x																			
Gyrocarpus americanus																																
Gyrocarpus americanus subsp. *pachyphyllus*																																
Hakea arborescens		x		x								x	x									x									
Hakea macrocarpa																											x					
Hakea sp.																							x									
Heliotropium diversifolium															x																	
Heliotropium glabellum							x		x							x																
Heliotropium leptaleum																																
Heliotropium sp. A						x																										
Heliotropium sp. B																																
Heliotropium sp. C																																
Heteropogon contortus																																
Hibiscus geranioides							x																									
Hibiscus leptocladus																x														x		
Hibiscus sp.																																
Hybanthus aurantiacus																x																
Hybanthus enneaspermus subsp. *enneaspermus*									x																							
?*Hybanthus* sp.																																
Indigofera haplophylla																																
Indigofera linifolia																																
Indigofera linnaei																																
Indigofera sp.																											x					
Ipomoea coptica																																
Ipomoea muelleri																																
Ipomoea sp.																																
Iseilema ?*fragile*																							x									
Malvaceae sp.					x	x																	x							x		
?*Marsdenia viridiflora*																																
Melaleuca alsophila																																x
Melaleuca nervosa																																
Melaleuca viridiflora															x		x						x					x				
Melaleuca sp.						x				x								x					x									
Melhania oblongifolia							x					x																				
Microstachys chamaelea		x	x	x	x			x	x	x		x	x						x	x	x				x				x	x		
Neptunia sp.																																
Panicum decompositum												x																				
Persoonia falcata			x																x						x							
?*Phyllanthus baccatus*																																

APPENDIX F: VASCULAR PLANT SPECIES RECORDED AT EACH SURVEY QUADRAT WITHIN THE THUNDERBIRD PROJECT AREA, JUNE 2016

Note - * denotes an introduced species; P1 - P5 denotes prioirty taxon (DPaW 2016g)

Species	Quadrat Reference																															
	TB065	TB066	TB067	TB068	TB069	TB070	TB071	TB072	TB073	TB074	TB075	TB076	TB077	TB078	TB079	TB080	TB081	TB082	TB083	TB084	TB085	TB086	TB087	TB088	TB089	TB090	TB091	TB092	TB093	TB094	TB095	TB096
Phyllanthus rhytidospermus																											x					
Phyllanthus sp.																																
Planchonia careya	x			x		x																										
Pluchea ?tetranthera																																
Poaceae sp.																																
Polycarpaea longiflora							x																									
Polygala tepperi		x											x																			
**Portulaca pilosa*																																
Proteaceae sp.																																
Pterocaulon intermedium (P3)																																
Pterocaulon paradoxum												x									x			x							
Pterocaulon serrulatum var. *velutinum*																																
Pterocaulon sp.																																
Ptilotus corymbosus							x																									
Ptilotus fusiformis		x																														
Ptilotus lanatus					x																				x							
Ptilotus nobilis subsp. *nobilis*																																
Ptilotus polystachyus			x	x															x						x				x			
Ptilotus sp.																																
Rhynchosia minima													x																			
?*Santalum lanceolatum*																																
Sehima nervosum																	x	x				x										
Senna costata	x																			x	x											
Senna notabilis																																
Setaria surgens																																
Sida rohlenae subsp. *occidentalis*				x						x					x															x		
Solanum cunninghamii	x	x		x	x								x																			
Solanum dioicum																																
Solanum lucani																																
Solanum sp. A																																
Solanum sp. B																					x								x		x	
Sorghum ?plumosum																					x			x							x	
Sorghum plumosum				x				x	x				x										x									
Sorghum timorense	x	x	x		x	x	x			x	x	x			x	x			x	x			x		x	x	x	x	x			
Spermacoce laevigata																																
Spermacoce occidentalis																					x											
Spermacoce sp.																																
Sporobolus actinocladus																																
Stemodia lathraia		x				x												x														
Stemodia lythrifolia																																
?*Stemodia* sp.																																
Streptoglossa ?odora																																
**Stylosanthes hamata*							x					x									x											

APPENDIX F: VASCULAR PLANT SPECIES RECORDED AT EACH SURVEY QUADRAT WITHIN THE THUNDERBIRD PROJECT AREA, JUNE 2016

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**Stylosanthes humilis*																																
**Stylosanthes scabra*															x								x									
Tephrosia aff. croccea												x	x								x									x		
Tephrosia leptoclada							x									x																
Tephrosia remotiflora		x							x							x																
Tephrosia sp. B Kimberley Flora (C.A. Gardner 7300)																																
Tephrosia sp. D Kimberley Flora (R.D. Royce 1848)																																
Tephrosia sp. F Kimberley Flora (B.R. Maslin 5139)																																
Tephrosia sp.						x										x																
Terminalia canescens									x			x			x				x	x										x		
Terminalia volucris																																
Terminalia sp.					x											x																
Tinospora smilacina			x				x																									x
Trachymene didiscoides																																
Trianthema pilosum	x	x																														
Tribulopis angustifolia																																
?*Trichodesma zeylanicum*					x																											
Triodia ?*bynoei*																																
Triodia caelestialis (P3)	x								x	x				x	x	x	x	x		x		x	x			x	x					
Triodia ?*intermedia*																																
Triodia schinzii			x		x			x			x								x		x			x				x	x		x	
Triodia "schinzii group"																																
Triodia sp.		x		x		x							x										x								
Triumfetta albida							x																									
Triumfetta plumigera							x																									
Uraria lagopodioides									x	x																						
Urochloa piligera																																
Vachellia pachyphloia subsp. *brevipinnula*																																
Velleia panduriformis																																
Ventilago viminalis																																
Waltheria indica					x	x			x	x	x	x			x	x	x	x		x	x		x			x			x	x		x
Wrightia saligna	x								x	x	x		x																			
Xenostegia tridentata																																
Xerochloa barbata																							x									
Xerochloa laniflora																																x
Xyris complanata																																
Yakirra australiensis				x																												
Zornia chaetophora																																
Zornia prostrata var. *prostrata*																																

APPENDIX F: VASCULAR PLANT SPECIES RECORDED AT EACH SURVEY QUADRAT WITHIN THE THUNDERBIRD PROJECT AREA, JUNE 2016

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Species	Quadrat Reference																														
	TB097	TB098	TB099	TB100	TB101	TB102	TB103	TB104	TB105	TB106	TB107	TB108	TB109	TB110	TB111	TB112	TB113	TB114	TB115	TB116	TB117	TB118	TB119	TB120	TB121	TB122	TB123	TB124	TB125	TB126	TB127	TB128
Abildgaardia schoenoides																																
Abutilon hannii																																
Acacia ?colei	x									x																			x			
Acacia hippuroides																										x						
Acacia monticola		x	x													x								x	x					x		
Acacia platycarpa				x							x											x		x								x
Acacia plectocarpa subsp. *plectocarpa*							x																									
Acacia stigmatophylla																																
Acacia ?tumida																											x				x	x
Acacia tumida var. *tumida*				x	x		x	x			x	x	x	x	x		x	x	x		x	x								x		
Acacia sp.										x																		x				x
Aeschynomene indica																				x												
Alternanthera angustifolia																							x									
Amyema sp.		x																						x								
Aristida contorta		x	x			x											x									x	x					
Aristida holathera var. *holathera*	x									x																				x		
Aristida holathera var. *latifolia*				x	x																											
Aristida hygrometrica												x	x		x			x			x									x		
Aristida ?inaequiglumis												x	x		x				x		x	x								x		
Aristida sp.																			x			x										
Asteraceae sp.																																
Atalaya hemiglauca	x	x								x								x		x		x			x		x					
Atalaya variifolia						x																					x				x	
Atalaya sp.																																
Bauhinia cunninghamii	x				x	x	x		x	x	x	x	x						x	x	x	x	x	x		x	x	x	x			x
Bonamia linearis				x			x				x				x																	
Bonamia sp.			x																												x	
Brachychiton diversifolius subsp. *diversifolius*	x		x		x		x	x		x	x		x	x	x				x		x	x				x	x	x	x	x		x
Breynia cernua																	x															
Buchnera asperata																x																
Buchnera ?ramosissima																		x														
Buchnera urticifolia																																
Byblis filifolia												x																				
Cajanus marmoratus																																
Calandrinia quadrivalvis									x										x	x												
Calandrinia strophiolata							x								x																	
Calytrix exstipulata																								x	x	x					x	
Capparis lasiantha																							x									
Carissa lanceolata			x		x	x			x	x									x		x		x				x	x	x			
Cassytha sp.		x																x									x					
**Cenchrus ciliaris*																		x														
Chamaecrista symonii							x					x																		x		
Chrysopogon fallax		x		x						x					x			x			x		x			x	x	x		x	x	x

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Chrysopogon pallidus																																
Chrysopogon sp.								x						x																		
Cleome tetrandra var. *tetrandra*																																
Cleome viscosa																x		x														
?*Clerodendrum floribundum*																					x										x	
Corchorus aestuans																																
Corchorus ?*incanus*																x								x	x							
Corchorus pumilio				x							x				x		x				x					x					x	
Corchorus sidoides subsp. *vermicularis*			x				x	x						x								x		x							x	
Corchorus sp.																			x						x							
Corymbia dendromerinx		x			x					x						x		x	x			x		x	x						x	
Corymbia flavescens																																
Corymbia greeniana			x	x	x		x	x			x	x		x	x							x								x		x
Corymbia ?*polycarpa*																																
Corymbia sp.																																x
Corymbia zygophylla								x			x	x	x		x															x		
Crotalaria brevis																																
Crotalaria ?*medicaginea*							x																									
Crotalaria ramosissima																				x												
Crotalaria sp.																																
Cullen balsamicum																																
Cullen sp.																																
Cymbopogon ambiguus																																
Cymbopogon bombycinus																																
Cymbopogon procerus																		x														
Cynanchum carnosum														x		x					x											
Cyperaceae sp.																				x												
Cyperus carinatus																							x									
Cyperus ?*conicus*																																
Cyperus ?*microcephalus*																x																
Cyperus microcephalus subsp. *microcephalus*		x																x														
Cyperus nervulosus																				x												
Cyperus tenuispica																																
Cyperus sp. A																																
Cyperus sp. B																																
Dactyloctenium radulans																																
Denhamia cunninghamii																								x								
Desmodium brownii																																
Dicliptera armata														x																	x	
Digitaria brownii																										x					x	
Digitaria ctenantha																				x			x									
Dodonaea hispidula var. *arida*				x	x														x												x	
Dolichandrone heterophylla	x									x	x							x								x	x					x

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Ectrosia schultzii																	x			x			x									
?*Ehretia saligna*																																
Ehretia saligna var. *saligna*				x						x																						
Eragrostis cumingii																				x			x									
Eragrostis eriopoda					x		x				x		x	x	x						x	x								x		x
Eragrostis tenellula																																
Eragrostis sp.																																
Eriachne ciliata																																
Eriachne melicacea																																
Eriachne obtusa		x	x	x		x	x	x	x	x	x		x	x	x	x	x	x	x		x	x		x		x	x	x	x	x		x
Eriachne sulcata			x																	x												
Eriachne sp. Dampier Peninsula (K. F. Kenneally 5946)																									x							
Eriachne sp.																																
Erythrophleum chlorostachys				x	x		x				x	x	x	x	x				x			x				x				x		
Eucalyptus camaldulensis																																
Eucalyptus tectifica	x	x				x				x						x										x	x	x	x			
Eucalyptus sp.																		x														
Eulalia aurea																				x												
Euphorbia hassallii																x								x								
Euphorbia trigonosperma							x	x					x		x					x	x		x							x		
Euphorbia ?*vaccaria*							x												x	x			x									
Euphorbia sp.																x																
Evolvulus alsinoides																																
Evolvulus alsinoides var. *decumbens*			x																							x	x			x		
Evolvulus alsinoides var. *villosicalyx*								x						x					x											x		
Evolvulus sp.																																
Ficus aculeata																																
Ficus platypoda																																
Fimbristylis dichotoma																				x												
Fimbristylis littoralis																				x			x									
Fimbristylis oxystachya																																
Fimbristylis tetragona																				x												
Flueggea virosa subsp. *melanthesoides*																		x								x				x		
Galactia tenuiflora																x									x							
Gardenia pyriformis subsp. *keartlandii*																								x						x		
Glycine tomentella					x													x						x								
Gomphrena affinis																								x	x							
Gomphrena brachystylis subsp. *pindanensis*		x																								x				x		
Gomphrena canescens subsp. *canescens*																																
Gomphrena flaccida																				x												
Gomphrena sp.																																
Goodenia scaevolina																						x										
Goodenia sepalosa var. *sepalosa*							x	x											x													

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Gossypium australe																						x										
Grevillea pyramidalis subsp. *pyramidalis*		x	x							x			x			x		x				x		x	x	x				x	x	
Grevillea refracta subsp. *refracta*		x		x						x			x					x				x										
Grevillea striata																													x			
Grevillea sp.																																x
Gyrocarpus americanus																																
Gyrocarpus americanus subsp. *pachyphyllus*													x																			
Hakea arborescens	x			x		x				x																x	x		x			
Hakea macrocarpa																								x								
Hakea sp.																																
Heliotropium diversifolium																																
Heliotropium glabellum		x																						x	x							
Heliotropium leptaleum											x																					
Heliotropium sp. A																																
Heliotropium sp. B																																
Heliotropium sp. C																					x											
Heteropogon contortus																																
Hibiscus geranioides																																
Hibiscus leptocladus																								x							x	
Hibiscus sp.										x																						
Hybanthus aurantiacus			x															x														
Hybanthus enneaspermus subsp. *enneaspermus*																									x						x	
?*Hybanthus* sp.																																
Indigofera haplophylla		x														x															x	
Indigofera linifolia																																
Indigofera linnaei																																
Indigofera sp.																																
Ipomoea coptica																							x									
Ipomoea muelleri																																
Ipomoea sp.													x																			
Iseilema ?*fragile*																																
Malvaceae sp.																		x									x					
?*Marsdenia viridiflora*																		x														
Melaleuca alsophila																					x											
Melaleuca nervosa	x							x																								
Melaleuca viridiflora			x			x	x		x												x		x			x	x					
Melaleuca sp.													x																			
Melhania oblongifolia																																
Microstachys chamaelea				x							x	x	x					x				x								x		
Neptunia sp.									x																							
Panicum decompositum																																
Persoonia falcata				x																												
?*Phyllanthus baccatus*																																

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Phyllanthus rhytidospermus					x																											
Phyllanthus sp.																																
Planchonia careya										x					x																	
Pluchea ?tetranthera																																
Poaceae sp.																				x												
Polycarpaea longiflora																		x														
Polygala tepperi							x					x																				
**Portulaca pilosa*																																
Proteaceae sp.																																
Pterocaulon intermedium (P3)																						x										
Pterocaulon paradoxum												x																				
Pterocaulon serrulatum var. *velutinum*																																
Pterocaulon sp.																																
Ptilotus corymbosus																x		x				x		x							x	
Ptilotus fusiformis																																
Ptilotus lanatus																																
Ptilotus nobilis subsp. *nobilis*																																
Ptilotus polystachyus																						x										
Ptilotus sp.																																
Rhynchosia minima																																
?*Santalum lanceolatum*																																
Sehima nervosum	x			x						x																		x				
Senna costata													x											x								
Senna notabilis																																
Setaria surgens									x							x		x		x			x		x							
Sida rohlenae subsp. *occidentalis*												x	x		x						x			x						x	x	
Solanum cunninghamii													x											x								
Solanum dioicum																																
Solanum lucani																																
Solanum sp. A																			x													
Solanum sp. B							x																									
Sorghum ?plumosum																						x		x	x							
Sorghum plumosum											x	x	x	x	x	x		x														
Sorghum timorense					x		x																								x	
Spermacoce laevigata							x																									
Spermacoce occidentalis								x				x	x																			
Spermacoce sp.																																
Sporobolus actinocladus																																
Stemodia lathraia																																
Stemodia lythrifolia												x																				
?*Stemodia* sp.																																
Streptoglossa ?odora																																
**Stylosanthes hamata*																							x									

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**Stylosanthes humilis*																				x												
**Stylosanthes scabra*																																
Tephrosia aff. croccea							x					x		x	x															x		
Tephrosia leptoclada		x																								x					x	
Tephrosia remotiflora													x			x		x						x							x	
Tephrosia sp. B Kimberley Flora (C.A. Gardner 7300)																																
Tephrosia sp. D Kimberley Flora (R.D. Royce 1848)																																x
Tephrosia sp. F Kimberley Flora (B.R. Maslin 5139)					x																											
Tephrosia sp.		x																							x							
Terminalia canescens		x	x							x						x		x				x		x	x	x			x		x	
Terminalia volucris																																
Terminalia sp.																																
Tinospora smilacina							x								x										x							
Trachymene didiscoides																																
Trianthema pilosum								x							x																	
Tribulopis angustifolia																																
?*Trichodesma zeylanicum*																																
Triodia ?*bynoei*																																
Triodia caelestialis (P3)	x	x	x			x				x						x		x						x		x	x	x			x	x
Triodia ?*intermedia*																																
Triodia schinzii				x			x	x			x	x	x	x							x				x							
Triodia "schinzii group"																													x			
Triodia sp.															x				x											x		
Triumfetta albida		x																														
Triumfetta plumigera		x																														
Uraria lagopodioides																																
Urochloa piligera																				x			x									
Vachellia pachyphloia subsp. *brevipinnula*																																
Velleia panduriformis																																
Ventilago viminalis																	x												x			
Waltheria indica			x		x		x			x	x		x	x		x	x			x	x	x		x	x	x				x	x	x
Wrightia saligna																		x							x							
Xenostegia tridentata																																
Xerochloa barbata																																
Xerochloa laniflora									x																							
Xyris complanata																																
Yakirra australiensis															x				x	x												
Zornia chaetophora								x				x							x													
Zornia prostrata var. *prostrata*																																

APPENDIX F: VASCULAR PLANT SPECIES RECORDED AT EACH SURVEY QUADRAT WITHIN THE THUNDERBIRD PROJECT AREA, JUNE 2016

Note - * denotes an introduced species; P1 - P5 denotes prioirty taxon (DPaW 2016g)

Species	Quadrat Reference																									
	TB129	TB130	TB131	TB132	TB133	TB134	TB135	TB136	TB137	TB138	TB139	TB140	TB141	TB142	TB143	TB144	TB145	TB146	TB147	TB148	TB149	TB150	TB151	TB152	TB153	TB154	TB155
Abildgaardia schoenoides																											
Abutilon hannii																											
Acacia ?colei																				x		x					
Acacia hippuroides																											
Acacia monticola				x																							
Acacia platycarpa				x	x			x	x		x		x					x					x			x	
Acacia plectocarpa subsp. *plectocarpa*														x		x			x	x	x						
Acacia stigmatophylla																											
Acacia ?tumida	x	x				x	x				x	x			x		x						x	x	x		x
Acacia tumida var. *tumida*					x			x	x	x			x	x				x								x		
Acacia sp.																											
Aeschynomene indica																											
Alternanthera angustifolia																											
Amyema sp.																											
Aristida contorta						x					x	x					x				x		x	x	x		x
Aristida holathera var. *holathera*			x					x					x						x							x		
Aristida holathera var. *latifolia*			x		x									x		x		x		x		x						
Aristida hygrometrica													x														
Aristida ?inaequiglumis				x																							
Aristida sp.																											
Asteraceae sp.								x		x																	
Atalaya hemiglauca																						x					
Atalaya variifolia											x																
Atalaya sp.							x								x												
Bauhinia cunninghamii		x	x			x		x	x	x	x	x	x	x	x		x	x	x	x	x	x	x	x	x	x	x
Bonamia linearis			x	x			x		x		x														x	x		
Bonamia sp.																											
Brachychiton diversifolius subsp. *diversifolius*		x		x		x		x	x	x	x	x	x	x			x	x			x		x		x	x	x
Breynia cernua																											
Buchnera asperata																											
Buchnera ?ramosissima																											
Buchnera urticifolia	x																										
Byblis filifolia																											
Cajanus marmoratus															x						x						
Calandrinia quadrivalvis					x							x				x		x									
Calandrinia strophiolata													x						x								
Calytrix exstipulata	x																										
Capparis lasiantha																											
Carissa lanceolata																						x					
Cassytha sp.	x																										
**Cenchrus ciliaris*																											
Chamaecrista symonii			x																								
Chrysopogon fallax		x	x		x	x	x	x		x		x	x		x				x		x	x		x			x

APPENDIX F: VASCULAR PLANT SPECIES RECORDED AT EACH SURVEY QUADRAT WITHIN THE THUNDERBIRD PROJECT AREA, JUNE 2016

Note - * denotes an introduced species; P1 - P5 denotes prioirty taxon (DPaW 2016g)

Species	Quadrat Reference																										
	TB129	TB130	TB131	TB132	TB133	TB134	TB135	TB136	TB137	TB138	TB139	TB140	TB141	TB142	TB143	TB144	TB145	TB146	TB147	TB148	TB149	TB150	TB151	TB152	TB153	TB154	TB155
Chrysopogon pallidus																	x						x		x		
Chrysopogon sp.																											
Cleome tetrandra var. *tetrandra*								x																			
Cleome viscosa																											
?*Clerodendrum floribundum*																											
Corchorus aestuans																x											
Corchorus ?*incanus*																											
Corchorus pumilio		x				x	x			x							x	x						x	x		
Corchorus sidoides subsp. *vermicularis*				x																							
Corchorus sp.									x																		
Corymbia dendromerinx	x	x		x							x			x							x		x				
Corymbia flavescens																			x								
Corymbia greeniana					x	x	x	x		x		x	x		x		x	x	x				x	x	x	x	x
Corymbia ?*polycarpa*																											
Corymbia sp.																	x										
Corymbia zygophylla								x	x	x					x			x								x	x
Crotalaria brevis																											
Crotalaria ?*medicaginea*																											
Crotalaria ramosissima												x			x												
Crotalaria sp.																											
Cullen balsamicum																	x										
Cullen sp.																				x							
Cymbopogon ambiguus																											
Cymbopogon bombycinus																											
Cymbopogon procerus																											
Cynanchum carnosum																											
Cyperaceae sp.																											
Cyperus carinatus																											
Cyperus ?*conicus*																	x										
Cyperus ?*microcephalus*																											
Cyperus microcephalus subsp. *microcephalus*	x																										
Cyperus nervulosus																											
Cyperus tenuispica																											
Cyperus sp. A																											
Cyperus sp. B																											
Dactyloctenium radulans																x											
Denhamia cunninghamii																											
Desmodium brownii																x											
Dicliptera armata	x																										
Digitaria brownii																											
Digitaria ctenantha																x											
Dodonaea hispidula var. *arida*		x		x			x	x		x								x						x			
Dolichandrone heterophylla			x	x		x	x			x	x	x	x	x	x		x	x					x	x		x	x

APPENDIX F: VASCULAR PLANT SPECIES RECORDED AT EACH SURVEY QUADRAT WITHIN THE THUNDERBIRD PROJECT AREA, JUNE 2016

Note - * denotes an introduced species; P1 - P5 denotes prioirty taxon (DPaW 2016g)

Species	Quadrat Reference																									
	TB129	TB130	TB131	TB132	TB133	TB134	TB135	TB136	TB137	TB138	TB139	TB140	TB141	TB142	TB143	TB144	TB145	TB146	TB147	TB148	TB149	TB150	TB151	TB152	TB153	TB154	TB155
Ectrosia schultzii																											
?*Ehretia saligna*																											
Ehretia saligna var. *saligna*																											
Eragrostis cumingii																											
Eragrostis eriopoda						x			x	x				x			x	x					x	x	x	x	
Eragrostis tenellula																						x					
Eragrostis sp.		x					x																				
Eriachne ciliata																											
Eriachne melicacea																											
Eriachne obtusa		x	x	x	x	x		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Eriachne sulcata																											
Eriachne sp. Dampier Peninsula (K. F. Kenneally 5946)																								x	x		
Eriachne sp.																											
Erythrophleum chlorostachys		x	x	x	x	x	x	x	x		x	x			x		x						x	x	x		x
Eucalyptus camaldulensis																											
Eucalyptus tectifica		x	x	x		x			x					x		x			x	x	x	x					
Eucalyptus sp.																											
Eulalia aurea																											
Euphorbia hassallii																											
Euphorbia trigonosperma											x								x					x			
Euphorbia ?*vaccaria*					x				x							x		x									
Euphorbia sp.	x																			x							
Evolvulus alsinoides																	x										
Evolvulus alsinoides var. *decumbens*												x			x												
Evolvulus alsinoides var. *villosicalyx*		x				x	x	x		x			x			x		x	x							x	
Evolvulus sp.																											
Ficus aculeata																											
Ficus platypoda																											
Fimbristylis dichotoma																											
Fimbristylis littoralis																											
Fimbristylis oxystachya																											
Fimbristylis tetragona																											
Flueggea virosa subsp. *melanthesoides*																											
Galactia tenuiflora																											
Gardenia pyriformis subsp. *keartlandii*			x	x			x					x		x			x							x	x	x	
Glycine tomentella	x								x																		
Gomphrena affinis																											
Gomphrena brachystylis subsp. *pindanensis*	x																					x					
Gomphrena canescens subsp. *canescens*																											
Gomphrena flaccida																											
Gomphrena sp.																x											
Goodenia scaevolina																											
Goodenia sepalosa var. *sepalosa*																x		x									

APPENDIX F: VASCULAR PLANT SPECIES RECORDED AT EACH SURVEY QUADRAT WITHIN THE THUNDERBIRD PROJECT AREA, JUNE 2016

Note - * denotes an introduced species; P1 - P5 denotes prioirty taxon (DPaW 2016g)

Species	Quadrat Reference																									
	TB129	TB130	TB131	TB132	TB133	TB134	TB135	TB136	TB137	TB138	TB139	TB140	TB141	TB142	TB143	TB144	TB145	TB146	TB147	TB148	TB149	TB150	TB151	TB152	TB153	TB154	TB155
Gossypium australe																											
Grevillea pyramidalis subsp. *pyramidalis*			x	x			x		x	x			x			x				x	x			x		x	
Grevillea refracta subsp. *refracta*				x	x	x	x					x			x					x							x
Grevillea striata																											
Grevillea sp.																											
Gyrocarpus americanus																											
Gyrocarpus americanus subsp. *pachyphyllus*																											
Hakea arborescens														x													
Hakea macrocarpa																		x									
Hakea sp.																											
Heliotropium diversifolium																											
Heliotropium glabellum														x													
Heliotropium leptaleum			x																								
Heliotropium sp. A												x															
Heliotropium sp. B					x			x																			
Heliotropium sp. C																											
Heteropogon contortus																											
Hibiscus geranioides																											
Hibiscus leptocladus										x																	
Hibiscus sp.																											
Hybanthus aurantiacus		x																	x								
Hybanthus enneaspermus subsp. *enneaspermus*																											
?*Hybanthus* sp.																											
Indigofera haplophylla																											
Indigofera linifolia																x											
Indigofera linnaei																x											
Indigofera sp.						x														x						x	
Ipomoea coptica																x											
Ipomoea muelleri																											
Ipomoea sp.																											
Iseilema ?*fragile*																											
Malvaceae sp.													x														
?*Marsdenia viridiflora*																										x	
Melaleuca alsophila																				x	x						
Melaleuca nervosa																											
Melaleuca viridiflora																											
Melaleuca sp.																				x							
Melhania oblongifolia																											
Microstachys chamaelea		x		x		x		x	x	x		x			x		x									x	
Neptunia sp.																											
Panicum decompositum																											
Persoonia falcata															x							x					
?*Phyllanthus baccatus*																											

APPENDIX F: VASCULAR PLANT SPECIES RECORDED AT EACH SURVEY QUADRAT WITHIN THE THUNDERBIRD PROJECT AREA, JUNE 2016

Note - * denotes an introduced species; P1 - P5 denotes prioirty taxon (DPaW 2016g)

Species	Quadrat Reference																									
	TB129	TB130	TB131	TB132	TB133	TB134	TB135	TB136	TB137	TB138	TB139	TB140	TB141	TB142	TB143	TB144	TB145	TB146	TB147	TB148	TB149	TB150	TB151	TB152	TB153	TB154	TB155
Phyllanthus rhytidospermus								x																			
Phyllanthus sp.																											
Planchonia careya										x			x													x	
Pluchea ?tetranthera																											
Poaceae sp.																				x							
Polycarpaea longiflora	x																										
Polygala tepperi																			x								
**Portulaca pilosa*																											
Proteaceae sp.																											
Pterocaulon intermedium (P3)														x						x							
Pterocaulon paradoxum																											
Pterocaulon serrulatum var. *velutinum*																											
Pterocaulon sp.																											
Ptilotus corymbosus	x																										
Ptilotus fusiformis																											
Ptilotus lanatus								x						x													
Ptilotus nobilis subsp. *nobilis*																											
Ptilotus polystachyus					x	x	x				x														x		
Ptilotus sp.																											
Rhynchosia minima																											
?*Santalum lanceolatum*																											
Sehima nervosum																				x			x			x	
Senna costata												x	x				x	x							x		
Senna notabilis									x																		
Setaria surgens																											
Sida rohlenae subsp. *occidentalis*								x		x			x						x			x					
Solanum cunninghamii					x		x	x		x	x	x	x		x				x		x			x			x
Solanum dioicum																x								x			
Solanum lucani																		x									
Solanum sp. A																											
Solanum sp. B																											
Sorghum ?plumosum																				x							
Sorghum plumosum		x								x					x									x			x
Sorghum timorense	x		x	x	x	x	x	x	x		x	x	x	x			x	x	x		x		x		x		
Spermacoce laevigata																											
Spermacoce occidentalis													x					x									
Spermacoce sp.																									x		
Sporobolus actinocladus																						x					
Stemodia lathraia														x													
Stemodia lythrifolia																											
?*Stemodia* sp.																											
Streptoglossa ?odora																											
**Stylosanthes hamata*														x		x						x					

APPENDIX F: VASCULAR PLANT SPECIES RECORDED AT EACH SURVEY QUADRAT WITHIN THE THUNDERBIRD PROJECT AREA, JUNE 2016

Note - * denotes an introduced species; P1 - P5 denotes prioirty taxon (DPaW 2016g)

Species	Quadrat Reference																										
	TB129	TB130	TB131	TB132	TB133	TB134	TB135	TB136	TB137	TB138	TB139	TB140	TB141	TB142	TB143	TB144	TB145	TB146	TB147	TB148	TB149	TB150	TB151	TB152	TB153	TB154	TB155
Species																											
Quadrat Reference																											
**Stylosanthes humilis*																											
**Stylosanthes scabra*																											
Tephrosia aff. croccea													x					x									
Tephrosia leptoclada	x		x											x					x				x	x			
Tephrosia remotiflora																	x										
Tephrosia sp. B Kimberley Flora (C.A. Gardner 7300)																											
Tephrosia sp. D Kimberley Flora (R.D. Royce 1848)																											
Tephrosia sp. F Kimberley Flora (B.R. Maslin 5139)											x																
Tephrosia sp.			x																								
Terminalia canescens	x	x							x					x				x			x		x			x	x
Terminalia volucris																											
Terminalia sp.																											
Tinospora smilacina										x	x		x				x									x	
Trachymene didiscoides																											
Trianthema pilosum			x		x			x	x				x		x			x						x	x		
Tribulopis angustifolia								x										x									
?*Trichodesma zeylanicum*																											
Triodia ?*bynoei*																											
Triodia caelestialis (P3)	x	x	x		x	x		x		x	x												x	x	x		
Triodia ?*intermedia*																						x					
Triodia schinzii				x					x					x				x				x				x	
Triodia "schinzii group"									x																		
Triodia sp.					x		x	x				x	x		x				x		x						x
Triumfetta albida	x																										
Triumfetta plumigera																											
Uraria lagopodioides							x														x						
Urochloa piligera																											
Vachellia pachyphloia subsp. *brevipinnula*																											
Velleia panduriformis					x							x															
Ventilago viminalis																	x										
Waltheria indica				x		x		x	x	x		x	x	x	x	x	x	x					x	x	x		
Wrightia saligna	x		x			x	x			x	x															x	
Xenostegia tridentata																											
Xerochloa barbata																											
Xerochloa laniflora																x				x		x					
Xyris complanata																											
Yakirra australiensis					x			x																			
Zornia chaetophora							x																				
Zornia prostrata var. *prostrata*			x																								

APPENDIX G: LOCATIONS AND POPULATIONS OF PRIORITY FLORA RECORDED WITHIN THE THUNDERBIRD PROJECT AREA

Mattiske Consulting Pty Ltd – June 2016 Survey

Notes: 1 – number of plants is per 50 m x 50 m quadrat;
2 – plant numbers estimated by extrapolation, based on a 5 m x 5 m subset of the quadrat.

Species	Quadrat Reference	Location (GDA94, Zone 51)		Number of Plants[1]
		Easting (mE)	Northing (mN)	
Pterocaulon intermedium (P3)	Opportunistic	504415	8070743	1
	Opportunistic	500141	8070719	1
	Opportunistic	491113	8076144	1
	Opportunistic	498700	8076078	1
	TB017	499923	8076197	13
	TB052	504458	8070740	5
	TB054	503905	8070626	25
	TB064	505040	8069200	3
	TB118	506340	8064660	5
	TB142	513606	8050948	2
	TB148	515453	8049943	5
Triodia caelestialis (P3)	Opportunistic	502431	8066522	10,000[2]
	Opportunistic	503209	8064645	10,500[2]
	Opportunistic	500141	8070719	1
	TB001	491459	8077134	4
	TB002	491087	8077033	3,000[2]
	TB003	497092	8077031	3,000[2]
	TB006	496500	8076972	5,000[2]
	TB009	498831	8076669	1
	TB013	493878	8076519	200
	TB015	497993	8076226	2,500[2]
	TB016	490921	8076219	12,000[2]
	TB022	497596	8075454	10,000[2]
	TB023	496400	8075420	250
	TB026	491250	8074800	3,000[2]
	TB027	498319	8074128	51
	TB028	490600	8074100	26
	TB029	494343	8074100	50
	TB030	491751	8073892	150
	TB031	500297	8073706	1
	TB032	499959	8073689	1
	TB033	490746	8073301	150
	TB034	492397	8073255	26
	TB035	493956	8073228	100
	TB036	499684	8073106	1
	TB037	502973	8073018	3,000[2]
	TB038	496823	8072877	100
	TB040	495709	8072344	26

APPENDIX G: LOCATIONS AND POPULATIONS OF PRIORITY FLORA RECORDED WITHIN THE THUNDERBIRD PROJECT AREA

Mattiske Consulting Pty Ltd – June 2016 Survey

Notes: 1 – number of plants is per 50 m x 50 m quadrat;
2 – plant numbers estimated by extrapolation, based on a 5 m x 5 m subset of the quadrat.

Species	Quadrat Reference	Location (GDA94, Zone 51)		Number of Plants[1]
		Easting (mE)	Northing (mN)	
Triodia caelestialis (P3)	TB042	491903	8071849	1
	TB043	491300	8071800	26
	TB044	503951	8071750	1
	TB045	496000	8071428	26
	TB046	490950	8071403	26
	TB047	491751	8071303	100
	TB048	494300	8071300	26
	TB050	500241	8070901	11
	TB051	492250	8070824	10,000[2]
	TB052	504458	8070740	150
	TB055	500466	8070546	150
	TB056	502860	8070275	1
	TB058	504291	8070070	1,000[2]
	TB060	500136	8069658	1,000[2]
	TB061	501478	8069607	3,000[2]
	TB062	499800	8069400	100
	TB064	505040	8069200	700
	TB065	492955	8069182	1,000[2]
	TB073	500190	8068149	26
	TB074	500030	8067880	11,000[2]
	TB078	498219	8067535	90
	TB079	504247	8067511	200
	TB080	503542	8067420	5,000[2]
	TB081	499893	8067199	100
	TB082	497569	8067109	11
	TB084	501349	8067066	51
	TB086	499200	8066998	250
	TB087	504821	8066933	51
	TB090	504626	8066787	700
	TB091	503478	8066764	55
	TB097	499202	8066303	200
	TB098	503134	8066177	100
	TB099	504349	8066171	1
	TB102	504774	8066063	13,000[2]
	TB106	501710	8065607	1,500[2]
	TB112	505222	8064801	150
	TB114	506534	8064755	11
	TB120	504323	8064554	150

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Mattiske Consulting Pty Ltd – June 2016 Survey

Notes: 1 – number of plants is per 50 m x 50 m quadrat;
2 – plant numbers estimated by extrapolation, based on a 5 m x 5 m subset of the quadrat.

Species	Quadrat Reference	Location (GDA94, Zone 51)		Number of Plants[1]
		Easting (mE)	Northing (mN)	
Triodia caelestialis (P3)	TB122	503009	8064490	130
	TB123	500719	8064436	1,200[2]
	TB124	499626	8064352	100
	TB127	502842	8064142	100
	TB128	500342	8064136	1,000[2]
	TB129	506031	8063200	1
	TB130	505951	8063100	150
	TB131	506000	8061900	100
	TB133	506152	8061498	26
	TB134	507898	8058832	2,000[2]
	TB136	510122	8055501	11
	TB138	513148	8052699	51
	TB139	511789	8052190	1,500[2]
	TB151	511756	8049321	900[2]
	TB152	512370	8048600	1
	TB153	512281	8047660	120

APPENDIX G: LOCATIONS AND POPULATIONS OF PRIORITY FLORA RECORDED WITHIN THE THUNDERBIRD PROJECT AREA

Ecologia Environment: 2012 - 2015 Surveys

Notes: Data extracted from Ecologia (2014, 2015); Survey – 1 and 2 (Ecologia 2014), 3 (Ecologia 2015)

Species	Location (GDA94, Zone 51)		Number of Plants	Survey
	Easting (mE)	Northing (mN)		
Fuirena nudiflora (P1)	498513	8075814	n/a	2
Fuirena incrassata (P3)	498513	8075814	n/a	2
Pterocaulon intermedium (P3)	496948	8076082	n/a	2
	496014	8069515	n/a	2
	496874	8068718	n/a	2
	501746	8071736	n/a	2
	499645	8074211	n/a	2
	499736	8074001	n/a	2
	499143	8068184	n/a	2
	504227	8070776	n/a	2
	495997	8071402	n/a	1
	499972	8069648	1	3
	500041	8069802	1	3
	499540	8069960	1	3
	512043	8053129	1	3
	504309	8065397	1	3
	515172	8049723	1	3
	508905	8056914	1	3
	513902	8051201	1	3
	504489	8065127	1	3
	512185	8053074	1	3
	512185	8053074	1	3
	513285	8051678	1	3
	503365	8066681	1	3
	501697	8069412	1	3
Tephrosia valleculata (P3)	501559	8071691	n/a	2
	500103	8071806	n/a	2
	499300	8071679	n/a	2
Triodia caelestialis (P3)	494788	8075983	n/a	2
	499653	8075125	n/a	2
	495360	8074330	n/a	2
	498468	8074919	n/a	2
	497024	8073661	n/a	2
	500377	8073356	n/a	2
	500377	8073356	n/a	2
	492865	8075608	n/a	2
	501241	8073130	n/a	2
	501241	8073130	n/a	2
	493844	8076206	n/a	2

APPENDIX G: LOCATIONS AND POPULATIONS OF PRIORITY FLORA RECORDED WITHIN THE THUNDERBIRD PROJECT AREA

Ecologia Environment: 2012 - 2015 Surveys

Notes: Data extracted from Ecologia (2014, 2015); Survey – 1 and 2 (Ecologia 2014), 3 (Ecologia 2015)

Species	Location (GDA94, Zone 51)		Number of Plants	Survey
	Easting (mE)	Northing (mN)		
Triodia caelestialis (P3)	491518	8072513	n/a	2
	499645	8074186	n/a	2
	500610	8072377	n/a	2
	491802	8072820	n/a	2
	493180	8072364	n/a	2
	501559	8071691	n/a	2
	502849	8070745	n/a	2
	502849	8070745	n/a	2
	495292	8070277	n/a	2
	492804	8069895	n/a	2
	492954	8069182	n/a	2
	496014	8069515	n/a	2
	502909	8067801	n/a	2
	501441	8067567	n/a	2
	498783	8067452	n/a	2
	496522	8067652	n/a	2
	495748	8066057	n/a	2
	492382	8076000	n/a	2
	493471	8072099	n/a	2
	500103	8071806	n/a	2
	495707	8072341	n/a	2
	497215	8075412	n/a	2
	497215	8075412	n/a	2
	497215	8075412	n/a	2
	499300	8071679	n/a	2
	496547	8073307	n/a	2
	494237	8076007	n/a	2
	502361	8067614	n/a	2
	501977	8064692	n/a	2
	502224	8063975	n/a	2
	496166	8073465	n/a	2
	495405	8074098	n/a	2
	499749	8073601	n/a	2
	492865	8075563	n/a	2
	498021	8068475	n/a	2
	498914	8068318	n/a	2
	497584	8075440	n/a	2
	503967	8070730	n/a	2
	503519	8070695	n/a	2

APPENDIX G: LOCATIONS AND POPULATIONS OF PRIORITY FLORA RECORDED WITHIN THE THUNDERBIRD PROJECT AREA

Ecologia Environment: 2012 - 2015 Surveys

Notes: Data extracted from Ecologia (2014, 2015); Survey – 1 and 2 (Ecologia 2014), 3 (Ecologia 2015)

Species	Location (GDA94, Zone 51)		Number of Plants	Survey
	Easting (mE)	Northing (mN)		
Triodia caelestialis (P3)	497574	8075714	n/a	2
	497004	8075953	n/a	2
	497183	8075890	n/a	2
	493341	8074570	n/a	2
	491539	8072602	n/a	2
	497985	8068005	n/a	2
	497865	8075466	n/a	2
	498001	8075549	n/a	2
	503097	8067697	n/a	2
	501772	8067538	n/a	2
	501241	8067496	n/a	2
	501960	8064274	n/a	2
	502916	8064085	n/a	2
	502636	8072555	n/a	2
	502523	8067699	n/a	1
	493955	8073234	n/a	1
	500545	8068053	n/a	1
	496085	8075978	n/a	1
	495950	8075987	n/a	1
	493242	8074375	n/a	1
	494332	8074125	n/a	1
	495997	8071422	n/a	1
	497314	8068357	n/a	1
	497776	8071234	n/a	1
	494080	8073582	n/a	1
	497409	8074676	n/a	1
	500192	8073619	n/a	1
	491807	8074300	n/a	1
	500022	8067396	n/a	1
	512037	8053110	300	3
	499689	8069847	1500	3
	501015	8069032	100	3
	502678	8067418	50	3
	512322	8051853	200	3
	512324	8051958	1000	3
	512185	8053074	50	3
	505982	8062571	1	3
	511403	8054250	20	3
	508905	8056914	50	3

APPENDIX G: LOCATIONS AND POPULATIONS OF PRIORITY FLORA RECORDED WITHIN THE THUNDERBIRD PROJECT AREA

Ecologia Environment: 2012 - 2015 Surveys

Notes: Data extracted from Ecologia (2014, 2015); Survey – 1 and 2 (Ecologia 2014), 3 (Ecologia 2015)

Species	Location (GDA94, Zone 51)		Number of Plants	Survey
	Easting (mE)	Northing (mN)		
Triodia caelestialis (P3)	503921	8066082	100	3
	500946	8069120	200	3
	500798	8069186	100	3
	500656	8069273	100	3
	500373	8069441	50	3
	500273	8069488	100	3
	499926	8069682	100	3
	499834	8069766	1000	3
	512216	8052028	1000	3
	499512	8069908	100	3
	499685	8069931	500	3
	499908	8069827	1000	3
	500036	8069802	500	3
	502526	8067594	50	3
	502306	8067938	100	3

APPENDIX H

Department of Parks and Wildlife

Threatened and Priority Flora Report Forms

Pterocaulon intermedium (p3)

Triodia caelestialis (P3)

Department of Parks and Wildlife

Threatened and Priority Flora Report Form

Version 1.2 August 2013

Please complete as much of the form as possible.
For information on how to complete the form please refer to the Threatened & Priority Flora Report Form (TPRF) manual on the DPaW website at http://www.dpaw.wa.gov.au/

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

OBSERVATION DATE: 21-26/06/2016 **CONSERVATION STATUS:** P3 New population ☒

OBSERVER/S: David Angus, Natalie Murdock, Jeffry Cargill **PHONE:** 08 9257 1625

ROLE: Botanist / Ecologist **ORGANISATION:** Mattiske Consulting Pty Ltd

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

Survey area located on Dampier Peninsula, within Mt. Jowlaenga Station and Yeeda Stations, approximately midway between Broome and Derby. The survey area was approximately 19,000 ha.

Reserve No:

DISTRICT: Kimberley **LGA:** Broome 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 attcahed list
Long / Easting: see attcahed list
Zone: 51

METHOD USED:
GPS ☒ Differential GPS ☐ Map ☐
No. satellites: 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): _____

EFFORT: Time spent surveying (minutes): _____ 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	62			62
Dead				

Area of pop (m²): 17,500

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

QUADRATS PRESENT: No. 7 Size 50 x 50 m Data attached ☐ Total area of quadrats (m²): 17,500

Summary Quad. Totals: Alive				

REPRODUCTIVE STATE: Clonal ☐ Vegetative ☐ Flowerbud ☒ Flower ☒
Immature fruit ☐ Fruit ☐ Dehisced fruit ☐ Percentage in flower: approx 90%

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

COMMENT:

THREATS - type, agent and supporting information: E.g. 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)**
• Fire Parts of entire survey area burnt within last 12 months, parts unburint for more than 10 years. Fire events occur every year on portion of the survey area	L	M	M
• Mining Sheffield Resources mineral sand mining operation - potential for vegetation clearing leading to some direct and indiret imopacts to local populations	L	L-M	M
•			

Please return completed form to **Species And Communities Branch** DPaW,
Locked Bag 104, BENTLEY DELIVERY CENTRE WA 6983
RECORDS: Please forward to **Flora Administrative Officer,** Species and Communities Branch.

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

Department of Parks and Wildlife

Threatened and Priority Flora Report Form

Version 1.2 August 2013

HABITAT INFORMATION: (Check more than one box for combinations or where necessary)

LANDFORM:	ROCK TYPE:	LOOSE ROCK:	SOIL TYPE:	SOIL COLOUR:	DRAINAGE:
Crest ☐	Granite ☐	(on soil surface; e.g. gravel, quartz fields)	Sand ☒	Red ☒	Well drained ☒
Hill ☐	Dolerite ☐		Sandy loam ☐	Brown ☒	Seasonally inundated ☐
Ridge ☐	Laterite ☐		Loam ☐	Yellow ☐	
Outcrop ☐	Ironstone ☐	0-10% ☒	Clay loam ☐	White ☐	Permanently inundated ☐
Slope ☐	Limestone ☐	10-30% ☐	Light clay ☐	Grey ☒	Tidal ☐
Flat ☒	Quartz ☐	30-50% ☐	Peat ☐	Black ☐	
Open depression ☐		50-100% ☐			
Drainage line ☒	Specify other:		Specify other:	Specify other:	Specify other:
Closed depression ☐					
Wetland ☐					

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

CONDITION OF SOIL:

Dry ☐ Moist ☒ Waterlogged ☐ Inundated ☐ Cracked ☐ Saline ☐ Other:

VEGETATION CLASSIFICATION:* E.g. **1**. Banksia woodland (B. attenuata, B. ilicifolia); **2**. Open shrubland (Hibbertia sp., Acacia spp.) **3**. Isolated clumps of sedges (Mesomelaena tetragona)	1. Erythrophleum chlorostachys, Brachychiton diversifolius subsp. diversifolius and Corymbia greeniana low-mid open woodland
	2. Acacia tumida var. tumida, Bauhinia cunninghamii and Dodonaea hispidula var. arida tall sparse shrubland
	3. Triodia caelestialis (P3), Triodia schinzii and Eriachne obtusa mid sparse tussock grassland
	4.
ASSOCIATED SPECIES: Other (non-dominant) spp	Corymbia zygophylla, Dolichandrone heterophylla
	Grevillea pyramidalis subsp. pyramidalis, Grevillea refracta subsp. refracta,
	Microstachys chamaelea, Solanum cunninghamii, Waltheria indica
	Chrysopogon fallax, Chrysopogon pallidus, Eragrostis eriopoda, Sorghum timorense

* 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: ~2010 **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.)

List of co-ordinates and associated site information attached from multiple locations recorded in the survey area

Please return completed form to **Species And Communities Branch** DPaW,
Locked Bag 104, BENTLEY DELIVERY CENTRE WA 6983
RECORDS: Please forward to **Flora Administrative Officer,** Species and Communities Branch.

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

Department of Parks and Wildlife

Threatened and Priority Flora Report Form

Version 1.2 August 2013

DRF PERMIT/ LICENCE No: SLO11706, SLO11719, SLO11715

Note if only observing plants (i.e. no specimens or plant matieral is taken) then no permit/licence is required. For further information on permit and licening requirements see the Threatened Flora and Wildlife Licensing pages on DPaW's website. Any actions carried out under licence/permit should be recorded above in the OTHER COMMENTS section.

SPECIMEN: Collectors No: 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: David Angus **Role:** Senior Botanist

Signature: DA **Date submitted:** 9/09/2016

Please return completed form to **Species And Communities Branch** DPaW,
Locked Bag 104, BENTLEY DELIVERY CENTRE WA 6983
RECORDS: Please forward to **Flora Administrative Officer,** Species and Communities Branch.

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

Threatened and Priority Flora report Form – Attachment – *Pterocaulon intermedium* (P3)

Species	Quadrat Reference	Location (GDA94, Zone 51)		Number of Plants[1]
		Easting (mE)	Northing (mN)	
Pterocaulon intermedium (P3)	Opportunistic	504415	8070743	1
	Opportunistic	500141	8070719	1
	Opportunistic	491113	8076144	1
	Opportunistic	498700	8076078	1
	TB017	499923	8076197	13
	TB052	504458	8070740	5
	TB054	503905	8070626	25
	TB064	505040	8069200	3
	TB118	506340	8064660	5
	TB142	513606	8050948	2
	TB148	515453	8049943	5

Department of Parks and Wildlife

Threatened and Priority Flora Report Form

Version 1.2 August 2013

Please complete as much of the form as possible.
For information on how to complete the form please refer to the Threatened & Priority Flora Report Form (TPRF) manual on the DPaW website at http://www.dpaw.wa.gov.au/

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

OBSERVATION DATE: 21-26/06/2016 **CONSERVATION STATUS:** P3 New population ☒

OBSERVER/S: David Angus, Natalie Murdock, Jeffry Cargill, Adrian Barrett **PHONE:** 08 9257 1625

ROLE: Botanist / Ecologist **ORGANISATION:** Mattiske Consulting Pty Ltd

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

Survey area located on Dampier Peninsula, within Mt. Jowlaenga Station and Yeeda Stations, approximately midway between Broome and Derby. The survey area was approximately 19,000 ha.

Reserve No:

DISTRICT: Kimberley **LGA:** Broome 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 attcahed list
Long / Easting: see attcahed list
Zone: 51

METHOD USED:
GPS ☒ Differential GPS ☐ Map ☐
No. satellites: 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): _____

EFFORT: Time spent surveying (minutes): _____ 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	120,492			120,492
Dead				

Area of pop (m²): 202,500

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

QUADRATS PRESENT: No. 81 Size 50 x 50 m Data attached ☐ Total area of quadrats (m²): 202,500

Summary Quad. Totals: Alive				

REPRODUCTIVE STATE: Clonal ☐ Vegetative ☐ Flowerbud ☐ Flower ☒
Immature fruit ☐ Fruit ☐ Dehisced fruit ☐ Percentage in flower: approx 20%

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

COMMENT:

THREATS - type, agent and supporting information: E.g. 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)**
• Fire Parts of entire survey area burnt within last 12 months, parts unburint for more than 10 years. Fire events occur every year on portion of the survey area	L	M	M
• Mining Sheffield Resources mineral sand mining operation - potential for vegetation clearing leading to some direct and indiret imopacts to local populations	L	L-M	M
•			

Please return completed form to **Species And Communities Branch** DPaW,
Locked Bag 104, BENTLEY DELIVERY CENTRE WA 6983
RECORDS: Please forward to **Flora Administrative Officer,** Species and Communities Branch.

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

Department of Parks and Wildlife

Threatened and Priority Flora Report Form

Version 1.2 August 2013

HABITAT INFORMATION: (Check more than one box for combinations or where necessary)

LANDFORM:	ROCK TYPE:	LOOSE ROCK:	SOIL TYPE:	SOIL COLOUR:	DRAINAGE:
Crest ☐	Granite ☐	(on soil surface; e.g. gravel, quartz fields)	Sand ☒	Red ☒	Well drained ☒
Hill ☒	Dolerite ☐		Sandy loam ☐	Brown ☒	Seasonally inundated ☐
Ridge ☒	Laterite ☐	0-10% ☒	Loam ☐	Yellow ☐	Permanently inundated ☐
Outcrop ☐	Ironstone ☐	10-30% ☒	Clay loam ☐	White ☐	Tidal ☐
Slope ☐	Limestone ☐	30-50% ☐	Light clay ☐	Grey ☒	
Flat ☒	Quartz ☐	50-100% ☐	Peat ☐	Black ☐	
Open depression ☐					
Drainage line ☒					
Closed depression ☐	Specify other: Sandstone		Specify other: clayey sand	Specify other:	Specify other:
Wetland ☐					

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

CONDITION OF SOIL:

Dry ☐ Moist ☒ Waterlogged ☐ Inundated ☐ Cracked ☐ Saline ☐ Other:

VEGETATION CLASSIFICATION:* E.g. **1**. Banksia woodland (B. attenuata, B. ilicifolia); **2**. Open shrubland (Hibbertia sp., Acacia spp.) **3**. Isolated clumps of sedges (Mesomelaena tetragona)	1. Erythrophleum chlorostachys, Brachychiton diversifolius subsp. diversifolius and Corymbia greeniana low-mid open woodland
	2. Acacia tumida var. tumida, Bauhinia cunninghamii and Dodonaea hispidula var. arida tall sparse shrubland
	3. Triodia caelestialis (P3), Triodia schinzii and Eriachne obtusa mid sparse tussock grassland
	4.
ASSOCIATED SPECIES: Other (non-dominant) spp	Corymbia zygophylla, Dolichandrone heterophylla
	Grevillea pyramidalis subsp. pyramidalis, Grevillea refracta subsp. refracta,
	Microstachys chamaelea, Solanum cunninghamii, Waltheria indica
	Chrysopogon fallax, Chrysopogon pallidus, Eragrostis eriopoda, Sorghum timorense

* 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: ~2005 Year: ~2015 **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.)

List of co-ordinates and associated site information attached from multiple locations recorded in the survey area

Specimens were submitted to WAHERB for paid ID for verification purposes

Please return completed form to **Species And Communities Branch** DPaW,
Locked Bag 104, BENTLEY DELIVERY CENTRE WA 6983
RECORDS: Please forward to **Flora Administrative Officer,** Species and Communities Branch.

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

Department of Parks and Wildlife

Threatened and Priority Flora Report Form

Version 1.2 August 2013

DRF PERMIT/ LICENCE No: SLO11706, SLO11719, SLO11715, SLO11707

Note if only observing plants (i.e. no specimens or plant matieral is taken) then no permit/licence is required. For further information on permit and licening requirements see the Threatened Flora and Wildlife Licensing pages on DPaW's website. Any actions carried out under licence/permit should be recorded above in the OTHER COMMENTS section.

SPECIMEN: Collectors No: 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: David Angus **Role:** Senior Botanist

Signature: DA **Date submitted:** 9/09/2016

Please return completed form to **Species And Communities Branch** DPaW,
Locked Bag 104, BENTLEY DELIVERY CENTRE WA 6983
RECORDS: Please forward to **Flora Administrative Officer,** Species and Communities Branch.

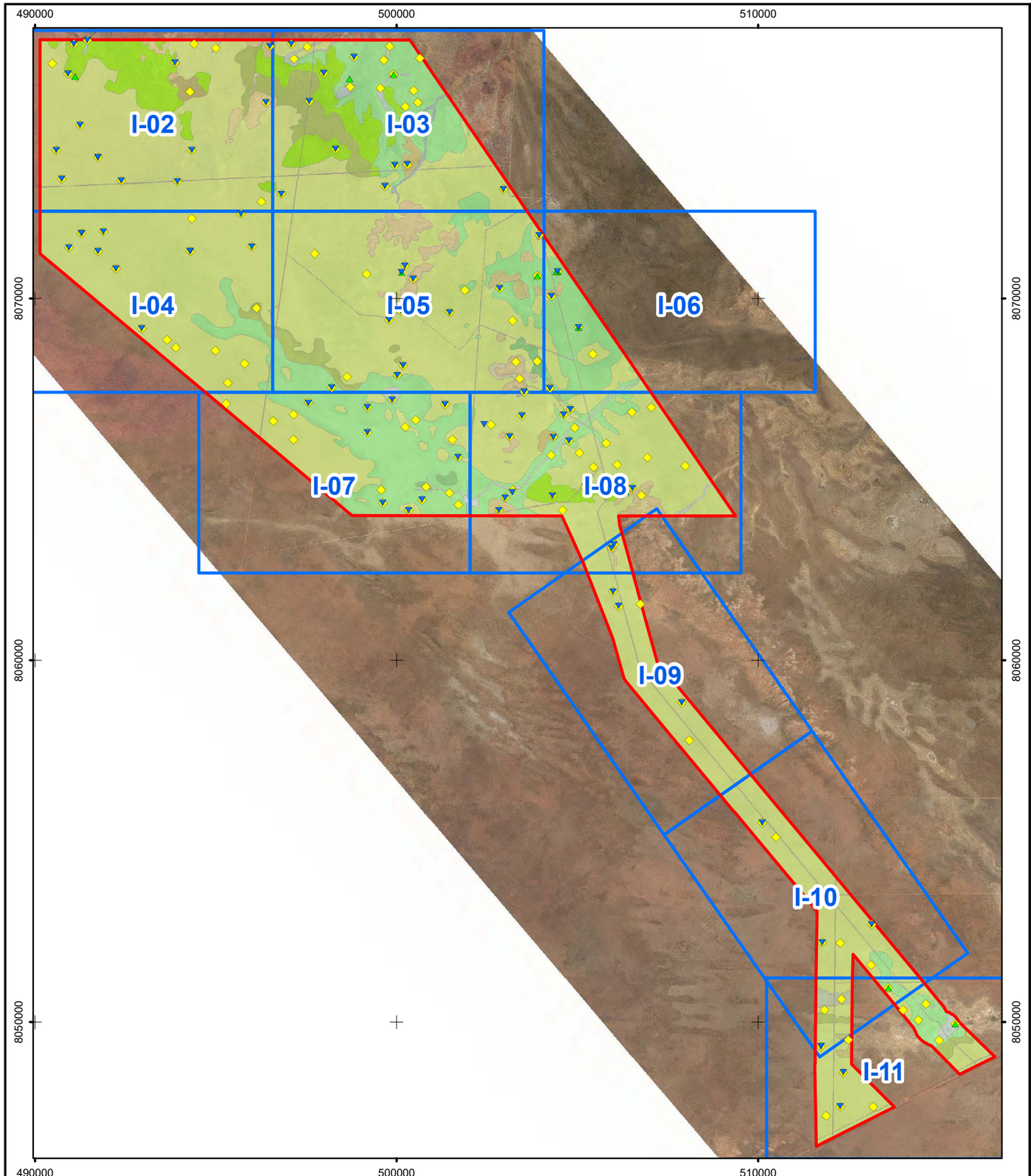
Record entered by:_____ **Sheet No.:**_____ **Record Accepted in Database** ☐

Threatened and Priority Flora report Form – Attachment – *Triodia caelestialis* (P3)

Species	Quadrat Reference	Location (GDA94, Zone 51)		Number of Plants
		Easting (mE)	Northing (mN)	
Triodia caelestialis (P3)	Opportunistic	502431	8066522	$10,000^2$
	Opportunistic	503209	8064645	$10,500^2$
	Opportunistic	500141	8070719	1
	TB001	491459	8077134	4
	TB002	491087	8077033	$3,000^2$
	TB003	497092	8077031	$3,000^2$
	TB006	496500	8076972	$5,000^2$
	TB009	498831	8076669	1
	TB013	493878	8076519	200
	TB015	497993	8076226	$2,500^2$
	TB016	490921	8076219	$12,000^2$
	TB022	497596	8075454	$10,000^2$
	TB023	496400	8075420	250
	TB026	491250	8074800	$3,000^2$
	TB027	498319	8074128	51
	TB028	490600	8074100	26
	TB029	494343	8074100	50
	TB030	491751	8073892	150
	TB031	500297	8073706	1
	TB032	499959	8073689	1
	TB033	490746	8073301	150
	TB034	492397	8073255	26
	TB035	493956	8073228	100
	TB036	499684	8073106	1
	TB037	502973	8073018	$3,000^2$
	TB038	496823	8072877	100
	TB040	495709	8072344	26
	TB042	491903	8071849	1
	TB043	491300	8071800	26
	TB044	503951	8071750	1
	TB045	496000	8071428	26
	TB046	490950	8071403	26
	TB047	491751	8071303	100
	TB048	494300	8071300	26
	TB050	500241	8070901	11
	TB051	492250	8070824	$10,000^2$
	TB052	504458	8070740	150
	TB055	500466	8070546	150
	TB056	502860	8070275	1
	TB058	504291	8070070	$1,000^2$
	TB060	500136	8069658	$1,000^2$
	TB061	501478	8069607	$3,000^2$
	TB062	499800	8069400	100

	TB064	505040	8069200	700
	TB065	492955	8069182	1,000[2]
	TB073	500190	8068149	26
	TB074	500030	8067880	11,000[2]
	TB078	498219	8067535	90
	TB079	504247	8067511	200
	TB080	503542	8067420	5,000[2]
	TB081	499893	8067199	100
	TB082	497569	8067109	11
	TB084	501349	8067066	51
	TB086	499200	8066998	250
	TB087	504821	8066933	51
	TB090	504626	8066787	700
	TB091	503478	8066764	55
	TB097	499202	8066303	200
	TB098	503134	8066177	100
	TB099	504349	8066171	1
	TB102	504774	8066063	13,000[2]
	TB106	501710	8065607	1,500[2]
	TB112	505222	8064801	150
	TB114	506534	8064755	11
	TB120	504323	8064554	150
	TB122	503009	8064490	130
	TB123	500719	8064436	1,200[2]
	TB124	499626	8064352	100
	TB127	502842	8064142	100
	TB128	500342	8064136	1,000[2]
	TB129	506031	8063200	1
	TB130	505951	8063100	150
	TB131	506000	8061900	100
	TB133	506152	8061498	26
	TB134	507898	8058832	2,000[2]
	TB136	510122	8055501	11
	TB138	513148	8052699	51
	TB139	511789	8052190	1,500[2]
	TB151	511756	8049321	900[2]
	TB152	512370	8048600	1
	TB153	512281	8047660	120

2 – population extrapolated by counting a 5 m x 5 m subset of 50 x 50 m quadrat



Vegetation Legend

W1 *Melaleuca viridiflora*, *Melaleuca alsophila* and *Eucalyptus tectifica* low sparse woodland over *Bauhinia cunninghamii*, *Carissa lanceolata* and *Atalaya hemiglauca* tall sparse shrubland over *Ectrosia schultzii*, *Eriachne sulcata* and *Cyperus conicus* low sparse grassland on grey-white to light brown sandy soils in drainage channels and low lying drainage areas.

W2 *Eucalyptus tectifica* mid open woodland over *Acacia plectocarpa* subsp. *plectocarpa* and *Grevillea pyramidalis* subsp. *pyramidalis* tall sparse shrubland over *Aristida holathera* subsp. *latifolia*, *Eriachne obtusa* and *Xerochloa laniflora* mid sparse grassland on light brown clayey sands in low lying drainage areas.

W3 *Corymbia dendromerinx*, *Eucalyptus tectifica* and *Corymbia greeniana* mid open woodland over *Dolichandrone heterophylla*, *Dodonaea hispidula* var. *arida* and *Grevillea pyramidalis* subsp. *pyramidalis* mid sparse shrubland over *Triodia caelestialis* (P3), *Triodia schinzii* and *Eriachne obtusa* mid sparse hummock grassland on orange-brown clayey sands on flats and drainage areas.

W4 *Corymbia dendromerinx* mid open woodland over *Terminalia canescens*, *Calytrix exstipulata* and *Wrightia saligna* tall sparse shrubland over *Triodia caelestialis* (P3), *Triumfetta albida* and *Polycarpaea longiflora* mid open tussock grassland on brown sandy clay soils on mid-slopes to ridges of hills with sandstone outcropping.

W5 *Corymbia dendromerinx* mid open woodland over *Grevillea pyramidalis* subsp. *pyramidalis*, *Terminalia canescens* and *Waltheria indica* mid sparse shrubland over *Triodia caelestialis* (P3), *Sorghum plumosum* and *Hybanthus enneaspermus* subsp. *enneaspermus* low sparse tussock grassland on pale brown to orange-brown sandy clay loam soils on slopes and broad flat hill tops with sandstone outcropping.

W6 *Eucalyptus tectifica*, *Bauhinia cunninghamii* and *Brachychiton diversifolius* subsp. *diversifolius* mid open woodland over *Carissa lanceolata* and *Dolichandrone heterophylla* mid sparse shrubland over *Triodia caelestialis* (P3), *Triodia schinzii* and *Eriachne obtusa* mid sparse tussock grassland on pale brown to grey brown sandy clay loams on flats.

W7 *Brachychiton diversifolius* subsp. *diversifolius* and *Eucalyptus tectifica* low open woodland over *Bauhinia cunninghamii*, *Acacia plectocarpa* subsp. *plectocarpa* and *Melaleuca viridiflora* tall sparse shrubland over *Triodia caelestialis* (P3), *Triodia schinzii* and *Aristida holathera* var. *holathera* mid sparse hummock grassland on pale orange-grey clayey sands on flats.

W8 *Erythrophleum chlorostachys*, *Brachychiton diversifolius* subsp. *diversifolius* and *Corymbia greeniana* mid open woodland over *Acacia tumida* var. *tumida*, *Bauhinia cunninghamii* and *Dodonaea hispidula* var. *arida* tall sparse shrubland over *Triodia caelestialis* (P3), *Triodia schinzii* and *Eriachne obtusa* mid sparse tussock grassland on orange-brown to red fine sandy soils on flats.

W8a *Erythrophleum chlorostachys*, *Brachychiton diversifolius* subsp. *diversifolius* and *Corymbia greeniana* mid open woodland over *Acacia tumida* var. *tumida*, *Bauhinia cunninghamii* and *Dodonaea hispidula* var. *arida* tall sparse shrubland over *Triodia caelestialis* (P3), *Triodia schinzii* and *Eriachne obtusa* mid sparse tussock grassland on orange-brown to red fine sandy soils in swale area subject to seasonal inundation.

W9 *Corymbia dendromerinx* low open woodland over *Grevillea pyramidalis* subsp. *pyramidalis*, *Microstachys chamaelea* and *Terminalia canescens* mid sparse shrubland over *Chrysopogon* sp. (*C. fallax* or *C. pallidus*), *Glycine tomentella* and *Sorghum plumosum* mid sparse grassland on orange-brown sandy clay with sandstone rocks and outcropping on hills.

W10 *Corymbia greeniana*, *Corymbia dendromerinx* and *Brachychiton diversifolius* subsp. *diversifolius* low open woodland over *Grevillea pyramidalis* subsp. *pyramidalis*, *Grevillea refracta* subsp. *refracta* and *Terminalia canescens* tall sparse shrubland over *Triodia caelestialis* (P3), *Solanum cunninghamii* and *Aristida hygrometrica* mid open tussock grassland on orange-brown clayey sands with occasional sandstone or ironstone rocks on flats and slopes associated with drainage areas.

W11 *Corymbia zygophylla* low open woodland over *Acacia tumida* var. *tumida* and *Erythrophleum chlorostachys* tall sparse shrubland over *Triodia schinzii* and *Microstachys chamaelea* low sparse grassland on orange-brown clayey sands on flats and slopes.

W12 *Corymbia greeniana*, *Eucalyptus tectifica* and *Corymbia dendromerinx* mid open woodland over *Dolichandrone heterophylla*, *Bauhinia cunninghamii* and *Acacia tumida* var. *tumida* tall sparse shrubland over *Triodia caelestialis* (P3), *Triodia schinzii* and *Eriachne obtusa* mid sparse tussock grassland, on brown clayey sands on flats and drainage channels.

W13 *Brachychiton diversifolius* subsp. *diversifolius*, *Erythrophleum chlorostachys* and *Corymbia dendromerinx* mid open woodland over *Grevillea refract* subsp. *refracta*, *Acacia monticola* and *Microstachys chamaelea* tall sparse shrubland over *Corchorus sidoides*, *Goodenia sepalosa* subsp. *sepalosa* and *Pterocaulon paradoxum* low sparse for bland on orange-brown clayey sands on flats

S1 *Acacia tumida* var. *tumida* low sparse shrubland over *Waltheria indica* and *Bauhinia cunninghamii* low isolated shrubs over *Ectrosia schultzii*, *Eriachne obtusa* and *Corchorus pumilio* low sparse grassland on pale grey sandy clay loam soils on flats and slopes.

CL cleared

Legend
- ▲ *Pterocaulon intermedium*
- ▼ *Triodia caelestialis*
- ◆ MCPL Sites 01/09/2016
- Thunderbird Survey Area
- Sheet_Layout_20160906_A3

Vegetation Communities
W1 W5 W8a W12
W2 W6 W9 W13
W3 W7 W10 S1
W4 W8 W11 CL

Note
Aerial Photography: Sheffield Resources (09/2015)
Quadrats: MCPL
Flora: MCPL
Vegetation: MCPL (08/2016)
Refer figure 2 for detailed vegetation

Client: Sheffield Resources Limited

N

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MGA94 (Zone 51)
CAD Ref: a2409_f50_12
Date: Sep 2016 | Rev: A | A3

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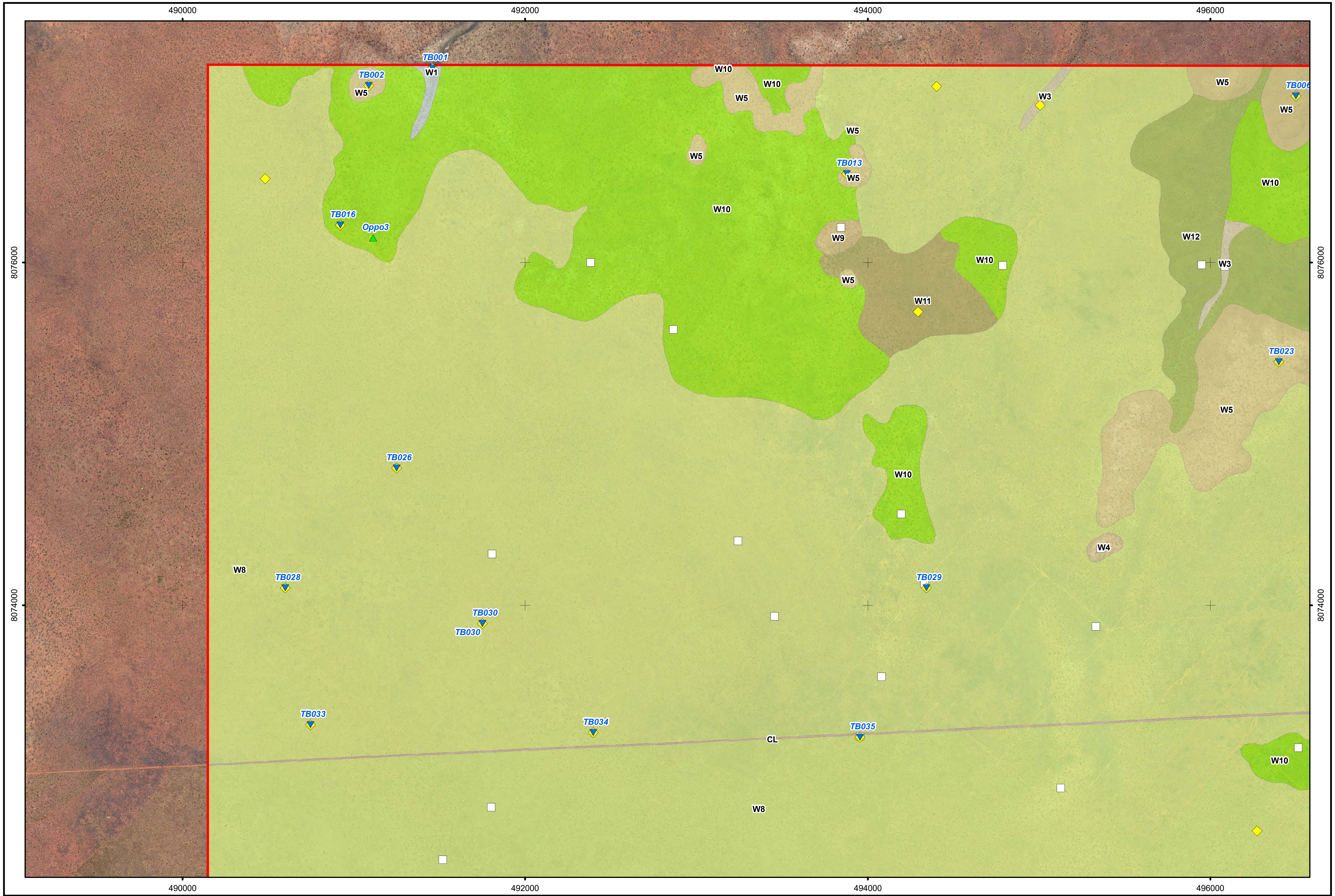
Thunderbird Mineral Sands Project
Vegetation
Legend and Sheet Layout

Appendix
I-01



Legend
- Pterocaulon intermedium
- Triodia caelestialis
- MCPL Sites 01/09/2016
- ecologia Quadrats
- Thunderbird Survey Area

Note
Aerial Photography: Sheffield Resources (09/2015)
Quadrats: MCPL, ecologia
Flora: MCPL, ecologia
Vegetation: MCPL (08/2016)
Refer figure 1 for detailed vegetation legend

Sheet Layout:

Client: Sheffield Resources LIMITED

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Scale: 1:20,000
MGA94 (Zone 51)

CAD Ref: a2409_f50_13
Date: Sep 2016 | Rev: A | A3

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Thunderbird Mineral Sands Project
Vegetation
Sheet 1 of 10

Appendix:
I-02

498000 500000 502000 504000

8076000

8074000

TB003 TB009 TB015 TB017 Oppo TB022 TB027 TB032 TB031 TB036 TB037 TB038

W1 W3 W4 W5 W6 W7 W8 W10 W12 W13 CL

Legend
- *Pterocaulon intermedium*
- *Triodia caelestialis*
- MCPL Sites 01/09/2016
- ecologia Quadrats
- Thunderbird Survey Area

Note
Aerial Photography: Sheffield Resources (09/2015)
Quadrats: MCPL, ecologia
Flora: MCPL, ecologia
Vegetation: MCPL (08/2016)
Refer figure 1 for detailed vegetation legend

Sheet Layout:

Client: Sheffield Resources Limited

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Scale: 1:20,000
MGA94 (Zone 51)

CAD Ref: a2409_f50_13
Date: Sep 2016 | Rev: A | A3

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Thunderbird Mineral Sands Project
Vegetation
Sheet 2 of 10

Appendix:
I-03

490000 492000 494000 496000

8072000 8070000 8068000

TB040 TB043 TB043 TB042 TB046 TB047 TB051 TB045 TB048 TB048 TB065

W8 W7 CL W8 W12 W6 CL W6 W6

490000 492000 494000 496000

Legend
- *Pterocaulon intermedium*
- *Triodia caelestialis*
- MCPL Sites 01/09/2016
- ecologia Quadrats
- Thunderbird Survey Area

Note
Aerial Photography: Sheffield Resources (09/2015)
Quadrats: MCPL, ecologia
Flora: MCPL, ecologia
Vegetation: MCPL (08/2016)
Refer figure 1 for detailed vegetation legend

Sheet Layout:

Client: Sheffield Resources Limited

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Scale: 1:20,000
MGA94 (Zone 51)
CAD Ref: a2409_f50_13
Date: Sep 2016 | Rev: A | A3

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Thunderbird Mineral Sands Project
Vegetation
Sheet 3 of 10

Appendix:
I-04

498000 500000 502000 504000

8072000 8070000 8068000

W8 W4 W4 W4 W4 W6 W4 W8 TB044 W5 W8 W5 TB050 Oppo Oppo2 TB055 W4 W5 TB054 W6 TB056 W6 W7 W5 W5 CL W8 TB060 TB061 TB062 W6 W12 W12 W6 W6 W6 W5 S1 W8 W8 W12 W8 W8 S1 W12 W12 TB073 W4 W8 TB074 W3 W6 W6 W4 TB078 W1 CL TB080

498000 500000 502000 504000

Legend
- *Pterocaulon intermedium*
- *Triodia caelestialis*
- MCPL Sites 01/09/2016
- ecologia Quadrats
- Thunderbird Survey Area

Note
Aerial Photography: Sheffield Resources (09/2015)
Quadrats: MCPL, ecologia
Flora: MCPL, ecologia
Vegetation: MCPL (08/2016)
Refer figure 1 for detailed vegetation legend

Sheet Layout:

Client: Sheffield Resources Limited

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Scale: 1:20,000
MGA94 (Zone 51)

CAD Ref: a2409_f50_13
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Thunderbird Mineral Sands Project
Vegetation
Sheet 4 of 10

Appendix:
I-05

506000 508000 510000

8072000 8070000 8068000

W5 W8 W8 TB052 TB052 Oppo1 W6 W5 W5 TB058 W8 W6 TB064 TB064 W6 W8 W8 CL W6 S1 W8 W8 W7 TB079 W8 W8 W6 W1 W6 W8

Note
Aerial Photography: Sheffield Resources (09/2015)
Quadrats: MCPL, ecologia
Flora: MCPL, ecologia
Vegetation: MCPL (08/2016)
Refer figure 1 for detailed vegetation legend

Sheet Layout:

Client: Sheffield Resources LIMITED

N

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Scale: 1:20,000
MGA94 (Zone 51)

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Date: Sep 2016 | Rev: A | A3

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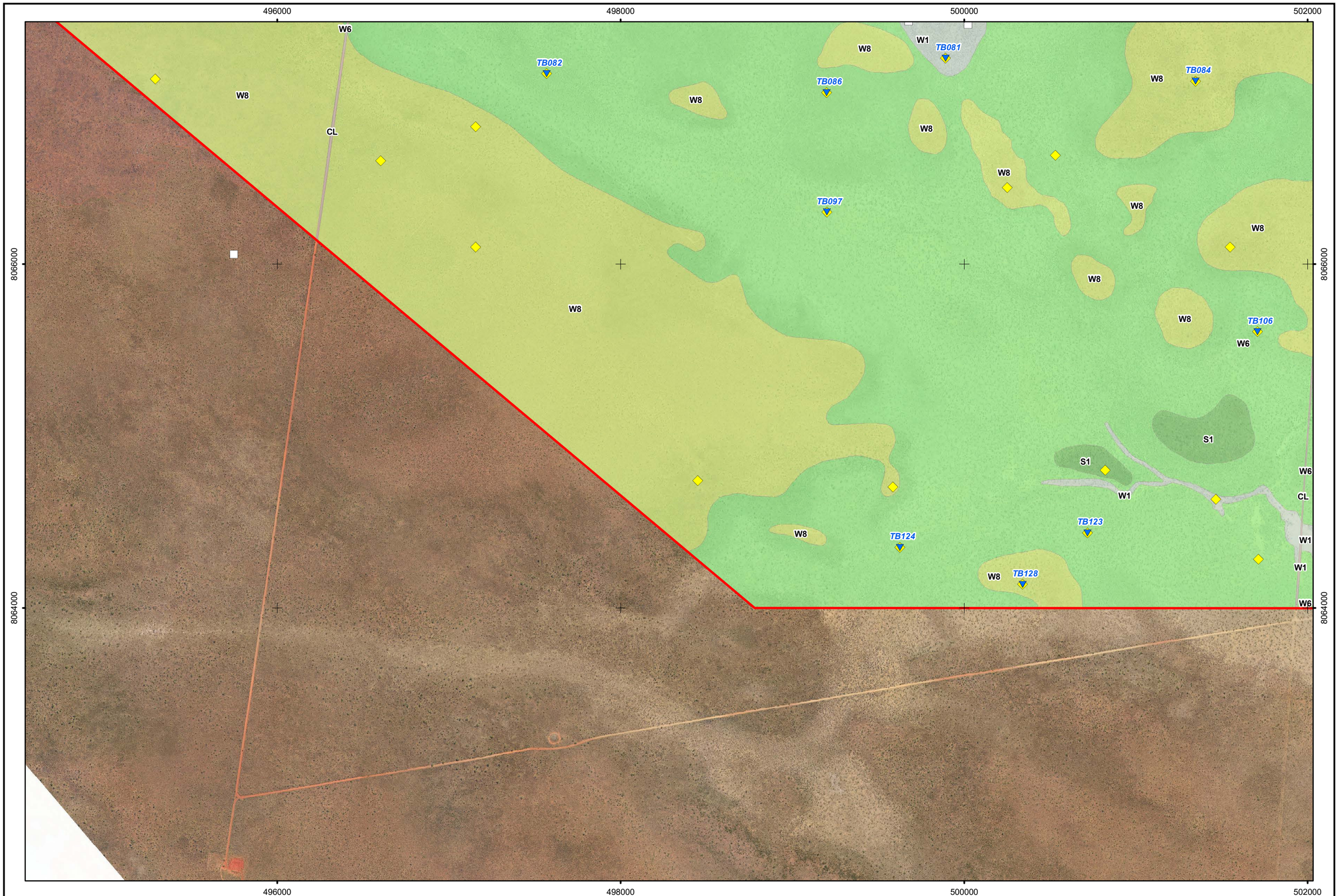
Thunderbird Mineral Sands Project
Vegetation
Sheet 5 of 10

Appendix:
I-06



Legend
- ▲ *Pterocaulon intermedium*
- ▼ *Triodia caelestialis*
- ◇ MCPL Sites 01/09/2016
- ecologia Quadrats
- Thunderbird Survey Area

Note
Aerial Photography: Sheffield Resources (09/2015)
Quadrats: MCPL, ecologia
Flora: MCPL, ecologia
Vegetation: MCPL (08/2016)
Refer figure 1 for detailed vegetation legend

Sheet Layout:

Client: Sheffield Resources Limited

N

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Scale: 1:20,000
MGA94 (Zone 51)
CAD Ref: a2409_f50_13
Date: Sep 2016 | Rev: A | A3

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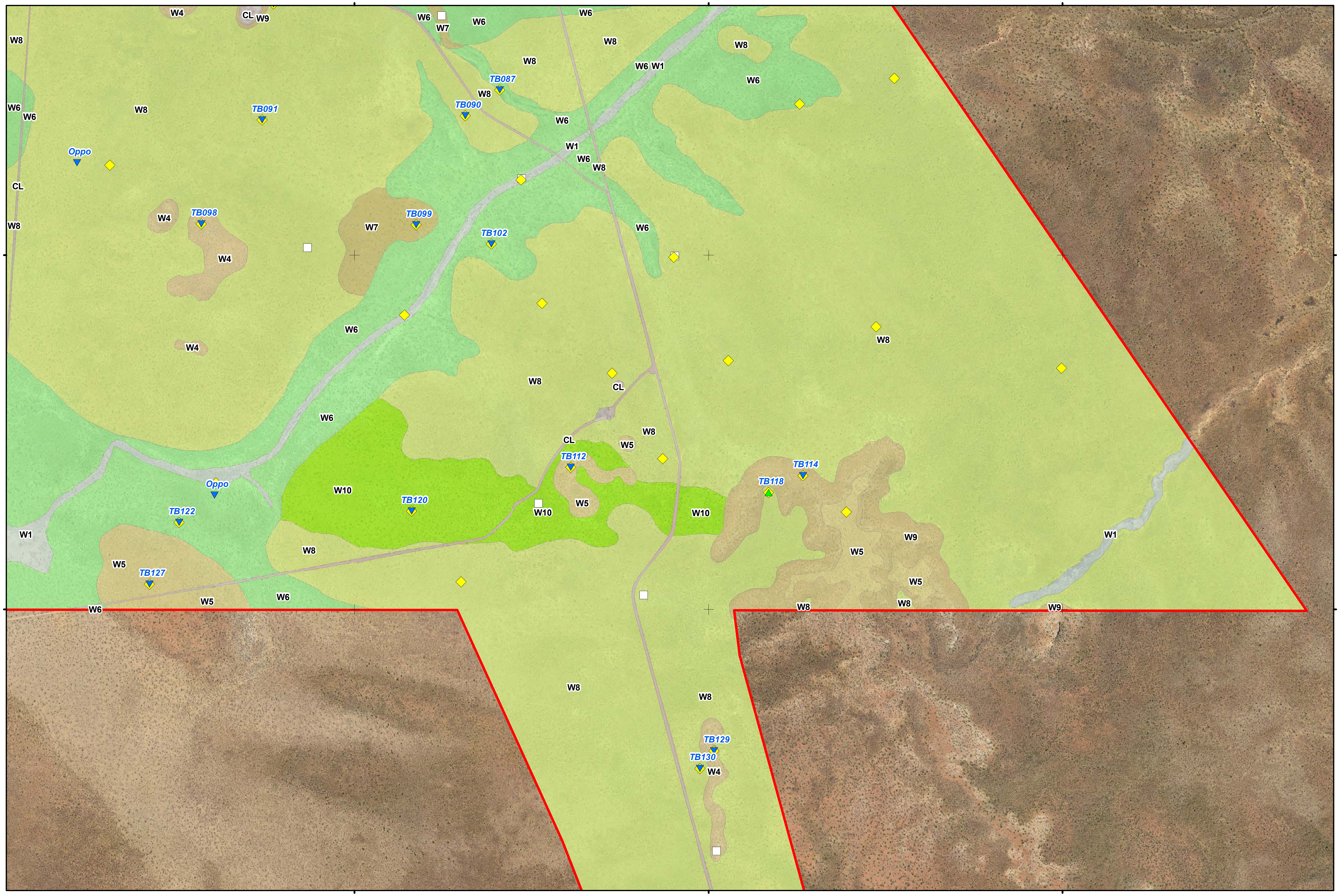
Thunderbird Mineral Sands Project
Vegetation
Sheet 6 of 10

Appendix:
I-07



Legend
- *Pterocaulon intermedium*
- *Triodia caelestialis*
- MCPL Sites 01/09/2016
- ecologia Quadrats
- Thunderbird Survey Area

Note
Aerial Photography: Sheffield Resources (09/2015)
Quadrats: MCPL, ecologia
Flora: MCPL, ecologia
Vegetation: MCPL (08/2016)
Refer figure 1 for detailed vegetation legend

Sheet Layout:

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N

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Scale: 1:20,000
MGA94 (Zone 51)
CAD Ref: a2409_f50_13
Date: Sep 2016 | Rev: A | A3

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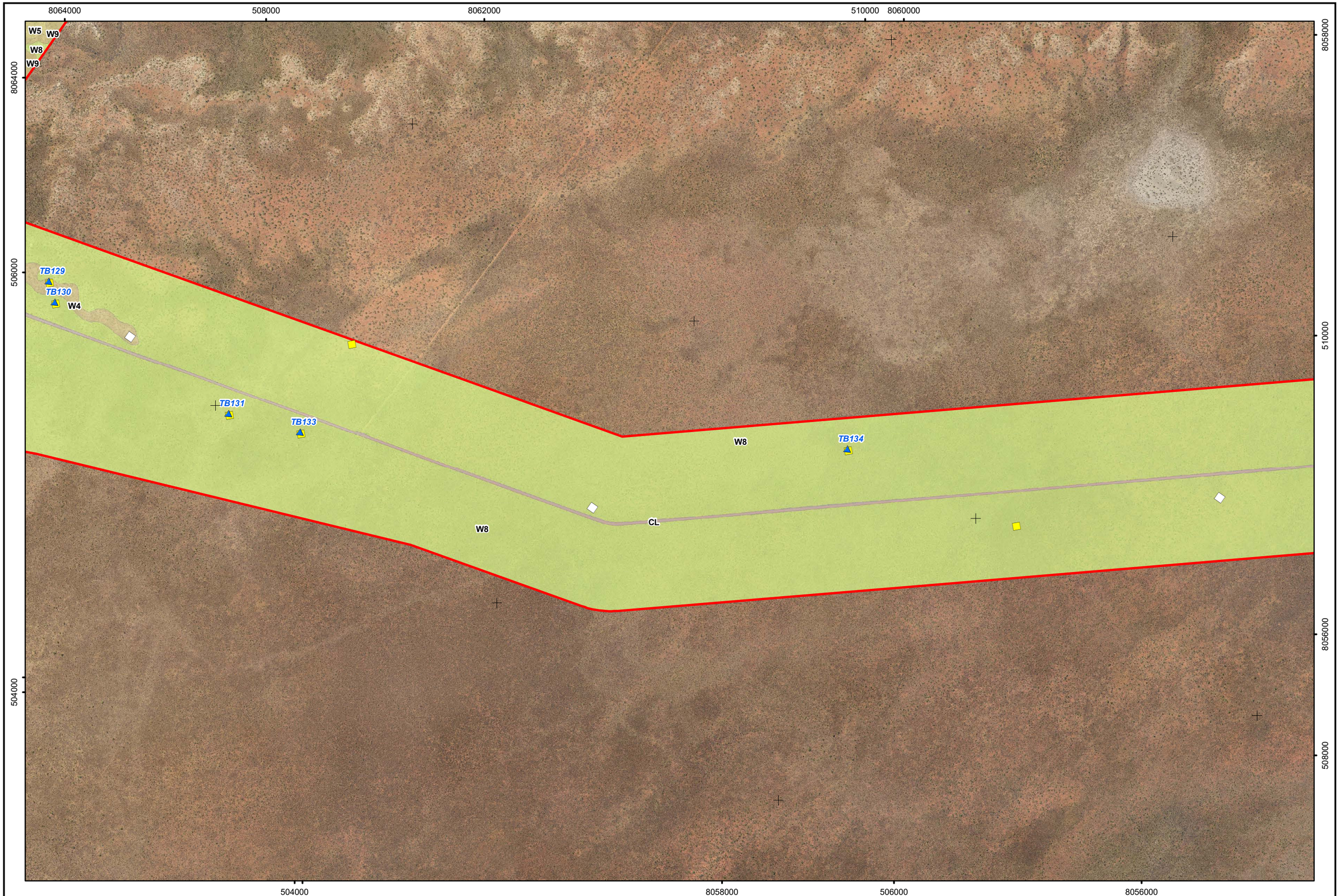
Thunderbird Mineral Sands Project
Vegetation
Sheet 7 of 10

Appendix:
I-08



Legend
- ▲ *Pterocaulon intermedium*
- ▼ *Triodia caelestialis*
- ◆ MCPL Sites 01/09/2016
- ecologia Quadrats
- Thunderbird Survey Area

Note
Aerial Photography: Sheffield Resources (09/2015)
Quadrats: MCPL, ecologia
Flora: MCPL, ecologia
Vegetation: MCPL (08/2016)
Refer figure 1 for detailed vegetation legend

Sheet Layout:

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Scale: 1:20,000
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CAD Ref: a2409_f50_13
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Thunderbird Mineral Sands Project
Vegetation
Sheet 8 of 10

Appendix:
I-09

Legend
- *Pterocaulon intermedium*
- *Triodia caelestialis*
- MCPL Sites 01/09/2016
- ecologia Quadrats
- Thunderbird Survey Area

Note
Aerial Photography: Sheffield Resources (09/2015)
Quadrats: MCPL, ecologia
Flora: MCPL, ecologia
Vegetation: MCPL (08/2016)
Refer figure 1 for detailed vegetation legend

Sheet Layout:

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Scale: 1:20,000
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CAD Ref: a2409_f50_13
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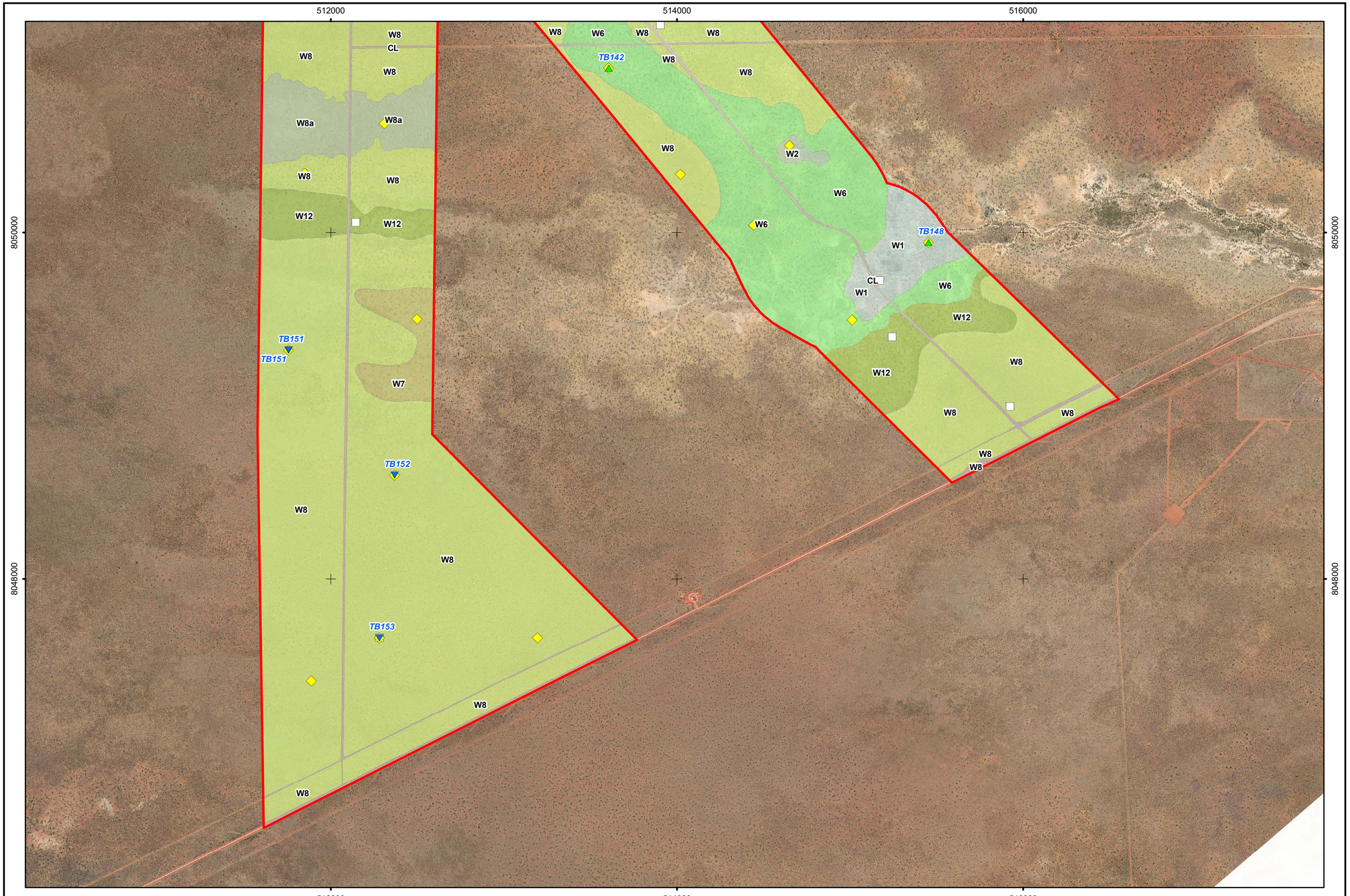
Thunderbird Mineral Sands Project
Vegetation
Sheet 9 of 10

Appendix:
I-10



Legend
- *Pterocaulon intermedium*
- *Triodia caelestialis*
- MCPL Sites 01/09/2016
- ecologia Quadrats
- Thunderbird Survey Area

Note
Aerial Photography: Sheffield Resources (09/2015)
Quadrats: MCPL, ecologia
Flora: MCPL, ecologia
Vegetation: MCPL (08/2016)
Refer figure 1 for detailed vegetation legend

Sheet Layout:

Client: Sheffield Resources Limited

N

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Scale: 1:20,000
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CAD Ref: a2409_f50_13
Date: Sep 2016 | Rev: A | A3

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Thunderbird Mineral Sands Project
Vegetation
Sheet 10 of 10

Appendix:
I-11

APPENDIX J: VASCULAR PLANT SPECIES RECORDED IN EACH VEGETATION COMMUNITY IN THE THUNDERBIRD PROJECT AREA

Notes: * denotes introduced species; P1 - P5 denotes prioirty species

Species	Vegetation Community													
	S1	W1	W2	W3	W4	W5	W6	W7	W8	W9	W10	W11	W12	W13
Abildgaardia schoenoides									x		x	x	x	
Abutilon hannii					x						x			
Abutilon otocarpum									x					
Acacia ?colei		x	x				x							
Acacia colei var. *colei*		x							x				x	x
Acacia colei var. *ileocarpa*													x	
Acacia drepanocarpa subsp. *drepanocarpa*									x				x	
Acacia drepanocarpa subsp. *latifolia*										x				
Acacia eriopoda											x		x	x
Acacia hippuroides	x			x		x	x	x	x	x	x		x	x
Acacia monticola				x	x	x	x	x	x	x	x		x	x
Acacia platycarpa	x	x		x	x	x	x	x	x	x	x		x	
Acacia plectocarpa subsp. *plectocarpa*			x	x			x	x	x					
Acacia stigmatophylla				x	x				x					x
Acacia stipuligera											x			
Acacia synchronicia							x							
Acacia ?tumida		x		x	x	x	x		x		x		x	
Acacia tumida var. *tumida*	x			x	x		x	x	x	x	x	x	x	
Acacia sp.							x		x					
Achyranthes aspera													x	
Adansonia gregorii											x			
Aeschynomene indica		x												
Alternanthera angustifolia		x												
Alysicarpus muelleri									x					
Amyema sanguinea var. *sanguinea*									x					
Amyema sp.						x								
Apocynaceae sp.		x												
Aristida contorta	x			x		x	x	x	x		x			
Aristida holathera									x		x		x	
Aristida holathera var. *holathera*		x			x		x	x	x		x		x	
Aristida holathera var. *latifolia*			x				x		x		x		x	
Aristida hygrometrica		x		x	x		x	x	x	x	x	x	x	
Aristida inaequiglumis		x		x			x		x				x	
Aristida aff. nitidula									x				x	
Aristida sp.								x			x		x	
Asteraceae sp.		x		x		x			x		x			
Atalaya hemiglauca		x		x	x	x	x		x	x	x		x	
Atalaya variifolia				x		x	x		x	x	x		x	
Atalaya sp.							x		x					
Bacopa floribunda													x	
Bauhinia cunninghamii	x	x	x	x	x	x	x	x	x		x	x	x	x
Blumea integrifolia		x											x	
Boerhavia gardneri									x					

APPENDIX J: VASCULAR PLANT SPECIES RECORDED IN EACH VEGETATION COMMUNITY IN THE THUNDERBIRD PROJECT AREA

Notes: * denotes introduced species; P1 - P5 denotes prioirty species

Species	Vegetation Community													
	S1	W1	W2	W3	W4	W5	W6	W7	W8	W9	W10	W11	W12	W13
Bonamia linearis				x	x		x	x	x	x	x			
Bonamia sp.						x	x	x	x					
Bothriochloa sp.									x					
Brachychiton diversifolius								x			x		x	
Brachychiton diversifolius subsp. *diversifolius*	x	x		x		x	x	x	x	x	x	x	x	x
Breynia cernua	x										x			
Bridelia tomentosa											x			
Buchnera asperata		x		x	x	x			x	x	x		x	x
Buchnera linearis									x	x	x			
Buchnera ramosissima		x			x				x	x	x		x	
Buchnera urticifolia		x			x				x					
Bulbostylis barbata		x		x	x			x	x		x		x	
Byblis filifolia		x			x		x	x	x		x	x	x	x
Cajanus cinereus									x					
Cajanus marmoratus					x			x	x		x		x	
Calandrinia quadrivalvis		x	x					x	x		x			
Calandrinia strophiolata		x			x		x	x	x		x		x	
Calandrinia translucens									x					
Calytrix exstipulata				x	x	x	x		x	x	x			x
Capparis lasiantha		x					x							
Carissa lanceolata		x		x		x	x	x	x		x		x	
Cassytha capillaris					x				x					
Cassytha sp.					x	x	x	x		x				
**Cenchrus ciliaris*					x					x				
Cenchrus elymoides									x	x				
Cenchrus elymoides var. *elymoides*									x					
Chamaecrista mimosoides		x												
Chamaecrista moorei									x					
Chamaecrista symonii					x			x	x		x	x	x	
Cheilanthes brownii					x									
Cheilanthes ?*nudiuscula*							x							
Chloris lobata		x											x	
Chrysopogon fallax		x				x	x	x	x	x				
Chrysopogon pallidus		x		x	x	x	x	x	x		x		x	x
Chrysopogon sp.		x				x			x	x	x	x		
Cleome tetrandra var. *tetrandra*									x		x			
Cleome viscosa					x	x			x	x				x
?*Clerodendrum floribundum*						x	x		x					
Clerodendrum floribundum var. *ovatum*											x			
Clerodendrum tomentosum var. *tomentosum*									x					
Codonocarpus cotinifolius									x					
Corchorus aestuans			x								x		x	
Corchorus ?*incanus*						x								

APPENDIX J: VASCULAR PLANT SPECIES RECORDED IN EACH VEGETATION COMMUNITY IN THE THUNDERBIRD PROJECT AREA

Notes: * denotes introduced species; P1 - P5 denotes prioirty species

Species	Vegetation Community													
	S1	W1	W2	W3	W4	W5	W6	W7	W8	W9	W10	W11	W12	W13
Corchorus pumilio	x			x		x	x	x	x		x			
Corchorus sidoides									x		x			
Corchorus sidoides subsp. *vermicularis*		x		x	x	x	x	x	x		x	x	x	x
Corchorus tridens		x			x				x					
Corchorus sp.	x					x			x					
Corymbia dendromerinx		x		x	x	x	x	x	x	x	x		x	x
Corymbia flavescens					x			x			x		x	
Corymbia greeniana	x	x		x	x		x	x	x		x	x	x	x
Corymbia ?*polycarpa*							x							
Corymbia zygophylla		x			x				x		x	x		
Corymbia sp.							x	x	x					
Corynotheca micrantha											x			
Crosslandia setifolia									x					
Crotalaria brevis	x	x		x			x	x	x		x		x	x
Crotalaria crispata									x				x	
Crotalaria ?*medicaginea*									x					
Crotalaria medicaginea var. *neglecta*					x			x	x	x	x		x	x
Crotalaria ramosissima		x							x					
Crotalaria sp.		x											x	
Cullen balsamicum									x					
Cullen pustulatum													x	
Cullen sp.			x											
Cyanthillium cinereum											x			x
Cymbopogon ambiguus							x		x					
Cymbopogon bombycinus							x							
Cymbopogon procerus				x	x				x	x	x		x	x
Cynanchum carnosum									x					
**Cynodon dactylon*									x					
Cyperaceae sp.		x							x					
Cyperus carinatus		x												
Cyperus conicus		x		x			x		x				x	x
Cyperus latzii					x				x					x
Cyperus microcephalus					x	x				x				
Cyperus microcephalus subsp. *microcephalus*					x	x			x	x			x	
Cyperus nervulosus		x							x					
Cyperus pulchellus							x		x		x		x	
Cyperus tenuispica				x				x	x					
Cyperus sp. A		x					x							
Cyperus sp.									x					
Dactyloctenium radulans			x						x				x	
Denhamia cunninghamii				x		x			x		x			
Dentella misera									x		x			
Desmodium brownii	x	x	x						x					

APPENDIX J: VASCULAR PLANT SPECIES RECORDED IN EACH VEGETATION COMMUNITY IN THE THUNDERBIRD PROJECT AREA

Notes: * denotes introduced species; P1 - P5 denotes prioirty species

Species	Vegetation Community													
	S1	W1	W2	W3	W4	W5	W6	W7	W8	W9	W10	W11	W12	W13
Desmodium filiforme					x		x		x		x		x	x
Dicliptera armata				x	x	x			x	x	x		x	x
Digitaria bicornis		x												
Digitaria brownii		x				x	x		x		x		x	
Digitaria ctenantha		x	x					x						
Dodonaea hispidula				x									x	
Dodonaea hispidula var. *arida*		x		x	x	x	x	x	x	x	x		x	
Dolichandrone heterophylla		x		x	x	x	x	x	x	x	x		x	
Drosera broomensis							x		x		x		x	x
Drosera derbyensis									x				x	
Drosera indica		x							x					
Ectrosia schultzii	x	x							x					
Ectrosia schultzii var. *schultzii*									x		x		x	
Ehretia saligna				x	x	x		x	x		x		x	x
Ehretia saligna var. *saligna*					x		x		x	x	x		x	
Eleocharis geniculata		x												
Eragrostis cumingii		x		x				x	x		x		x	
Eragrostis eriopoda		x			x		x		x		x		x	
Eragrostis exigua											x			
Eragrostis sp.									x				x	
Eragrostis tenellula							x							
Eriachne ciliata		x		x	x				x	x	x		x	
Eriachne melicacea					x		x	x	x	x	x			x
Eriachne obtusa	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Eriachne sulcata		x		x				x					x	
Eriachne sp. Dampier Peninsula (K. F. Kenneally 5946)					x	x			x	x	x		x	x
Eriachne sp.												x		
Erythrophleum chlorostachys		x		x	x		x	x	x		x	x	x	x
Eucalyptus camaldulensis		x												
Eucalyptus tectifica	x	x	x	x	x	x	x	x	x	x	x		x	x
Eucalyptus sp.						x				x				
Eulalia aurea		x												
Euphorbia hassallii					x	x	x		x				x	x
Euphorbia mitchelliana											x			
Euphorbia myrtoides				x							x			
Euphorbia psilosperma					x				x		x			
Euphorbia schultzii													x	
Euphorbia schultzii var. *comans*									x		x			
Euphorbia trigonosperma		x		x	x	x		x	x		x	x		
Euphorbia ?vaccaria			x						x					
Euphorbia vicina											x			
Euphorbia sp.			x	x	x	x			x				x	
Evolvulus alsinoides									x		x		x	

APPENDIX J: VASCULAR PLANT SPECIES RECORDED IN EACH VEGETATION COMMUNITY IN THE THUNDERBIRD PROJECT AREA

Notes: * denotes introduced species; P1 - P5 denotes prioirty species

Species	Vegetation Community													
	S1	W1	W2	W3	W4	W5	W6	W7	W8	W9	W10	W11	W12	W13
Evolvulus alsinoides var. *decumbens*		x			x	x	x	x	x		x		x	
Evolvulus alsinoides var. *villosicalyx*			x	x				x	x		x	x		
Evolvulus sp.									x					
Ficus aculeata									x					
Ficus aculeata var. *indecora*									x		x			
Ficus platypoda					x				x	x				
Fimbristylis ammobia					x			x	x		x		x	
Fimbristylis caespitosa		x							x					
Fimbristylis dichotoma		x											x	
Fimbristylis littoralis		x											x	
Fimbristylis macrantha									x		x		x	
Fimbristylis microcarya									x		x			
Fimbristylis neilsonii					x				x		x		x	
Fimbristylis nuda													x	
Fimbristylis oxystachya								x	x					
Fimbristylis punctata							x						x	
Fimbristylis rara													x	
Fimbristylis schultzii		x												
Fimbristylis simulans				x					x	x	x		x	
Fimbristylis tetragona		x							x				x	
Fimbristylis trigastrocarya							x				x			
Fimbristylis sp.													x	
Flueggea virosa subsp. *melanthesoides*		x		x	x	x	x		x	x	x		x	x
Fuirena ciliaris		x							x				x	
Fuirena incrassata (P3)									x					
Fuirena nudiflora (P1)									x					
Galactia tenuiflora				x	x	x			x		x			x
Gardenia pyriformis subsp. *keartlandii*				x		x	x		x		x		x	
Glycine tomentella		x		x	x	x		x	x	x	x		x	
Gomphrena affinis		x				x			x					
Gomphrena brachystylis subsp. *pindanensis*					x	x	x							
Gomphrena canescens											x			x
Gomphrena canescens subsp. *canescens*		x		x	x	x	x	x	x	x	x		x	x
Gomphrena flaccida		x		x	x	x			x	x	x		x	
Gomphrena lanata					x				x				x	
Gomphrena leptoclada					x									
Gomphrena leptoclada subsp. *leptoclada*											x			x
Gomphrena sp.			x			x								
Goodenia armitiana									x		x		x	
Goodenia scaevolina						x	x	x	x		x		x	x
Goodenia sepalosa														x
Goodenia sepalosa var. *sepalosa*			x	x	x			x	x		x	x	x	x
Gossypium australe				x	x	x	x	x	x		x			x

APPENDIX J: VASCULAR PLANT SPECIES RECORDED IN EACH VEGETATION COMMUNITY IN THE THUNDERBIRD PROJECT AREA

Notes: * denotes introduced species; P1 - P5 denotes prioirty species

Species	Vegetation Community													
	S1	W1	W2	W3	W4	W5	W6	W7	W8	W9	W10	W11	W12	W13
Grevillea pyramidalis					x				x		x			x
Grevillea pyramidalis subsp. *pyramidalis*			x	x	x	x	x	x	x	x	x		x	
Grevillea refracta subsp. *refracta*			x	x	x	x	x	x	x	x	x	x	x	x
Grevillea striata		x					x						x	
Grevillea sp.									x					
Gyrocarpus americanus							x							
Gyrocarpus americanus subsp. *pachyphyllus*									x					
Hakea arborescens				x		x	x		x		x		x	
Hakea macrocarpa						x	x		x		x		x	x
Hakea sp.								x						
Heliotropium cunninghamii									x				x	
Heliotropium dichotomum										x	x			
Heliotropium diversifolium								x			x			
Heliotropium foliatum									x		x			
Heliotropium glabellum					x	x	x		x					
Heliotropium leptaleum		x			x		x	x	x		x		x	
Heliotropium sp. A	x								x					
Heliotropium sp. B									x					
Heliotropium sp. C						x			x					
Heliotropium sp.													x	
Heteropogon contortus		x		x	x				x		x		x	x
Hibbertia gracilipes													x	
Hibiscus geranioides					x				x		x		x	x
Hibiscus leptocladus						x	x		x					
Hibiscus sp.		x					x		x					
Hybanthus aurantiacus				x	x		x	x	x	x	x		x	
Hybanthus enneaspermus subsp. *enneaspermus*					x	x	x	x	x		x			
?*Hybanthus* sp.				x		x								
Ichnocarpus frutescens					x									
Indigofera colutea									x		x			
Indigofera haplophylla				x	x	x			x		x			x
Indigofera hirsuta									x					
Indigofera linifolia			x		x		x	x	x		x		x	x
Indigofera linnaei			x											
Indigofera sp.			x						x					
Ipomoea coptica		x	x										x	
Ipomoea muelleri									x					
Ipomoea sp.									x					
Iseilema ?*fragile*								x						
Jacquemontia paniculata					x									
Jasminum molle				x					x				x	
Lipocarpha microcephala		x												
Ludwigia perennis		x		x										

APPENDIX J: VASCULAR PLANT SPECIES RECORDED IN EACH VEGETATION COMMUNITY IN THE THUNDERBIRD PROJECT AREA

Notes: * denotes introduced species; P1 - P5 denotes prioirty species

Species	Vegetation Community													
	S1	W1	W2	W3	W4	W5	W6	W7	W8	W9	W10	W11	W12	W13
Malvaceae sp.	x	x				x	x	x	x	x				
**Malvastrum americanum*											x			
Marsdenia angustata									x		x			
?*Marsdenia viridiflora*							x		x	x				
Marsdenia viridiflora subsp. *tropica*									x		x		x	
Melaleuca alsophila		x	x					x	x				x	
Melaleuca nervosa							x		x		x	x	x	
Melaleuca viridiflora	x	x					x	x	x				x	
Melaleuca sp.	x		x				x		x					
Melhania oblongifolia				x	x	x			x					
Melochia corchorifolia		x												
Microstachys chamaelea				x	x	x	x	x	x	x	x	x	x	x
Mimulus uvedaliae var. *lutea*		x												
Mitrasacme connata									x				x	
Mitrasacme exserta							x		x		x			
Mitrasacme hispida													x	
Mitrasacme lutea									x		x			
Mitrasacme sp.							x							
Mnesithea formosa				x					x		x		x	
Murdannia graminea					x				x		x		x	x
Neptunia sp.		x												
Oldenlandia galioides		x									x		x	
Oldenlandia mitrasacmoides					x		x	x	x		x		x	x
Oldenlandia mitrasacmoides subsp. *mitrasacmoides*				x					x	x	x		x	
Opilia amentacea									x					
Panicum decompositum				x										
Paspalidium rarum									x					
Perotis rara				x							x		x	
Persoonia falcata					x		x	x	x		x			
?*Phyllanthus baccatus*				x										
Phyllanthus exilis									x		x			
Phyllanthus maderaspatensis									x					
Phyllanthus rhytidospermus				x					x		x		x	
Phyllanthus virgatus		x											x	
Phyllanthus sp.									x					
Planchonia careya	x						x		x					
Pluchea rubelliflora		x												
Pluchea ?tetranthera							x							
Poaceae sp.		x	x				x	x	x			x		
Polycarpaea corymbosa		x		x				x	x	x	x		x	
Polycarpaea longiflora					x	x			x	x	x		x	x
Polygala galeocephala									x		x			x
Polygala tepperi		x			x		x	x	x		x	x	x	

APPENDIX J: VASCULAR PLANT SPECIES RECORDED IN EACH VEGETATION COMMUNITY IN THE THUNDERBIRD PROJECT AREA

Notes: * denotes introduced species; P1 - P5 denotes prioirty species

Species	Vegetation Community													
	S1	W1	W2	W3	W4	W5	W6	W7	W8	W9	W10	W11	W12	W13
Polymeria ambigua									x		x		x	
Portulaca bicolor									x		x			
Portulaca aff. *filifolia*									x					
**Portulaca pilosa*								x						
Premna acuminata				x					x	x	x		x	
Proteaceae sp.							x		x					
Pterocaulon intermedium (P3)		x	x	x			x		x		x		x	
Pterocaulon paradoxum				x			x		x		x	x	x	x
Pterocaulon serrulatum											x			
Pterocaulon serrulatum var. *velutinum*				x	x	x			x		x		x	
Pterocaulon sphacelatum				x				x	x	x	x		x	
Pterocaulon tricholobum					x				x		x		x	
Pterocaulon sp.				x									x	
Ptilotus corymbosus				x	x	x		x	x	x	x			
Ptilotus fusiformis									x		x			
Ptilotus lanatus		x		x			x		x		x			
Ptilotus polystachyus		x							x		x		x	
Ptilotus sp.													x	
Rhynchosia minima									x					
Rotala occultiflora		x												
Sacciolepis indica		x												
Santalum lanceolatum									x	x	x			x
Schizachyrium fragile				x	x		x	x	x		x		x	
Scleria brownii							x		x		x		x	x
Sehima nervosum	x		x				x	x	x					
Senna costata									x					
Senna notabilis									x					
Senna oligoclada				x					x					
Setaria apiculata									x	x	x		x	
Setaria surgens		x				x			x	x			x	
Sida hackettiana		x							x					
Sida rohlenae subsp. *occidentalis*					x	x	x	x	x		x	x		
Sida spinosa									x	x				
Solanum cleistogamum									x					
Solanum cunninghamii		x			x			x	x	x	x		x	x
Solanum dioicum		x	x						x					
Solanum lucani									x					
Solanum sp. A									x					
Solanum sp. B									x					
Sorghum plumosum		x	x	x	x	x	x		x	x	x	x	x	
Sorghum timorense	x	x		x	x		x	x	x		x		x	x
Spermacoce laevigata									x					
Spermacoce occidentalis				x	x		x		x		x	x	x	x

APPENDIX J: VASCULAR PLANT SPECIES RECORDED IN EACH VEGETATION COMMUNITY IN THE THUNDERBIRD PROJECT AREA

Notes: * denotes introduced species; P1 - P5 denotes prioirty species

Species	Vegetation Community													
	S1	W1	W2	W3	W4	W5	W6	W7	W8	W9	W10	W11	W12	W13
Spermacoce sp.									x					
Sporobolus actinocladus							x							
Sporobolus australasicus		x		x					x					
Stackhousia intermedia		x							x		x		x	
Stemodia lathraia	x	x		x			x		x		x		x	
Stemodia lythrifolia				x	x				x		x	x	x	x
?*Stemodia* sp.											x			
Streptoglossa ?odora		x												
Striga curviflora		x			x		x		x		x		x	x
Striga squamigera									x					
**Stylosanthes hamata*		x	x	x	x	x	x	x	x		x		x	x
**Stylosanthes humilis*		x												
**Stylosanthes scabra*		x					x	x	x		x		x	
Synaptantha scleranthoides											x		x	
Tephrosia brachyodon var. *longifolia*									x					
Tephrosia crocea									x					
Tephrosia aff. *croccea*				x					x		x	x		
Tephrosia forrestiana													x	
Tephrosia leptoclada				x	x	x	x	x	x		x		x	x
Tephrosia remotiflora		x		x	x	x	x	x	x	x	x	x	x	
Tephrosia simplicifolia								x	x		x			x
Tephrosia sp. B Kimberley Flora (C.A. Gardner 7300)					x									
Tephrosia sp. C Kimberley Flora (K.F. Kenneally 5599)									x					
Tephrosia sp. D Kimberley Flora (R.D. Royce 1848)		x							x		x		x	
Tephrosia sp. F Kimberley Flora (B.R. Maslin 5139)									x					
Tephrosia valleculata (P3)									x					x
Tephrosia sp.	x	x				x	x		x					
Terminalia canescens		x		x	x	x	x	x	x	x	x		x	x
Terminalia ferdinandiana									x		x			
Terminalia volucris														
Terminalia sp.					x		x		x	x				
Thaumastochloa major									x		x			
Thaumastochloa pubescens													x	
Thecanthes punicea											x			
Thysanotus chinensis		x					x							
Tinospora smilacina		x			x	x			x	x	x		x	x
Trachymene microcephala					x				x		x			
Trachymene oleracea subsp. *oleracea*									x					
Trianthema oxycalyptrum var. *oxycalyptrum*													x	
Trianthema pilosum		x		x	x		x	x	x		x	x	x	
Tribulopis angustifolia					x			x	x		x		x	x
Tribulopis pentandra									x					
Tribulus ranunculiflorus													x	

APPENDIX J: VASCULAR PLANT SPECIES RECORDED IN EACH VEGETATION COMMUNITY IN THE THUNDERBIRD PROJECT AREA

Notes: * denotes introduced species; P1 - P5 denotes prioirty species

Species	Vegetation Community													
	S1	W1	W2	W3	W4	W5	W6	W7	W8	W9	W10	W11	W12	W13
Trichodesma zeylanicum									x				x	
Trichodesma zeylanicum var. *latisepalum*									x					
Trichodesma zeylanicum var. *zeylanicum*		x							x		x		x	
* *Tridax procumbens*		x												
Triodia ?*bynoei*									x					
Triodia ?*intermedia*							x							
Triodia caelestialis (P3)	x	x		x	x	x	x	x	x	x	x		x	x
Triodia schinzii		x		x	x	x	x		x		x	x	x	x
Triodia "schinzii group"							x		x			x		
Triodia sp	x				x		x	x	x		x		x	
Triumfetta albida				x	x	x			x					
Triumfetta breviaculeata										x			x	
Triumfetta plumigera					x	x			x	x	x			
Triumfetta sp.				x										
Uraria lagopodioides		x				x	x	x	x					
Urochloa piligera		x												
Urochloa praetervisa									x					
Vachellia pachyphloia subsp. *brevipinnula*		x												
Velleia panduriformis									x					
Ventilago viminalis	x			x	x	x	x		x	x	x		x	
Vigna lanceolata									x		x			
Vigna lanceolata var. *filiformis*								x	x	x	x			
Waltheria indica	x	x	x	x	x	x	x	x	x	x	x	x	x	
Wrightia saligna		x		x	x	x	x	x	x	x	x		x	
Xenostegia tridentata				x										x
Xerochloa barbata								x						
Xerochloa imberbis		x												
Xerochloa laniflora		x	x				x						x	
Xyris complanata		x							x					
Yakirra australiensis		x		x	x			x	x				x	
Yakirra australiensis var. *australiensis*									x				x	
Yakirra australiensis var. *intermedia*					x				x		x			x
Yakirra pauciflora									x				x	
Zornia chaetophora									x			x		
Zornia prostrata								x	x		x		x	
Zornia prostrata var. *prostrata*					x			x	x	x	x		x	

APPENDIX K: SUMMARY OF VEGETATION COMMUNITIES DEFINED IN THE THUNDERBIRD PROJECT AREA

Vegetation Community Description

Vegetation map code: W1

Description

Melaleuca viridiflora, *Melaleuca alsophila* and *Eucalyptus tectifica* low sparse woodland over *Bauhinia cunninghamii*, *Carissa lanceolata* and *Atalaya hemiglauca* tall sparse shrubland over *Ectrosia schultzii*, *Eriachne sulcata* and *Cyperus conicus* low sparse grassland.

Statistically associated species

Shrubs: *Waltheria indica*

Grasses: *Aristida* sp., *Chrysopogon fallax, Chrysopogon pallidus, Eriachne obtusa*

Soils and Landforms: grey-white to light brown sandy soils in drainage channels and low lying drainage areas.

Outcropping: not present

Condition: poor to excellent

Area: 141.0203 ha

Proportion of survey area: 0.75 %

Number of Quadrats: 13

Average species richness: 21.15 ± 2.84 (s.e.m.)

Range of species richness: 8 to 43

Similarity Percentage: 35.69 %

Representative Photograph

Quadrat TB116

APPENDIX K: SUMMARY OF VEGETATION COMMUNITIES DEFINED IN THE THUNDERBIRD PROJECT AREA

Vegetation Community Description
Vegetation map code: W2 **Description** *Eucalyptus tectifica* mid open woodland over *Acacia plectocarpa* subsp. *plectocarpa* and *Grevillea pyramidalis* subsp. *pyramidalis* tall sparse shrubland over *Aristida holathera* subsp. *latifolia*, *Eriachne obtusa* and *Xerochloa laniflora* mid sparse grassland. **Statistically associated species** no applicable **Soils and Landforms:** light brown clayey sands in low lying drainage areas. **Outcropping:** not present **Condition:** very good **Area:** 3.0769 ha — **Proportion of survey area:** 0.02 % **Number of Quadrats:** 2 — **Average species richness:** 20.00 ± 2.00 (s.e.m.) **Range of species richness:** 18to 22 — **Similarity Percentage:** 47.62 %
Representative Photograph
 Quadrat TB144

APPENDIX K: SUMMARY OF VEGETATION COMMUNITIES DEFINED IN THE THUNDERBIRD PROJECT AREA

Vegetation Community Description

Vegetation map code: W3

Description

Corymbia dendromerinx, *Eucalyptus tectifica* and *Corymbia greeniana* mid open woodland over *Dolichandrone heterophylla*, *Dodonaea hispidula* var. *arida* and *Grevillea pyramidalis* subsp. *pyramidalis* mid sparse shrubland over *Triodia caelestialis* (P3), *Triodia schinzii* and *Eriachne obtusa* mid sparse hummock grassland.

Statistically associated species

Trees: *Erythrophleum chlorostachys*

Shrubs: *Acacia tumida* var*. tumida, Bauhinia cunninghamii, Carissa lanceolata, Tephrosia remotiflora, Terminalia canescens, Waltheria indica*

Forbs: *Corchorus sidoides, Microstachys chamaelea*

Grasses: *Sorghum timorense*

Soils and Landforms: orange-brown clayey sands on flats and drainage areas.

Outcropping: not present

Condition: very good - excellent

Area: 35.7049 ha

Proportion of survey area: 0.19 %

Number of Quadrats: 8

Average species richness: 29.38 ± 3.44 (s.e.m.)

Range of species richness: 18 to 45

Similarity Percentage: 47.79 %

Representative Photograph

Quadrat TB005

APPENDIX K: SUMMARY OF VEGETATION COMMUNITIES DEFINED IN THE THUNDERBIRD PROJECT AREA

Vegetation Community Description

Vegetation map code: W4

Description

Corymbia dendromerinx mid open woodland over *Terminalia canescens*, *Calytrix exstipulata* and *Wrightia saligna* tall sparse shrubland over *Triodia caelestialis* (P3), *Triumfetta albida* and *Polycarpaea longiflora* mid open tussock grassland.

Statistically associated species

Trees: *Ehretia saligna* var*. saligna, Flueggea virosa* subsp*. melanthesoides*

Shrubs: *Acacia stigmatophylla, Grevillea pyramidalis* subsp*. pyramidalis*

Forbs: Glycine tomentella, Hybanthus aurantiacus

Grasses: *Cymbopogon procerus, Eriachne obtusa, Eriachne* sp. Dampier Peninsula (K.F.Kenneally 5946)*, Sorghum timorense*

Sedges: *Cyperus microcephalus* subsp*. microcephalus*

Soils and Landforms: brown sandy clay soils on mid-slopes to ridges of hills with sandstone outcropping.

Outcropping: sandstone

Condition: excellent

Area: 271.9573 ha

Proportion of survey area: 1.44 %

Number of Quadrats: 10

Average species richness: 29.90 ± 2.69 (s.e.m.)

Range of species richness: 17 to 44

Similarity Percentage: 50.83 %

Representative Photograph

Quadrat TB129

APPENDIX K: SUMMARY OF VEGETATION COMMUNITIES DEFINED IN THE THUNDERBIRD PROJECT AREA

Vegetation Community Description

Vegetation map code: W5

Description

Corymbia dendromerinx mid open woodland over *Grevillea pyramidalis* subsp. *pyramidalis*, *Terminalia canescens* and *Waltheria indica* mid sparse shrubland over *Triodia caelestialis* (P3), *Sorghum plumosum* and *Hybanthus enneaspermus* subsp. *enneaspermus* low sparse tussock grassland.

Statistically associated species

Trees: *Eucalyptus tectifica, Wrightia saligna*

Shrubs: *Calytrix exstipulata*

Grasses: *Chrysopogon fallax, Eriachne obtusa, Eriachne* sp. Dampier Peninsula (K. F. Kenneally 5946)

Soils and Landforms: pale brown to orange-brown sandy clay loam soils on slopes and broad flat hill tops with sandstone outcropping.

Outcropping: sandstone

Condition: excellent

Area: 234.5105 ha

Proportion of survey area: 1.24 %

Number of Quadrats: 12

Average species richness: 21.17 ± 1.39 (s.e.m.)

Range of species richness: 14 to 27

Similarity Percentage: 46.90 %

Representative Photograph

Quadrat TB006

APPENDIX K: SUMMARY OF VEGETATION COMMUNITIES DEFINED IN THE THUNDERBIRD PROJECT AREA

Vegetation Community Description

Vegetation map code: W6

Description

Eucalyptus tectifica, *Bauhinia cunninghamii* and *Brachychiton diversifolius* subsp. *diversifolius* mid open woodland over *Carissa lanceolata* and *Dolichandrone heterophylla* mid sparse shrubland over *Triodia caelestialis* (P3), *Triodia schinzii* and *Eriachne obtusa* mid sparse tussock grassland.

Statistically associated species

Trees: *Hakea arborescens, Melaleuca viridiflora*

Shrubs: *Acacia tumida* var*. tumida, Atalaya hemiglauca, Grevillea pyramidalis* subsp*. pyramidalis, Terminalia canescens*

Grasses: *Chrysopogon fallax, Chrysopogon pallidus*

Soils and Landforms: pale brown to grey brown sandy clay loams on flats.

Outcropping: not present

Condition: very good to excellent

Area: 3,432.0202 ha

Proportion of survey area: 18.17 %

Number of Quadrats: 26

Average species richness: 19.35 ± 1.62 (s.e.m.)

Range of species richness: 9 to 39

Similarity Percentage: 49.41 %

Representative Photograph

Quadrat TB025

APPENDIX K: SUMMARY OF VEGETATION COMMUNITIES DEFINED IN THE THUNDERBIRD PROJECT AREA

Vegetation Community Description

Vegetation map code: W7

Description

Brachychiton diversifolius subsp. *diversifolius* and *Eucalyptus tectifica* low open woodland over *Bauhinia cunninghamii*, *Acacia plectocarpa* subsp. *plectocarpa* and *Melaleuca viridiflora* tall sparse shrubland over *Triodia caelestialis* (P3), *Triodia schinzii* and *Aristida holathera* var. *holathera* mid sparse hummock grassland.

Statistically associated species

Shrubs: *Acacia hippuroides, Solanum cunninghamii, Waltheria indica*

Forbs: *Evolvulus alsinoides* var*. decumbens*

Grasses: *Chrysopogon fallax, Eriachne sulcata, Sorghum timorense*

Soils and Landforms: pale orange-grey clayey sands on flats.

Outcropping: not present

Condition: very good to excellent

Area: 101.6397 ha

Proportion of survey area: 0.54 %

Number of Quadrats: 8

Average species richness: 23.75 ± 2.92 (s.e.m.)

Range of species richness: 16 to 41

Similarity Percentage: 49.19 %

Representative Photograph

Quadrat TB059

APPENDIX K: SUMMARY OF VEGETATION COMMUNITIES DEFINED IN THE THUNDERBIRD PROJECT AREA

Vegetation Community Description

Vegetation map code: W8 (combination of communities W8 and W8a)

Description

Erythrophleum chlorostachys, *Brachychiton diversifolius* subsp. *diversifolius* and *Corymbia greeniana* mid open woodland over *Acacia tumida* var. *tumida*, *Bauhinia cunninghamii* and *Dodonaea hispidula* var. *arida* tall sparse shrubland over *Triodia caelestialis* (P3), *Triodia schinzii* and *Eriachne obtusa* mid sparse tussock grassland.

Statistically associated species

Trees: *Corymbia zygophylla, Dolichandrone heterophylla*

Shrubs: *Grevillea pyramidalis* subsp*. pyramidalis, Grevillea refracta* subsp*. refracta, Microstachys chamaelea, Solanum cunninghamii, Waltheria indica*

Grasses: *Chrysopogon fallax, Chrysopogon pallidus, Eragrostis eriopoda, Sorghum timorense*

Soils and Landforms: orange brown to red fine sandy soils on flats.

Outcropping: not present

Condition: good to excellent

Area: 12,871.4592 ha

Proportion of survey area: 68.15 %

Number of Quadrats: 120

Average species richness: 25.06 ± 0.61 (s.e.m.)

Range of species richness: 14 to 43

Similarity Percentage: 51.52 %

Representative Photograph

Quadrat TB014

APPENDIX K: SUMMARY OF VEGETATION COMMUNITIES DEFINED IN THE THUNDERBIRD PROJECT AREA

Vegetation Community Description

Vegetation map code: W9

Description

Corymbia dendromerinx low open woodland over *Grevillea pyramidalis* subsp. *pyramidalis*, *Microstachys chamaelea* and *Terminalia canescens* mid sparse shrubland over *Chrysopogon* sp. (*C. fallax* or *C. pallidus*), *Glycine tomentella* and *Sorghum plumosum* mid sparse grassland.

Statistically associated species

Trees: *Dolichandrone heterophylla, Flueggea virosa* subsp*. melanthesoides*

Shrubs: *Acacia tumida* var*. tumida , Dodonaea hispidula* var*. arida , Grevillea refracta* subsp*. refracta, Waltheria indica*

Forbs: *Hybanthus aurantiacus, Polycarpaea longiflora*

Grasses: *Aristida hygrometrica*

Soils and Landforms: orange-brown sandy clay with sandstone rocks and outcropping on hills.

Outcropping: sandstone

Condition: very good to excellent

Area: 67.8791 ha

Proportion of survey area: 0.36 %

Number of Quadrats: 4

Average species richness: 39.00 ± 3.49 (s.e.m.)

Range of species richness: 31 to 47

Similarity Percentage: 54.45 %

Representative Photograph

Quadrat TB114

APPENDIX K: SUMMARY OF VEGETATION COMMUNITIES DEFINED IN THE THUNDERBIRD PROJECT AREA

Vegetation Community Description

Vegetation map code: W10

Description

Corymbia greeniana, *Corymbia dendromerinx* and *Brachychiton diversifolius* subsp. *diversifolius* low open woodland over *Grevillea pyramidalis* subsp. *pyramidalis*, *Grevillea refracta* subsp. *refracta* and *Terminalia canescens* tall sparse shrubland over *Triodia caelestialis* (P3), *Solanum cunninghamii* and *Aristida hygrometrica* mid open tussock grassland.

Statistically associated species

Trees: *Dolichandrone heterophylla, Wrightia saligna*

Shrubs: *Acacia tumida* var*. tumida, Bauhinia cunninghamii, Corchorus sidoides, Dodonaea hispidula* var*. arida, Microstachys chamaelea, Waltheria indica*

Forbs: *Goodenia sepalosa var. sepalosa*

Grasses: *Chrysopogon pallidus, Sorghum timorense*

Soils and Landforms: orange-brown clayey sands with occasional sandstone or ironstone rocks on flats and slopes associated with drainage areas.

Outcropping: not present

Condition: very good to excellent

Area: 964.2910 ha

Proportion of survey area: 5.11 %

Number of Quadrats: 16

Average species richness: 39.81 ± 2.85 (s.e.m.)

Range of species richness: 24 to 68

Similarity Percentage: 54.41 %

Representative Photograph

Quadrat TB027

APPENDIX K: SUMMARY OF VEGETATION COMMUNITIES DEFINED IN THE THUNDERBIRD PROJECT AREA

Vegetation Community Description

Vegetation map code: W11

Description

Corymbia zygophylla low open woodland over *Acacia tumida* var. *tumida* and *Erythrophleum chlorostachys* tall sparse shrubland over *Triodia schinzii* and *Microstachys chamaelea* low sparse grassland.

Statistically associated species

Shrubs: *Corchorus sidoides* subsp. *vermicularis*

Grasses: *Eriachne obtusa, Sorghum plumosum*

Soils and Landforms: orange-brown clayey sands on flats and slopes.

Outcropping: not present

Condition: excellent

Area: 40.9165 ha

Proportion of survey area: 0.22 %

Number of Quadrats: 4

Average species richness: 13.50 ± 2.22 (s.e.m.)

Range of species richness: 8 to 18

Similarity Percentage: 45.03 %

Representative Photograph

Quadrat TB057

APPENDIX K: SUMMARY OF VEGETATION COMMUNITIES DEFINED IN THE THUNDERBIRD PROJECT AREA

Vegetation Community Description
Vegetation map code: W12 **Description** *Corymbia greeniana*, *Eucalyptus tectifica* and *Corymbia dendromerinx* mid open woodland over *Dolichandrone heterophylla*, *Bauhinia cunninghamii* and *Acacia tumida* var. *tumida* tall sparse shrubland over *Triodia caelestialis* (P3), *Triodia schinzii* and *Eriachne obtusa* mid sparse tussock grassland. **Statistically associated species** Trees: *Brachychiton diversifolius* subsp. *diversifolius* Shrubs: *Acacia colei* var. *colei, Acacia platycarpa* Forbs: *Glycine tomentella, Polygala tepperi* Grasses: *Chrysopogon pallidus, Eriachne* sp. Dampier Peninsula (K.F.Kenneally 5946)*, Heteropogon contortus, Sorghum plumosum* **Soils and Landforms:** brown clayey sands on flats and drainage channels. **Outcropping:** not present **Condition:** good to excellent **Area:** 519.7978 ha **Proportion of survey area:** 2.75 % **Number of Quadrats:** 9 **Average species richness:** 31.22 ± 1.70 (s.e.m.) **Range of species richness:** 25 to 38 **Similarity Percentage:** 41.49 %
Representative Photograph
No photograph available

APPENDIX K: SUMMARY OF VEGETATION COMMUNITIES DEFINED IN THE THUNDERBIRD PROJECT AREA

Vegetation Community Description
Vegetation map code: W13 **Description** *Brachychiton diversifolius* subsp. *diversifolius, Erythrophleum chlorostachys* and *Corymbia dendromerinx* mid open woodland over *Grevillea refract* subsp. *refracta*, *Acacia monticola* and *Microstachys chamaelea* tall sparse shrubland over *Corchorus sidoides*, *Goodenia sepalosa* subsp. *sepalosa* and *Pterocaulon paradoxum* low sparse forbland. **Statistically associated species** Shrubs: *Acacia hippuroides* Forbs: *Solanum cunninghamii* **Soils and Landforms:** orange-brown clayey sands on flats. **Outcropping:** not present **Condition:** very good to excellent **Area:** 25.1385 ha **Proportion of survey area:** 0.13 % **Number of Quadrats:** 3 **Average species richness:** 28.67 ± 2.62 (s.e.m.) **Range of species richness:** 24 to 36 **Similarity Percentage:** 43.17 %
Representative Photograph
No photograph available

APPENDIX K: SUMMARY OF VEGETATION COMMUNITIES DEFINED IN THE THUNDERBIRD PROJECT AREA

Vegetation Community Description

Vegetation map code: S1

Description

Acacia tumida var. *tumida* low sparse shrubland over *Waltheria indica* and *Bauhinia cunninghamii* low isolated shrubs over *Ectrosia schultzii*, *Eriachne obtusa* and *Corchorus pumilio* low sparse grassland.

Statistically associated species

No other statistically associated species

Soils and Landforms: pale grey sandy clay loam soils on flats and slopes.

Outcropping: not present

Condition: very good to excellent

Area: 58.9207 ha

Proportion of survey area: 0.31 %

Number of Quadrats: 6

Average species richness: 13.00 ± 2.86 (s.e.m.)

Range of species richness: 8 to 21

Similarity Percentage: 49.74 %

Representative Photograph

Quadrat TB113